A HISTORY OF AGRICULTURE IN INDIA

VOLUME III

1757-1947

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PREFACE

This volume of *A History of Agriculture in India,* third in the series, deals with the history of agriculture in India during the colonial period from 1757, when the foundation of the British Empire was laid in this country by Robert Clive, to 1947, when the Colonial rule ended and India became independent. The rise of the British colonialism in the wake of the Portuguese and the Dutch colonialism is closely connected with the European Age of Exploration. The countries of Europe facing the Atlantic, namely Spain, Portugal, England, Holland and France, became sea-powers and the centres of commercial activity. The economic and technological changes in Europe in the seventeenth century as a result of expanded trade influenced the growth of science in Europe. The commercial revolution in England at the close of the sixteenth century stimulated the ship-building industry. The emergence of the East India Company on 31 December 1600 during the reign of Queen Elizabeth is one of the results of the commercial revolution.

The primary concern of the British rulers was to promote the commerce of their country in India. Among them were some men of outstanding ability. Warren Hastings, the first British Governor-General of India, was a scholar, a patron of learning and a keen gardener. The grain *gola* at Patna was built by him for storing foodgrains to meet the requirement of food during the years of famine. The first map of India was prepared under his patronage. One of his supporters was Sir William Jones, a great linguist and scholar, who founded the Asiatic Society of Bengal, which promoted research in arts and field sciences.

Botanical gardens played a great role in plant introduction in the late eighteenth and early nineteenth centuries. The founding of the Sibpur Botanical Garden by Colonel Robert Kyd in 1787 is an event of great importance. The garden made rapid progress under the stewardship of Dr William Roxburgh, the Father of Indian Botany, from 1793 onwards. A large number of economic plants were introduced into India from the East Indies, China and Europe. Botanical gardens were later on established at Saharanpur, Bangalore and Ootacamund.

The Agricultural Revolution in England, which closely followed the Industrial Revolution, profoundly affected agriculture in India. The Industrial Revolution increased the power of the British vastly and their grip over India tightened. Their army had better weapons, and the manufacturing of improved agricultural tools was taken up on a vast scale. Thus their agriculture improved and their industry flourished. Their textile industry required cotton and India was their source of supply and also a market for the sale of textiles.

The British rulers of India in the early nineteenth century were from the landed aristocracy and were interested in agriculture. Marquis of Hastings was one such person. It was under his patronage that the Royal Agri-Horticultural Society, Calcutta, was founded in 1820 by a Baptist missionary, Dr William Carey. Later on, branch societies were founded in nearly all the provincial capitals. The introduction of seeds of crops and ornamental plants in various places in India was largely the work of these societies. The botanical gardens and the agri-horticultural societies were the main institutions for introducing agricultural improvements in India down to 1866.

The most honoured name in British Colonial History is that of Lord William Bentinck. He was a liberal and a disciple of Jeremy Bentham, whose cardinal principle was 'the greatest good of the greatest number'. Bentinck made English the medium of education in India. Thus the vast treasure of European science came within the reach of educated Indians. Bentinck also had sympathy for the Indian cultivators. In 1830, he opened the Eastern Jamuna Canal to provide irrigation for a neglected, but fertile, area in the Northern Provinces. An era of extension of irrigation to meet the challenges of periodical famines followed. In this work, two military engineers played a great role, viz. Major Proby T. Cautley, who constructed the Ganga Canal (1836-1854), and Sir Arthur Cotton, who conceived and executed the schemes of Cauvery, the Godavari and the Krishna deltas. The names of these men are still honoured in India.

The insecurity of tenure was the bane of Indian agriculture. Without security, agriculture cannot develop; and it makes little difference whether this insecurity is climatic, economic or political. This insecurity had a historical background. Moreland, who studied the economic history of India in the mediaeval period from the twelfth century to the eighteenth century observed that the human environment in the country was not conducive to agricultural development. It was fatal for a man to raise his standard of life, because to do so marked him out as a fair game for robbers and extortioners and to be "suspected of property" was a dire calamity. It was an environment which penalized productive effort, which necessitated the concealment of any surplus income that might accrue, and which operated to stereotype the low standard of life which offered the only chance of being let alone.

The first objective of the British administration was that of restoring law and order, and the next was to organize the collection of land revenue. Cornwallis accepted the agrarian structure as it was and made the absentee *zamindars* of Bengal landlords of vast estates. The real cultivators of land, the lower strata of the rural population who bore the brunt of agricultural work, were totally ignored in the Permanent Settlement of the eastern provinces of Bengal and Bihar.

Soon after, the injustice of this arrangement became evident. Thomas Munro, Governor of the Madras residency, under his *Ryotwari* Settlement of Land Tax gave security of tenure to the cultivators (*ryots*). Later on, Montstuart Elphinstone, Governor of the Bombay Presidency, adopted this system in his Presidency, and Sir John Lawrence in the Punjab. Under these various arrangements, the land tax gradually became a uniform rate, at least in theory. In Bengal it was about one-half of the rental in the middle of the nineteenth century. In northern India, it was fixed at one-half of the rental by the Saharanpur Rule of 1855. In the Bombay and Madras Presidencies, Sir Charles Wood fixed in 1864 the land tax at about one-half of the economic rent. In the Punjab, the Government demand was reduced to one-half of the rents ordinarily paid by the tenants-at-will. This, then, was the theory of the Indian land tax. Where the land tax was not permanently fixed, one-half of the actual or economic rent could be claimed as the land revenue.

Romesh Chander Dutt, who made a deep study of this problem, concluded that the burden on the cultivators was excessive, and they were left with no surplus so that they could make improvements in their farms or better their standard of living. Besides, he exposed the drain of India's wealth in various forms to Britain as a major cause of poverty of the peasant, and observed, 'A poor underdeveloped country with a low saving potential must continue to remain desperately poor if a significant part of its economic surplus is being constantly drained away.'

From 1848 to 1856, India was ruled by Lord Dalhousie, an innovative, but ruthless, person. The effects of his administration were deep and lasting. He introduced railways, telegraph and half-anna postage. He set up the Public Works Department and constructed roads. To settle the disbanded Sikh soldiers in the Punjab, he constructed the Upper Bari Doab Canal. The railways gave a new orientation to Indian agriculture and the export of cotton to England encouraged cotton cultivation.

The Earl of Mayo, who was the Governor-General of India from 1869 to 1872, had an agricultural background. He was a practising farmer from Ireland. He encouraged the digging of canals and organized a Department of Knowledge and Statistics, Animal Husbandry, Fisheries and Forests in the Government of India. He received great support from a civilian, with radical views, Allan Octavian Hume. Hume and Mayo failed to organize a Department of Agriculture in the Government of India owing to opposition from conservative colleagues, but their work had the desired impact on the organization of agriculture at the Centre and in the provinces in due course.

Ripon instituted the Revenue and Agricultural Department in the

Government of India in 1881 and the directors of agriculture were appointed in the provinces. During the rule of his successor, Dufferin, an event of great importance was the establishment of the Imperial Bacteriological Laboratory at Mukteswar in Kumaon in 1895 and also the setting up of the Civil Veterinary Department, with Hallen as the first Director-General.

The period 1877 to 1900 was marked by a number of disastrous famines. The famines of 1877, 1878, 1889, 1892, 1897 and 1900 took a heavy toll of about fifteen million lives. The population of a fair-sized European country was swept away from India within twenty-five years. To meet this situation, the Sirhind Canal in the Punjab, the Lower Ganga Canal and the Betwa Canal in the North-Western Provinces, and the Mutha and the Nira Canals in the Bombay Presidency were constructed.

The greatest progress in agriculture took place during the rule of Lord Curzon (1898-1905). Stimulus to all this work came from the terrible famine of 1899-1900, which affected a population of over five crores. The necessity of providing irrigation for the famine-prone areas was realized. The great canal system of the western Punjab was started and prosperous canal colonies developed in the waste-land of the Punjab. The Imperial Agricultural Research Institute was started at Pusa, and departments of agriculture were set up and also colleges of agriculture in the provinces. Curzon also gave relief to the peasants by allowing suspension and remission of land revenue in the years of drought. Indebted farmers also received relief and the Punjab Land Alienation Act of 1921 saved the peasants of the Punjab from the clutches of the money-lenders. Co-operative credit societies were also started to provide the farmers with credit.

In the first quarter of the twentieth century, leadership in agricultural research was provided by the British scientists at the Imperial Agricultural Research Institute, Pusa. The most prominent among them were five persons, namely Sir Albert Howard who worked on wheat; John Walters Leather who developed soil science; Harold Maxwell-Lefroy and Thomas Bainbridge Fletcher who worked on Indian insect pests, and Sir Edwin John Butler whose work on fungi is still a classic.

Then followed a period of tutelage of Indian scientists under the British scientists. Sir T. S. Venkataraman worked with Dr C. F. Barber and at Coimbatore they evolved hybrid canes, which made India self-sufficient in sugar. Ram Dhan Singh and Dr B. P. Pal, who had worked with Sir Albert Howard at Pusa, made a distinguished contribution in wheat-breeding on their own.

From 1914 to 1933, the rural scene in the Punjab was dominated by two stalwarts, Mian Sir Fazl-i-Husain and Choudhri Sir Chhotu Ram. They provided relief to the indebted Punjab farmer by important enactments. Incidentally, it was Sir Fazl-i-Husain who shifted the Imperial Agricultural Research Institute from the earthquake-ravaged Pusa to New Delhi.

This period is also marked by the emergence of improving landlords. In 1914, Sardar Jogendra Singh carried out experiments on tractor cultivation in the United Provinces and in the Punjab. Sir Ganga Ram, a distinguished engineer and agriculturist, played a remarkable role in irrigating the high-lying lands in the Canal Colonies of the Punjab with lift irrigation.

In 1929 the Imperial Council of Agricultural Research was set up, following the recommendation of the Royal Commission on Agriculture, headed by Lord Linlithgow. This was a great event in the history of agriculture in India and had a far-reaching impact on agricultural production in the country.

In 1935, following the rural development done by F. L. Brayne, of the ICS, in Gurgaon, great interest arose in the country in such a work. The first Congress Ministry in the United Provinces of Agra and Oudh, with Pandit Govind Ballabh Pant as Chief Minister, and Dr Kailash Nath Katju as Development Minister, gave a lead to the country by launching a rural development programme.

The food crisis created by the Second World War and the Bengal Famine of 1943 were the reminders of a grim situation. Dr W. Burns, Agricultural Commissioner of the ICAR, discovered in that year that whereas the population of the country was rising alarmingly, its food production was going down. This was a situation which the British in India could not handle. It required a national effort. Moreover, sufficient education spread in India and an educated and enlightened middle class arose. That class was ready to control its own affairs. Mahatma Gandhi organized the National Liberation Movement, which stirred the masses. The British parted with power in a graceful manner and a free India came into existence on 15 August 1947. Thus the prophecy of Thomas Munro that "people might themselves so far develop that they would oust the British from control", was fulfilled. From thence onwards, the responsibility for increasing agricultural production was entirely of our own countrymen. How they acquitted themselves in accomplishing this great task will be told in the fourth volume of the series.

Kharar (near Chandigarh) M. S. RANDHAWA
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MERCHANTS and traders from European countries facing the Atlantic landed in coastal India at the close of the Sixteenth century and in the early Seventeenth century. The Portuguese were the earliest, followed by the Dutch, the English and the French. What were the reasons for this new development in commerce between Europe and India?

The confrontation of Christendom with Islam entered a new phase in the Fifteenth century. Constantinople was captured by the Ottoman Sultan Muhammad II in 1453 and the Turks controlled the land trade route to India via Levant. The conquest of Egypt by the Turks in 1517 made them masters of the trade routes from India, China and Africa, and the Ottoman warships patrolled the whole of the Mediterranean. The Turks imposed heavy levies on the Indian spices, silks, tapestries and precious stones. As a result, the Europeans had to pay exhorbitant prices for spices, particularly pepper, which not only made their food tasty, but was also used as a preservative for meat. The Italian cities of Venice and Genoa were the main beneficiaries of this trade in Europe, and their ships carried the goods from Levant. Now these cities faced indigence. An important result of this policy of the Turks was that land-ways gave place to sea-ways. The countries of Europe facing the Atlantic, namely Spain, Portugal, England, Holland and France, became sea-powers and centres of commercial activity. Genoa, and Venice were gradually supplanted by Lisbon, Seville, Cadiz, Bordeaux, Nantes, Dieppe, Dunkirk, St Malo, Antwerp, Amsterdam, Bristol, Liverpool and London.

THE PORTUGUESE AND THE AGE OF EXPLORATION

The Portuguese under Prince Henry the Navigator opened the Age of Exploration in 1415. Henry established an observatory and a school for navigation at Sagre. He summoned learned mathematicians, astronomers, cartographers, and navigators from all parts of Europe. He engaged the most famous cosmographer of the age, Jafuda Cresques, a Catalan Jew from Majorca. He also collected the most daring captains and mariners he could find. Charts were made, and the working of the mariner's compass was improved. He also realized that the ships, which were suitable for coastal trade, were not good enough for sailing in open seas. He improved the caravel which carried batteries of cannon, and made it a floating fortress.

Vasco da Gama, the Portuguese noble, arrived at Calicut in 1498 via the Cape of Good Hope. The ocean-going ships on the Cape route could take bulky goods on a much greater scale than the land route through Egypt. Thus the European countries could also sell goods in India and the drain of gold and silver from Europe to India was partially stopped. In 1502, Vasco da Gama arrived for the second time on the Malabar Coast with twenty ships, and after cannonading Calicut, and destroying all the ships in the port, he strengthened the Portuguese factories at Cochin and Cannanore and returned.

Albuquerque, the Portuguese Viceroy, conquered Malacca, the market-town, for spices in 1506. In 1510, he captured Goa. These conquests firmly established the Portuguese mastery over the Indian ocean and also opened the way for expansion into the Pacific. In 1518, Albuquerque was recalled, and the Portuguese power in the East began to decline. The circumnavigation of the globe by Magellan's ship during the period 1519-1522 brought the first phase of the Age of Exploration to a close.

The success achieved by the Portuguese and the Dutch in navigation was rendered possible by a number of innovations. In the first place, a number of nautical instruments, from the earlier compass and astrolabe to the mariner's log were put into use. The compass was introduced into Europe at the close of the Twelfth Century by the Arabs. The astrolabe, a graduated brass circle for estimating the altitude of heavenly bodies, was known before 800, but was first employed in Western navigation by the Portuguese in 1485. The quadrant, which was more accurate than the astrolabe, dates from the early Sixteenth century. By means of these devices, the mariners were enabled to calculate their position north or south of the Equator with some accuracy. With the aid of the mariner's compass, the quadrant, the telescopes, and other instruments, the sea could be navigated far more safely and precisely than ever before. Above all, they made long voyages across open water possible. Maps, charts, and tables were constantly improved, lighthouses were built, harbours were cleared of obstacles, and the pilot service was inaugurated. The age of exploration was made possible by improvements in the art of navigation inaugurated by Portugal and Spain, who employed Italian seamen. It not only greatly extended the territorial possessions of the Western Europeans and increased their knowledge, but, more than any other movement of the age of transition, it made possible the development of modern civilization.

Invention of Printing and Rise of Universities

A radical development which took place in Europe in the Fifteenth century was the invention of printing. As a multiplier of knowledge, the printing-press promoted literature and science. Credit goes to Johann Gutenberg (1398-1468), of Mainz in Germany, for the invention of printing, and its conversion into a practical art and a productive industry. He was printing from movable type as early as 1438. The art of printing spread rapidly in Europe. In England, Caxton set up his printing-press in 1477 at Westminster. It is estimated that by the end of the Fifteenth century, approximately 30,000 editions of different books had been published, and western Europe possessed about 9,000,000 printed volumes.[1]

Originally, only Bibles were printed, but soon there was a shift from religious to secular subjects. The rise of vernaculars in place of Latin, heralded by Petrarch and Boccaccio in Italy, and by Chaucer in England soon after, led to new literature in western European countries. The printing of books also led to the development of education, and by 1500, there were eighty universities and colleges in western Europe. The universities of Salerno and Padua in Italy, and Montpellier in France were the chief medical universities. The printing industry also contributed to the development of science.

Credit for the introduction of printing in India goes to the Portuguese. The first printing press was established in Goa, in 1556, by John de Bustamante, a Spaniard. In 1557 St Francis Xavier's *Catechism on the Doctrine of Christianity* was printed. Between 1556 and 1674 more than hundred books were printed in Goa, and some of these were in Tamil and Malayalam. In 1577 several books were printed in Malayalam by Joannes Gonsalves at Ambalkad in Malabar. However, the printing press made no impact on Mughal India.

Birth of Science

The economic and technological changes in Europe between 1500 and 1700, as a result of vastly expanded trade, influenced the growth of sciences and the arts. The Commercial Revolution of these 200 years was made possible by the introduction of the compass by the Arabs and their astronomical observations. The Atlantic sea-ports of Europe became important. A large number of new commodities were introduced into Europe and the travellers with their experience of the people and their customs in different countries developed a new outlook on life and its problems. The political unification and the establishment of law and order created a peaceful environment which was conducive to the steady development of science and the arts. The merchant princes of Europe, with their newly acquired wealth,

[1]Geise, J. *Man and the Western World*, p. 583

became patrons of the scientists and encouraged societies and publications. The rapidly growing cities of Europe attracted men of talent. The Protestant Revolt of Martin Luther liberated the European mind from the thraldom of Papacy and encouraged rationalism. These are conditions which are conducive to the development of science and the arts, activities which can only flourish when men of genius acquire sufficient income so that they do not starve and have leisure to work freely and they get opportunities of association with like-minded persons, so that they are enabled to exchange ideas and to hear the criticism of others on their theories and they are at liberty to express their ideas as freely as possible.

In this age of the Revival of Science, a great name is that of a Pole, Copernicus (1473-1543), who showed that the earth revolves around the sun and the sun is the centre of the planetary system. This was a revolutionary discovery which disproved the Ptolemian theory. Tycho Brahe (1546-1601), the Danish astronomer, made valuable observations on celestial movements. Johann Kepler (1571-1630), a German astronomer, showed that the planets move in elliptical paths and they travel most rapidly when near the sun. Galileo (1546-1642) made the first telescope and also founded the science of dynamics by his famous discovery of the law of falling bodies. Isaac Newton (1642-1727) discovered the law of gravitation. He combined Kepler's law of planetary motion with Galileo's law of falling bodies and explained that the planets, which revolve around the sun in ellipses, are kept in their courses by the attraction of the sun, which varies directly with the mass of the object and inversely with the square of the distance from the sun. Newton's law of gravitation is one of the most remarkable and revolutionary discoveries in science. It gave a new conception of the universe and the planetary system and revealed a cosmos of infinite expanse and complexity.

In mathematics also, there was rapid advance during this period. Napier and Briggs devised Logarithms and thus greatly facilitated astronomical computations. Descartes (1596-1650) established analytical geometry and Newton and Leibnitz perfected calculus which later on facilitated the development of physical science. The progress of physical science was also stimulated by the discovery of a number of scientific instruments. Galileo, of Italy, invented the thermometer in 1597; Torricelli, an Italian, invented the barometer in 1644; Otto von Guericke, a German, invented the air pump and manometer in 1650. Christian Huygens, a Dutch, invented the pendulum clock in 1657. Newton and Huygens discovered the spectrum analysis and the nature of colours and light. Gilbert (1540-1603) discovered magnetism.

Robert Boyle (1627-1691), an Irishman, and Friedrich Stahl (1660-1734), a German, established the science of chemistry and exploded the Aristotelian theory of the four basic elements, earth, air, fire and water, and showed that there are many more elements.

Vesalius (1514-1564) made a systematic study of anatomy, and William Harvey (1578-1657) discovered the circulation of blood. The invention of microscope by a Dutchman, Leeuwenhoek (1632-1723), opened out a new world, which was so far hidden from the eyes of man. Robert Hooke, an Englishman, in his *Micrographia* (1667) announced the cellular structure of plants. Malpighi (1628-1694) made studies in plant anatomy and Leeuwenhoek isolated blood corpuscles, bacteria, etc. Jan Swammerdam (1637-1680) carried out studies on insects. Francesco Redi (1626-1679) studied putrefaction and founded the science of pathology.

Rise of the Dutch Colonialism

In the Sixteenth century, Holland and Belgium together constituted the Netherlands, which was ruled by Charles V (1519-1556), the Habsburg King of Spain. Southern Italy, Sicily, Sardinia, Austria, Bohemia (as Bavaria was then known) were also in his empire. The Protestant doctrines of Martin Luther spread into the Netherlands from Germany. Besides, the Netherlands had her own prophet of enlightenment, culture and sanity in Erasmus of Rotterdam (1467-1536). He visited many European universities, and from 1500 to 1513 held the Chair of Divinity at Cambridge. He wished to see the Bible translated into every European language, so that its message could reach the masses. He believed in humane, tolerant and enlightened Catholicism, shorn of accretions of ritualism, and ceremonials. Charles V, a devout Catholic, the patron saint of the Inquisition, wanted to purge his empire of heretical ideas which were fast spreading among the urban middle class. Hence the Netherlands attracted his special attention.

Philip II (1556-1598) succeeded Charles V. His younger brother Don John of Austria defeated the Turks at the naval battle of Lepanto (1571). With his ego inflated by that victory, Philip II regarded himself as the defender of Christendom, and set before himself the task of purifying his empire of all heresy. To crush Protestantism, he instituted a provincial inquisition on the Spanish model. He deprived the provinces and the cities of their traditional rights and put over them autocratic Spanish governors. Besides, the finances of Spain were in a mess, not due to lack of resources, but on account of ignorance of economic laws and a vicious system of taxation. The Netherlands, with rich merchants of Haarlem, Amsterdam, Leyden, Utrecht, Bruges and Ghent, appeared like beehives to him, full of honey.

Philip II sent Duke of Alva, a ruthless man, as Governor-General of the Netherlands, with picked Spanish troops. In 1567, the Netherlands were in open revolt. The leader of the revolt was William of Nassau, Prince of Orange, also known as William the Silent, and his associates were Counts

Egmont and Hoorn. Egmont and Hoorn were captured and executed by the Spaniards. They provided the martyrs for the liberation movement. To pay his troops, Alva imposed a sales tax of ten per cent on the merchants of the Netherlands. This imposition united the Catholics and the Protestants, and gave them a common cause to oppose the Spaniards. The Dutch fought the Spaniards valiantly under the leadership of the Prince of Orange, their national hero and the founder of their country.

The resistance movement received great support from the Dutch pirates, who infested the Atlantic littoral. They seized the town of Brill in 1572. In 1578, Holland and Belgium were separated. On 21 July 1581, the representatives of Holland, Zealand, Gueldcrland, Utrecht, Brabant and Flanders met at the Hague, and signed the Act of Abjuration, renouncing their allegiance to the King of Spain. In 1648, Spain and Holland concluded the peace of Munster. Thus was born the Dutch Republic, whose navy challenged the navies of England and Portugal, and whose merchant ships sailed to Ceylon, India and Indonesia, and built up a vast empire. Considering the size of the country, its achievement in colonial expansion and empire-building is by no means small.

After winning their freedom from the Spaniards in 1581, the Dutch merchants embarked upon the task of breaking down the Portuguese monopoly of trade in spices with Asia. This they did with ease, since, with the true commercial spirit, they not only imported spices from the East to Holland, but also distributed them through Dutch merchants to every country in Europe. The Portuguese were satisfied with the bringing over of the commodities to Lisbon, and letting the merchants of other European nations come and fetch them. The incursion of the Dutch merchants into Asia was caused by the action of Philip II in closing the Port of Lisbon to them in 1594. In 1595, Cornelius Houtman, a Dutchman, who had been employed by the Portuguese as a pilot in the Indian seas, led a Dutch fleet round the Cape of Good hope for the first time. Houtman reached the Indonesian islands, and returned to Holland after an absence of two years and a half.

The Seventeenth century is the golden century in the history of Holland. Houtman's exploit led to the foundation of the United East India Company on 20 March 1602. Amboyna was seized from the Portuguese in 1605. Jan Pieterz Coen occupied Jakarta on 30 May 1619. Antony Van Diemen was appointed Governor-General of the East Indies in 1633, and in 1641 he captured Molucca from the Portuguese. In 1654, Van der Heyden occupied the Port of Colombo and expelled the Portuguese from Ceylon. In 1660, the Dutch occupied Cochin on the west coast of south India. They then systematically extirpated the Portuguese naval power in the Indian Ocean.

In the East, the Dutch achieved victory after victory over the Portuguese. In Europe, too, they were equally successful. In the battle of the Downs (1639), Van Tromp defeated the combined fleet of the Spanish and the Portuguese. He also swept English warships from the Channel, and as a token of his victory hoisted a broom at his masthead. In 1667, the Dutch sailed up the Thames to Gravesend and burnt an English fleet in the Medway.

The Dutch ships also sailed to America and founded a trading-post on the banks of the River Hudson. The Dutch named it Nieuw Amsterdam and it is now known as New York. Brooklyn, Harlem, and many other places were founded by the Dutch settlers, whose descendants are a sizeable part of the population of the eastern coast of the USA. The profits of commerce, plus the proceeds from the industries they stimulated, made Holland one of the foremost countries of Europe, and a rival of France and England in the struggle for commercial supremacy. Amsterdam became the chief money-market in Europe.

Contribution of the Dutch in India to Botany was notable. Henrich van Rheede tot Draakenstein, the Dutch Governor of Malabar in India, collected a large number of plants in 1676. These were sketched for him by an artist from Cochin, and later on were described in *Hortus Malabaricus* in twelve volumes, with 794 plates. It was on Rheede's work that Linnaeus based the nomenclature of Indian plants in his *Species Plantarum*. Commenting on his botanical work, Sir William Jones remarked, 'When we complain, and myself as much as any, that we have little leisure in India for literary and philosophical pursuits, we should consider that van Rheede was a noble-man at the head of an Indian government and that he fully discharged all the duties of his important station, while he found leisure to complete those 12 large volumes, which Linnaeus himself pronounces accurate'.

Another important work which originated from this Dutch Settlement was that of George Everhard Rumphius. Professor John Burman, of Amsterdam, rescued it, edited it and published it in 1757 in six volumes. It contained 696 plates.

In 1737, John Burman published his *Thesaurus Zeylanicus*, based on Paul Herman's specimens collected from Ceylon. Herman's herbarium was rediscovered by M. Gunthar, an apothecary to the King of Denmark, who sent it to Linnaeus. In 1747, Linnaeus published *Flora Zeylanica*, in which he described new genera and included Malabari and Sinhalese names.

The Protestant Mission in the Dutch Settlement in Tranquebar was another centre of Dutch work on botany in India. In 1768, John Gerard Koenig was appointed at the Tranquebar Mission in the south. He was a missionary surgeon and had his early training in Uppsala in Sweden under Linnaeus. Koenig was the first botanist to introduce the Linnaean system of classification of plants in India. Before this, the classification was mainly based on the economic use of plants, ignoring the floral parts and their structure.

CHAPTER 2

THE COMMERCIAL REVOLUTION IN ENGLAND

1509-1700

THE EAST INDIA COMPANY
LIFE IN THE ENGLISH EAST INDIA COMPANY AT SURAT
THE FRENCH IN INDIA

THE expansion of commerce, the growth of the navy, the regulation of commerce and industry, and the tolerance of the non-conformists, helped to strengthen the monarchy in the Tudor period. Henry VII initiated oversea expansion by subsidising John and Sebastian Cabot's expedition across the Atlantic in 1497. The English naval power was increased by Elizabeth's support of the freebooters who preyed on the Spanish trade and by Drake's defeat of the Spanish Armada in 1588. Elizabeth encouraged explorers and freebooters like Drake, Frobisher, and Hawkins, and "split" with them the proceeds of their piracy. Her policies in the main were favourable to the commercial interests. While Catholics and radical Protestants were denied many rights and privileges, their treatment was not harsh. These policies, supplemented by the poor laws, the statutes encouraging agricultural improvements, and governmental support of the new trading companies, increased English prosperity and favoured the middle class.

'The Commercial Revolution in England consisted of: a series of innovations in navigation; the enormous territorial expansion of European trade; the shifting of commercial routes and centres from the Mediterranean coast to the Atlantic seaboard of Europe; a far-reaching transformation of commercial methods; a revolution in the European price system; and an increase in the variety of trade goods, which created a revolution in European tastes and standards of living. Closely associated with these innovations was the development of commercial capitalism, with its novel banking methods, insurance, joint-stock companies, and produce and stock exchanges, and the formulation of a new economic theory, *Mercantilism*. Although of the greatest importance in their own right, and with a history and influence much more extensive than that of the Commercial Revolution proper, capitalism and mercantilism may be regarded as essential parts of that revolution.

'The extension of oceanic commerce stimulated the ship-building industry, which made many important technical improvements. The expansion of English shipping was characteristic of the age. In 1560 the total tonnage of English merchant ships was 7,600, by 1691 it had increased to 500,000. This was accompanied with almost as remarkable a growth of naval tonnage, from 23,000 in 1607 to more than 120,000 a century later.'[1]

The East India Company

Queen Elizabeth (r. 1558-1603), the contemporary of Emperor Akbar, granted on 31 December 1600 the first Charter to a Corporation of "Governor and Company of Merchants of London trading to the East Indies"—enabling them to trade for fifteen years. It was thus that the East India Company was founded with a capital of £70,000. Emperor Jahangir permitted the English to establish factories at Surat, Gogha, Ahmedabad and Khambay by a *farman* on 12 March 1612. Thus Surat was the first established settlement of the English in India. The English defeated the Portuguese fleet in 1615, off Surat. The Mughals realized that the English could give security to their commerce and pilgrim traffic to Mecca, and readily gave them privileges in their trade with India. On 7 February 1615, Mr Edwardes, the English Company's agent, obtained a general and perpetual *farman* from Jahangir for trade in the Mughal dominions. On 10 January 1616, Sir Thomas Roe, Ambassador of King James, was received by Jahangir, and on 26 March he presented his nineteen articles of Amity, Commerce, and Intercourse. Jahangir did not regard the English King as his equal and, as such, the signing of a treaty was out of the question, but he accepted some of the requests of Roe. On 3 April 1661, Charles II granted a new charter "for ever", confirming former privileges and authorizing the East India Company to make peace or war with any non-Christian people, to erect fortifications, maintain armies, administer justice, and to have the right of sending unlicensed persons to England.

The Company built Fort St George in Madras in 1639; bought the island of Bombay from King Charles II, and removed their factories to that place in 1687; and made their Bengal headquarters in Calcutta in 1700.

Life in the English Factory at Surat in the Seventeenth Century

These so-called factories were, in fact, warehouses-cum-godowns. Frayer and Brighton, who came to Surat in 1673 and 1689 respectively, state, 'The factory was housed in a large solid two-storeyed building with a number of rooms. Some of the rooms on the ground floor were used as godowns and store rooms. There was much hurly burly in the factory and the banias, brokers, merchants and the warehouse-keepers all made a 'mere billing gate'. The brokers plied a good trade and often took advantage of the ignorance of the English factors of the Indian languages. The upper storey was used for residential purposes. The President was allotted a set of rooms. The factory had a large open dining-hall and an oratory or chapel, decently embellished so as to render it both neat and solemn without the

[1]Geise, J. *Man and the Western World*, pp. 636, 665

figure of any living creature in it, for avoiding all occasion of offence to the Moors, who were well pleased with the innocence of this worship. The head of the factory was the President.

"The English President lived in almost as great state as the Mughal Governor. Outside the door of his bedchamber stood servants with silver staves, and when he appeared they followed him from room to room. If he went downstairs, a picket of liveried guardsmen sprang to attention in the hall, and if he left the factory "Bandarines and Moors under two Standards marched before him". He was provided with "well-filled stables for pleasure or services" and he had his own chaplain, physician, surgeon, linguist and mint-master. At his entry into the dining-room, trumpets blew and while he sat at table, violins played softly. All the English merchants dined together in the hall of the factory, the President at the head of the table and the others seated in order of seniority.

DINNER

"On certain church festivals, however, they dined in the gardens outside the city. They went in a solemn procession, the President and his lady in a palanquin with banners ahead, the Council in ox-drawn coaches of special splendour, each having "a Four Square Seat, inlaid with Ivory", and the other factors on Arab horses whose saddles were of embroidered velvet and whose headstalls, reins and cruppers were of solid silver. All the dishes and drinking-vessels were of massive silver. Each diner was attended by a page with a silver basin and ewer, so that he might wash both before and after the meal.

"Generally, there were many and various courses. "Cabob" was a favourite dish, not unlike a goulash; "dumpoked fowl", that is, chicken boiled in butter and stuffed with raisins and almonds; "mango achar and sony sauce". On Sundays, for dinner there would be "deer and antelopes, peacocks, hares and partridges and all kinds of Persian fruits, pistachios, plums, apricots, cherries". But meat was sometimes scarce and though the senior merchants never went without it, the common sailors had to fast twice a week and content themselves with saffron rice. Beef was unprocurable. Captain Downton attempted to start an abattoir, but the Hindu humanitarians bribed the Moghul Governor to prohibit this; pork was, of course unheard of in the Musulman territory; and so the English had to satisfy their seventeenth-century appetites with mutton and chicken. At first, some of the young factors tried to supplement this meagre diet by shooting doves and pigeons, but the tender-hearted Hindus would implore them not to do this, and would as a last resort offer them money to spare the poor birds. This method of persuasion was so successful that it became a regular practice for impecunious young sportsmen (and the contrast between their splendid style of living and their small salaries was responsible for the general indebtedness among all the junior factors) to take out a gun near some rich Hindu's house and talk loudly and ferociously about the number of pigeons they would massacre that afternoon till the Hindu ran out with tears in his eyes and money in his hands. Only on Sundays were the European wines served at table; on weekdays, they drank Persian wines from Shiraz and, more commonly, *arak*.

"Occasionally, the factors dined with Muhammadan friends and found the *pulavs* and *birianis* delicious. These meals were, however, of enormous length and coffee was served between courses. And once they could persuade their hosts to ignore the Prophet's ban, they found Musulman heads stronger than their own. They were "not content with such little glasses as we drink out of, nor Claret nor Rhenish (which they call vinegar), but Sack and Brandy out of the bottle they will tiffle till they are well warmed".

"After Sir Thomas, Della Valle, an Italian traveller, reported that not only the junior factors drank to excess but also the President himself.

"The prejudice against employing gentlemen rapidly declined after the fall of Charles I. The Company had to appease the voracious appetites of the Parliamentarian oligarchs by enrolling as many of them as possible among their shareholders and finding jobs for their stupid nephews.

Amusements

"On holidays, the factors amused themselves with archery and musket-shooting; or they would stroll around the bazaar, the temples and old palaces. Instead of attending the President's sermon, the young factors preferred to spend their time with their fighting cocks, especially imported from Siam, or with their other pets, with which the factory was crowded—we hear of innumerable fan-tail pigeons, Basra turtle-doves, tame cockatoos and a performing cassowary. They were less interested in pomp and ceremony than in comfort, and the officials stationed at Swally, the Port of Surat, had been formerly satisfied with tents, they now demanded bungalows. Private rooms began to be furnished with an elegance that disturbed the directors, and what was to be said of Mr Young who sat up till two or three 'in drinking of healths...thus perverting or converting to an ill private use those refreshments intended for the factory in general'?[2]

"Interest in the arts was regarded with some suspicion and when Mr Lenton ventured on an ode, he was told 'the Court did not well relish his conceits and desired him neither to print them nor proceed any further in making verses'."[2]

The French in India

The French were the last to join the colonial game in India. They

[2]Kincaid, D. *British Social Life in India* 1608-1937, pp. 10-12

established the *Compagnie des Indies-Orientales*. The first French factory was started at Surat in 1668. Pondicherry was established in 1674 and Chandernagore in Bengal in 1690. The initiative for these ventures came from Colbert, Minister of Louis XIV (1643-1715), a resolute man with great energy, who knew the art of creative administration. Colbert realized the importance of agriculture, industry and commerce, and gave encouragement to farmers, industrialists and traders. He improved communications in France by roads, rivers and canals, so that goods could circulate more freely. He also induced the French to conquer their aversion for the sea. He strengthened the French navy, and launched France upon a vigorous programme of colonial expansion. He sent expeditions and colonists to America, Africa and India. In America, in the provinces of Quebec and Louisiana, a large number of French settled. They introduced the chateau with its noble architecture, and also the planting of poplars in avenues along the roads. In the West Indies and Madagascar, the French developed the plantations of sugarcane and other tropical crops.

"In Pondicherry, the French introduced gardens and parks with elegant geometrical designs, great square lawns with star-shaped flower beds and long well-swept walks protected from the sun by creeper-hung pergolas, in whose shade gentlemen in high-heeled buckled shoes exchanged compliments in as leisurely and elaborate a manner as if they were at Versailles or Marly. Moreover, while the English at Madras made little effort to grow fruit, the French took the trouble to lay down vineyards in Pondicherry and were rewarded by a surfeit of delicious grapes. This was provoking enough; but all Madras exclaimed at the mercenary spirit of the French in refusing to sell their grapes to the English for less than a rupee a bunch."[3]

War between the French and the English in India

The wars of Frederick the Great found the English and the French opposed to each other in the battlefields of Europe, Asia, and America, for well nigh twenty years, from 1744 to 1763. The servants of the English and the French Companies eagerly took up the contest in India, made alliances with Indian princes, besieged each other's commercial settlements, and evinced in the East those bitter jealousies which divided them in the West. The three wars between the English and the French, which were carried on in India within these twenty years, are known as the Karnatic wars.

In the first Karnatic war the French had decidedly the advantage. They took Madras from the English, and they beat back the army of the Nawab of the Karnatic which came to retake the town.

Dupleix, the Director-General of the French Company, was fired by

[3]Kincaid, D. *British Social Life in India*, 1608-1937, p. 63

a lofty ambition to make his countrymen supreme in India; and for a time his success was complete. He helped an Indian ally to become Nizam of the Deccan, and he enabled another ally to become Nawab of the Karnatic. He was thus the most powerful "king-maker" in Southern India, and the influence of the British seemed completely annihilated. The French obtained the whole of the eastern seaboard, called the Northern Circars, from the Nizam.

Clive conquered the Northern Circars from the French, and made the East India Company a great territorial power in India. The third Karnatic war ended in the complete destruction of the French power. Lally, the patriotic but impulsive leader of the French, besieged the fort of Madras, but failed to take it. He was defeated by Eyre Coote in the battle of Wandewash in 1761, and the French settlement of Pondicherry was taken by the British after an obstinate defence. Pondicherry was restored by the Peace of Paris in 1763, but the power of the French in India had been irrevocably extinguished. After 1763, the British had no European rivals in India.

It was, however, Dupleix who made the discovery that Indians could be disciplined and trained in techniques of European methods of warfare and could be used to subjugate other Indians. This lesson was quickly learnt by the British. Military successes of Clive, Wellesley and others were ample proof of this. It was with the use of Indian troops led by a handful of Englishmen that the English built their Empire in India.

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CHAPTER 3

CLIVE LAYS THE FOUNDATION OF THE BRITISH EMPIRE IN INDIA
1757-1767

WARREN HASTINGS CONSOLIDATES THE BRITISH RULE IN INDIA
1772-1785

ON 23 June 1757, Robert Clive defeated the forces of Nawab Siraj-ud-Daula, of Bengal, at Plassey, and thus laid the foundation of the British Empire in India. It was more a skirmish than a battle, and the casualties were 65 from among the British troops and 500 from among those of the Nawab. Treachery of Mir Jafar duly contributed to the British victory. The East India Company became the *zamindar* of the Twenty-four Parganas, nearly nine hundred square miles of territory, south of Calcutta.

CHECKING CORRUPTION

In 1765, Clive was appointed Governor and Commander-in-Chief of Bengal. To clean up a corrupt administration, he wrote to the Directors, 'Upon my arrival, I am sorry to say, I found your affairs in a condition so nearly desperate as would have alarmed any set of men whose sense of honour and duty to their employers had not been estranged by the too eager pursuit of their own advantage. The sudden, and, among many, the unwarrantable acquisition of riches, had introduced luxury in every shape and in the most pernicious excess. These two enormous evils went hand in hand together through the whole Presidency, infecting almost every member of each Department; every inferior seemed to have grasped at wealth that he might be able to assume that spirit of profusion which was now the only distinction between him and his superior .... It is no wonder that the lust of riches should readily embrace the proffered means of its gratification, or that the instruments of your power should avail themselves of their authority, and proceed even to extortion in those cases where simple corruption could not keep pace with their capacity. Examples of this sort, set by superiors, could not fail of being followed in proportionable degree by inferiors; the evil was contagious, and spread among the civil and military, down to the writer, the ensign, and the free merchant.'

In a determined manner, he devised measures to check corruption. The acceptance of gifts above a certain level was forbidden. Private trade by the Company's officials was regulated. Though he could not claim that he eradicated corruption, at least he took the first long step towards an ordered and honest administration in Bengal.

Shah Alam II Grants the Diwani of Bengal to the Company

On 22 December 1772, the Emperor Shah Alam II, besieged by the Marathas in Delhi and unable to resist any longer, opened the gates to them. He was now entirely under their control, and they extorted from him a grant of the provinces of Kota and Allahabad. In 1765, he became a homeless wanderer, but was still recognized as the titular Sovereign of India. In 1765, Clive obtained from the Emperor of Delhi a charter, making the East India Company the Dewan or administrator of that province. The East India Company thus obtained a legal status, and also formally took upon themselves the responsibility for administering the province which they had conquered eight years before. Lord Clive effected some other reforms in civil and military administration, and finally left India in 1767. An energetic man and a leader of men, Clive had the gift of inspiring his subordinates. His achievement was that he laid the foundation of the British Empire in India.

Warren Hastings (1772-1785): Consolidation of the British Rule

In 1772, the East India Company appointed a remarkable man their Governor at Calcutta. He was Warren Hastings, a scholar, a patron of learning and a keen gardener. Dennis Kincaid, describing his interest in horticulture, writes, "He was almost happiest when pottering about a garden in the shabbiest of clothes. From his first arrival in India he had been trying to acclimatise English plants, and, as Governor-General, we find him writing to England for seeds of honeysuckle and sweet-brier, to be packed for the voyage "in small bottles with ground-glass stoppers". And on one occasion, he records delightedly the arrival of a consignment of "Troffles, Morrelles and Artichoke Bottomes". He bought eagerly rare Asian plants from the Himalaya and the upland frontiers of Burma. He was never tired of experimenting, and was proud of a hybrid grain he had produced which he called "barley-wheat". With animals he was less fortunate; some shawl-goats he had ordered from England died on the way; and he had to content himself with ordinary Indian cattle. It was perhaps from his readings in Hindu Literature that he caught an almost Hindu feeling for cows; he described how they run after him when they hear his voice, and in a letter to Imhoff he confesses his devotion to his cows "on account of their accomplishments and moral virtues".[1]

There is a painting by an unknown artist which shows Purley Hall, Berkshire, the house which Warren Hastings rented for three years during his impeachment. It shows two shawl-goats on the lawn outside the house and, in the foreground, the yak which Samuel Turner, who had been on the 1783 mission to Bhutan and Tibet, later sent to Hastings. There are

[1] Dennis Kincaid, *British Social Life in India*, 1608-1937, pp. 110, 118

also a Brahminy bull and another animal which is probably the yak's progeny. Turner records in his 'Embassy':

"I had the satisfaction to send two of this species (i.e. yak) to Mr Hastings after he left India, and to hear that one reached England alive. This, which was a bull, remained for some time after he landed in a torpid languid state, till his constitution had in some degree assimilated with the climate, when he recovered at once both his health and vigour. He afterwards became the father of many calves, which all died without reproducing, except one, a cow, which bore a calf by connection with an Indian bull.

"Though naturally not intractable by temper, yet, soured by the impatient and injudicious treatment of his attendants during a long voyage, it soon became dangerous to suffer this bull to range at liberty abroad. He had at all times been observed to bear a marked hostility towards horses; and... he happened to gore a valuable coach-horse belonging to Mr Hastings, which had the range of the same pasture with him, and lacerating the entrails occasioned his death. After this, to prevent further accidents, he was kept alone within a secure enclosure." In the picture he seems to be in this enclosure, looking rather mournful (Fig. 3).

Hastings also had the yak painted by Stubbs in 1791 and another version was made for the famous anatomist surgeon, John Hunter, which is still in the Royal College of Surgeons in London. It shows how interested these scholars were in Indian animals and the possibility of breeding from them.

The Famine of 1769-1770

The famine of 1769-1770 was the worst. It ravaged eastern India. About one-third of the population of Bengal, or about ten million people, died, and one-third of the cultivated land became waste. Hunter thus describes its horrors:

'The husbandmen sold their cattle; they sold their implements of agriculture; they devoured their seed grain; they sold their sons and their daughters, till at length no buyer of children could be found; they ate the leaves of trees and the grass of the field; and in June 1770 the Resident at the Durbar affirmed that the living were feeding on the dead. Day and night a torrent of famished and disease-stricken wretches poured into the great cities. At an early period of the year pestilence had broken out. In March we find small-pox at Moorshedabad, where it glided through the Viceregal mutes and cut off the Prince Syfut in his palace. Interment could not do its work quick enough, even the dogs and jackals, the public scavangers of the East, became unable to accomplish their revolting work, and the multitude of mangled and festering corpses at length threatened the existence of the citizens.'[2]

'The famine had several important effects. It meant that Bengal and

[2]Hunter, W.W. *Annals of Rural Bengal*, pp. 53-54

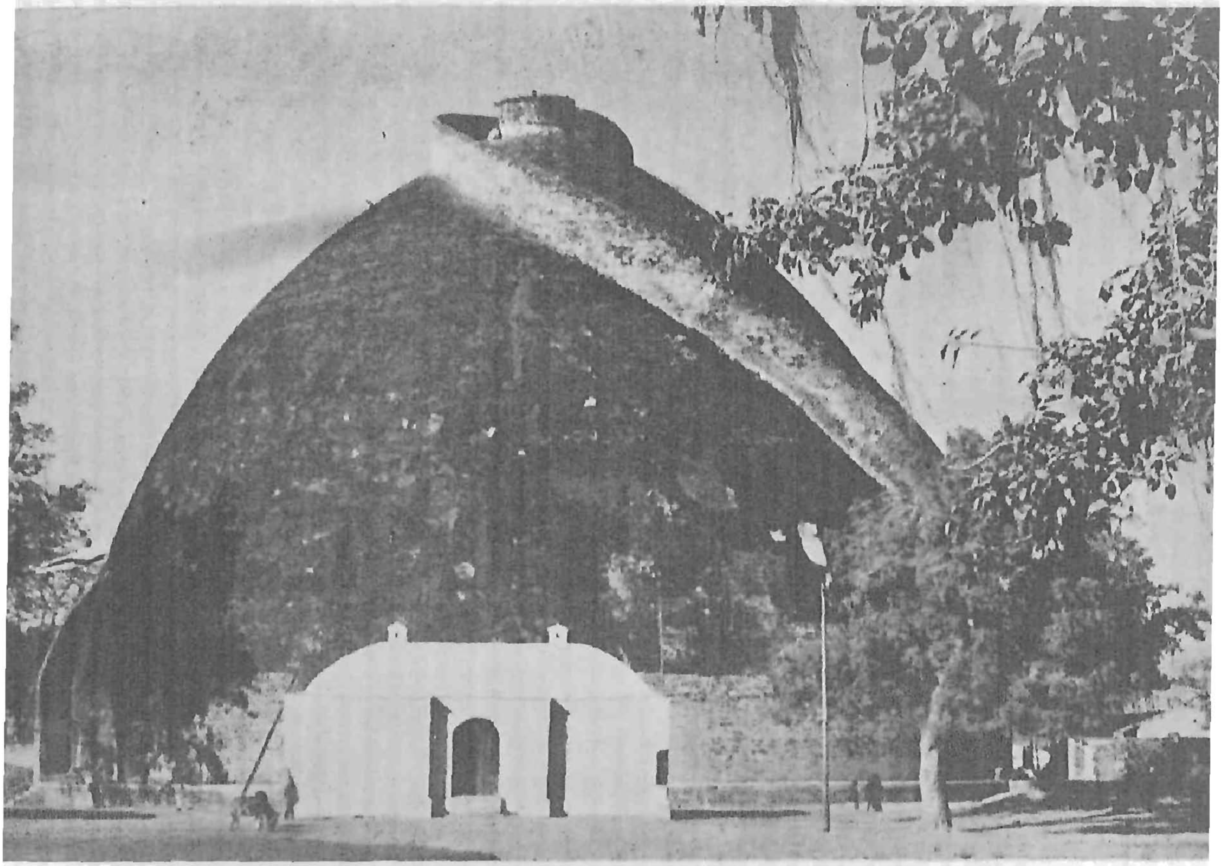

FIG. 1. Grain *gola* built at Bankipore, Patna, in 1786 under the orders of Warren Hastings. It was to serve as a grain store during famines

FIG. 2. Mr and Mrs Warren Hastings, Calcutta, 1783-7, by John Zoffany
(Courtesy: Victoria Memorial, Calcutta)

Bihar, for the first time in centuries, were seriously underpopulated for two generations. It dealt a heavy blow at the whole social system. Many of the zamindars, or hereditary farmers of the revenue, were ruined as the result of inability to collect the regular assessments from a reduced and enfeebled peasantry. Hunter dates the ruin of two-thirds of the old aristocracy from this time.'

The land tax was, however, rigorously collected during the years of human sufferings and deaths, perhaps unexampled in the history of mankind. Warren Hastings wrote thus to the Court of Directors on the 3 November 1772. "Notwithstanding the loss of at least one-third of the inhabitants of the province, and the consequent decrease of the cultivation, the nett collections of the year 1771 exceeded even those of 1768. . . . It was naturally to be expected that the diminution of the revenue should have kept an equal pace with the other consequences of so great a calamity. That it did not was owing to its being violently kept up to its former standard."[3]

GRAIN *Gola* OF PATNA

The autumn rains failed in 1783 in Bihar and the condition of scarcity arose. Memories of the disastrous famine of 1770 were still fresh in the minds of the Company's administrators. John Shore proposed a scheme for the construction of a number of granaries to be kept filled in anticipation of scarcity. A beehive-type granary was built by John Garstin in 1786 at Bankipore, 96 feet (29.26 m) high, with walls twelve feet (3.66 m) thick at the bottom, with two staircases on the outside winding to the top. Its object was the perpetual prevention of famine (Fig. 1).

Marquess of Hastings during his tour of Bihar saw the *Gola* in Patna on 13 August 1814. He stated, 'Rode in the morning to see the Golah. This is a brick building, rising as a dome, constructed by order of Mr Hastings, as one of many receptacles for grain which he meditated establishing, with the view of guarding against famine. This building seems admirably calculated for the purpose. Its height, and its diameter, are about 100 feet (30.48 m). The wall is very thick and well built. Four doors, on a level with the ground, afforded facility for taking out the grain. Two spiral stair-cases lead by an easy ascent to the top, where the grain was to be delivered into the building by a central aperture. The plan was that in cheap years rice should be purchased and accumulated in buildings of that sort, till each should be full. No second Golah has been built, and no grain has ever been lodged in this one. I understand it is urged that grain would swell and spoil if laid up in such a mass, and that the having of such a resource (if the grain did not spoil) would make the people less active in tilling the ground. I am not satisfied of the validity of these objections. The supposition that

[3]Extracts from India Office Records, quoted in Hunter's *Annals of Rural Bengal*, 1868, p. 381

the grain would spoil is gratuitous. Rice in the husk, if kept secure from the weather, will remain good for very many years, and inattention to the cultivation of the lands is by no means a consequence that can be connected with such a provision.'[4]

The building is remarkable for its reverberating echo, and for the view of the surrounding country which is to be obtained from its roof. Now it is a tourist attraction and reminder of an ill-conceived scheme, which ignored practical needs of such a structure.

Five-Year Settlement of Revenue

The main concern of Hastings was the welfare of the cultivator, who had been mercilessly exploited. If he could get a hearing and receive justice and could work his land unhindered and enjoy a fair share of the produce, that would be a great improvement, he felt.

As a first step, the revenue business and the treasury were removed from Murshidabad to Calcutta in 1772. The law courts were also transferred, under the name of *Sadar Diwani Adalat*, composed of Governor and two councils for civil cases and *Sadar Nizamat Adalat* for criminal cases, composed of Indian law officers, exclusively subject to the review of the Governor and the Council. Under these were district courts. The collectors had revenue and financial authority.

The land-revenue system of Bengal was in a state of confusion. As the Company held the Diwani, it was their duty to collect the revenues. The collection was entrusted to zamindars who were, in practice, hereditary and, in some districts, belonged to rich and noble families. The peasants were often at the mercy of the zamindars against whom they had no redress. The payment of revenue depended upon the power of the zamindar to defy. If he was a powerful man, he rack-rented the peasantry and paid little to the Government. In 1769, English 'supervisors' were appointed to safeguard the interests of the *ryots* and supervise the working of the courts of justice. But this system failed.

When Hastings assumed charge of the administration of Bengal, he saw clearly that the system needed to be reformed. The produce of land was shared among three parties—the State, the zamindar and the cultivator. A just distribution among these three required a thorough understanding of the problem involved; an exact knowledge of the value of every estate and holding; an efficient system of collection and a system of law courts.

In May 1772, the Governor and the Council reached decisions in regard to the revenue and administration as below:

(1) 'The lands were to be let out to revenue farmers for a period of 5

[4]The Marchioness of Bute (Ed.), *The Private Journal of the Marquess of Hastings, K. G., Governor-General and Commander-in-Chief in India*, Vol. I, pp. 107, 108

years. (2) A Committee of Circuit, consisting of the Governor and four members of the Council, was to be appointed to visit the principal districts and form the five years' settlements. (3) The supervisors posted in the districts were henceforth to be called collectors. (4) No *banya* or agent of the collectors should be permitted to farm any portion of the revenues. (5) Presents to the collectors from zamindars and from the *ryots* to the zamindars were not allowed. (6) The collectors and their agents were not allowed to advance money to the *ryots*. Such were the labours which the Committee of Circuit set to themselves. They desired 'to secure the inhabitants the quiet possession of the lands, while they held them on terms of cultivation. The leases granted to the farmers were to record precisely the exact claims of the *ryots* and all demands, not included in the lease, rendered the former contractors to whom the lands were farmed liable to severe penalties. The *ryots* were to be given *pattas* by the farmers in which conditions of the holding and the amount to be paid were stated clearly. A regular establishment was provided in the Kutcheries of the district to keep the charges of collection within certain limits.'[5]

The lands were farmed to the existing zamindars for a period of five years with a view to giving them some security and a new assessment was made after making enquiries into the productivity of the land in each district. The interests of the *ryots* were guarded by *patta* which have been mentioned before. Hastings judged it advantageous to enter into agreements with the old zamindars, because he thought that their entire deprivation would be prejudicial to revenue. As they had long been in the business, he concluded they had acquired an ascendancy over the minds of the *ryots* and ingratiated their affection. He expected solid advantages 'from continuing the lands under the management of those who had a natural and perpetual interest in their prosperity'.[6]

'Taken together, all these constructive measures, carried out in the first year of Hastings' administration, amounted to a revolution', observes Ishwari Prasad. They laid a solid basis for the British power in India, so that it was able to survive the formidable avalanche that attacked it in its early stages. They laid the foundation of the empire which was to spread all over India in the next hundred years.'[7]

Corruption among Company Officials

Under the rule of the East India Company, the English considered India as a vast estate or plantation, the profits of which were to be withdrawn from India and deposited in Europe. They reserved all the high

[5] *Fifth Report on East India Affairs*, I, p. 226
[6] Ibid., p. 227
[7] Ishwari Prasad, *India in the Eighteenth Century*, p. 150

appointments in India for their own nominees seeking a lucrative career in the East. The employees of the Company were mostly nephews and relations of the Directors or their political supporters. Clive had rallied against the prevalent corruption among the Embassy officials. 'I will only say that such a scene of anarchy, confusion, bribery, corruption and extortion was never seen or heard of in any country but Bengal, nor such and so many fortunes acquired in so unjust and rapacious manner. This corruption did not abate during the rule of Warren Hastings. Edmund Burke caustically commented, "Our conquest there, after twenty years, is as crude as it was the first day. The natives scarcely know what it is to see the grey head of an Englishman; young men, boys, almost govern there, without society, and without sympathy with the natives. They have no more social habits with the people then if they still resided in England; nor, indeed, any species of intercourse but that which is necessary to making a sudden fortune, with a view to a remote settlement. Animated with all the avarice of age, and all the impetuosity of youth, they roll in one after another, wave after wave, and there is nothing before the eyes of the natives but an endless, hopeless prospect of new flights of birds of prey and passage, with appetites continually renewing for a food that is continually wasting. Every rupee of profit made by an Englishman is lost for ever to India."[8]

ESTABLISHMENT OF A BANK

An important measure to assist the currency, which had been advocated among experienced servants of the Company, was the establishment of a bank. Money-lending had been hitherto in the hands of individual shroffs, amongst whom the house of Jagat Seth was the most famous. Transactions involved the actual carriage of bullion from place to place at immense expense and risk of loss both from those employed to convey it and from the many robbers who infested the provinces. There was also constant loss to the merchant from exchanges of the local rupees. The new proposal was to entrust certain responsible shroffs with the management of a bank at Calcutta, into which the revenues should be paid through branch houses set up at each collectorship. These branches would receive the revenue payments from the collectors in the current coin of the particular district, which coins they would find no difficulty in returning into the local circulation, while their bills only were to be accepted by revenue officials at the districts and headquarters of the Khalsa. The bank would thus obviate the necessity for treasury staffs at the collectorships, and would act in Calcutta as the agent of the Khalsa much as the Bank of England acts for the Treasury, and share its profits with the Company. The first managers appointed were Raja Huzoorimul and Raja Dolchand, men of credit among the zamindars,

[8] M.E. Monckton Jones, *Warren Hastings in Bengal*, 1772-1774, pp. 234-235

who would thus be encouraged to employ the bank in their own affairs. The natives were too much accustomed to fraud and oppression to believe readily that any public body could be safely entrusted with their treasure. Although, to judge from an inquiry held into the effects of its working, the bank appears to have achieved its objects, it was abolished in February 1775.

Regulating Act of 1773

The British Parliament passed a measure, called the Regulating Act of 1773, to improve the state of affairs in India. This Act gave a parliamentary title to the Company's administration in India, and created the post of a Governor-General for all the Company's possessions in that country. Warren Hastings, who was then Governor of Bengal, became the first Governor-General in 1774.

There was no abler Englishman in India at that time than Warren Hastings, and none who knew the country and its people more intimately. He had come to India, almost as a boy, in 1750; he had protested against the abuse of power by his own countrymen both in Bengal and in Madras; and he was animated by a sincere desire, as he was now invested with the power, to improve the administration.

Warren Hastings stopped the stipulated tribute to the Emperor of Delhi; he took away the Emperor's possessions at Kota and Allahabad, and sold them to the Nawab of Oudh for £ 500,000; and he lent an English brigade to the same Nawab to crush the Rohilas for another sum of £ 400,000.

Mission to Tibet

Warren Hastings encouraged researches in geography and natural history and sent forth his officers to Tibet, to the Red Sea and Cochin China to explore the possibilities of establishing diplomatic and trade relations with them. In March 1774, two envoys were sent by the Panchen Lama to Calcutta and their arrival gave Hastings his chance to make contact with Tibet. He made a treaty with the Deb Raj of Bhutan and on 13 May 1774 commissioned George Bogle, a Bengal Company servant, to lead an embassy to the Panchen (Teshu) Lama in Tibet. Hastings privately commissioned Bogle to sent back interesting specimens such as shawl-goats, yaks, walnuts, rhubarb and ginger and to keep a sharp look-out for all curiosities, 'whether natural productions, manufactures, paintings or what else may be acceptable to persons of taste in England'. He was told to make notes on the people, their manners and customs.

First Map of India by James Rennel

With the expansion of its domain, the Board of Directors of the East India Company felt the need for accurate maps of India, which would be used in military operations and administrations. They appointed Captain James Rennel, a capable naval officer, as the Surveyor-General of Bengal in 1767. By 1773, the survey of the Company's possession was complete and for three years Rennel settled at Dacca to compile maps from the thousands of rough sketches drawn in the field. In this work, Rennel enjoyed the patronage of Hastings, who encouraged him to complete the arduous task. In 1779, Rennel's major work, the *Bengal Atlas*, was published. It contained eight maps of different districts, and one general map of Bengal and Bihar. In the next three years, Rennel had collected sufficient material and published a large map of Hindoostan in 1783.

Warren Hastings was passionately desirous of promoting India's indigenous culture and with this end in view he established the Calcutta Madarsa for the cultivation of Arabic and Persian studies. He was a lover of oriental learning and he desired to give an impetus to its cultivation by European scholars. By doing so, he hoped to unlock the vast treasures which lay hidden in the literature and philosophy of the East to the world. There were four men who gave him great help in these endeavours, viz. Nathaniel Halhead, Sir Charles Wilkins, Sir William Jones and Colebrooke. An assembly of Pandits was held at Calcutta in 1776 to prepare a compendium of laws for the guidance of courts. It was written in Persian and Halhead was asked by Hastings to translate it into English. Wilkins and Halhead worked together and founded a press for printing books in oriental languages. The most remarkable of this learned group was Sir William Jones, a born linguist and scholar, who had been in England a Fellow of the Royal Society. From the day of his arrival in India he became a great friend of Hastings and in co-operation with him founded in January 1784 the Asiatic Society of Bengal. Hastings was offered the Presidentship, but he declined the honour and at his suggestion Sir William Jones was elected President. Jones devoted himself with great zeal to the study of Indian literature, philosophy and science and opened new fields of enquiry to Western scholars. Thomas Colebrooke also finished the codification of the law Jones had started. Wilkins produced a translation of the *Bhagwad Gita* to which an introduction was provided by Warren Hastings, who described it as a performance of great originality, of a sublimity of conception, reasoning, and diction, almost unequalled, and a single exception among all the known religions of mankind, of a theology accurately corresponding with that of the Christian dispensation, and most powerfully illustrating its fundamental doctrines.[9]

Patronage of Art

In the last quarter of the eighteenth century, a number of British

[9]Ishwari Prasad, *India in the Eighteenth Century*, pp. 196, 197

portrait-painters and miniaturists came to India, attracted by its exotic glamour and prospect of easily won fortunes. Among them, the most distinguished was John Zoffany (1733-1810), who was in India from 1783 to 1789. In Warren Hastings, with his love of arts and literature, he found a generous patron. Zoffany painted some excellent portraits of Warren Hastings and his wife, which are now in Victoria Memorial Museum, Calcutta. One of these is most expressive (Fig. 2). Hastings and his wife, followed by a Bengali servant girl, are standing under a banyan-tree. In the background is Calcutta with its spacious *maidan*. Calcutta of those days was grand and imposing; the public buildings, mostly of the Grecian order, were extremely handsome: porticoes, colonnades, and piazzas abounded everywhere. The river was crowded with shipping, chiefly European, with budgerows, bolios, and other Indian craft.

Other artists whom Warren Hastings patronized were Ozias Humphry, a miniaturist, Arthur William Devis, John Thomas Seton and Tilly Kettle who painted some excellent portraits of their patron.

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CHAPTER 4

CHARLES CORNWALLIS, FIRST MARQUESS

1786-1793

REFORMATION OF THE PUBLIC SERVICES

PERMANENT SETTLEMENT OF LAND REVENUE IN BENGAL, BIHAR AND ORISSA

CORNWALLIS (1738-1805) was a distinguished soldier who fought in the US War of Independence. His reputation survived the surrender of Yorktown in October 1781, and he was appointed Governor-General and Commander-in-Chief of India in 1786. He enjoyed the friendship of William Pitt, the then Prime Minister of the United Kingdom, and of Dundas, the President of the Board of Control.

As a man of high integrity, his first concern was the reformation of public services. He gave generous fixed salaries to the company's servants and abolished commission and private trade. He established the rule of law, and made all officers of the Government amenable to the courts for acts done in their official capacity. He also decreed that Government itself, in cases in which it may be a party with its subjects in matters of property, shall submit its rights to be tried in these courts under the existing laws and regulations. This rule laid the foundation of the civil liberty of the subjects.

His second measure was the establishment of police, first in Calcutta and then in the districts, for the maintenance of law and order.

PERMANENT SETTLEMENT OF LAND REVENUE IN BENGAL, BIHAR AND ORISSA

The most important reform of Cornwallis was the permanent settlement of land revenue in the lower provinces of Bengal, Bihar and Orissa. When he came to Bengal, the system of annual settlement was in operation. The whole rural life of the Bengal Presidency was disturbed by the regulation of demand by the people, ignorant of the prevailing conditions, and who acted as unfeeling agents of the impersonal calculating-machine at Calcutta.

Cornwallis, who himself was a landlord, regarded the zamindars as proprietors of land. After his arrival in the beginning of 1787, circular letters were addressed to district officers, asking them to submit reports on the working of the revenue system within their jurisdiction. They were asked to pay special attention to three questions:

1. With whom was the Settlement to be made?
2. What was to be the amount of assessment?
3. Whether the Permanent Settlement was to be made at once or gradually?

Connected with these questions was also the question of making rules for safeguarding the cultivator from the oppression of the zamindar or the under-farmers of the land tax. The first question was not easy to settle, for there were several classes of claimants in the field. There were the zamindars, the *taluqdars*, the revenue farmers, military and other holders of land and those who held land either free of revenue or at a low land tax for charitable, educational or religious purposes, such as the land attached to temples, *pathshalas*, mosques and other philanthropic institutions. Opinion was divided on the question. Sir John Shore, the chief *Sarishtadar* of the Board of Revenue, agreed that the zamindars were the proprietors of land, subject to the payment of revenue to the Government. Grant held a different view and said that zamindars were merely agents of the Government for the collection of revenue and they were entitled to a share of the proceeds as their wages. In a Minute, dated 18 June 1789, Shore discussed the entire problem and made out a strong case for dealing with zamindars as the actual proprietors of the soil on grounds of both policy and expediency. The main principles, stated by Sir John Shore, were the security of the Government with respect to its revenues, and the security and protection of its subjects. He hoped to accomplish the former by concluding a Permanent Settlement with the zamindars or proprietors of the soil and the second by carrying into practice, as far as possible, an acknowledged maximum of taxation. The settlement was to be made in the first instance for ten years, but with a view to permanency. The conclusions of Shore were not accepted by Sir Thomas Munro, who, with his experience of the *ryotwari* system of Madras, advocated a similar measure for Bengal. Lord Cornwallis, and the Home Government, accepted the recommendation of Shore in favour of the zamindars.

Cornwallis decided to grant proprietary rights to the zamindars, for, without such a body, there was no means of extending and improving agriculture. Large tracts of land in the possession of the Company still lay waste and it was idle to expect that they could be brought under cultivation through agents who changed from time to time. The success of the cultivators was limited and it was necessary and desirable that the zamindars should be made proprietors, if improvement in agriculture was desired.

As regards the question of assessment, Shore said that it should be based on the actuals of recent years. Dundas and Pitt declared in favour of permanence. In 1793, their sanction reached India and the settlement in Bengal and Bihar was made permanent.

Lord Cornwallis's proclamation, dated 22 March 1793, contained two articles as below:

II "The Marquis Cornwallis Knight of the most noble order of the Garter, Governor-General in Council, now notifies to all Zamindars, independent taluqdars, and other actual proprietors of land, in the provinces of Bengal, Bihar and Orissa, that he has been powered by the Court of Directors for the affairs of the East India Company, declares the *Jumma* which has been or may be assessed before their lands under the regulations above mentioned, fixed for ever."

III "The Governor-General in Council accordingly declares to the Zamindars, independent taluqdars, and other actual proprietors of land, with or on behalf of whom a settlement has been concluded under the regulation (21) above mentioned, that at the expiration of the term of the settlement, no alteration will be made in the assessment which they have respectively engaged to pay, but that they and their heirs and lawful successors will be allowed to hold their estates at such assessment for ever."[1]

Bishop Heber, recording his impressions about the zamindars of Bengal and their tenants in 1824, states, 'The country through all Bengal, is divided into estates generally of a considerable size, called "Zemindaries", from "Zemindar", a landholder, held immediately of Government, on payment of rate which was fixed by Lord Cornwallis, and does not increase with any fresh improvement or inclosure. These lands may be sold or divided by the proprietors, remaining subject to the tax, but cannot be touched by the Government so long as the tax is paid. The great Zemindars generally live in Calcutta or the other cities, where some of them have very splendid palaces, under-letting their territories to dewans, or stewards, answering to what the Scots call tacksmen, who, as well as the smaller landholders, generally occupy dingy brick buildings, with scarcely any windows, and looking a little like deserted manor-houses in England. Placed in the middle of the villages (whose bamboo huts seem far cooler and cleaner dwellings), they are overhung with a dark and tangled shade of fruit trees, and surrounded by stables, cow-houses, threshing-floor, circular granaries raised on posts, and the usual litter of a dirty and ill-managed farm; but the persons who reside in them are often really very wealthy, and when we meet them on horseback on a gala-day, with their trains of servants, their splendid shawls, and gold and silver trappings, might almost meet the European notion of an eastern Raja. Under them the land is divided into a multitude of small tenements, of which the cultivators are said to be often racked very high, though they are none of them attached to the soil, but may change, if aggrieved, to any landlord who is likely to use them better.'[2]

While making the permanent settlement, it was forgotten that the zamindar was not the cultivator, and no protection was given to the ryot, the real tiller (perhaps the real proprietor) of the soil, against the oppressive

[1]Forrest, G.W. *Selections from State Papers*, p. 206

[2]Bishop Heber, R. *Narrative of a Journey through the Upper Provinces of India from Calcutta to Bombay*—1824-1825, Vol. II, 1828, p. 323

exactions of the zamindar, whose actual dependent he was made by this settlement.

How the system was operating could well be judged by the experience of John Beames—a civilian, who, after serving in the Punjab, was transferred to Bihar as an Assistant Collector in 1860. Narrating the experience of peasants in Bihar and their sad plight, he states, 'When I spoke to my new Collector, Bayley, about the welfare of the peasant class and suggested intervention in cases where they were oppressively treated by the zemindar, he laughed at me and told me it was no business of ours: the zemindar has a right to do what he liked with his ryots. My Panjabi zeal was in fact laughed down by all the Bengal men.'[3]

The difficulty was at last overcome by Lord Canning. His Bengal Rent (Act X, of 1859) is considered the Charter of the Bengal Cultivators. It divided the settled cultivators of Bengal into three classes. For those who had held lands at the same rents since 1793, the law declared that the rental should remain unaltered for all the time to come. For those who had held lands at the same rents for twenty years, the law presumed that they had paid the same rents since 1793 until the contrary was proved. And, lastly, to those cultivators who had held lands for twelve years, the right of occupancy was conceded; and their rents could not be raised in future except on specific and reasonable grounds laid down in the law.

According to Romesh Chander Dutt, writing in 1903, 'This law created a revolution in Bengal. The population of Bengal are at the present time more resourceful and prosperous than elsewhere in India, *first*, owing to the limitation placed on the State-demand from landlords in 1793, and *secondly*, owing to the limitation placed on the landlord's demand from tenants.'[4]

Romesh Chander Dutt concludes that the Permanent Settlement was a wise and benevolent measure which improved agriculture and diffused prosperity among the people. Waste lands were brought under cultivation and the value of land increased.

'The beneficial results of the Permanent Settlement of 1793, which limited the State-demand from landlords, and the Rent Acts of 1859 and 1885, which limited the landlord's demand from tenants, are obvious in every part of Bengal at the present day', states Dutt. There is an educated and influential class of landlords, who had identified themselves with the British Rule, and have always given loyal help in the cause of good administration. There is a strong and intelligent middle class, holding tenures of various degrees under the landlords, and forming the strongest element in a progressive society. And there is a resourceful peasantry, able to defend their rights, and able also to resist the first effects of a drought and a failure

[3]Beames, J. *Memoirs of a Bengal Civilian*
[4]Dutt, R.C. *The Economic History of India*, Vol. II, p. 190

of crops. The rents are light; the cultivators are not under the thraldom of money-lenders; and British administrators can view with a just pride a province where their moderation has insured agricultural prosperity to a nation.'[5]

As a short-cut to securing revenue and as a measure of expediency, permanent settlement had its merits. It promoted the rise of Bengali middle class in the City of Calcutta where educational facilities were available. The zamindars of Bengal were, however, not improvers, and were largely absentees, who preferred amenities of urban life to hardship of living on land in the rural area. The cultivators of land, their tenants, continued to live in squalor. Ultimately, the City of Calcutta grew enormously and sucked in the rural intelligentsia of Bengal to the detriment of the countryside. If the permanent settlement had been made with the actual cultivators rather than with the intermediaries, rural Bengal would have presented a different picture, viz. a thriving and progressive peasantry supplying the needs of a metropolis and sharing its prosperity.

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[5]Dutt, R.C. *The Economic History of India*, Vol. II, pp. 335, 336

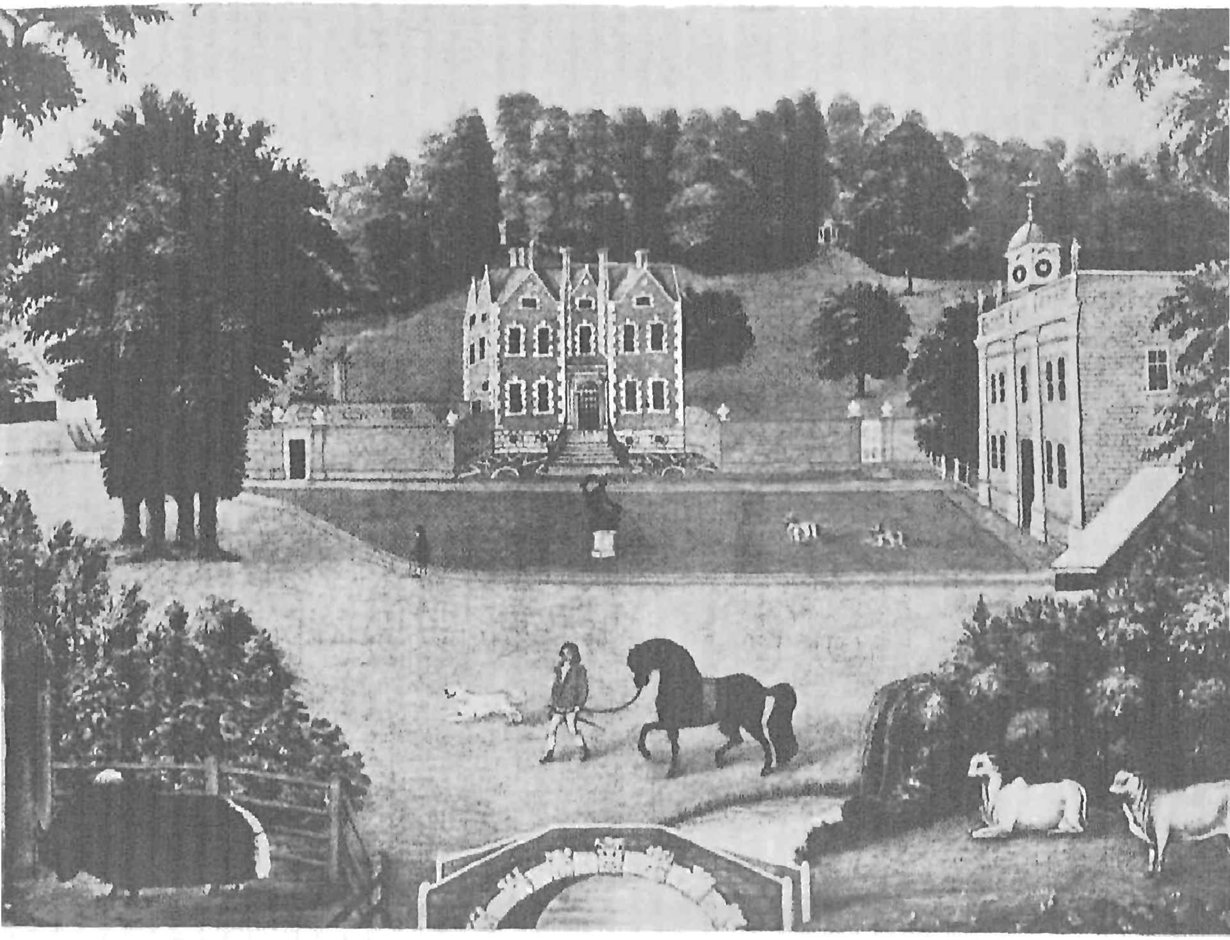

FIG. 3. This paintings of Purley Hall, Berkshire, the house which Warren Hastings rented for three years during his impeachment, shows his interest in animal husbandry. Two shawl goats are on the lawn outside the house. In the foreground to the left is the yak that Samuel Turner, who had been on the 1783 mission to Bhutan and Tibet later sent to Hastings. To the right is a cow and a Brahminy bull. Painting by an unknown artist, c. 1790, private collection, England
(Courtesy: Mrs Mildred Archer)

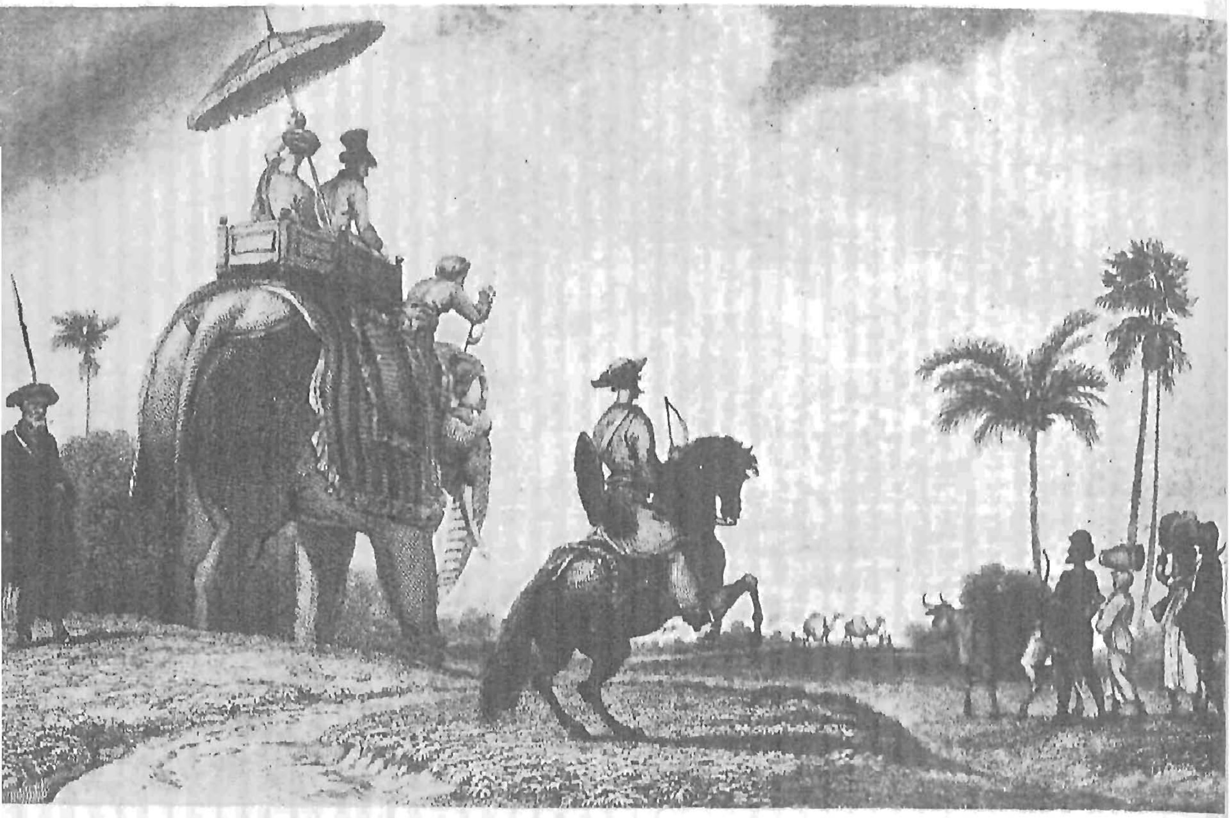

FIG. 4. Bishop R. Heber riding an elephant accompanied by his retinue. He made perceptive observations on the people of India and the country in his 'Narrative of a Journey Through the Upper Province of India' (1826)

CHAPTER 5

THE ROYAL BOTANIC GARDEN, SIBPUR, CALCUTTA

ITS ROLE IN PLANT INTRODUCTION

1787-1848

To understand the genesis of the Royal Botanic Garden, Sibpur, Calcutta, it is necessary to know the developments in the fields of botany and gardening in the seventeenth and eighteenth centuries in England and Europe. The Elizabethan age witnessed the birth of botany in England. William Turner (1508-1568) was the first to make an attempt to identify and classify the British flora. His book, *A New Herball,* was published in 1568. John Gerard (1545-1612) laid out a garden in Holborn. Two lists of flowering plants, which he made in 1596 and 1599, show the plants which were cultivated in England. John Evelyn (1620-1706), one of the founders of the Royal Society, is considered one of the greatest encouragers of improvements. He published, in 1664, his *Sylva,* or *A Discourse on Forest Trees and the Propagation of Timber in his Majesty's Dominions*, a classic of arboriculture, which had a great influence on the landscape of the country. He also wrote a tract on smoke-abatement, and advocated the creation of green belts. Thus he can be considered a pioneer environmentalist. Evelyn was also a pioneer in the production of literature on gardening. He translated De la Quintaye's book on gardening into English under the title *The Complete Gardener*.

Thomas Fairchild (1667-1729), a London nurseryman, hybridized carnation with sweet william, and obtained a new type of plant, named Fairchild's sweet william. Thus he can claim to be the first creator of a horticultural plant by deliberate interference with the normal course of reproduction.

During the seventeenth century, numerous plants were introduced into England from the East, through Constantinople, as well as from the East and the West Indies. The Oxford Botanic Garden was established in 1632, and that of Edinburgh in 1680. In 1673, Sir Hans Sloans gave the ground of the Chelsea Garden to the Society of Apothecaries on the condition that they presented fifty new plants annually to the Royal Society.

The eighteenth century was a great era of gardening in England. The Industrial Revolution, which was followed by the agricultural revolution, greatly added to the wealth of the country. Money made in commerce and industry was invested in land improvement, gardening and house-building. About the middle of the eighteenth century, the landscape-garden, with the imitation of nature, came into vogue under the leadership of William Kent (1685-1748), Lancelot Brown (1715-1783) and Humphrey Repton (1752-1818). Kent introduced the new concept into garden design that nature abhored a straight line. He replaced the formal bodies of water by lakes of irregular shapes. Apart from landscape-gardens and their patrons, the contribution made by nurserymen and seedsmen to English gardening was substantial. They employed plant-collectors who travelled in foreign countries and sent plants, bulbs and seeds. The first great nursery was of George London (died 1707) and Wise. Another was of Philip Miller (1692-1771), who was appointed Curator of the Chelsea Physic Garden, and was the author of the *Gardeners' Dictionary*.

To the realm of botany, Linnaeus (1707-1778), a Swedish naturalist, made a great contribution by establishing the binomial system of nomenclature, by which every plant was distinguished by two Latin names—the first a genus, followed by a specific epithet. His system of classification of plants was based on the structure of flowers, the number of their sepals, petals, stamens and the gynoeceum. Linnaeus made biology an orderly science, and for the first time the vast confusion which prevailed in the names of plants was cleared. The gain to the owners of gardens, and to the nurserymen was obvious. The nurserymen knew what plant his clients required and vice versa.

The Royal Botanic Garden at Kew is the mother of botanical gardens. The history of the Kew Garden and the vicissitudes through which it has passed is the history of gardening in England. The foundation of the Kew Garden is attributed to William Turner, herbalist, who died in 1568. Lord Capel, its next known owner, introduced a number of fruit-plants from France. Describing a visit to Kew in 1668, thus wrote Evelyn: 'From thence we went to Kew to visit Sir Henry Capel's whose orangery and myrtetum are most beautiful, and perfectly well kept'.

The garden, as it exists today, was formed by the fusion of two royal properties, the eastern half corresponding to the grounds of the Kew House, and the western half known as the Richmond Gardens. The Richmond Gardens was developed with great care by Queen Caroline who spent a large sum on its improvement.

Frederick, Prince of Wales, leased the property in 1730, and he engaged the services of William Kent to lay out the grounds. His wife, Princess Augusta of Saxe-Gotha, took great interest in the development of the garden. It is she who gave scientific character to the garden. She engaged William Aiton in 1759, and in twenty years he made it a true botanical garden. Aiton started the practice of sending botanical expeditions to foreign countries for the exploration and collection of plants. In 1789, Aiton published the second *Hortus Kewensis*, in which he listed 5,500 species grown at Kew, classified according to the Linnaean system.

Robert Kyd Founds Sibpur Garden, 1787

The English middle class of the eighteenth century, which provided

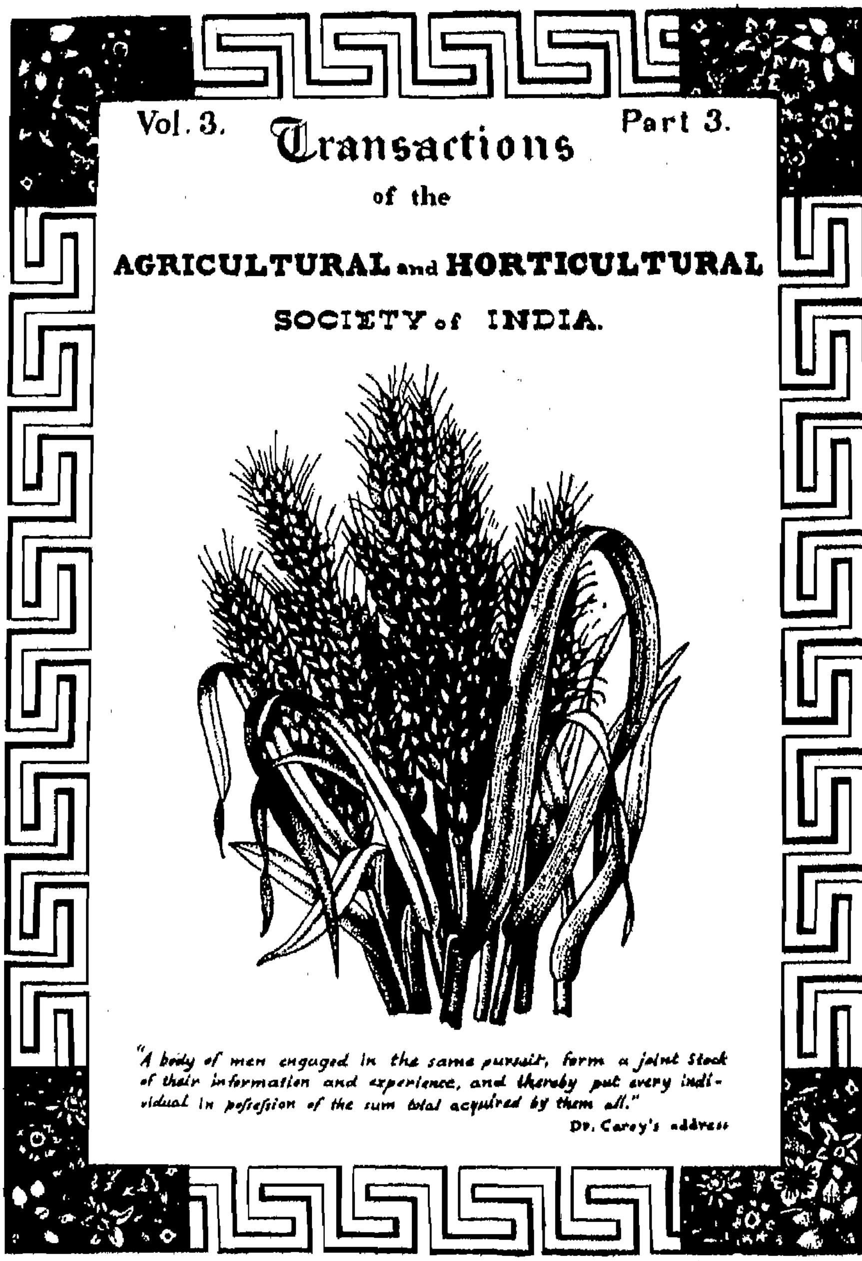

FIG. 5. Cover of the 'Transactions of the Agricultural and Horticultural Society of India', 1823, which bears the following inscription from Dr Carey's address, 'A body of men engaged in the same pursuit, from a joint stock of their information and experience and thereby put every individual in possession of the sum total acquired by them all'

recruits for the colonial military service in India, had imbibed the love of gardens and gardening. The suggestion for the establishment of a botanical garden in Calcutta came from Colonel Robert Kyd, of the Bengal infantry in 1787. A block of 310 acres (125·45 ha) on the bank of the River Hooghly was selected. Kyd was appointed Honorary Superintendent and he contributed his own collection of exotic plants to the garden. He continued as Superintendent until his death in 1793.

Patronage of Natural History by Governors-General and their Wives

Botanists and artists were patronized by the Governors-General and their wives. This interest was also shared by the judges and their wives. Lady Impey, wife of the Chief Justice of the Supreme Court, Sir Elijah Impey, engaged three Indian painters from 1774 to 1782 to make large pictures of birds, animals, insects and flowers.

Marquis Wellesley, Governor-General from 1798 to 1805, was keenly interested in natural history. On 26 July 1804, he issued a minute on natural history in which he pointed out that 'the knowledge hitherto obtained in Europe respecting certain branches of the natural history of the continent of India and of the Indian isles is defective. Notwithstanding the progress which has been made within the last twenty years in the prosecution of scientific enquiries connected with the manners, produce, and antiquities of this part of Asia, many of the most common quadrupeds and birds of this country are either altogether unknown to the naturalists of Europe or have been imperfectly and inaccurately described.

'The illustration and improvement of that important branch of the natural history of India, which embraces an object so extensive as the description of the principal parts of the animal kingdom, is worthy of the munificence and liberality of the English East India Company, and must necessarily prove an acceptable service to the world.

'To facilitate and promote all enquiries which may be calculated to enlarge the boundaries of general science, is a duty imposed on the British Government in India by its present exalted situation, and the discharge of that duty is in a more especial manner required from us, when any material addition can be made to the public stock of useful knowledge without involving considerable expense.'[1]

'In 1800 the Marquis Wellesley ordered the collection of birds and quadrupeds at Garden Reach for his proposed Fort William College. When the Directors, who did not share his intellectual curiosity, vetoed this scheme, he endeavoured to achieve a similar end through the Institution for promoting the Natural History of India. This was established in 1804 at Barrackpore, with a menagerie and aviary and came to be popularly known as 'The

[1] R.M. Martin, *Despatches* (London, 1836-40), iv, 674

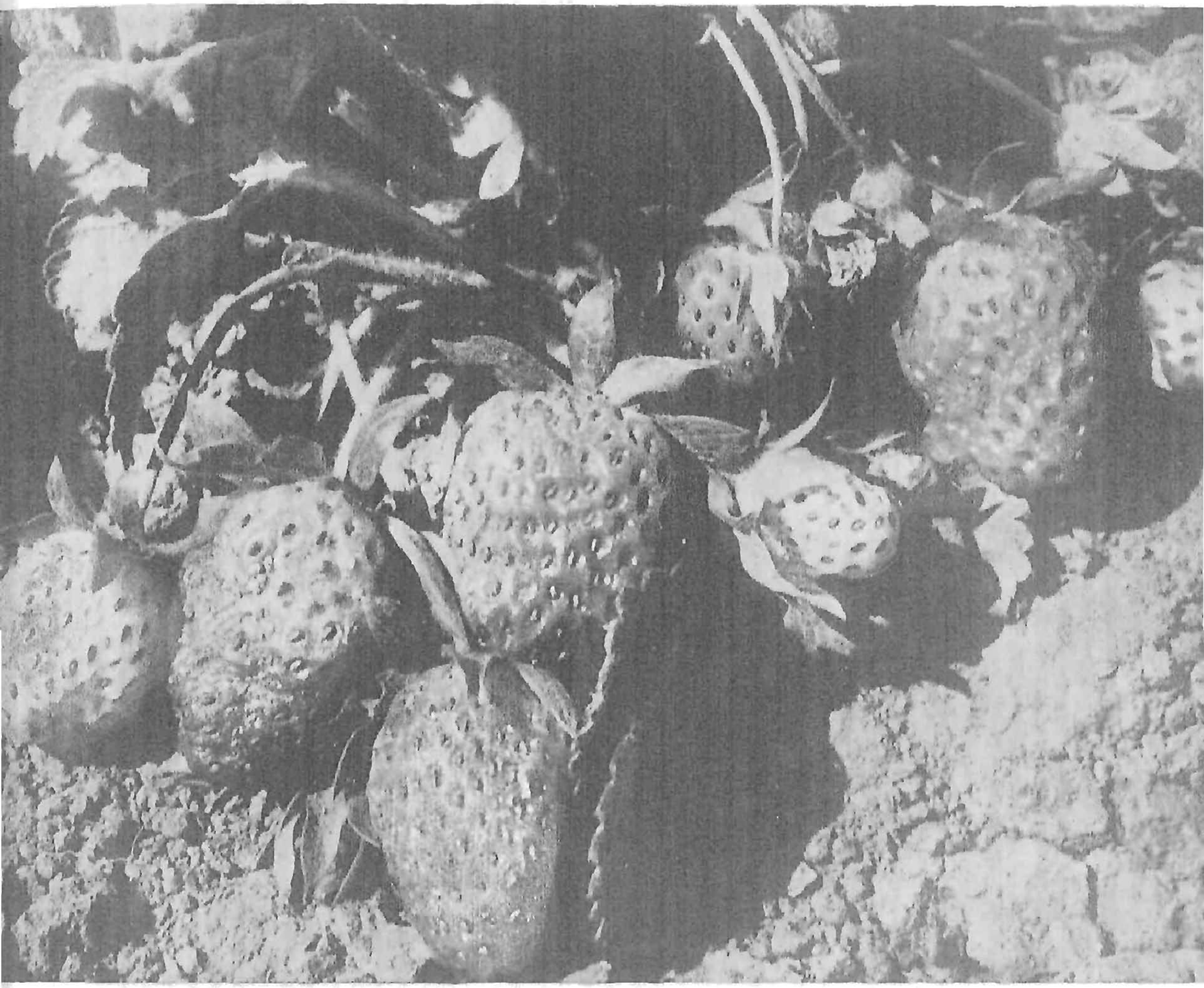

FIG. 6. Marquess of Hastings saw the cultivation of strawberries in March 1815 in Fatehgarh. The fruit came from the garden of one Mr Donnithorne

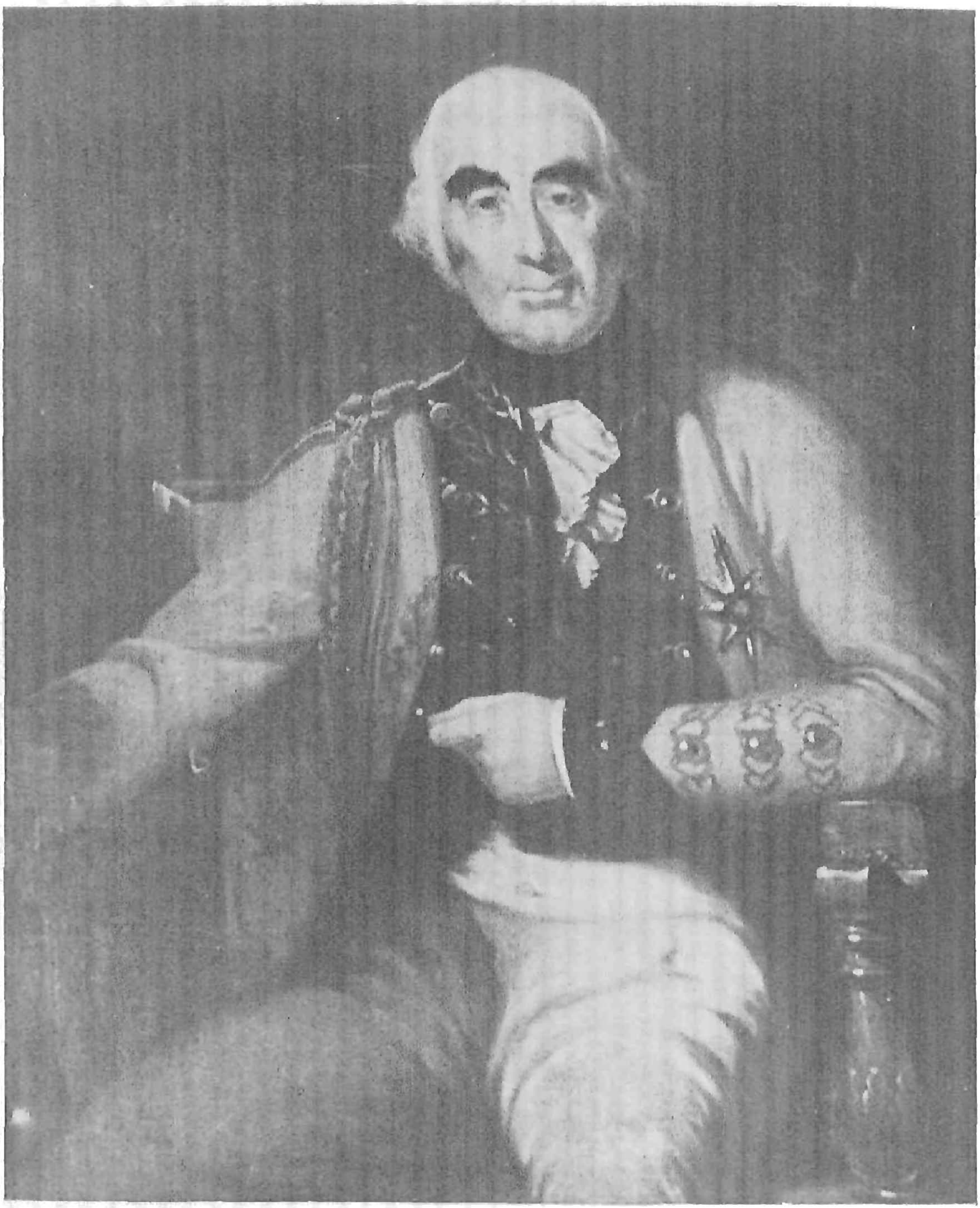

FIG. 7. Portrait of Marquess of Hastings. The Royal Agri-Horticultural Society was founded under his patronage and the Western Jamuna Canal was constructed. Portrait by George Chinnery, *c.* 1818
(Courtesy: Rashtrapati Bhavan, New Delhi)

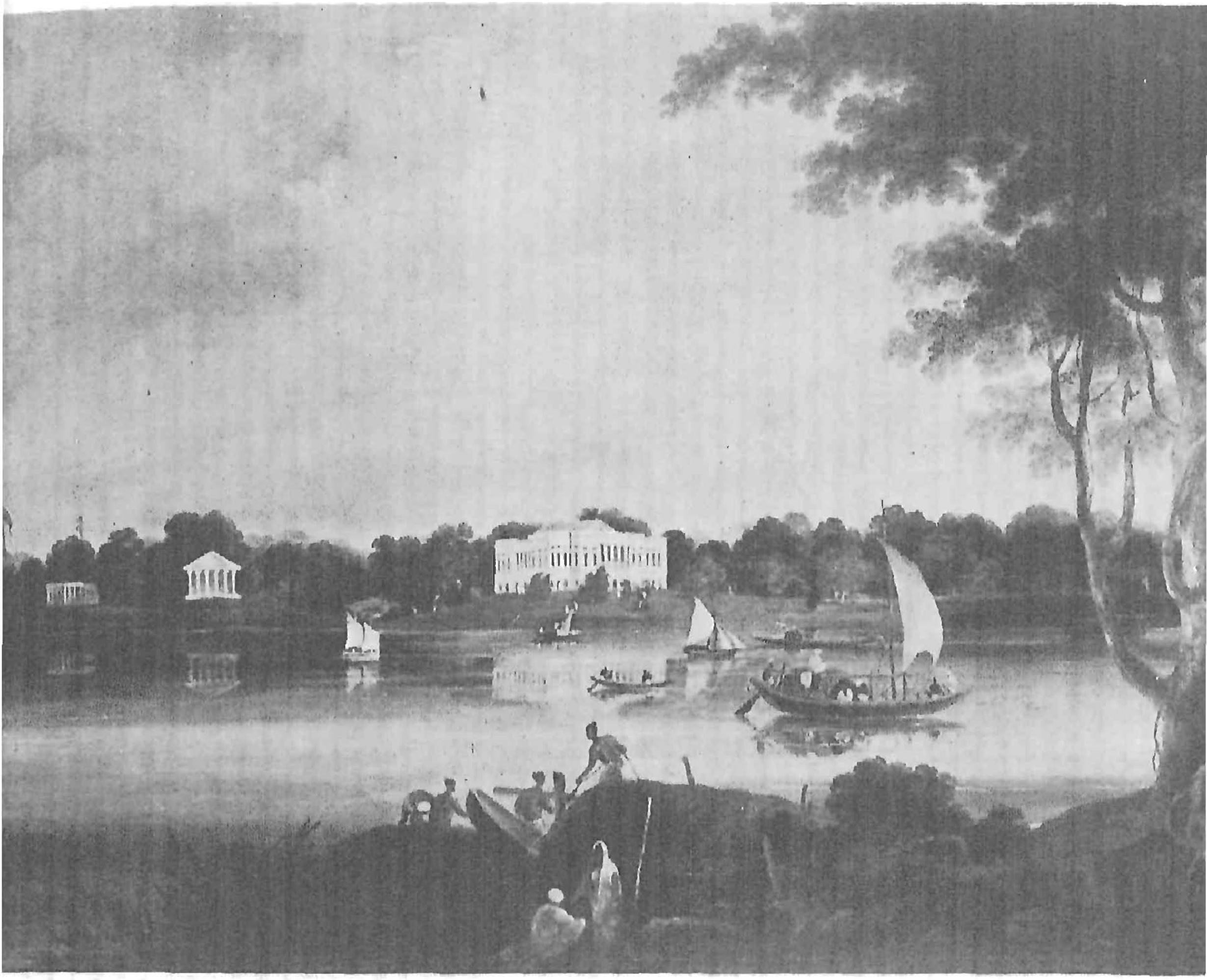

Fig. 8. Barrackpur was a pleasant place on the Hughli, about 16 miles (25.75 km) from Calcutta. In the centre was a great mansion in a stately park, to which the Governor-General retired from the dust and steam of Calcutta
(Courtesy: Rashtrapati Bhavan, New Delhi)

Fig. 9. William Moorcroft introduced the cultivation of oats into India for the first time in 1816

Barrackpore Menagerie'. The institution was placed under the supervision of Francis Buchanan (1762-1829), who had been attached to the Governor-General's staff as Surgeon since 1803. Buchanan was entrusted with the establishing of the institution and directed 'to collect materials for a correct account of all the most remarkable quadrupeds and birds in the provinces subject to the British Government in India'. Civil and military officers all over India and the East Indies received circulars enjoining them to send specimens to Barrackpore, 'where the quadrupeds and birds which may be collected for Dr Buchanan will be kept until they shall have been described and drawn with that degree of attention to minute distinctions, which is essentially necessary for the purposes of the natural historian.'[2]

Wellesley employed Indian artists to prepare drawings, depicting plants, quadrupeds, birds, fishes and insects from India and the East Indies. There are 2,660 folios of such drawings from his collection in the India Office Library, London.

Lady Amherst, wife of William Pitt, Lord Amherst, Governor-General (1823-1828) collected plants and flowers, and made sketches. Dr Wallich honoured her by naming a tree, with beautiful red flowers, *Amherstia nobilis*. Amherst himself did not pose as a naturalist, but took interest in plants and flowers.

Dr William Roxburgh—the Father of Indian Botany

William Roxburgh succeeded Kyd in 1793. He had been in India since 1776 and from 1781 had been in charge of a botanic garden at Samalkot, an experimental station in the Madras Presidency where pepper, sappan, tobacco and cardamoms were grown. From 1789 until 1793, he was the Company's Botanist in the Carnatic and he distinguished himself by studying the flora of the Northern Sircars and the Coromandel Coast. While in the south, he also began describing the Indian flora. He worked methodically, giving a number to each plant and at the same time having a life-size drawing made, to which the same number was given. Duplicates of his descriptions and drawings were despatched to the Company, and between 1791 and 1794, about five hundred of these were received in London.

'Roxburgh's task on joining the Botanic Garden was to make an exhaustive survey of India's flora. Although, as in selecting the Coromandel plants, the Company 'with a view to utility' gave preference to the study of 'subjects connected either with medicine, the arts, or manufactures', it also encouraged 'the admission of new plants, or of such as have hitherto been imperfectly described'. Roxburgh continued to add to his list, and as part of his work he recruited and trained a team of Indian artists to draw every species of plant listed. He followed the plan of Koenig and Banks, where-

[2]Mildred Archer, *Natural History Drawings in the India Office Library*, pp. 29, 30

by specimens were collected and then drawn, the description being made at the same time from the same fresh specimen. When sending his drawings to the Company from south India, Roxburgh noted, 'The whole of the drawings and descriptions, six or seven excepted, were taken from the living plants, repeatedly examined and corrected during a period of twenty years' constant application to the study of Indian Botany'. The drawings were on folio-size sheets, and both plants and dissections were natural size.

'This method was continued at the Calcutta Garden for twenty years, and, when Roxburgh retired in 1813, a total of two thousand five hundred and forty-two paintings had been made in the south and at Calcutta by his team of Indian artists. They are still in the Sibpur Herbarium bound in thirty-five volumes, known as the *Roxburgh Icones*.

'Such drawings were to play a supreme role in later botanical research. Together with their descriptions they formed the basis of the first standard works on Indian Botany—the *Hortus Bengalensis* and the *Flora Indica* edited by Carey from Roxburgh's material in 1814 and 1820. They account for almost four hundred plates in Wight's *Icones Plantarum Indiae Orientalis* (1838-1853) while three hundred were also selected by Sir Joseph Banks and published at the Company's expense as *Plants of the Coast of Coromandel* (1795-1820). Their importance, however, greatly exceeds this limited function. Besides providing Roxburgh's successors at the Garden with rigorous standards, they served as models for many important collections of drawings made in Calcutta. At this time there was a keen group of Company servants in the Bengal Presidency. It is clear, for example, from notes on Wellesley's drawings that Company servants in Bengal, such as William Cowper, Charles Crommelin, John Fombelle and John Thornhill, were interested in natural history, raising rare flowers and keeping private menageries. In Calcutta itself there were distinguished men and women such as the Marquis Wellesley and Lady Hastings. There was Hardwicke at Dumdum and a number of Company surgeons, as well as visitors such as Lord Valentia and Maria Graham. Many of these natural historians exchanged information and collected drawings.'*

Roxburgh's *Flora Indica*, his *Plantae Coromandelianae* and his portfolio of paintings of 2,382 plants, mainly the work of Indian artists, formed the basis of Hooker's *Flora of British India*. Roxburgh was the first botanist to adopt the Linnaean system of binomial nomenclature in relation to the plants of India. On account of his pioneering work, he is rightly called the Father of Indian Botany.

Sir Joseph Banks (1743-1820), traveller and explorer, who had the privilege of sailing around the world with Captain James Cook (1768-1771), was keenly interested in economic plants and their introduction into coun-

*Mildred Archer, *Natural History Drawings in the India Office Library*, pp. 20-22 tries. After he became President of the Royal Society (1778), he improved the status of science in Britain and promoted interchange with scientists of other countries. In his capacity as honorary director of the Royal Botanic Gardens, at Kew, he sent botanical collections to various countries including India. The Sibpur garden received a number of exotic economic plants through the generosity of Sir Joseph Bank.

POTATOES AND STRAWBERRY

The plant-introduction activities of the Botanic Garden were already showing results in the field. Marquis Hastings, who toured Bihar in 1814, observed, 'The cultivation of potatoes is spreading fast, and will be a material security against dearth; but it does not yet go to an extent to be reckoned upon.

At Fatehgarh in March 1815, Hastings noticed the cultivation of strawberries. He observes, 'The young men were much pleased with strawberries, which they had never seen before; I gratified them with an assurance that I would endeavour to get some plants for them. This fruit came from a garden of Mr Donnithorne's, and was tolerably good.'[4]

DR NATHANIEL WALLICH (1817-1846)

Dr Nathaniel Wallich, a Dane, succeeded Roxburgh in 1817 and continued as Superintendent until 1846. He surveyed Kumaon, Nepal, Sylhet, Tenasserim, Penang and Singapore. His collections of plants were catalogued in Europe and distributed to all the leading botanical institutions.

Bishop Heber who paid a visit to the Botanic Garden in 1824 and also met Dr Wallich, thus records his impressions: 'The Botanic Garden is a very beautiful and well-managed institution, enriched, besides with the noblest trees and most beautiful plants of India, with a vast collection of exotics, chiefly collected by Dr Wallich himself, in Nepal, Pulo Penang, Sumatra and Java, and increased by contributions from the Cape, Brazil and many different parts of Africa and America, as well as from Australia and the South Sea islands.

'Dr Wallich has the management of another extensive public establishment at Titty-ghur, near Barrackpore, of the same nature as this, but appropriate more to the introduction of useful plants into Bengal. He is himself a native of Denmark, but left his country when young and has devoted his life to Natural History and Botany in the East. His character and conversation are more than usually interesting; the first, all frankness, friendliness and ardent zeal for the service of science; the last enriched by a greater store

[4] *The Private Journal of the Marquess of Hastings, K.G., Governor-General and Commander-in-Chief in India*, Vol. I, p. 108

of curious information relating to India and the neighbouring countries, than any which I have yet met with.'

Heber continues, 'These different public establishments used to be all cultivated by the convicts in chains. In the Botanic Garden their labour is now supplied by peasants hired by the day or week, and the exchange is found cheap, as well as otherwise advantageous and agreeable; the labour of freemen here, as elsewhere, being infinitely cheaper than that of slaves.'[5]

Wallich continued Roxburgh's scheme for adding to the systematic knowledge of India's flora. The Company's team of Indian artists painted new specimens and these drawings were added to the Herbarium's collection. Some were used by Wallich for the engravings in his *Tentamen Florae Nepalensis Illustratae* (1824-1826) and his *Plantae Asiaticae Rariores* (1830). In the preface to the latter book, he notes that 'the present work consists of a selection of plants made chiefly from a series of 1200 drawings, executed under my direction by Indian artists, at the Calcutta Gardens, and on my various journeys.'

'While extensive surveys were proceeding in India, expeditions were organized to collect information from the little known regions adjoining India to the north and east.

'Wallich visited Nepal in 1820-1821, Singapore and Penang in 1822, and in 1825 toured the foothills of the Himalayas in Oudh up to Hardwar and Dehra Dun. In 1827 he visited Prome, Ava, Rangoon and the Irrawaddy and in 1827 went to Amherst, Moulmein, Martaban, Rangoon and Tenasserim. Several drawings made by the draughtsman who accompanied him on these expeditions are in the India Office Library.'

Role in Plant Introduction

Royle thus describes the contribution made by this garden to plant introduction into India: "The Botanic Garden of Calcutta has been useful in introducing many important plants into India." So long ago as 1814, Dr Carey stated: "The Mahogany tree, for instance, which but a few years ago was brought from Jamaica to this country, thrives so luxuriantly in Bengal that many thousand trees of it are growing here, and even small pieces of furniture have been already made of the wood. The Pimento and Coffee prosper now as well in Bengal as in their native soil, and the Nutmeg, notwithstanding the climate which is somewhat too cold for it, already produces fruit every year." The nutmeg was but imperfectly known until it was correctly described by Dr Roxburgh from specimens growing in the Calcutta Botanic Garden, which were obtained from the Molucca Islands, while they were in the possession of the English from 1796 to 1802. In addi-

[5]Right Rev. Reginald Heber, *Narrative of a Journey through the Upper Provinces of India from Calcutta to Bombay*, 1824-1825, pp. 42, 43

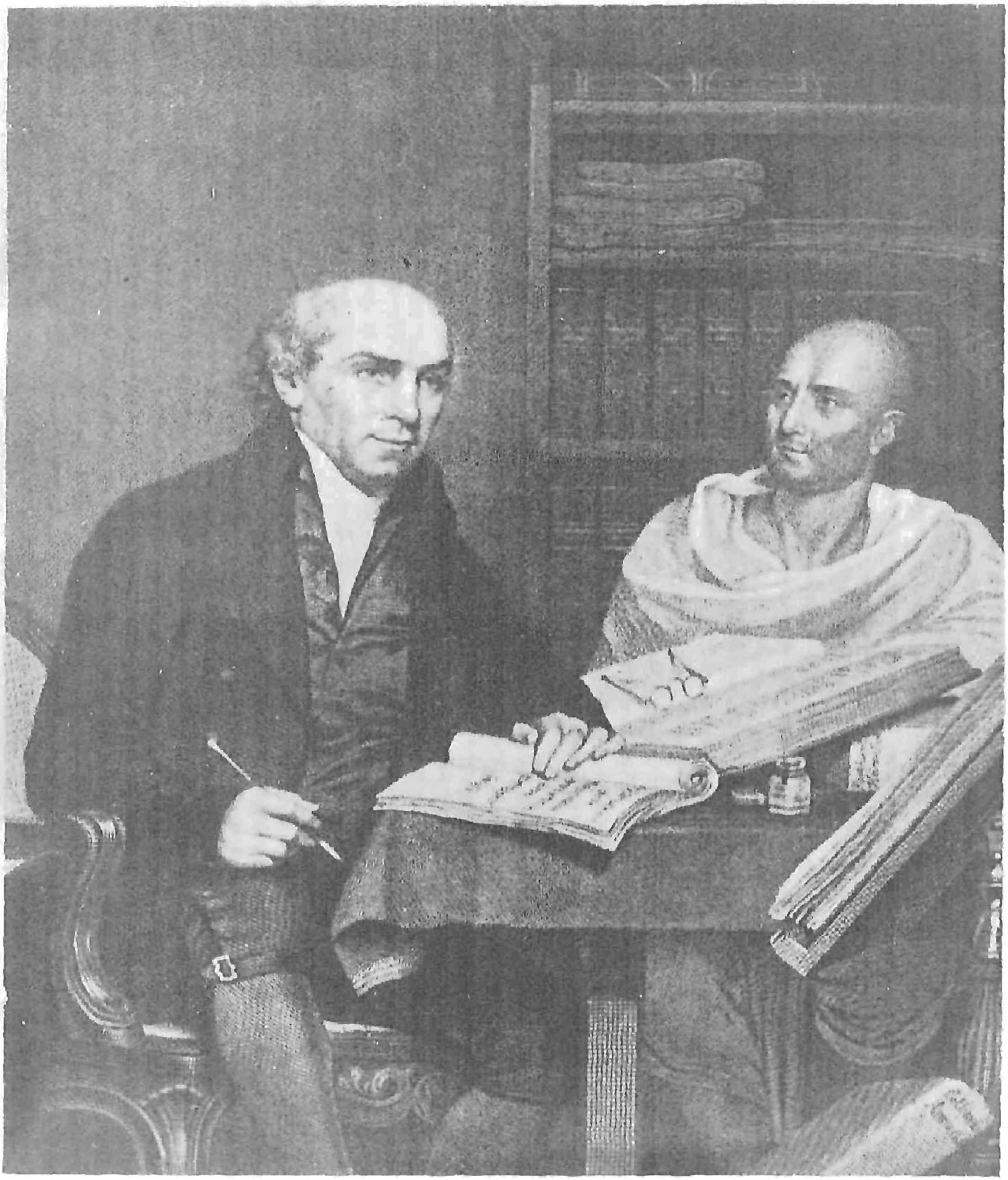

FIG. 10. Dr William Carey, the first Secretary of the Agri-Horticultural Society of India, with Pandit Mritunjaya, 1823
(Courtesy: Victoria Memorial, Calcutta)

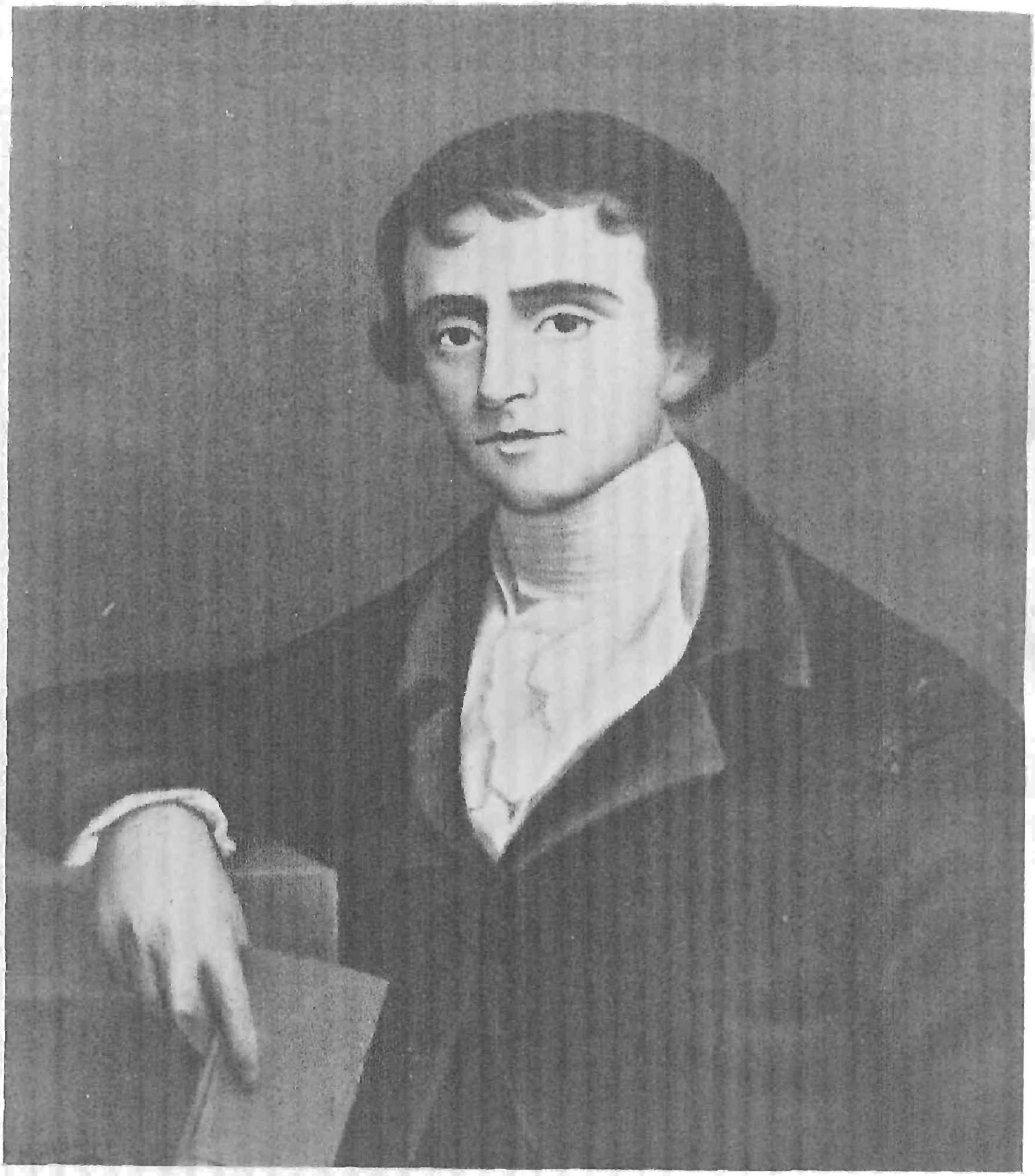

FIG. 11. Sir William Jones, the first President of the Royal Asiatic Society, 1793 (Courtesy: Victoria Memorial, Calcutta)

tion to the spice trees, the cinnamon was introduced into the Calcutta Botanic Garden from Ceylon, and the camphor tree from the Cape of Good Hope, where it had been conveyed by the Dutch; also, the Benzoin tree, from Sumatra and the Culitlawan from Amboyna.[6]

This garden also claims the introduction of economic plants, like flax, hemp, Rhea or ramie, tobacco, henbane, vanilla, coffee, India-rubber, Japanese mulberry, cardamoms, tapioca and cocoa.[7]

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[6]Royle, J.F. *Essay on Production Resources of India*

[7]Biswas, K. *Address of Welcome on 150th Anniversary of the Royal Botanic Garden, Calcutta* (1787-1937), Herbarium, Royal Botanic Garden, Calcutta, p. 8

CHAPTER 6

RURAL ENGLAND—THE MANORIAL SYSTEM

AGRICULTURAL REVOLUTION IN ENGLAND IN THE 18TH CENTURY
INVENTION OF HORSE-HOE AND THE SEED-DRILL
INTRODUCTION OF TURNIPS AND CLOVER FOR ANIMAL FEED
IMPROVED BREEDS OF SHEEP AND CATTLE, AND ENCLOSURES

To understand the innovations, which the British introduced into Indian agriculture in the early nineteenth century, it is necessary to know the history of English agriculture in the seventeenth and eighteenth centuries. How were the villages organized? What were the types of houses occupied by the various classes? The Manorial System grew up in England during the period 800-1200. Trevelyan provides a graphic account of an English village in the twelfth century when the manorial system was at its height.

'In Henry II's reign (1154-1189), the lord's dwelling, whether an abbey, a castle or a manor-house, was often built of stone. But the villein's cottages were still hovels, without chimneys or glass, and sometimes without any aperture but the door. They were built either of split logs, erected side by side in the old Saxon fashion, or, where timber became scarce, of 'half-timber' walls, with mud filling in the oaken framework. The art of baking bricks had died with the Romans and had not yet been revived. The roof was of turf or thatch. A small orchard, garden or yard, surrounded the villein's cottage, even when it faced the village street.

'In the best agricultural districts in east and middle England, the prevailing system was the large village of two to five hundred souls, grouped round the parish church and manor-house, in the middle of the open field. This 'open' or 'common field' was not cut up by hedges into the chessboard appearance presented by rural England today. It was divided into hundreds of little strips each of an acre or half an acre, divided by 'balks' of grass or footpath. It must have looked somewhat like a group of allotments of our time, but on a gigantic scale, and all under corn.

'Each of these strips was a separate holding, a unit of proprietorship as well as of agriculture. Each peasant had his property scattered about in the field in a number of separate strips, and a single freeman or villein might hold any number from one upwards; thirty formed a usual holding. The lord's domain, though part of it might be in continuous tract separate from the village field, was in part scattered about among the peasant holdings.

'Lord, freeman and villein were perforce subject to the general village policy as to the cultivation of the 'common field', of which the private strips were the component parts. There were in fact three separate fields, in each of which every man had his share, small or great. Each year one of these three huge fields lay fallow with the cattle grazing over it; one was planted with wheat or rye, and the third with oats or barley. While under cultivation, the area was generally enclosed by hurdles. Agricultural improvements and private enterprise were severely handicapped by such a system, yet it lasted in some of the best agricultural districts of England from times long before the Conquest to the great age of agricultural change in the eighteenth century. The chief improvements took place in that part of the lord's domain which formed a self-contained whole, and could be enclosed, or let as a separate block to leasehold farmers.'[1]

Apart from the 'fields' lay the meadow, if possible down beside the brook. The meadow was a common hayfield and common pasture subject to elaborate rules and 'stints' discussed and enforced in the Manor Court. Astride the brook or mill-stream stood the water-mill, usually belonging to the lord, who could make the villeins bring their own corn to be ground there at his price, which was sometimes so exhorbitant that the right to use hand-mills at home was striven for as a rare privilege. Of all the obligations and restrictions under the manorial system, none were probably more generally disliked than the mill soke and the sanctity of the lord's pigeons. The right of the lord to have his tenants' corn ground at his mill for a toll of corn paid in kind was never enforced by law, but became in most manors a binding local custom which caused much friction and ill-will. In some manors, the private quern stones, by which the tenants evaded the custom, were confiscated and broken; in the manor of the Abbey of St Alban, Cirencester, the Abbot paved the floor of his room with the broken quern stones of his tenants. The manorial dovecots, built like fortresses, with walls 3 feet (0.91 m) thick, and doors of solid oak, housed thousands of pigeons which fattened for the lord's table on the corn strips of his tenants at sowing time and harvest. Nor were the tenants allowed to kill these robbers of their winter food, even when caught in the act of taking their corn, although it was estimated that they destroyed 4 million bushels of grain all over the country each year.

Bailliff-farming, which was the most salient feature of manorial system, declined in the period 1300-1500. After 1500, the manor survived only in non-essentials, some of them, however, being of considerable importance.

Agricultural Revolution in England

During the seventeenth and eighteenth centuries, agriculture, in England, responded actively to the conditions created by the Commercial Revolution. New techniques were introduced and capitalist principles were applied to its organization. The open-field system gradually gave way to

[1]Trevelyan, G. M. *History of England—New illustrated edition*, pp. 178-180

more efficient forms. New products were introduced and great steps were taken in improving crops that had been cultivated for centuries. The sum total of these changes comprised the Agricultural Revolution. Considering the long period over which this agricultural change was spread, it would be more appropriate to call it evolution rather than revolution. If the term Revolution is used, it is more for convenience. The Agricultural Revolution was the result of the application of capitalist methods to the production of crops, the demand for which had been multiplied by conditions created during the Commercial Revolution. The agricultural revolution began in England in the early Eighteenth century. The naked-fallow system disappeared and the legume rotation and the field-grass husbandry declined. The scientific rotation of crops was introduced. As Gras observes, 'The agricultural revolution was made in England out of Continental materials: Spanish clover, Burgundian and French grasses, the Dutch plow, the horse-hoe of Languedoc, and the Flemish method of cultivating turnips in fields.'[1] The period 1650-1700 is that of incubation when English travellers showed curiosity in Flemish agriculture and clover and turnip cultivation received attention. From 1700 to 1770 is the period of experimentation.

From 1770 to 1850, new agriculture spread in England. A balance was struck between tillage and cattle-breeding. Intensive agriculture with truck-gardening and fruit-farming on smaller holdings was established. Improvements in agriculture were made by men with cultivated minds, who adopted it as a recreation, or with the desire of improving what they saw being imperfectly performed.

Invention of Seed Drill and Horse Hoe

Jethro Tull (1674-1741), the Morning Star of the Agricultural Revolution, was a gentleman farmer, educated at Oxford. He began to apply his intelligence and sense of observation to the problems of agriculture. Tull invented a horse-drawn hoe and a drill with the tines, rightly distanced, to fit the rows, and so was able to cultivate his crops and keep them free from weeds while they were growing. Without fallowing or manuring, he grew on the same land for 13 years successive wheat crops, from one-third the quantity of seed sown by his neighbours, and this smaller quantity of seed produced a yield far above anything they could produce. He left to his successors in farming a tradition of drilling, clean farming and economy of seed, which in later years was to be the basis of a vastly improved system of agriculture by large farmers in many parts of England.

New Fodder Crops—Turnips and Clover

It was impossible to grow any winter crop, because it would inevitably have been eaten off by the sheep and cattle when the autumn grazing of

[1]Gras, N.S.B. *A History of Agriculture in Europe and America*

the stubbles took place; that was the weak spot in the open-field system of farming in England. The lack of winter feed for the animals was a nightmare that returned every year, and the farmer could only keep through the winter as many animals as his supply of grass, hay and straw would feed during the last two lean months before the return of spring. The rest were slaughtered and their meat was salted. During the long winter months, their families lived on salted meat and they could do little more than odd jobs round the homestead or some poaching in the dripping sodden woods.

Turnips had been grown as a vegetable in the gardens in England for some years. About 1660, Sir Richard Weston showed how turnips and clover could be used as food for sheep and cattle. This was an enormous step forward, because with the arrival of turnips on the farm, it was possible to grow a crop on the fallow field which did not use up its fertility or prevent the proper cultivation of the land to clear it of weeds. Turnips were not sown until May and before that the field could be ploughed two or three times; also they were sown in wide rows, so that hoeing the weeds between the rows was possible during most of the summer. And, as the turnips were largely eaten off by the sheep folded on them in the autumn and winter, the field got a lavish supply of manure and had its fertility enormously increased.

'Sir Richard Weston, who brought these two new crops—turnips and clover—to the notice of farmers, was a Royalist and a Roman Catholic. He had an estate in Surrey, but he was obliged to flee for his life to Flanders during the Civil War. There he studied the methods of farming, and when he came back at the Restoration, he wrote a book on what he had learnt about turnips and clover, and began to grow both these crops on his own home farm. But it took a long time to persuade the farmers to change their way of farming; many of them, either through lack of money or insecurity of tenure, were unwilling to improve their farms for the benefit of their landlords.

'So it was mainly the few farmers with freehold enclosed farms that at first grew turnips and clover. And in this they were encouraged by the example of such landowners as Lord Townshend—who about 1736 introduced these crops into Norfolk. He founded the famous four-course Norfolk rotation of Turnips, Barley, Grass and Clover, Wheat, which for over two hundred years became the standard cropping for light land, instead of the old rotation of winter corn, spring corn and fallow of the open fields. In this he was helped by Jethro Tull's Drill and Horse Hoe, as these new implements enabled him to drill the seed easily and quickly in rows, and to encourage the young plants to grow by killing the weeds with the horse hoe which could work between the rows.'

THOMAS WILLIAM COKE AND IMPROVED BREEDS OF SHEEP, 1791

In Thomas William Coke of Holkham in Norfolk the new system of large farms found a champion, and he became famous for his good farming. He used Tull's drill for sowing his wheat and he encouraged the quick work of the Norfolk ploughmen, who with their light plough and quick step were able to cover up to two acres (0.80 ha) in a day's ploughing. Very early in his farming career, he invited Robert Bakewell to Holkham, and soon after he put into practice Bakewell's advice to change from the Norfolk breed of sheep to flocks of Southdown. In 1791, he wintered 2,400 sheep and a herd of Devon cattle from the West country.

'His farm buildings, houses and cottages on his estate were models for all, and it is estimated that he spent on them £30,000 in his life time. He gave his tenants long leases of 21 years, and so ensured that they too could share in the profits from their work and the expense of improving their farms.

'At sheep-shearing time he held each year a festival at Holkham, to which came farmers from every district and breeders of all kinds of stock to see what he was doing and exchange views on farming with him and his tenants. Early in the day, stock and implements were inspected, and at 3 o'clock many hundreds of his tenants and friends sat down to dinner. A day of lavish hospitality was rounded off by speeches and discussions on every farming activity. In the words of Cobbett, 'Everyone made use of expressions towards Coke which affectionate children use towards their parents.'[3]

Robert Bakewell and Animal Breeding

Robert Bakewell (1725-1795) brought about a revolutionary change in stock-breeding. Realizing that no one type of animal could be adapted for all purposes, he bred horses for draft purposes, cattle for beef and milk, and sheep for wool and mutton. During the eighteenth century some special types of horses and cows became common in Europe, such as the black Friesian horse and the black and white Friesian cow. Friesian horses were used by Bakewell for breeding his "Black Horse", Friesian, Swiss, and Holstein cows were already exported to other countries, such as England, Saxony, and the Baltic states.

Symbiosis of Agriculture and Industry

'In the eighteenth century the landlords as a class were able and willing to devote their personal attention and their accumulated wealth to the improvement of the land and the methods of cultivation', states Trevelyan. 'Much of the capital created by the incipient industrial revolution was conducted through the channel of the great-estate system to fertilize agriculture with money derived from cloth, cotton, coal, and commerce. But capital also flowed in the opposite direction, from land into industry: many of the

[3]Franklin, B. *A History of Agriculture*, pp. 145-148

new industrialists who set up factories, mills, and businesses in the eighteenth century, derived the money they so employed from their own or their fathers' success as cultivators of the land. The county banks, now growing up in great numbers, assisted this double flow of capital from industry into agriculture and from agriculture into industry. In that fortunate era industry and commerce were not the enemies but the allies of agriculture.'[4]

The rise in the prices of agricultural products during the revolutionary and Napoleonic wars (1793-1815) gave stimulus to agriculture, and the use of new implements and machinery made progress. The eighteenth century also saw the rise of agriculture as a profession. A professorship in agriculture was established at Edinburgh in 1790. Societies for the improvement of cultivation were formed in Scotland in 1723, and in the west of England in 1777. *The Farmers' Magazine*, a monthly, was established in 1776.

ENCLOSURES

Like the Consolidation of Holdings Scheme in the Punjab and Haryana which provided the base for improvement of agriculture, during the current Green Revolution, enclosures greatly facilitated agricultural development in England. There was, however, material difference in the impact on the farmers under these two schemes. Under the Consolidation of Holdings Scheme, the holdings of farmers, big or small, were made into compact blocks. Under the enclosures, the big fish swallowed the small fry. In districts in England where the open field of the village was enclosed for pasture, many ploughmen were evicted to make room for a few shepherds.

'Many of the evicted ploughmen wandered off to swell the ranks of the 'sturdy beggars', 'staff-strikers', and 'rogues forlorn', who figure so largely in the literature and the Statute Book of Tudor times,' states Trevelyan.

'The 'beggars' were the characteristic evil of the sixteenth century as the 'retainers' had been of the century before; and enclosing landlords who set them adrift on society were denounced by moralists like More and Latimer.'[5] Most of the evicted small farmers in the eighteenth century migrated to urban areas and became industrial workers.

This process of enclosures started in the twelfth century and was more or less complete by the first quarter of the nineteenth century. Between 1760 and 1830 enclosures were on an unprecedented scale. Between 1790 and 1799, about 469 enclosure bills were passed by Parliament affecting 858,270 acres (347,333.09 ha). Between 1810 and 1819, about 853 bills were passed which permitted the enclosure of 1,560,990 acres (631,710.79 ha). The General Enclosures Act of 1845 permitted enclosures without recourse to private enabling acts.[6] By 1845, open fields were enclosed into rectangular

[4]Trevelyan, G.M. *Illustrated English Social History*, p. 136
[5]Trevelyan, G.M. *History of England—New illustrated edition*, pp. 336, 337
[6]Geise, J. *Man and the Western World*, p. 806

fields with hedges on the boundaries. The small peasant land-holders were squeezed out and large farms owned by landlords came into being. The enclosures also led to the new methods of draining land, making roads and rebuilding farmhouses. The country-houses with their gardens and parks multiplied.

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CHAPTER 7

THE INDUSTRIAL REVOLUTION IN ENGLAND

THE FIRST PHASE 1764-1785
THE AGE OF REASON AND PROGRESS IN SCIENCE
THE MECHANIZATION OF TEXTILE INDUSTRY
IMPACT ON RURAL AND COTTAGE INDUSTRIES

INDUSTRIAL revolution in England, which began about the middle of the eighteenth century, was not a sudden development. It was in a large measure, the product of free thought, which liberated the people's minds from dogmas and religious orthodoxy. The eighteenth century has been called the Age of Reason. During this age, there flourished men of towering intellect, e.g. Thomas Paine, Voltaire (1694-1778) and Diderot (1713-1784). These three men were the most influential intellectual figures of the eighteenth century. They made rationalism into a popular force. Thomas Paine, by writing *The Age of Reason* (1795), cleared many cobwebs of superstition. They also made people realize that freedom of thought was the mainspring of all progress.

PROGRESS IN SCIENCE

A good deal of new data had accumulated on account of scientific research in the seventeenth century, and it was during the eighteenth century that all these facts were systematized and assimilated. The discovery of relationships of facts and data, and the evaluation of new information, according to its place in the cultural pattern, is just as important for the progress of science as the discovery of new data. It is in this respect, i.e. the summation, codification and interpretation of scientific data, that the scientists and the philosophers of the eighteenth century made their greatest contribution. Denis Diderot, a journalist and scholar of great versatility, compiled the *Encyclopedie* in thirty-four volumes, in which he presented the synthesis of existing knowledge, and particularly of rationalistic thought, which exercised a great influence upon the thinking of the people of the Western World. They attacked all that was superstitious and obsolete in the fabric of religious and social beliefs of the European society.

Among the scientists, the Swedish naturalist, Carolus Linnaeus (1707-1778), synthesized the sciences of botany and zoology from the data which had been accumulated by the naturalists and explorers. The contribution of Linnaeus to botany and zoology is great. Before him, biology consisted of observations of men on plants and animals, mixed with travellers' tales, myths and legends. In his *System of Nature*, he provides the first major classification of plants and animals. He cleared a vast confusion, and purified the sciences of botany and zoology from the dross of myths and legends. He invented a convenient system of naming plants and animals, the binomial nomenclature, which is still in use. Formerly, the names given to living beings were only of a descriptive nature, and did not indicate their relationship to one another. Linnaeus adopted the universal language, Latin, for naming the plants and animals in two words: the first word indicated the genus, and the second, the specific epithet. Thus man in the binomial nomenclature is called *Homo sapiens*. In this combination, *Homo* is the genus and *sapiens*, the specific epithet. Among the vast confusion of names, which outwardly appeared unrelated to one another previously, the people merely floundered. By inventing the binomial system for plants and animals, Linnaeus also opened the way for the theory of evolution.

Redy and Spallanzani in Italy showed experimentally that the larger forms of life could not be generated spontaneously. Spallanzani also made discoveries about reproduction by observing spermatozoa. Owing to improvements in the microscope, and advances in chemistry, a good deal of progress was made in biology. Plant nutrition, physiology, embryology and comparative anatomy, and pathology received attention, and biology became more scientific.

In medicine, progress was also notable. Edward Jenner (1749-1823) showed that a person inoculated with the mild disease of cowpox was saved from smallpox, and thus made the most important discovery in the history of preventive medicine, i.e. the immunization to diseases through vaccination. Auenbrugger(1722-1809) discovered the use of percussion to detect the diseases of the chest. John Hunter (1728-1793) extended the knowledge of pathology, and by his discovery of the method of ligature of arteries, greatly improved the technique of surgery.

James Hutton (1785) in his *Principles of the Earth* systematized the geological knowledge of his time, and it was on account of his work that the significance of fossils, and of rock strata in interpreting the history of the earth was recognized.

In astronomy, James Bradley (1693-1762) calculated the distance of the stars, discovered the shifting of the earth's poles, and also calculated the velocity of light. Laplace (1749-1827) propounded his famous nebular hypothesis of the origin of the universe. The invention of the achromatic lens revolutionized the telescope. Sir William Herschel (1738-1822) discovered the planet Uranus in 1781, and investigated the problems of nebulae, and double stars.

During the eighteenth century, the foundations of electrophysics were also laid. Charles du Fay (1698-1739) discovered that electricity is of two kinds, positive and negative. Benjamin Franklin (1706-1790), a versatile American genius, proved that lightning in the clouds is electricity.

Galvani (1745-1827), through his experiment on frogs discovered the so-called 'Animal magnetism'. Volta (1745-1827) constructed the first electric battery. Coulomb (1736-1806) discoverd that Newton's law of universal gravitation also applies to the attraction and repulsion of electrical charges. Black, by his study of latent heat, laid the foundation for the invention of the steam-engine in due course.

Important advances were made in chemistry. Joseph Priestley (1733-1804), and Scheele (1742-1786) independently discovered oxygen. Cavendish (1731-1780) discovered the chemical compostition of water. He combined the gases, now called hydrogen and oxygen, to form water, and thus proved that water is a compound and not an element, as was until then universally believed. Lavoisier demolished the so-called phlogiston theory by his study of combustion. Phlogiston was regarded as a definite substance which escaped from materials when they were burned. By actually weighing the substances concerned in burning gases as well as in solids, Lavoisier showed that combustion could be explained as the result of the combination of two different substances, i.e. oxygen with the material that was burnt. He further proved that the breathing in animals and the rusting of metals are all oxidation processes akin to burning. Lavoisier, the greatest of the chemists, was guillotined during the French Revolution. While sentencing him to death, his judges remarked, "the republic has no need of learned men"—a sad commentary, indeed, on the politicians of the age.

THE MECHANIZATON OF TEXTILE INDUSTRY

Industrial revolution in England began with the textile industry. Up to 1746, spinning was done with the spinning-wheel, when one person could make one thread at a time. Three great inventions, Hargreaves' spinning-jenny of 1764, Arkwright's water-frame of 1769, and Crompton's mule of 1779, made the first real breach in the old hand techniques, first by multiplying the action of the hand and then by the use of power in the primary process of spinning. Hargreaves' spinning-jenny permitted a single workman at his spinning-wheel to spin up to ten threads, and thus do the work of ten persons. This invention, and an improvement by Arkwright, resulted in Samuel Crompton's invention, in 1779, of the mule, combining the spinning-jenny and the roller machine; and by the end of the century, power-driven machines had been invented, permitting the spinning of 200 threads at a time by a machine, watched by only one or two workmen.

The enormous output of thread forced man's ingenuity to improve the weaving process. A Kentish clergyman, named Cartwright, in 1784, invented a new and improved loom, which altered the whole current of weaving. A machine watched by one workman could do as much weaving in a day as several hundred weavers could do with the old-fashioned handloom.

ADVANCES IN METALLURGY

The blast-furnace arose in the eighteenth century, and developed with the use of coke. Before this period we do not find rolled sheet-iron (1728) and rolled rods and bars (1783). The steam-engine and the pumping-engine could only develop with the availability of sheet-iron.

To start with, these machines were driven by water-mills installed on small streams. The first steam-engines in the eighteenth century were the pumping-engines used to keep water out of the newly opened coal-mines. These coal-mines were being worked to supply coke for iron-smelting, for which wood-charcoal had previously been used. It was James Watt, a mathematical instrument-maker, of Glasgow, who improved this steam pumping-engine and made it available for the driving of machinery. In 1785 the first steam engine was used in Nottingham cotton-mill. 'It was the use of the steam engine for power in the textile industry that joined together, the two originally separate strands of heavy and light industry and created that modern industrial complex that was to spread from its origin in Britain all over the world', states Bernal.

'Capital was derived in the first place from the great merchant profits of the preceding century, which had begun to skim the resources of the newly-discovered lands in mines and plantations, both worked by slaves, or from the almost undisguised loot of India,'[1] says Bernal. Labour liberated from the land through the enclosures flocked to the factories. As they were not cramped by the guild restrictions of the medieval towns, they worked long hours for low pay in the mills.

'Nothing less than the term revolution can be used for the change of productivity in those fields of manufacture in which it first arose. The output of cotton goods rose five-fold between 1766 and 1787. The consequent effects on trade, agriculture, and population were as definite and almost as rapid.'[2]

ROLE OF ENGINEERS AND ARTISANS

The Industrial Revolution was not mainly, and certainly not in its first phases, a product of scientific advance, though certain contributions of science, notably the steam-engine, were to be the essential ingredients in its success. Nevertheless, the whole movement was far more closely identified with the growth and inner transformation of the economic system of capitalism, from the phase dominated by merchants and small manufacturers to one dominated by financiers and heavy industry.[3]

The "Industrial Revolution" is the name that Engels was apparently

[1]Bernal, J.D. *Science in History*, p. 370
[2]Ibid, p. 366
[3]Bernal, J.D. *Science in History*, p. 352

the first to give it as far back as 1844. The first architects of the Industrial Revolution were artisan inventors whose success was made possible by exceptionally favourable economic circumstances.

The engineers who sparked off the Industrial Revolution were the lineal descendants of the millwrights and the metal-workers of the days of craftsmanship. Bramah (1748-1814), Maudslay (1771-1831), Muir (1806-88), Whitworth (1803-87) and the great George Stephenson (1781-1848) were all men of this type. They also included men, such as Scotsmen James Watt (1736-1819), and Murdock (1754-1839), the inventor of coal-gas lighting, and Mathew Boulton (1728-1809), who became the first manufacturer of steam-engines. The engineers, the scientists, and the manufacturers mixed together in their work and social life. They exchanged views about problems with each other, experimented and associated in new projects.

Impact on Rural Artisan and Cottage Industries in England

The Industrial Revolution had a harmful effect on rural artisans and craftsmen in England. Franklin states, 'The agricultural revolution took away the villager's land and cattle, but to make matters worse the industrial revolution took away his cottage crafts from which, in the past, he had augmented his wages. In almost every country these cottage crafts died as the introduction of massed machinery in the towns moved work from the cottage to the factory. How complete was the blow that the industrial revolution gave to both cottage and master craftsmen in the villages can be seen from the record of the village of Finchinfield in Essex. About 1795 it contained carpenters, blacksmiths, a wheel-wright, a plumber, a painter, a cooper, a glazier, a clockmaker, thatchers, millers, mill stone dressers, weavers, tanners and turners. In 1948 it had one thatcher and one blacksmith.'[4]

Ruin of the Cottage Textile Industries in India

The impact of the Industrial Revolution of England on the cottage textile industries of Bengal was disastrous. 'India in the eighteenth century was a great manufacturing as well as a great agricultural country, and the products of the Indian loom supplied the markets of Asia and of Europe', states R.C. Dutt. He continues, 'The East India Company and the British Parliament discouraged Indian manufacturers in the early years of British rule in order to encourage the rising manufacturers of England. Their fixed policy, pursued during the last decades of the eighteenth century and the first decade of the nineteenth, was to make India subservient to the industries of Great Britain, and to make the Indian people grow raw produce only, in order to supply material for the looms and manufactories of Great

[4]Franklin, B. *A History of Agriculture*, p. 150, 151

Britain. This policy was pursued with unwavering resolution and with fatal success; orders were sent out, to force Indian artisans to work in the Company's factories; commercial residents were legally vested with extensive powers over villages and communities of Indian weavers; prohibitive tariffs excluded Indian silk and cotton goods from England; English goods were admitted into India free of duty or on payment of a nominal duty. Millions of Indian artisans lost their earnings; the population of India lost one great source of their wealth.'[5]

The Industrial Revolution caused profound social upheavals, but it also made England the workshop of the world. Apart from promoting its textile trade, it provided the English Army with artillery and matchlocks which were superior to those of other countries. These innovations were of great help in empire-building.

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[5]Dutt, R. C. *Economic History of India*, Vol. I, pp. xxv, xxvi

CHAPTER 8

EARL OF MOIRA (MARQUIS OF HASTINGS)

1813-1823

THE ESTABLISHMENT OF THE BOTANICAL GARDEN AT SAHARANPUR
THE TAKING OVER OF LALBAGH, BANGALORE
PROPOSAL FOR THE RESTORATION OF THE WESTERN JAMUNA CANAL

In 1813, the Second Earl of Moira, later called Marquis of Hastings, was appointed Governor-General of India. At that time, he was in his fifty-ninth year (Fig. 7). He was a soldier who had risen to the rank of general. Vincent Smith states, 'his gift for spacious planning was balanced by a faculty for vigorous action, and in all his arrangements he showed the flexibility which is the mark of distinguished leadership!' By his practice of the virtues of public justice, conciliation and tact and respect for susceptibilities of Indians, he effaced the memory of bullying tactics and rudeness of Wellesley, the aggressive Imperialist. Apart from these qualities, he had interest in plants. As soon as he landed in Madras, he noticed a large number of barren palm trees and commented that there was need of importation of male plants, whose pollen was necessary for pollinating the flowers of the female palm.

Though he came with peaceful intentions to India, his regime was far from peaceful. He was confronted by the Gurkhas of Nepal in the north. At that time, the Gurkhas were extending their empire in the western Himalayas and had occupied Kumaon, Garhwal and the Simla Hills and were investing the Kangra Fort. Kangra was saved by the intervention of Maharaja Ranjit Singh, whose forces chased the Gurkha Army across the Sutlej. In April 1815, the British Generals, Ochterlony and Gardner defeated the Gurkhas, and liberated the whole region from the Sutlej to the Kali River. In March 1816, the Gurkhas accepted the treaty of Sargauli, a British resident was posted at Kathmandu, and Kumaon, Garhwal and the Simla Hill States were passed to the British. The potentialities of Simla as a hill resort were soon realized and in 1822 Captain Kennedy built there the first permanent house.

From *1817* to *1818, Hastings dealt with the Pindaris* who were plundering the Ganges Valley and Central India. More than 100,000 troops were employed against the Pindaris who were defeated. In 1817 Metcalfe at Delhi made treaties with nineteen Rajput States of Rajasthan, including Jaipur, Udaipur and Jodhpur. In 1818, the Peshwa surrendered to Sir John Malcolm and his dominions were annexed. As a result of all these operations, the hegemony of the Company was established throughout India up to the Sutlej River. Only Ranjit Singh's Sikh Kingdom in the Punjab and Sind remained independent.

The Botanical Garden, Saharanpur

The interest of Hastings in plants has already been mentioned. He saved two important gardens and converted them into botanical gardens. The first of these was at Saharanpur, and the second at Bangalore. The Saharanpur garden was founded by one Intizam-ud-Daula before 1750 and he gave it the name of Farahat-baksh. Later, it was occupied by the Mahrattas, who ruined it. It was taken over by the East India Company from the Mahrattas for the introduction and acclimatization of medicinal plants. Hastings travelled by boat from Calcutta up the country in 1814. He paid a visit to the garden at Saharanpur and observed, 'In the evening I examined the Company's garden'. He states, 'The object of retaining the spot in that form was that the various trees and plants of the hill country might be brought down to it; when if they throve they might be forwarded to the garden at Agra, and so successively into Bengal. Little attention has been paid towards carrying into effect this rational and useful plan. The garden, very considerable in size, is full of large mango-trees, all of coarse quality as to fruit. I ordered the greater part of them to be cut away, as likewise a large proportion of the citron and orange-trees, which are much too numerous. There are two distinct kinds of the former. The lemons here have a marked difference from those of the West Indies, and are not so good. I must put this garden on a better footing, for it may be rendered extraordinarily useful.'[1]

Dr Govan was appointed the first Superintendent of the Botanic Garden in June 1817. In its early days, this Garden played an important role in naturalizing many plants from America. Some of them were: potato, tobacco, pineapple, guava, chillies, papaya, sapota, logwood, mahogany, *Parkinsonia aculeata, Gerbera thevetia, Asclepias curassavica, Martynia diandra, Canna glauca* and *Jatropha multifida*.

The Garden had become an important centre of research in taxonomy by 1820 and also maintained a herbarium. It was from Saharanpur that Falconer made his well-known contributions to botany. About five hundred drawings were made by the East India Company's establishment of painters. A set of specimens was left with Dr Falconer at Saharanpur, and the duplicates were presented by the Court of Directors of the East India Company to the Linnaean Society of London for general distribution.

Dr John Forbes Royle (1799-1858)

Royle, a surgeon in the Company's employment, who had spent his early years from 1819 to 1823 in various parts of Bengal and was particularly interested in medicinal plants and their geographical distribution, was ap-

[1]The Marchioness of Bute (Ed.), *The Private Journal of the Marquess of Hastings, K. G., Governor-General and Commander-in-Chief in India.* Vol. 1, pp. 75, 76

pointed Superintendent of the Botanic Garden. He studied the flora of the Himalayas in the area between Saharanpur in the south and Kashmir in the north. Although Jacquemont and Dr Govan had preceded him in the Himalayas, Royle, on expeditions of this type, made some of the earliest collections in the Himalayan area, and they were later arranged at the herbarium of the Saharanpur Botanic Garden. He also got drawings of these plants made by artists.

Lalbagh, Bangalore

This garden was established by Hyder Ali in 1760 on 40 acres (16.18 ha), west of the watch-tower in Bangalore. He planned it as a Mughal garden. Along with cypresses, pomegranates, figs and roses were planted.

After the death of Hyder Ali, the Lalbagh continued to be the pleasure-garden of his son, Tippu. He improved it and maintained a collection of mango-trees. Many plants were imported from Arcot. Tippu was a great lover of plants and flowers and he introduced many new species. He sent Hussein Ali and Sheikh Ibrahim as his ambassadors to Mauritius in December 1797. They returned to Mangalore on 30 April 1798 and brought with them twenty chests containing plants and seeds. Apricots, apples, raspberries, blackberries, sweet-limes, pineapples, grapes, figs, komaracs, cashewnuts, guavas, dates, papayas, Chinese oranges and various kinds of flowers were cultivated during Tippu's time.

In 1779, after the fall of Tippu, the Lalbagh was taken over by a botanist, Major Waugh. He showed great zeal in the improvement of the garden and introduced foreign plants. Major Waugh in 1819 gave the garden as a gift to the Marquess of Hastings. Dr Wallich, Superintendent of the Royal Botanic Gardens, Calcutta, recommended in1819 the acceptance of this garden as a branch of the Bengal Presidency Botanic Garden. He wrote: "The garden in question at Bangalore has been for a considerable time known to me from my correspondents both at that and other States, to the south of Ganjam, as affording a striking instance of the practicability of bringing the fruits of Europe to complete perfection in this country, under a happy combination of localities of soil and climate, when aided by such efforts of zeal, skill and indefatigable perseverance as those which distinguished the useful labour of Major Waugh. Some recent communication of seeds from thence have further tended to corroborate the convictions that the climate of Bangalore is eminently suited for the purposes of horticulture. For that reason, it might, with the fairest prospects of ultimate success, be made subservient to a very great desideratum in this part of the world, that of an intermediate nursery or a depot for the introduction and acclimatisation of fruit trees of England.

'Among the branches of botany which are included within the scope of this great establishment, that of introducing and disseminating foreign fruits maintains a very conspicuous place, which the labours of the successive Superintendents have now directed from its very commencement with the most signal benefit to the country. The endeavours however to bring the fruits of England to any degree of perfection here have hitherto been frustrated on account of excessive heat and profuse wetness which characterize the climate of Bengal, and which have hitherto imposed an unsurmountable barrier against every attempt of a direct introduction of those desirable articles of cultivation. To remedy this defect by insuring gradually the European fruit-trees to bear the vicissitudes of this counry, intermediate depots of auxiliary nurseries become very desirable, and for such a purpose the garden of Major Waugh seems to be in every point of view highly calculated.'

Marquess of Hastings, while accepting this offer, wrote: 'That Major Waugh's garden might in connection with the Honourable Company's Botanic Garden established at this Presidency, be rendered of great public advantage as an intermediate nursery for introducing and acclimatising in India, the trees and plants of Europe and China.' Then the garden was entrusted by the Governor-General to the Resident of Mysore, Mr Cole. But the superintendence and control were kept under Dr Wallich. The Resident in Mysore was authorized to maintain the necessary establishment for the proper care of the garden, the expense being chargeable to the Supreme Government. Thus the garden remained as a branch of the Calcutta Botanic Garden under Dr Wallich from 1819 to 1831.

On the assumption of the Province of Mysore by the British in 1831, the Lalbagh passed into the hands of the Chief Commissioner and remained so until 1839. Sir Mark Cubbon, the Chief Commissioner founded an Agri-Horticultural Society in 1839 and handed over the Lalbagh to the Society. He helped the Society by providing convicts to work in the garden. So long as the garden remained under the auspices of the Society, it was supported by private subscriptions. The Society ceased to exist in 1842, and the garden once again came under the management of the Chief Commissioner. For 14 years after the abolition of the Society, the garden was allowed to run waste, little being done for it beyond occasional cleaning and sweeping.

The West Jamuna Canal

On 5 January 1815, Hastings saw the neglected bed of the West Jamuna Canal and the surrounding countryside. He observes in his private journal, 'I traced for a considerable distance the vestiges of the famous canal of Murdun Ali Khan (*sic* Ali Mardan Khan). It began where the Jamuna bursts through the hills into the plain, and it took a direction nearly parallel to that of the river quite close to Delhi. Its object was to fertilize the long tract of country from its source to its termination; in which extent no tolerable water is to be procured but by sinking wells to such an enormous depth as is beyond the compass of ordinary funds. All the water found in the higher strata is brackish, and is deleterious to vegetables as well as unwholesome for man. The stream of the Jamuna in running through this country becomes so tainted, that the necessity of drinking it at Delhi since the canal has been destroyed, has produced great unhealthiness in the city. This noble work of art formerly rendered the country through which it passed an absolute garden; and the sums paid by the several villages, in proportion to their respective population, for the privileges of drawing water from the canal, furnished a considerable revenue to Government. The effects of the canal on the cultivation of the country were so striking, that it obtained the name of the Sea of Plenty. During the wars which for a long period wasted the country between the Sutlej and the Jamuna, the banks of the canal were broken in many places, and its course stopped; so that when the works by which the water was conducted from the Jamuna into it were destroyed by accident, no set of men found an interest to excite their negotiating for their restoration, or perhaps saw a chance of prevailing on the Sikhs to allow it. The country has now, in consequence, an air of desolation. Ruins of villages meet the eye everywhere. There is no cultivation but close to considerable towns, where the residence of a chief and the opulence of the community have allowed the means to be contributed for providing the neighbourhood with deep wells and good water. The possibility of re-establishing this canal had early struck me. I conceived that it would be an enterprise not only dignified for our Government, but advantageous in a high degree by procuring us tenants for lands which no man can now have an inducement to rent from us. The report of the engineers has been favourable beyond what I had calculated. I had assured myself that, as all the deep excavations must remain little altered, the nature of the operations for re-establishing the trunk of the canal could not be expensive, and I find I had reasoned justly. On a rough estimate the engineers compute that three lacs of rupees would suffice to put the whole of the canal into perfect condition. From their explanations I believe they have made a liberal calculation. As such an outgoing is trifling indeed in comparison to the benefits which must result from the completion of the subject, I have determined on undertaking the repair immediately.'[1]

In 1817, G.R. Blane of the Bengal Engineers was appointed by the Government of India to restore the Western Jamuna Canal. It took Blane three years to do the job and he died of malaria at Ludhiana in the Punjab in 1821. Due to paucity of funds, and in order to cut down costs, Blane adhered to the alignment of the old Mughal Canal, consisting of natural

[1]The Marchioness of Bute (Ed.), *The Private Journal of the Marquess of Hastings, K.G., Governor-General and Commander-in-Chief in India*, Vol. I, pp. 283-284

channels and depressions, which resulted in the formation of large swamps and extensive waterlogging. The Western Jamuna Canal, as constructed by Blane, took off from the River Jamuna near Hathnikund, flowed down an old creek of the river until it joined the Pathral and Somb torrents. There were no permanent headworks built and the supplies rose and fell with the seasonal changes in the river levels.

The famine of 1832-33 led to the enlargement and multiplication of branch and distributary channels. The financial aspect of the project proved satisfactory: for, in 1847, it was yielding a net return of 13 per cent on the capital invested, which amounted to Rs 1,381,000.[8]

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[8] *Development of Irrigation in India*, p. 65

CHAPTER 9

PIONEERS IN ANIMAL HUSBANDRY AND VETERINARY SCIENCE

WILLIAM FRAZER (1793-1808) AND WILLIAM MOORCROFT (1808-1825) THE GOVERNMENT CATTLE FARM, HISSAR (1809)

CAVALRY had a pre-eminent place in the military organization of the East India Company. As such, the improvement of horses was its major concern. As the veterinary science was still to develop in England, veterinarians were not available, and the problems of feeding and breeding cavalry horses were the concern of army officers. An army officer, who had a profound influence on the development of livestock work, particularly horse-breeding in India, was Lieutenant William Frazer. In September 1793, he produced a plan for the improvement of horses in the valley of the Ganges by the setting up there of a stud. Frazer considered this area well suited to the purpose, and in this he received the full support of the Governor-General.

"Frazer proposed to assemble mares from different parts of India, such as the Punjab, the Deccan and Ajmere. He rated the horses from Cutch equal to those from Arabia, relating the local legend that the horses of Cutch originated from seven choice Arab horses shipwrecked on their coast. He proposed to breed from these various mares using Arab stallions. He had in mind also the breeding of cattle, using the Nagore bulls on the indigenous females. Frazer, in this report, made what was probably the first allusion in India to animal disease and the lack of veterinary knowledge.

"In December 1794 approval was given to the formation of a Board of Superintendence, consisting of three members and a secretary, to develop the scheme, and of the appointment of an agent to carry it out—Lieutenant Frazer. The latter's first task was to survey the area and select a site for the stud farm. He produced a report on this project in May 1795, and in August the Governor-General, Sir John Shore, approved the purchase of land at the site near Pusa, recommended by Frazer, and the payment of advances to cultivators of the *doob* and *ankree* grasses. He also authorized the purchase of twenty stallions to be maintained at the farm to cover selected mares brought in by breeders for service.

"From 1795 to 1803, there were references to improvements in the cultivation of the farm land, with the introduction of Dutch clover, guinea grass and lucerne. There were requests that English stallions might be sent out to the stud, and a notification of the fact that a high proportion of the mares at the stud were proving barren. In order to improve the herd of cattle kept at the stud farm, two bulls and six cows either of the North

Devon or of the Lancashire breed were brought from England.

"Frazer, promoted to Captain, referred in 1799 to the success of the *zemindari* system of horse-breeding, with the stallions placed out in the villages; and said that nearly a thousand mares had been covered by Arab and Persian stallions in the four years since the scheme was started.

"In December of that year, a request was made for the services of a skilful veterinarian to be employed at the stud 'to diffuse the knowledge of the art' among local horse-breeders. Three months later, the Court of Directors in London gave it as their opinion that it would be difficult to find men of sufficiently liberal education for this purpose.

"The request was, perhaps, a pointer to difficulties and partial failures at the stud, for in 1804, the Commander-in-Chief officially noted the defects of the Pusa-bred horses, when received as remounts for the army. He condemned them as undersized, deficient in bone, some spavined, others fired, while three were blind in one eye. He pointed out that the lack of size was not compensated for by great strength as is the case with the Turki, a horse that later Moorcroft was to seek in Central Asia.

"In June 1804, the Court of Directors intervened in what was becoming a major controversy, and asked for a committee of cavalry officers to inspect and report on the Pusa stud, which by this time had 1,200 animals on its books—though no longer many heads of cattle.

"In 1808, the Court of Directors decided in favour of the continuance of the Pusa stud, but considered—doubtless, from their experience of the valuable services rendered by Mr William Moorcroft at their stud farm in Essex—that the Pusa Superintendent must possess both a thorough knowledge of horse-breeding and of veterinary science. They strongly urged the appointment of Moorcroft in the place of Major Frazer, who wished to retire."[1]

William Moorcroft (1767-1825), First Veterinary Surgeon in India

Born at Ormaskirk, Lancashire, in 1767, William Moorcroft had first intended to become a doctor. The events which led to Moorcroft's entry into the veterinary profession are thus narrated by him. "Whilst a pupil of Dr Lyon, the colleague of Dr Currie, at the Liverpool Infirmary, the attention of the Physicians and Surgeons of that Institution was suddenly and strongly called to a formidable epidemic disease amongst the horned cattle of a particular district, and was thought to be extending. It was agreed to depute a pupil to examine the disease upon the spot. The choice fell upon me, and in company with Mr Wilson, the ablest farmer of the day, I performed my commission. As arising out of this occurrence, it is only necessary to remark, that two gentlemen, of whose judgement and patriotism I had the highest respect, took the trouble of endeavouring to

[1]West, G. P. (Ed.), *A History of the Overseas Veterinary Services, Part I, India*, pp. 12, 13

show that if I were to devote myself to the improvement of a degraded profession, closely connected with the interests of agriculture, I might render myself much more useful to the country, than by continuing in one already cultivated by men of the most splendid talents. Convinced by their arguments, but opposed by other friends, and especially by my master, the matter was compromised by a reference to the celebrated John Hunter. After a long conversation with me, Mr Hunter declared that if he were not advanced in years, he himself would, on the following day, begin to study, the profession in question. This declaration was decisive, and I followed the course of study which Mr Hunter was pleased to indicate."

There was no veterinary college in England at that time and Moorcroft went to Lyons, France, where Bourgelat had founded a veterinary school in 1762—the first in the modern world. On his return to England, Moorcroft settled in London and acquired a handsome amount of wealth through business.

'The Veterinary College, Camden Town, London, was opened on 8 April 1791, with a Frenchman, Chas, Vial de St Bel, as its Founder-Principal. In the spring of 1792, together with John Field, Moorcroft set up a veterinary practice in Oxford Street, London. Not only did the practice develop rapidly, but eighteen months later when the first principal of the Veterinary College in Camden Town died, Moorcroft was asked to fill the vacancy. He demurred on the grounds that his practice was already too extensive, though he did in the end share the appointment with Edward Coleman—for six weeks! But it was not to be expected that the partnership could long survive Coleman's pompous empirism; there was too much of the charlatan in his make-up, and during the next sixteen years Moorcroft was fully occupied with his practice, though he found time to collect information concerning the diseases of horses in India, and to produce a pamphlet to accompany a medicine chest which he designed for the use of the East India Company. A pioneer of the operation of neurectomy for the relief of lameness, Moorcroft also devised a new method of making horseshoes.

'In May 1808, Moorcroft sailed for India to take up his appointment as the first veterinary surgeon to be employed there in a civilian capacity. His salary had been fixed at £3,000, and he was to receive £500 for expenses on the voyage.

'The size of Moorcroft's salary—equivalent to a tax-free income of £8,000 today—was a measure of the standing of this man who, at forty-one, had already made a fortune estimated at £40,000.

'On arrival at Calcutta, Moorcroft proceeded to the Pusa stud, where he very soon justified his appointment. He introduced better methods of feeding and management, and brought under control the contagious diseases that were rampant, with the result that losses were cut by 90 per cent.

Moreover, realising that the hot humid climate of the Ganges valley was obviously unsuitable for horse breeding, he soon moved his breeding stock to healthier areas; co-operating with, and learning from, local horse breeders at the same time.

'Moorcroft found that the Arab and English blood crosses with the native mares did not prove the type of military animal required for the Company's cavalry and artillery.

'He pointed out that in view of the loss of fertility in brood mares, he needed 3,000 mares and 120 stallions in order to raise 600 army remounts a year from an expected progeny of 1,200 colts a year.

'It was the quest for suitable breeding stock, and the refusal of the Company to let him return to England to purchase any, that—at least as a secondary objective—took him to Central Asia. Four years after his arrival he was setting out in disguise, crossing the Himalayas from Nepal to Eastern Tibet.

'Moorcroft entrusted two missions to others before setting out himself. The Government provided financial support to the extent of some £20,000. But as the horses inspected *en route* were undersized and otherwise unsuitable, neither the Government nor the Company were again so forthcoming in the matter of money.

'In 1816 Moorcroft—the first veterinarian ever to do so—contributed to *Asiatic Researches* a long article entitled 'A Journey to Lake Manasarovara in Undes, a province of Little Tibet'. This account established Moorcroft's scientific status, beyond the confines of his professional reputation with the East India Company. It established him both as an intrepid explorer and as an ecologist. He also introduced the cultivation of oats into India for the first time (Fig. 9.)

For the improvement of the Company's cavalry horses in size and strength, he advocated the introduction of English sires in preference to the Arabian ones. Since the former could not be procured easily in sufficient numbers, he suggested the use of Turkoman stallions to be imported from Central Asia. It was in search of Turkoman horses that he tried to cross the Himalayas through Sikkim and Tibet. Not finding a suitable passage through those parts, he returned to Bengal and undertook a second journey through the Punjab, Kashmir and Afghanistan. It was during this journey that he stopped at Lahore in the summer of 1820.

In Lahore, Moorcroft stayed for a few weeks and departed after getting Maharaja Ranjit Singh's permission to go to Kashmir and to travel through Peshawar to Afghanistan. He had several interviews with Maharaja Ranjit Singh and, among other things they talked about horses. Moorcroft wrote: "One of the Raja's favourite themes was his stud. He told me that most of his horses were presents from his tributaries and zamindars, and that he not infrequently requited the donor of a superior animal with a village or a *jagir*"; no wonder therefore that he obtained capital horses for his own use.

"He was shown 60 horses of the Royal stable. "They were of the breeds of Dhani and Ghep, forest districts in the Punjab, the Lakhi Jangal, Rohtas, Attock, Kabul and Bokhara. One, which cost Rs 1,700 at Bokhara was beautifully made except in the legs below the knees and hocks, where he was too slight. For a grey Persian horse, the Raja told me he had given Rs 7,000 but it struck me as inferior to most of those exhibited." It appears that his expert taste was not satisfied with show horses purchased for sums, which in those days, were really fabulous. Moorcroft continues: "At the stud of Fateh Singh Ahluwalia in the town of Kapurthala, I found about 40 young horses and colts, but understood that the mares were the property of the zamindars, none of whom can dispose of the colts they rear until they have first offered them to their chief. Should he approve of any, he took them at his own price, which is rarely more than a half or a third of their value."[1]

At Leh in Ladakh, he mentions having seen Kirghiz and Kazak ponies having been brought from Yarkand and sold to local dealers for Rs 50 each. They were to be resold in the Punjab. These ponies were small and low, but of great depth of chest and strength in the forelegs.

In June-July 1820, he paid a visit to Tira-Sujanpur in the Kangra Valley and was the guest of Raja Sansar Chand, the renowned patron of Kangra painting. He saw a large collection of paintings with the Raja and also stated that he had a number of artists in his employ. Thus Moorcroft was not only the first veterinary surgeon in India, but also a connoisseur of art, and he was the first to record the existence of the Kangra School of Painting.

He reached Bukhara, and purchased the horses he wanted. On his way back, he developed a fever (typhus) at Andhko near Balkh in Afghanistan and died a few days afterwards; his body was carried to Balkh and buried near the grave of an Anglo-Indian, Mr Guthrie, in 1825.

Moorcroft maintained a journal of his travels and observations, the manuscript which was picked up in Afghanistan by an Englishman many years after Moorcroft's death. It was edited by Professor H. H. Wilson of Oxford and published in two volumes in London. These travel notes cover a wide range of subjects, such as industries, social and economic conditions, routes and military matters.

Moorcroft was a great explorer, ethnologist and ecologist, and a great veterinary surgeon. His achievements enabled the veterinary profession to have a place in the economic development of India, and an early recognition of its importance, generations before equivalent recognition was to be accorded to the profession in England.

[1]West, G.P. (Ed.), Ware, F. Sir. *A History of the Overseas Veterinary Services*, Part I, pp. 14-16

THE GOVERNMENT CATTLE FARM, HISSAR, HARYANA, 1809

This farm was established in 1809 for camel-breeding, because these animals were used for transport work in the army. The breeding of cattle and horses was started in 1815. In 1853, it was restricted to the breeding of bullocks for artillery. Later on, the breeding of donkey stallions for mule-breeding was started, as mules were required for ordnance purposes. The farm also produced siege-trained bullocks and bulls for the districts.

The farm covered 44,000 acres (17,806.18 ha), which included 2,500 acres (1,011.71 ha) irrigated by the Western Jamuna Canal. The rest of the land was for grazing and was covered by the grass *Cenchrus ciliaris*, which is relished by cattle. The famous Hariana breed of cattle is maintained at this farm.

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CHAPTER 10

THE ROYAL AGRI-HORTICULTURAL SOCIETY, CALCUTTA

1820-1840

INTRODUCTION OF NEW CROPS

PUBLICATION OF THE FIRST JOURNAL ON AGRICULTURE

THE Royal Agri-Horticultural Society was founded in 1820 by the great missionary scholar, Dr William Carey (1761-1834). He left the school at the age of twelve and wanted to become a farmer or a gardener. But after trying for two years he was forced to leave farming on health grounds. Then his father Edmund Carey engaged him in shoemaking and his apprenticeship continued for seven years. On 25 March 1785, Carey moved to Moulton, England to open a school. Simultaneously he started learning Latin, Greek and Hebrew. In January 1793, he was appointed as a Missionary to the Hindus of India and was advised to proceed to Bengal. Carey reached Calcutta on 11 November 1793.

To know and grow plants was his vocation and a pεssion. He had regular correspondence with Dr Roxburgh of Indian Botanic Garden, Howrah. He brought with himself bulbs of hyacinth, narcissi, irises, amaryllis, and tulips from England in 1793 and successfully grew these plants in India. He also collected seeds of nutmeg, coffee and cloves from abroad and brought them to India.

In 1794, he became Superintendent at an indigo plant at Mudnabati, Bengal. There he began his first Bible translation. Compelled to leave British-Indian territory, he and his family moved to the Danish colony of Frederiksnagar, near Calcutta, in 1800. There he and Joshua Marshman and William Ward, known as the "Serampore trio", founded the mission described by the English philanthropist William Wilberforce as "one of the chief glories" of the British nation.

Appointed in 1801 to teach Bengali, Sanskrit, and Marathi at Fort William College, Carey translated the Bible into Bengali, Oriya, Marathi, Hindi, Assamese, and Sanskrit. Parts of it he also translated into 29 other languages and dialects. He edited, with Marshman, a grammar in Bhotia and prepared six other grammars in different languages. In addition to dictionaries in Bengali, Sanskrit, and Marathi, Carey and Marshman prepared a translation of three volumes of the *Ramayana*.

He was admitted as a Member of the Royal Asiatic Society in 1806. The Brown University conferred a Doctorate degree upon him in 1807 for his profound knowledge in different languages.

Credit goes to Carey for establishing a printing press in India. Marquess of Hastings who paid a visit to the Missionary Printing Press at Serampore thus records his impressions:

'November 27th, 1815—I went to see the school and other establishments of the missionaries at Serampore. Dr Carey, Dr Marshman, and Mr Ward are the persons now conducting the concerns. They are all men of learning and skilful in various sciences. Their activity appears indefatigable, and its effects speak highly in favour of their zeal and judgement. The printing-house is conducted with great ability. The missionaries make the paper and cast the types within their own establishment. It was striking to see the number of natives learned in those several tongues, translating the Scriptures into them. This is ordinarily effected by one of the missionaries rendering the English into some middle dialect which they mutually understood, whence it is turned by the Asiatic into his own languages.'[1]

Between 1801 and 1832 the Serampore Mission press had printed twelve thousand volumes in forty different languages. The contribution of the Serampore Mission press to the cause of Indian printing is really immeasurable. It not only initiated but also standardised printing in most of the Indian languages.

When the Agri-Horticultural Society was founded on 19 September 1820, Carey was appointed the first Secretary. The first President was William Leycester, a civil servant. Patronage was extended to the Society by Lord Hastings, the Governor-General and his wife, who were known for their readiness to encourage everything related to the agriculture of India.

The Society published a journal, the *Journal of the Agricultural and Horticultural Society of India*, as well as its Transactions (Fig. 5). This was the first journal in India devoted to agriculture and horticulture in India and provided a medium for exchange of information and experience among its members in different parts of India. He trusted 'it would so develop peaceful pursuits as to hasten the beating of man's swords into ploughshares and their spears into pruning hooks'. Under his guidance an extensive investigation was started in the culture of coffee, cotton, tobacco, sugarcane and cereals. He died on 9 June 1834 at 5-30 a.m. at his Serampore residence.

Dr Carey drew a proforma for collecting information on agricultural conditions in the districts in the provinces under the control of the East India Company. Through this proforma, information was collected on climate, soil, modes of irrigation, marketing, rents and tenancy, size of farms, livestock, implements, systems of manuring gardens, woods and timber plantations. Obstacles to agricultural improvement and their most appropriate remedies were also studied. On the basis of that proforma, information was collected on agricultural conditions. The notes on the districts ultima-

[1]The Marchioness of Bute (Ed.), *The Private Journal of the Marquess of Hastings, K. G., Governor-General and Commander-in-Chief in India*, Vol. II, pp. 94, 95

tely provided the material for the gazetteers.'[2]

The proceedings of the Society were in English, but as an experimental measure, an edition in Bengali was also brought out which did not find much popularity. Mr Bell brought to the notice of the meeting the great number of copies of the Society's Transactions in Bengali which, unhappily, were only lumbering the room and serving as food for the white-ants. The President suggested the expediency of presenting twelve copies to each Society in India for distribution to native gentlemen, who might, by these means, infuse a taste for agricultural pursuits among their countrymen.

In 1839, the Society had 460 members, mostly Europeans, officers of the Civil Service and Army, clergymen, merchants and indigo-planters. There was little interest among the Indians of whom there were only 29 members. The President complains in regard "to the natives of the country, who would ultimately be the greatest gainers by the labours of the Society, that so few had joined it, and that its objects had not met from them a more cordial support."

In a letter to Maharaja Ranjit Singh of the Punjab, Lord William Bentinck, Governor-General of India, in 1833 summarized the activities of the Society and wrote: "The Agricultural Society, of which I am myself a member, consists of a number of gentlemen who consult together to encourage agriculture by the introduction of foreign seeds and plants and the improvement of the existing modes of cultivation, and Your Highness will not fail to perceive that, as the land is the original source of all wealth, this Society which has for its object to increase the quantity and improve the quality of its produce, is highly deserving of consideration and patronage."

In appreciation of the Society's activities, Lord Auckland, Governor-General of India, in the Revenue Department's Circular No. 4 of 1839, mentioned: "To that Society I consider the Government and community to be under the highest obligation and I would say that I would with perfect confidence and satisfaction entrust the employment of expected workmen with the application of any expenditure which may be sanctioned by the Government and the guidance of the further experiments to be now entered on to their general superintendence."

The Society did not limit its activities only to Calcutta or Bengal, but extension of improved agriculture was also done very successfully by distributing better seeds, plants, implements and livestock and dissemination of useful information through transactions, proceedings and information of Branch societies and similar other organizations in various parts of India.

Branch societies were founded at Dinapore, Berhampore, Bhagalpore, Bangalore, Delhi, Cuttack, Lucknow, Agra, Allahabad, Singapore and in many districts of Bengal as representatives of the main Society and rendered useful service in the development of agriculture in those areas.

[2] *Transactions of the Royal Agri-Horticultural Society*, Vol. I, p. 9

An Agricultural and Horticultural Society was established at Bombay in 1830 and in Madras in 1836.

INTRODUCTION OF SEEDS AND PLANTS

The following committees of experts were formed by the Society: (i) Cotton Committee; (ii) Flax and Hemp Committee; (iii) Sugarcane Committee; (iv) Tobacco Committee; (v) Silk Committee; (vi) Wheat Committee; (vii) Livestock and Implement Committee; (viii) Horticultural Committee.

Cotton: The quality of indigenous cotton cultivated in India at that time was very poor and its price in the foreign markets was almost half the price of New Orleans and Egyptian. In 1830, seeds of Sea Island, New Orleans, Seychelles, Bourbon and Upland Georgia were brought from America, Bourbon and Mauritius and grown at the Society's farm at Akra. In the same year, imported cotton seeds of different varieties were also distributed to 125 applicants from different parts of India. In 1831, Egyptian and Peruvian cotton seeds were also imported for trial. In 1841, the Society received 200 bushels of New Orleans, Upland Georgia and Sea Island cotton seeds from Baltimore and distributed these to the Branch Societies at Agra, Bombay, Madras and Singapore. The Society also sent samples of staple to Liverpool for expert opinion and to find the possibility of its competing with the produce of other countries in the Liverpool market. Cotton grown at Allahabad from the imported seeds was examined by a cotton expert, Mr Patrick, at Liverpool, and he sent this report to the Society: "This cotton produced at Allahabad was very superior in quality".

Flax and hemp: The Flax and Hemp Committee of the Society in 1841 clearly indicated the possibility of growing flax for fibres and reported: "Circumstances, however, were not wanting to lead to the belief that the soil and especially the moist warm atmosphere in Bengal, Bihar and Orissa was well adapted for the growth of flax for manufacturing process."

In 1842, the Society imported ten bushels of flax seeds from Europe. For the production of vegetable fibre which can be successfully applied to all the purposes for which flax is used, Rs 1,000 and a gold medal, for the production of a fibre substitute of hemp and also for the production of best-quality Rhea, the Society declared prizes of Rs 1,000 and Rs 500, respectively.

Sugarcane: The introduction of improved types of sugarcane into India was one of the most important contributions of the Society. Mauritius and Yellow Otaheite canes were first brought in 1830 and cultivated at the farm at Akra. From an area of four *bighas*, 2,449 Mauritius canes and 2,358 Yellow Otaheite canes were obtained.

Otaheite canes became very popular throughout the country and were in demand from every part of India. The Society distributed 38,000 canes in 1838 and 41,471 canes in 1840. A very favourable report was received in

1839 from Captain White, Secretary, Agricultural Society, Saugor branch, who recommended the distribution of more canes to that area. In 1840, Dr Stevenson, Secretary, Agricultural Society, Lucknow, wrote: "The only good of any consequence which we have got is the introduction of the Otaheite sugarcane".

Wheat: During the 19th century, almost all the varieties of wheat in India were hard and unsuitable for fine flour and the Society decided to import wheat seeds from Australia, Europe and Egypt. In 1840, 32 varieties of wheat were sent to the Society from Europe by Dr Royle. In 1842, he forwarded to the Society wheat seeds from Egypt and Europe and barley seed from Europe.

A sample of wheat grown in U.P. from imported seeds was examined by a wheat expert, Haworth, who reported: "The ears I should consider very fine and well grown. The quality of the grain is very superior for this country and it is also like some we imported in England from the Mediterranean."

Tobacco: Tobacco grown at the Akra farm from foreign seeds was examined by experts in England who pronounced it to be the best sample of tobacco grown in India and reported: "In flavour and general appearance, the leaf approached the description of leaves which are usually selected here for manufacturing into cigars and for the purpose of smoking in a pipe, viz. Havana, St Domingo, etc. all of which command high prices in relation to other kinds of leaf tobacco. The method pursued in its cultivation and preservation is that generally adopted by Americans."

Maize: Maize seeds were brought from America and distributed in various places in Bengal and U.P. In the opinion of some American cotton planters who visited Allahabad in 1831, the performance of this crop in U.P. and some parts of Bengal was as good as that in America. Attempts were made to follow the American method of cultivation and a marked increase in yield was recorded. Dunlop, Secretary, Cuttack branch of the Society, in his report mentioned: "Of the American maize seeds obtained from the Society, the 'Prolific' and 'White Flint' corn turned out to be very fine crop."

Dr A. Campbell, Resident in Nepal, also sent a report in 1837 to Bell, Secretary of the Society, and wrote: "I have now pleasure to inform you that I have been so fortunate as to produce a small crop from both the kinds of American maize you sent me and that on comparing the produce with the native article I am inclined to believe that the introduction of the new world grain into this country will probably be attended with advantage to the people."

Potato: In 1832, Captain Tichmond grew potatoes from a variety imported from England and distributed by the Society. He observed that the England potato was much superior to that of the local varieties in size and weight. Naini Tal and Shillong potatoes owe their origin to imported English strains brought by the Society.

On the point of introduction of potato in the hills, Ingles from Sylhet asked that the Society should supply potatoes to Cossias and 100 maunds (3,732.42 kg) was sent to Ingles in 1846.

Clover and guinea grass: In 1833, the Society imported seeds of clover and guinea grass from England. Successful cultivation of white and red clover and guinea grass was reported by Mines from Karnal. Hollings from Gaya reported that the guinea grass, where irrigated, grew very well and was an excellent fodder for cattle and horses.

With a view to encouraging the cultivation of fodder, the Society resolved at a General Meeting held in July 1837 that (i) a premium of Rs 200 and a Gold Medal be awarded for the best guinea grass cultivation in 20 *bighas* and (ii) a premium of Rs 100 and a Silver Medal be awarded for ten *bighas* of the best guinea grass.

Tea: Tea was another subject which called for much groundwork by the Society, and the valuable report of Drs Griffith and Maclelland was published in the transactions of the Society. The Tea Committee of the the Society first found the scope of cultivation of the species of tea plant existing in Assam.

Ginger: The Society thought that ginger could be grown well in Bengal, equal in every respect to the best Jamaica roots. In 1832, Hodgkinson presented some roots from Jamaica which showed a good yield in the Society's garden. The roots were then distributed to some growers in Orissa and Bengal.

Arrowroot: In 1831, arrowroot from the West Indies was cultivated in an area of four *bighas* at the Society's farm at Akra. One hundred and fifty-one maunds and twenty seers (5,654.62 kg) of rhizomes was obtained. Sixteen maunds and twenty-six seers (3,732.42 kg) of farina was made from 100 maunds (621.45 kg) of rhizomes and 51 maunds (1,922.19 kg) of roots was distributed to Branch Societies and members. It served as a food for patients in hospitals. J.C. Haugton, Superintendent of Port Blair, wrote: "The Arrowroot crop turned out very well. I have made about 2½ cwt. (27 kg) enough to supply our hospitals for the year."

Cacao: From the report of the Society for the year 1843, it is found that cacao plants were received from the Straits. These grew very well in the Society's garden and a few plants were sent to Chittagong. Cacao of superior description was also obtained from the West Indies in 1844 through the kindness of Professor Royle.

Fruits: In 1841, Dr Falconer of Saharanpur acknowledged the receipt of grafts of the following varieties of fruit-trees from the Society in very good condition. Early Admirable and Montaboa peaches; Red Roman nectarine; Brussels, Turkey and Orange apricot; Francis Pipin, Hawthornden, Ribston Pipin and Josephine apple and black currant. In 1850, the Society received a consignment of fruit-plants from the U.S.A., consisting of red currant, white currant, apple, gooseberry, cherries, peaches, pears and plums. These were sent to the Saharanpur Botanical Gardens, Shahphore, and Oondu Tirhot. Grapefruit from Florida, pomelos from Java and seedless litchi from China have been lately introduced by the Society. Mangosteen plants brought from Malacca fruited in the Society's garden.

Vegetables: The Society popularized the cultivation of English vegetables like cauliflower, cabbage, peas, etc. by importing improved and new types of vegetables from Europe and the Cape of Good Hope and distributing these to the Branch Societies and individual growers. A consignment of vegetable seeds from the Cape of Good Hope in 1824 contained prickly spinach, artichoke, asparagus, lettuce, sugar loaf, parsnip, cabbage, early cauliflower, squash, vegetable marrow, Brussels sprouts, celery, white beet and garden-cress in addition to the common English vegetables.

In 1842, J.P. Grant placed at the disposal of the Society a sum of Rs 264 with a view to improving the cultivation of celery. Sir Lawrence Peel granted Rs 400 annually to take up experiments on the manuring of vegetables.

John Elliot at Kanpur in 1844 grew vegetables from seeds collected from the Society and sent the following report: "Must now give you a slight account of my success with last year's seeds received from you and most happy am I to be able to say that success in this instance has been the rule and failure the exception." In 1827, the Society bought seeds of vegetables and flowers from the Cape of Good Hope worth Rs 8,137.

Leek, marjoram, thyme, endive, sage, etc. were also introduced into India by the Society.

Ornamental plants: The Society introduced a large number of ornamental plants which are now being grown in the gardens of India.

Improved Implements

The Society also gave attention to improvement of implements. Mouldboard ploughs and cultivators imported from America were found to be of great help for cotton and sugarcane cultivation in India. Hall, the indigo planter of Gorakhpore, wrote to the Secretary after using the American plough: "The plough you were so good as to give me is very admirably adapted for general use here. I wish I had a couple of hundreds of them."

For invention of an improved and efficient cotton cleaning machine, the Government of India granted a sum of Rs 5,000 to the Society in 1849. Mather was awarded Rs 500 and a gold medal for improving the *charkha*. Awards were given for making more efficient wind mill, cotton cleaning and silk winding machine and better devices for irrigation and butter making.

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CHAPTER 11

LORD WILLIAM BENTINCK

1828-1835

OPENING OF THE EASTERN JAMUNA CANAL 1830
HELP TO THE CULTIVATORS—REGULATION IX OF 1833
CONSTRUCTION OF THE GRAND TRUNK ROAD
ENGLISH AS THE MEDIUM OF EDUCATION AND ADMINISTRATION
SILK INDUSTRY IN BENGAL

LORD William Bentinck (1774-1839), a liberal, was greatly influenced by the social reform movement in England, led by Jeremy Bentham (1748-1832). Bentham's cardinal principle was 'the greatest good for the greatest number'. He suggested the establishment of a public-health system, encouraged public education, and was in the forefront of every movement for social progress in England. In Bentinck, he had a disciple who got an opportunity of applying the teachings of his *guru* on a vast scale. Europe had made great progress under the impact of science and technology, as he had himself seen while in India and China, 'the human mind had been buried for ages in universal darkness'. From among the British rulers of India, he was the most enlightened, and his seven years' term as Governor-General was a memorable period of improvement in education and social reform, which had a far-reaching effect on the country.

Bentinck became an army officer in 1791 and was appointed Governor of Madras in India in 1803. A mutiny by the Indian troops at Vellore in 1806 caused his recall, and he was sent to Spain and Sicily during the Napoleonic Wars. On his own initiative, he deposed the King of Sicily. He was recalled for the second time in 1815. He was later elected to Parliament.

In England, he worked for fifteen years in Fenland, improved the drainage and reclaimed land from the Wash. In 1809, he invested heavily in agricultural enterprise in the marshland district of Norfolk. 'He built a new great sluice at heavy expense; he bought a threshing mill; he set about building cottages and stables as well as—with the aim of exploiting the increasing sea-borne trade—a jetty on the west bank of the Ouse at North Lynn. But his biggest venture was the oil-mill he set up at North Lynn in 1818 for the commercial manufacture of cattle-cake and oil—a long-standing local industry, which in the 18th century worked by milling eastern linseed in wind-driven 'stamper' mills.

'His steward reported in 1820: the sea had overrun some 350 acres (141.64 ha). Bentinck, however, went on pursuing scientific improvement. What evidence there is of his farming practice suggests that he at least kept up with contemporary Marshland ideas about crop rotations. He urged his friends elsewhere to drain and irrigate, continually noted in his travels local practices of clay-burning, Swedish turnip cultivation, or the feeding of cattle on cake; he inspected new kinds of agricultural implements; he had forms printed for his farms to show in detail—rather as on an Army return—the weekly state of labour, tasks performed, numbers of cattle, cereal crops disposed of or brought, and receipts and expenditure.'[1]

His agricultural enterprise was not a financial success. Improvements and inventions in agriculture are costly. Besides, he was too liberal and kind to farm profitably. When the offer of Governor-Generalship came in 1827, he accepted it gladly.

Opening of Eastern Jamuna Canal, 1830

A great irrigation work for which credit is due to Bentinck is the Eastern Jamuna Canal opened for irrigation in 1830. This canal is said to have been originally designed by Ali Mardan Khan in the days of Shahjahan, though more probably its construction was not effected till the reign of Muhammad Shah. The alignment was faulty, and no great stream of water could have been carried down the channel for any lengthened period; and it is certain that the works were abandoned in the time of Ahmad Shah. It is said that Zabita Khan reopened the canal and brought water as far as Ghausgarh in Muzaffarnagar; and one story relates that in this way much damage was done to the towns of Behat and Saharanpur. In 1809, Lieutenant James Tod was deputed to survey the Canal, and this task was completed in the following year. Nothing was done, however, and a fresh examination by Major J.A. Hodgson in 1814 showed that the channel was obliterated in many places and elsewhere was covered with jungle. A third survey was ordered in 1822, and the next year Captain Robert Smith was appointed to superintend the work of reconstruction, which was estimated to cost Rs 203,633. Excavation was then commenced, and in 1829, Captain Proby Cautley, who had been engaged on the Canal for four years, took over charge. The work was opened on 3 January 1830, the expenditure up to that date being Rs 437,966. The completed work, 155 miles (250 km) in length, has been described with a legitimate pride by Colonel Baird Smith in the pages of an Indian Review:

"Most beautiful in all parts it truly is, with its broad road, smooth as an English lawn, its double rows of trees drooping over the stream, its long graceful sweeps, its rich bordering of the most luxuriant crops, its neat station houses, and the peculiar care with which all its works are maintained. It is certainly one of the most interesting and attractive of Indian sights."[2]

[1]Rosselli, J. *Lord William Bentinck—The Making of a Liberal Imperialist* 1774-1839, pp.92,93
[2]Dutt, R. C. *The Economic History of India*, Vol. II, p. 121

When first constructed, irrigation was effected directly from the Canal, water being supplied to the village water courses through openings in the bank. This led to much waste, and the area commanded was small. An attempt at extension was made by utilizing the natural drainage lines, across which earthen dams were thrown, but the channels quickly silted up and it became necessary to excavate regular distributaries. These were made by Colonel Cautley at the cost of the *zamindars*, who contributed nearly four lakhs for the purpose. The system, however, proved unsatisfactory both on account of unequal distribution and because the shareholders objected to the charges for maintenance and repairs levied, not in proportion to the area irrigated but according to the number of shares held by each owner.[3]

The Eastern Jamuna Canal runs throughout its length almost parallel to, but a few miles distant from the river. The area irrigated by the canal in the year 1960-61 was 478,000 acres (193,440 hectares). Financially, the canal started bringing in handsome returns on the invested capital, practically from the very beginning, and this fact encouraged the administration to undertake bigger irrigation projects elsewhere.

The Cultivator and Regulation IX of 1833

After fifteen years' work on agricultural improvement in England, Bentinck looked upon India as a great estate, of which he was the chief agent whose job was to improve the condition of tenants, by bringing into play, by judicious management and encouragement, all the resources which its soil and circumstances abundantly offer. He compared himelf to the man who had brought to the remote Scottish county of Sutherland 'noble improvements': 'India, more backward than Scotland two hundred years ago, can only be brought forward by the same means.'

Bentinck's achievement in 1830-33 was threefold. He settled long-standing the theoretical questions concerning the village community, the rights of landholders, the nature and extent of the Government revenue demand, and the positions of *raiyats*. He worked out a practical programme for recording rights and estimating revenue. He called into the task the assistance of Indian deputy collectors and a professional survey.

Bentinck shared Munro's admiration for bold, sturdy and independent cultivators in preference to *zamindars*. 'The husbandman in India is the most industrious, parsimonious creature in the world; a stranger to vice, thinking of nothing but cultivating his field, maintaining his family, and paying the sarkar rent (Government revenue)', he observed. The *raiyat* (peasant) is the man who feels, as it were, married to his field. What an effect the sense of a property in the soil would have upon him...! We talk

[3]Nevill, H.R. *Saharanpur Gazetteer*, Vol. II, p. 61, Allahabad, 1909

a great deal about the happiness of the people; how can we increase the happiness of the bulk of the people so much as by making their possession, (a) proprietary right, and giving them all the advantages of property and permanency?'[4]

Bentinck had a feeling that the cultivator was over-assessed and suffered great hardship....' We rode the country too hard', Bentinck declared, 'through over-assessment and arbitrary methods of collection: hence 'the most lamentable poverty'. Yet it was from the *raiyats* or peasants that the British drew 120 lakhs of pagodas a year (some £4.8 m). 'They are the wealth of the State. They are the most obedient subjects in the world, and they cannot be too much protected and encouraged....Our error has always been the killing the hen for her gold. Raiyatwari, on the other hand, would be the great bulwark of the rights of the lower orders of the people....'

'To Bentinck belongs the credit of reducing the excessive assessment, and of introducing long-term settlements. He held a Conference at Allahabad in 1833, and the result was the passing of Regulation IX, of 1833, the basis of land Settlements in Northern India. The State-demand was reduced to 66 per cent of the rental, and Settlements were made for thirty years.'[5]

Financial and Judicial Reform

Bentinck was a man of peace and a man of economy. He saved £1½ million by economies in civil and military services. He abolished the double *batta* in the Bengal army. *Batta* was an allowance to troops on active service. Under the new rule only half *batta* was allowed in the case of troops stationed within 400 miles (643.74 km) of Calcutta. This reform earned him the title of the 'Clipping Dutchman'.

In the judicial department, he abolished the provincial courts of appeal and circuit in which huge arrears of cases had accumulated. Indian judges were given more powers and higher salaries. As they were familiar with local conditions, the people and their language, there was more expeditious disposal of cases and appeals.

Discovery of Tea Plant in Assam and its Cultivation

'One of Wallich's most interesting expeditions was his visit to Assam in 1835 to study the tea plant *(Camellia sinensis)* and to discover the soil and climate in which it flourished', states Mildred Archer. 'At this time there was an anxious interest in tea, for the East India Company's monopoly of the tea trade with China was coming to an end. The Board

[4]Roselli, J. *Lord William Bentinck—the Making of a Liberal Imperialist*, p. 238
[5]Dutt, R. C. *The Economic History of India*, Vol. II, p. 22

of Directors wished to grow tea in India, and Bentinck, the Governor-General, established a 'Tea Committee' to investigate the possibility. In 1834, Gordon, Secretary of the Committee, was despatched to China for seeds, but in the same year a circular was sent to all East India Company officials, asking them for information about the tea plant in India. As a result, Captain Charlton reported that he had seen tea growing wild in Assam and he supplied the fruiting material. It was then remembered that as early as 1826, David Scott had sent leaves to James Kyd at Calcutta from which he said, the Assam villagers made tea. But with only leaves to go by, Wallich had been sceptical and had catalogued them as *Camellia* (?) *Scottiana* Wall.' It also appears that the Bruce Brothers in Assam had known about the tea plant between 1824 and 1826. As soon, however, as Charlton's specimens had been identified, a commission was sent to Assam to investigate. It consisted of Wallich, C.A. Bruce, Dr William Griffith and Dr John McClelland. Griffith had entered the Company's medical service in Madras in 1832 and was at Tenasserim when summoned to join the expedition. He had already made a name as a botanist. McClelland had come to Bengal as an Assistant Surgeon in 1830, and soon became well known for his keen interest in natural history, especially geology.'[6]

'In 1835, Lord William Bentinck brought to the notice of the Court of Directors that the tea plant was indigenous to Assam, and could be grown elsewhere in India; and the Court gave its sanction to an experimental establishment in Assam for the cultivation and manufacture of tea. Ninety-five chests of Assam tea—about 4,000 lb (1814 kg)—had recently arrived in London, and had been pronounced good; and applications from many persons, who had formed themselves into a company, had been referred by the Court of Directors to the Indian Government. The growing of tea in Assam by private enterprise and capital thus dates from about 1840.'[7]

CONSTRUCTION OF GRAND TRUNK ROAD, 1831

Bentinck realized the value of good roads as the key to economic development. The first road project which attracted this attention was the construction of the Grand Trunk Road from Calcutta to Delhi. 'The Grand Trunk, still one of the most notable roads anywhere, was much more clearly Bentinck's work,' states Rosselli. 'At his coming there was a bad stretch from Calcutta to Benares via Bankura—without ditches or bridges, much of it readily flooded—and a good stretch from Benares to Allahabad. Bentinck had the first stretch rerouted via Burdwan, along higher ground; in 1831, he made a start on the Allahabad-Delhi stretch through the great

[6]Mildred Archer, *Natural History Drawings in the India Office Library*, pp. 24, 25
[7]Dutt, R. C. *The Economic History of India* (Vol. II) *in the Victorian Age*, 1837-1900, p. 73

northern plain. The result by the 1850s was 'a first rate embanked, thoroughly drained, and well-metalled road, 837 miles (1,347.02 km) in length, and probably not surpassed in any part of the world....' It was everywhere 1 ft 6 in. (0.4572 m)above the highest flood level; at Bentinck's instance, trees were planted 60 ft (18.29 m) apart. Away from the Grand Trunk Road, his 1 per cent revenue levy was said to have been paid in Azamgarh district by 1851 for 638 miles (1,026.76 km) of road made, repaired, or bridged, in Bareilly for 77 bridges and 372 miles (598.68 km) planting in five years. The modern traveller who drives across the Gangetic Plain in the shade of great trees has something to thank Bentinck for.'[8]

English as the Medium of Instruction, 1835

The greatest contribution which Bentinck made to education in India was by his language policy which made English the medium of education and administration. In this task, he was assisted by his Law Member, Lord Macaulay. As Macaulay noted in his Minute on Education, 1835, 'the Indians themselves were demanding to be taught English and to be given a key to western knowledge'. He had also noted the aptitude of Indians, particularly Bengalis, for learning English. 'It is unusual to find, even in the literary circles of the Continent, any foreigner who can express himself in English with so much facility and correctness as we find in many Hindoos,' observed Macaulay.

Explaining the merits of the English language, Macaulay stated, 'The claims of our own language it is hardly necessary to recapitulate. It stands pre-eminent even among the languages of the West. It abounds with works of imagination not inferior to the noblest which Greece has bequeathed to us; with models of every species of eloquence; with historical compositions, which, considered merely as narratives, have seldom been surpassed, and which, considered as vehicles of ethical and political instruction, have never been equalled; with just and lively representations of human life and human nature; with the most profound speculations on metaphysics, morals, government, jurisprudence, and trade; with full and correct information respecting every experimental science which tends to preserve the health, to increase the comfort, or to expand the intellect of man.'

Raja Ram Mohan Roy, expressing the demand of Indians for education in English in preference to Sanskrit, exhorted the Governor-General to encourage instruction in scientific subjects. In his historic petition to the Governor-General, Raja Ram Mohan Roy emphasized as follows:

'The establishment of a new Sanskrit School in Calcutta evidences

[8]Rosselli, J. *Lord William Bentinck—The Making of a Liberal Imperialist* 1774-1839, p. 284

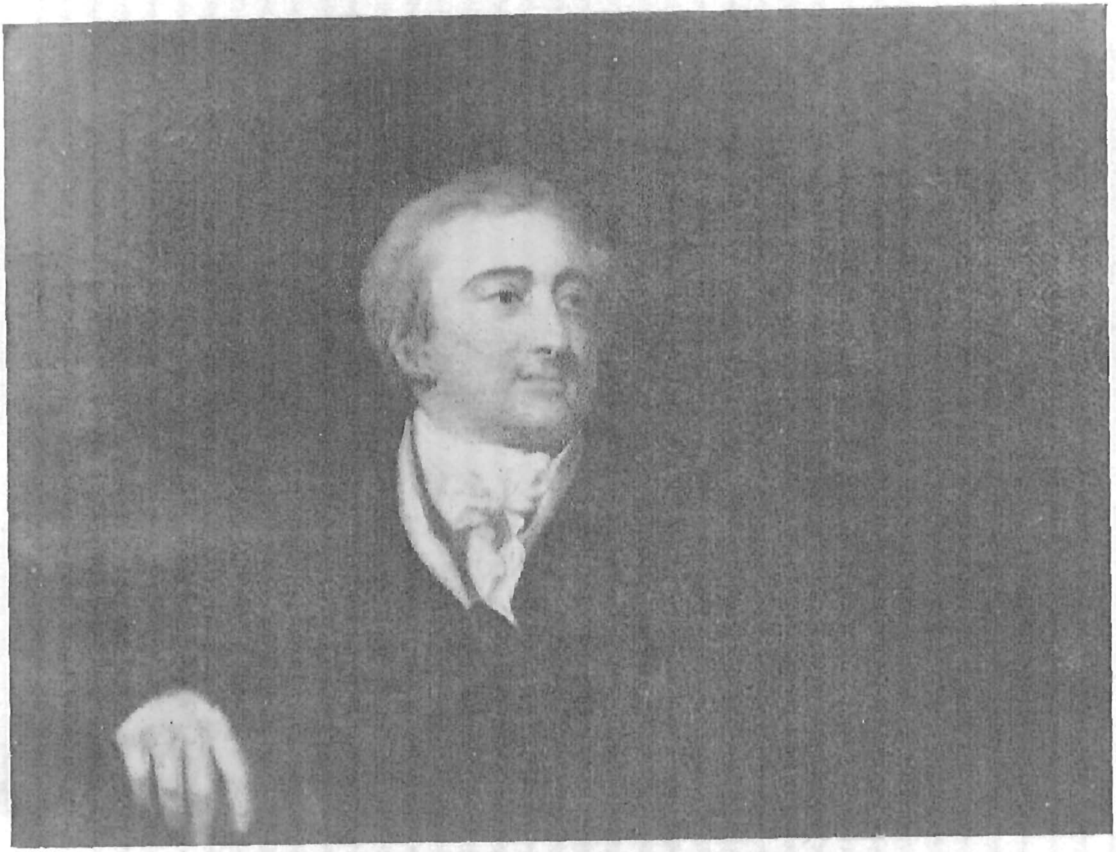

FIG. 12. Lord William Bentinck, Governor-General of India, 1828-1835. He made English the medium of education and thus made available to the Indian people treasures of Western science. He also opened the Western Jamuna Canal and constructed the Grand Trunk Road
(Courtesy: Victoria Memorial, Calcutta)

Fig. 13. Lord Macaulay, the Law Member of the Governor-General's Council, 1835. His minute on the education policy making English the medium of instruction in higher studies and the promotion of Western learning and science is a landmark in Indian history
(Courtesy: Victoria Memorial, Calcutta)

Fig. 14. Raja Ram Mohan Roy, Father of the Indian Renaissance. He supported Lord William Bentinck's policy to make English the medium of instruction and as a channel for acquiring knowledge of Western science
(Courtesy: Victoria Memorial, Calcutta)

the laudable desire of government to improve the natives of India by education—blessing for which they must ever be grateful.'

'When this seminary of learning was proposed, we understood that the government in England had ordered a considerable sum of money to be annually devoted to the instruction of its Indian subjects. We were filled with sanguine hopes that this sum would be laid out in employing European gentlemen of talents and education to instruct the natives of India in mathematics, natural philosophy, chemistry, anatomy and other useful sciences, which the nations of Europe have carried to a degree of perfection that has raised them above the inhabitants of other parts of the world.

'We find that the government are establishing a Sanskrit School under Hindu Pandits, to impart such knowledge as is already current in India. . . . This seminary (similar in character to those which existed in Europe before the time of Lord Bacon) can only load the minds of youth with grammatical niceties and metaphysical distinctions, of little or no practical use to the possessors or to society. The pupils will thereby acquire what was known two thousand years ago, with the addition of vain and empty subtleties since produced by speculative men, such as is already commonly taught in all parts of India.

'The Sanskrit language, so difficult that almost a lifetime is necessary for its acquisition, is well known to have been, for ages, a lamentable check on the diffusion of knowledge; and the learning, concealed under this almost impervious veil, is far from sufficient to reward the labour of acquiring it.'[9]

Emphasizing the inadequacy of Persian, Arabic and Sanskrit for the expression of the concepts of science, Macaulay observed, 'The question now before us is simply whether, when it is in our power to teach this language, we shall teach languages in which by universal confession there are no books on any subject which deserve to be compared to our own; whether, when we can teach European science, we shall teach systems which by universal confession whenever they differ from those of Europe differ for the worse; and whether, when we can patronise sound philosophy and true history, we shall countenance at the public expense medical doctrines which would disgrace an English farrier, astronomy which would move laughter in girls at an English Boarding School, history abounding with kings thirty feet (9.27m) high and reigns 30,000 years long, and geography made up of seas of treacle and seas of butter. . . . The languages of Western Europe civilized Russia. I cannot doubt that they will do for the Hindu what they have done for the Tartar. . . .'[10]

Macaulay finally clinched the issue as below:

[9]Sharp, H. *Selections from Educational Records* I, Calcutta, 1920, pp. 101-102

[10]Munshi, K. M. *The History and Culture of the Indian People—British Paramountcy and Indian Renaissance*, Part II, p. 84

'To sum up what I have said: I think it clear that we are free to employ our funds as we choose; that we ought to employ them in teaching what is best worth knowing; that English is better worth knowing than Sanskrit or Arabic; that the natives are desirous to be taught English, and are not desirous to be taught Sanskrit or Arabic; that neither as the languages of law, nor as the languages of religion, have the Sanskrit and Arabic any peculiar claim to our encouragement; that it is possible to make natives of this country thoroughly good English scholars, and that to this end our efforts ought to be directed.

'In one point I fully agree with the gentlemen to whose general views I am opposed. I feel, with them, that it is impossible for us, with our limited means, to attempt to educate the body of the people. We must at present do our best to form a class who may be interpreters between us and the millions whom we govern; a class of persons, Indian in blood and colour, but English in taste, in opinions, in morals, and in intellect. To that class we may leave it to refine the vernacular dialects of the country, to enrich those dialects with terms of science borrowed from the Western nomenclature, and to render them by degrees fit vehicles of conveying knowledge to the great mass of the population.'

Lord William Bentinck passed the famous Resolution of 7 March 1835, by which the English language was established as the language of superior education in India and also became the court language, replacing Persian. The Committee of Public Instruction was enlarged; Macaulay was appointed its President; Sir Edward Ryan, Hay Cameron, and other members were added; and three distinguished Indian gentlemen of the time, Radha Kant Deb, Rosomoy Dutt, and Nawab Tahawar Jung, were also enrolled as members.

English education opened the treasures of Western science to the Indians, which, in due course, led to progress in many directions. At the same time, it provided all Indians with a common language, which forged national unity and ultimately led to freedom.

Silk Industry in Bengal

In 1826, funds were set apart to carry out experiments in mulberry cultivation, rearing of silk-worms, and improvement of reeling; an experimental filature was started in Howrah in 1831. In 1830 about 12 lakh pounds (545 tonnes) of silk was exported from Bengal to England. In 1832, Italian mulberry plant and silkworms were imported in Bombay. The East India Company threw open the silk trade, and ceased to import silk in England directly on its own account. In 1845-46, pebrine epidemic in Europe considerably helped the Bengal Industry.

Lord William Bentinck left India in 1835. His seven years' rule was an era of peace, retrenchment, and reform. He secured tranquility in the

East India Company's dominions and lived at peace with the Indian Powers. He reduced the public debt, decreased the annual expenditure, and showed a surplus. He commenced the revised settlement of land revenue in northern India which gave relief to landlords and cultivators. He admitted the educated people of India to the higher appointments in the revenue and judicial departments. He abolished the practice of 'Sati' and suppressed the crime of thugs. He promoted English education in India, and endeavoured to carry out the maxim that the administration of India was primarily for the interests of the people.[11]

On his retirement, Bentinck continued to take interest in Indian problems. Being a man with conscience, he felt that for the people of India, the Raj was an infliction. He told a Committee of the House of Commons in 1837, 'British rule so far had been worse even than Muslim; 'cold, selfish, and unfeeling; the iron hand of power on the one side, monopoly and exclusion on the other.'

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[11]Dutt, R. C. *The Economic History of India* (Vol. II) *in the Victorian Age*, 1837-1900, New Delhi, 1976, p. 1

CHAPTER 12

MAHARAJA RANJIT SINGH, THE RULER OF THE PUNJAB
1780-1839

At the close of the eighteenth century, the Sikh social revolutionary movement threw up a remarkable leader, who won renown for his courage, wisdom, foresight and commonsense. Although illiterate like Akbar, he was a good judge of the qualities of men and chose his counsellors and subordinates with discrimination. Griffin observed, 'He possessed the faculty which is one of the highest attributes of genius, and for lack of which many brilliantly gifted men have suffered shipwreck—the faculty of choosing his subordinates well and wisely. He knew men, and he selected each servant for the special work which he could best perform, and consequently he was, even in a corrupt and violent age, wonderfully well served.'[1] Among his key men were Moslems, Sikhs, Khatris, Brahmins, Italians and French.

Ranjit Singh had a sharp and enquiring mind. Jacquemont, the French botanist, who met him at Lahore and stayed there as his guest, states in one of his letters, 'I have several times spent a couple of hours in conversing with Ranjeet "*de omni re scribili et quibusdam aliis*". His conversation is like a nightmare. He is almost the first inquisitive Indian I have seen; and his curiosity balances the apathy of the whole of his nation.'

Ranjit Singh came of a peasant family of Sikh Jats, and gave dignity to the profession of cultivation of land and soldiering. Rajputs who claimed superiority in the social hierarchy were humbled and regarded it as an honour to have marital relations with the Jat peasantry, whom he had ennobled. When his army was marching, he showed great concern for the safety of crops and restrained his troops severely from damaging them.

In person he was simple and unostentatious. 'The Maharaja has no throne', observed Hugel. "My sword", he observed, "procures me all the distinction I desire; I am quite indifferent to external pomp."[2] It was such a person who inherited Punjab from the Mughals.

Ranjit Singh was born at Gujaranwala on 2 November 1780. His father, Mahan Singh, was the Chief of the Sukerchakia *Misal*. His mother, Raj Kaur, was the daughter of the Raja of Jind. In 1799, he occupied Lahore and made it his capital. In 1802, he acquired Amritsar. In 1804-5, he conquered Jhang, Sahiwal and Multan. In 1809, he conquered Kangra. Later, he seized Faridkot and Ambala and

[1]Griffin, L. *Ranjit Singh*, p. 92

[2]Hugel, Baron C. *Travels in Kashmir and the Punjab*, p. 288

levied exactions on Malerkotla and Thanesar.

Confronted by the British power, which was based on the Industrial Revolution of England, Ranjit Singh modernized his army. He employed French and Italian officers, veterans of the Napoleonic wars, to train his army. He established an arsenal and laboratory for research in ballistics in the Gobindgarh Fort at Amritsar. The British, afraid of his military power, did not want him to occupy any territory in the area east of the Sutlej; and at the same time, they desired his friendship, so that his help be sought in case the apprehended invasion of Napoleon materialized. In 1808, Napoleon reached the zenith of his power, and stood forth as the undisputed master of Continental Europe. Spain, Italy, and Holland were his vassal States, and Austria and Prussia both lay crushed. Russia was recently bound by the fetters of the Peace of Tilsit. All the known circumstances seemed to justify the belief that he would now seek a new world to conquer in the Far East, and India was the obvious choice. The Sultan of Turkey was already his subservient ally; and, despite the exersions of Malcolm, the French influence had become predominant at the court of the Shah of Persia. General Gardane was sent by Napoleon to Teheran, with a brillant staff and a strong escort to prepare the way for a joint invasion of India by the Persian and French armies. It was rumoured that the Gomal Pass was selected as the route by which the invaders should descend from Afghanistan upon the plain of the Punjab.

On 25 April 1809, Ranjit Singh signed a formal treaty with the British at Amritsar, recognizing the Sutlej as the boundary between the two powers. No other choice was left for him, but to conquer territories to the north and north-west of the Punjab. In 1819, he annexed Derajat, and the Kashmir Valley. In 1834-35, Zorawar Singh Dogra, one of his generals, conquered Ladakh. India used to be invaded from Afghanistan and the North-West Frontier Province for centuries. Ranjit Singh turned the tide towards the north. This was a great event in Indian history.

Ranjit Singh died on 27 June 1839. He was a great statesman, an able administrator, a shrewd observer of men and events, a courageous leader of men and he was intensely humane and a wise and generous ruler, whose name is still a household word in the Punjab. Even now he is remembered with affection by the people of Punjab.

The Sikh State of the Punjab suffered from the weakness of basing a modern military machine on a purely agricultural economy. To maintain the army, the country was impoverished. After paying his soldiers, Ranjit Singh had no surplus left for the development of the country.

The Punjab's Countryside

What was the countryside of the Punjab like during the rule of Ranjit Singh? Osborne, who travelled through it to Adinanagar (now in Gurdaspur District), describes: 'The country between the Sutlej and Adinanagar is one continued flat and open plain, with here and there a grove of trees, and a few mud villages scattered over the surface. Every village, however, contemptible it may be in size and appearance, possesses a small round mud fort or turret in the centre, resembling an overgrown Martello tower, loop-holed for musketry, and the generality of them with a dry and shallow ditch, but without guns.

'The soil appears to be rich and prolific, as far as it is possible to judge from the small quantity of ground under cultivation; and with a more enlightened government, there can be little doubt of the Punjab becoming one of the richest provinces of India.'[3]

LAND REVENUE (*Malia*)

The main source of income of the Sikh State of Ranjit Singh was land revenue. Out of the total revenue of about Rs 25,000,000, 17,500,000 was contributed by the peasants. The bulk of the land was held by peasant-proprietors who cultivated their lands in whole or in part.

The Lahore Kingdom under Ranjit Singh did not have one uniform system of assessment. But in the earlier period and in the greater part of the State, *batai*, or crop-sharing, was the popular system. The cultivators liked it, for they had the satisfaction of not being cheated by rise or fall of prices, or the vagaries of weather. The revenue collectors, at the end of each harvest, would go to the cultivators and take the State share in kind. It was a cumbersome system, and so in the later period, Ranjit Singh adopted two other systems, *kankut* or appraisal and *ijaradari* or farming of revenue. Under the *kankut* system, the Government officials made an estimate of the gross produce while the crops were still standing in the field. Under the *ijaradari* system, the land under assessment was given on contract to the highest bidder for three to six years. The *ijaradar* was required to submit to the Government officials a detailed report of the produce and the money collected from the cultivators.

The unit for assessment was either a *bigha* or a plough. While estimating the standing crops or sharing the actual produce, the revenue officers first formed an idea of the yield of each crop per *bigha*, or per plough and, in that way, kept an eye on the dealings of the lower revenue officials with the cultivators.

Regarding the Government share in the produce of the land, the writers of the period have expressed divergent opinions. According to Lord Lawrence, the State took two-fifths from the peasants holding more productive land, but one-fourth or one-fifth from those having less productive holdings. Sir Lepel Griffin says that the Sikh ruler charged one-half of the

[3]Osborne, W.G. *Court and Camp of Runjeet Singh*, pp. 21, 22

gross produce from the land and, in addition, levied cesses.

Some of the historians are of the opinion that the Sikh Kingdom was divided into four provinces, viz. Lahore, Kashmir, Multan and Peshawar. Each province (*subah*) was under a *nazim*. There were seven major districts, and each district was under a *kardar* or collector. He was mainly a revenue official and his chief duty was to collect revenue and deposit it in the State Treasury. The Maharaja was very particular that the *kardars* should be efficient in the collection of revenue. The *kardars* also collected the duties and taxes which were imposed on various articles. The *kardar* also had judicial functions. For most offences, he imposed fines, as it was his great concern that his office should be paying. The *kardar* was also responsible for maintaining law and order in his locality, and he was required to carry out the royal decrees which concerned his locality.

The *patwari* maintained village records. Each *patwari* was in charge of a *tappa* which contained three to eight villages. The remuneration of the *patwari* was 1 to 2 per cent of the collection made from his jurisdiction.

Land revenue was collected twice a year. At the end of each harvest, i.e. in May and October, the revenue collectors, under the directions of *kardars*, approached the village officials—*muqadams* and *chaudhries*—to collect the land revenue in kind or in cash. It was the duty of the *kardar* of the area to see that all the revenue was collected at the proper time and was remitted to the State Treasury.[4]

Land revenue was remitted and relief was provided when there was a famine. To encourage reclamation of waste-lands lenient rates of assessment were imposed. *Takavi* loans were given, inundation canals and wells were dug, stud bulls were provided, *sarais* were built for travellers, and *harkaras* on horseback were provided for carrying mail.

Village disputes were settled by the *panchayats*. If any of the parties felt dissatisfied with the decision of the *panchayat*, appeal lay with the *kardar*. Forcible possession of any one's land was not permitted, nor was the demolition of houses.

The income from the land tax for all the four *subas* amounted to Rs 17,557,741, which accrued as follows: Lahore, Rs 11,494,221; Multan, Rs 2,726,300; Kashmir, Rs 2,115,590; and Peshawar, Rs 1,221, 630.

Though the assessment of land revenue was heavy, the village economy benefited in another manner. A large number of Jats were recruited in the army, and they sent their savings to their homes.

A remarkable fact was that as the money economy had not developed, indebtedness among the farmers was minimal. Thorburn comments, 'Selfish and short-sighted though the Sikh system was, still it had some virtues, which our's lacks. There being little money in circulation, most

[4]Narang, K. S. and Gupta, Hari Ram. *History of the Punjab*—1469-1857, p. 328

payments, including land-revenue, were made in kind. The revenue demand, therefore, corresponded with each season's yield. Self-interest limiting rapacity, the cultivator was always left a sufficiency of grain whereon to maintain himself and family until the next harvest. There being neither credit, nor money, nor civil courts, serious indebtedness was impossible. If advances of grain were made, the debt was repaid at harvest time, whenever there happened to be a good crop.[5]

Sawan Mal, the Governor of Multan

No account of the Sikh revenue administration can be regarded as complete without mentioning Sawan Mal, an administrator who was keenly interested in agricultural improvements. Thorburn states, 'In the south-west of the province, with headquarters at Multan, a Hindu named Sawan Mal, administered his charge from 1829 to 1844 with such rigour and justice that his name is still remembered with respect over an area as large as Scotland. He made life and property secure, caused canals to be cut, and was so successful in creating confidence, that he induced men to sink wells on long leases. In his time some hundreds of wells were sunk.' It is said that he showed so much concern for the farmers that he imprisoned his son for damaging the crop of a farmer.

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CHAPTER 13

MAJOR PROBY T. CAUTLEY CONSTRUCTS THE GANGA CANAL

1836-1854

UNDER the early British rule, all irrigation works, like other public works and the railways, were the responsibility of the military engineers of the three Engineers Corps of the Armies of the East India Company, working under the control of the Military Board, and subsequently of the Corps of Royal Engineers. Thus it was the military engineers who laid the foundation of modern irrigation in India. In the words of Colonel Sandes:

"It is not too much to say that the irrigation of northern India, as well as of southern India, is one of the greatest humanitarian works ever performed; and the men who initiated it, who evolved its elementary principles, who faced its early failures, who extended it between war and war, and who handed over to their civilian successors a system which these have elaborated to its present perfection, were the military engineers of India."[1] One of these distinguished engineers was Major Proby T. Cautley, of the Bengal Artillery. He constructed the Ganga Canal.

The history of the Ganga Canal belongs to the last years of the Company's rule. The great work was commenced by Lord Auckland when he had to deal with the famine which ravaged northern India in 1837-1838. In this famine, about 800,000 people died. His successor, Lord Ellenborough, however, suspended the work on the Ganga Canal.

In December 1839, Cautley undertook a close examination of the country near Hardwar. His first idea was to connect the Banganga with the west Kali Nadi from Badshahpur to Ranipur, but this again was shown to be quite impracticable. He then boldly proposed to adopt a direct line from Hardwar to Roorkee, even though this involved an aqueduct over the Solani. His original estimate was for a canal 256 miles (412 km) in length, with 73 miles (117 km) of subsidiary branches, to be constructed at a cost of 2.6 million lakhs of rupees. This project was sanctioned in 1841 by Lord Hardinge.

The court of Directors, encouraged by the financial results of the East and West Jamuna Canals, consented to the expenditure of over a million pound sterling over this great enterprise.

In 1842, operations were commenced between Kankhal and Hardwar, and though stopped for a time on account of various doubts that had arisen

[1]Sandes, E.W.C. Lieutenant-Colonel, *The Military Engineers in India*, Vol. II, The Institution of Royal Engineers, Chatham, 1935

with respect to the results of the canal, they were resumed shortly after, permission being given to spend 200,000 of rupees annually. Subsequently, it was resolved that the canal should primarily be a navigation channel, and this decision necessitated revised projects. This policy was reversed in 1847, and consequently it was determined to push on with the Solani aqueduct and other masonry works essential to the scheme in either case. The undertaking was carried out with great rapidity, and the canal was opened on 8 April 1854. At that time, the aqueduct was still imperfect, since the right embankment was incapable of retaining a full supply. The canal was accordingly closed and the defects were remedied, the task being completed on 6 November in the same year. In 1855, further work on the aqueduct proved necessary; but the difficulties to be overcome were slight, and from 1 May 1854, irrigation commenced in the upper sections. The system of distributaries was still very incomplete; nevertheless, irrigation steadily developed.

The rule of the East India Company terminated in November 1858 before the work was completed; but what was done in their time is thus described in their Memorandum:

"The total length of the Ganga Canal and its branches, when completed, will be 898½ miles (1,446 km), and it will furnish abundant irrigation for an area of 4½ million acres (1,821,087 ha). The canal, in the words of the Lieutenant-Governor of the North-Western Provinces, 'presents a system of irrigation unequalled in vastness throughout the world; while the dimensions of the main channel, and the stupendous works of masonry which occur in its course, more particularly in the section between Roorkee and Hardwar, render the work eminently one of national distinction and honour.' The amount expended on it up to the 1st May 1856 had reached the sum of £1,560,000; and, when completed, the total cost will fall little short of two million sterling. The canal has but just begun to be brought into operation; but it is estimated by Colonel Baird Smith, the Director, that the annual produce of the land already watered by it is of the value of from £150.000 to £200,000, and that when the canal is in full operation the value will ultimately reach the enormous sum of seven million sterling. From the 30th April 1856 the canal had been carried so far that the water flowed continuously through 449½ miles (723.40 km) of the main trunk and terminal branches."[2]

In 1862, the full supply of 6,750 cusecs (191.21 cumecs) was admitted, and this brought to light certain defects, the chief being the excessive gradient which caused much erosion of the bed and sides of the canal. At the end of 1863, a committee of experts went into the matter, and it was resolved to improve the slope by the construction of additional falls and at the same time to carry out other works connected with navigation and the regulation of the

[2]Dutt, R. C. *The Economic History of India*, Vol. II, pp. 121, 122

flow at a total cost of Rs 3,663,411. Meanwhile, the whole project came in for much criticism, and a second committee was appointed in 1866; but it was found that most of the objections raised were without foundation, and Captain Crofton's original scheme of improvements was adopted with a few modifications. At the same time, the project of the lower Ganga Canal was mooted and sanctioned, that work having begun in 1872. When the Lower Ganga Canal was opened in 1878, the original Ganga Canal was designated the Upper Ganga Canal. For the existing canal a revised completion estimate was found necessary, and the expenditure of Rs 9,406,664 was sanctioned in 1881. The remodelling of the canal was spread over a considerable period, and terminated in 1894. A large proportion of the sum was devoted to works in Saharanpur District, notably the construction of the Deoband branch and the improvement of the headworks at Mayapur. The dam at that place was raised so as to give 20-foot (6-m) openings with strong iron gates worked by powerful winches; a dam with falling shutters was erected in place of the temporary crib bund across the Hardwar spill channel; and several masonry bars were built across the river near Bhimgoda so as to facilitate the construction of the temporary dams made for the purpose of directing the river into the canal. In the main channel, the falls were strengthened with masonry and their number increased, this also necessitating the construction of additional locks. A large amount was spent on strengthening the Solani aqueduct and the embankments above it, while the distributaries were in most cases realigned and their scope extended.

Main Canal

The Ganga at Hardwar is about a mile (1.61 km) in breadth and is divided into separate channels by several islands. One of these channels leaves the main stream some two miles (3.22 km) above Hardwar and passes close to the town, carrying about one-third of the total volume. The canal is drawn off from this channel at Mayapur or Ganesh-ghat, the head being strengthened by a large spur dam. It thence takes an easterly direction, past Jwalapur, and at the fifth mile (8th kilometer) crosses the Ranipur torrent by a super-passage with a waterway of 200 feet (64.90 m), the navigation channel here being distinct from the canal and taking a separate line to the left. A similiar super-passage crosses the Pathri Rau at the 9th mile (14th kilometre); but three miles (4.83 km) farther on, at Dhanauri, the canal has to cross the much larger Ratmau Rau, which has a width of nearly a mile (1.61 km). This is negotiated by means of a dam with masonry sluices on the left for an escape and an open branch for admitting the flood water on the right. From Dhanauri the canal flows in a straight line towards Roorkee, taking a south-westerly direction, and enters the high ground near Piran Kaliar, passing through a cutting with a mean depth of 31 feet (9.17 m).

At the 18th mile (29th kilometre) comes the Solani aqueduct, consisting of a waterway 150 feet (45.72 m) wide carried over the torrent on 15 arches with a span of 50 feet (14.24 km) each, the flooring being 24 feet (7.31 m) above the bed of the river. The masonry portion is altogether 932 feet (274.32 m) in length, whereas at each end there are earthen embankments carrying the canal at a considerable elevation above the valley, the total length of the work being 15,687 feet (4,781.39 m) or nearly three miles. The earthen portion is revetted throughout with masonry disposed in the form of continuous steps resting on arches, and the floor is lined with boulders. The height of the aqueduct enables the canal to enter the uplands at Roorkee with a moderate cutting, an object of great importance, since at this point, though 80 feet (24.38 m) below the head at Hardwar, the surface of the water is 70 feet (21.336 m) above that of the Ganga to the east. From Roorkee the canal bends to the south and maintains this direction past Manglaur to the borders of the Saharanpur District, its total length within the confines of Saharanpur being 30 miles (40.28 km). It was a great engineering feat, transporting water over first 20 miles (32.19 km).

Deoband Branch

At the 22nd mile (35th kilometre), a short distance above Manglaur, the Deoband branch leaves the canal on the right bank. This was originally the right main distributary, but a project for remodelling and extending it through this district and Muzaffarnagar was sanctioned in 1876, and most of the work was carried out during the famine of 1877-78, the undertaking being completed by 1881. It is now a considerable channel, with an initial discharge of 495 cusecs (14 cumecs), taking a south-westerly direction through the *parganas* of Manglaur and Nagal as far as the railway, where it bends southwards through Deoband, following the line of the watershed to the east of the Hindan. The total length in Saharanpur District is about 26 miles (41.84 km). The canal has to cross the Sila *nadi* (the west Kali) by aqueducts, and these proved somewhat difficult and costly operations, necessitating an expenditure of more than Rs 150,000. Numerous syphons, too, were constructed so as to admit of the passage of the cross-country drainage.'[3]

Construction of Headworks, 1913

The Ganga Canal takes off from the Ganga River at Hardwar where it emerges from the Himalayas. When constructed, the canal had no permanent headworks, and in winter water was forced into the canal by means of a temporary weir made of wooden crates filled with boulders. The weir, which was washed off during the floods, had to be put up every year. Later

[3]Nevill, G. R. *Saharanpur Gazetteer*, Vol. II, pp. 65, 66

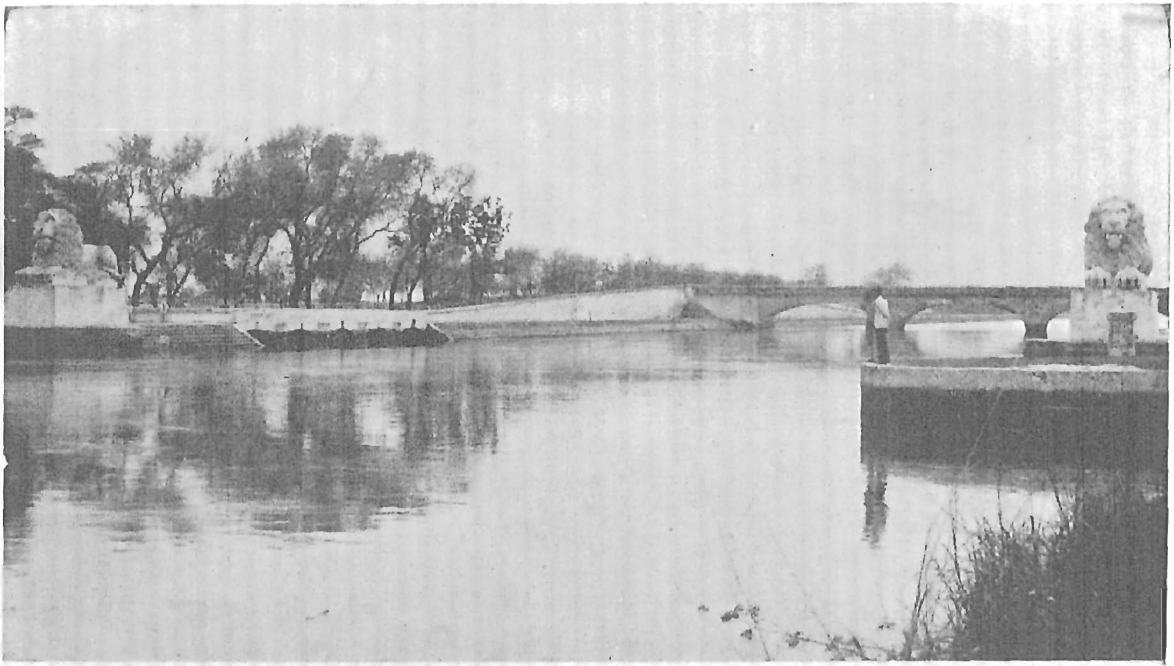

Fig. 15. The Ganga Canal at Roorkee
(Courtesy: Director, Public Relations, Uttar Pradesh Government, Lucknow)

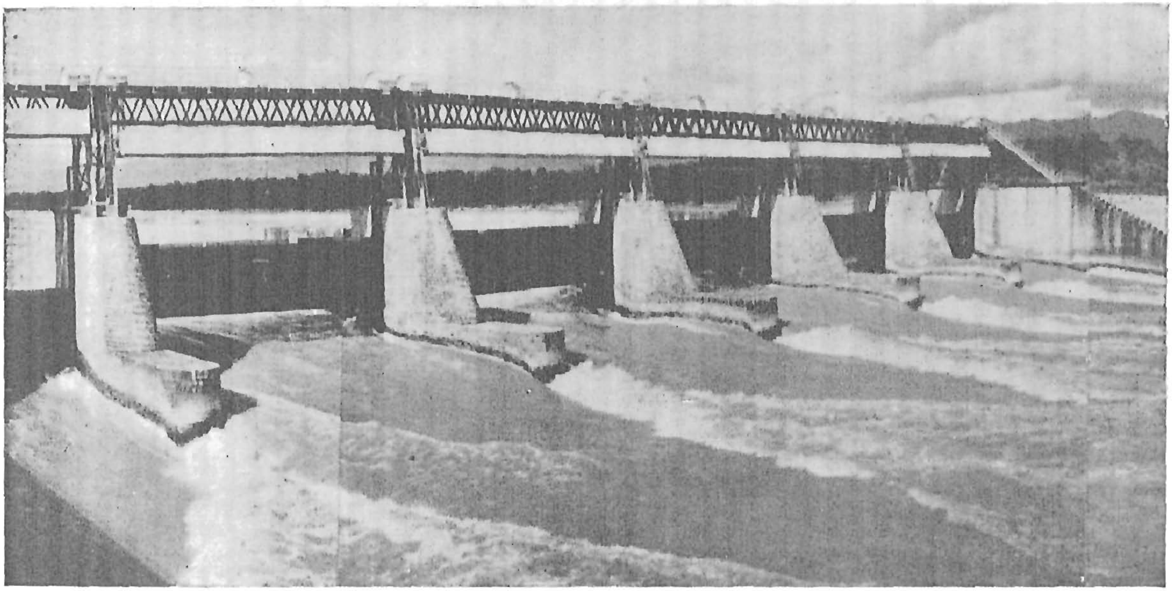

Fig. 16. The diversion of the Ganga Canal from the River Ganga at Hardwar
(Courtesy: Press Information Bureau)

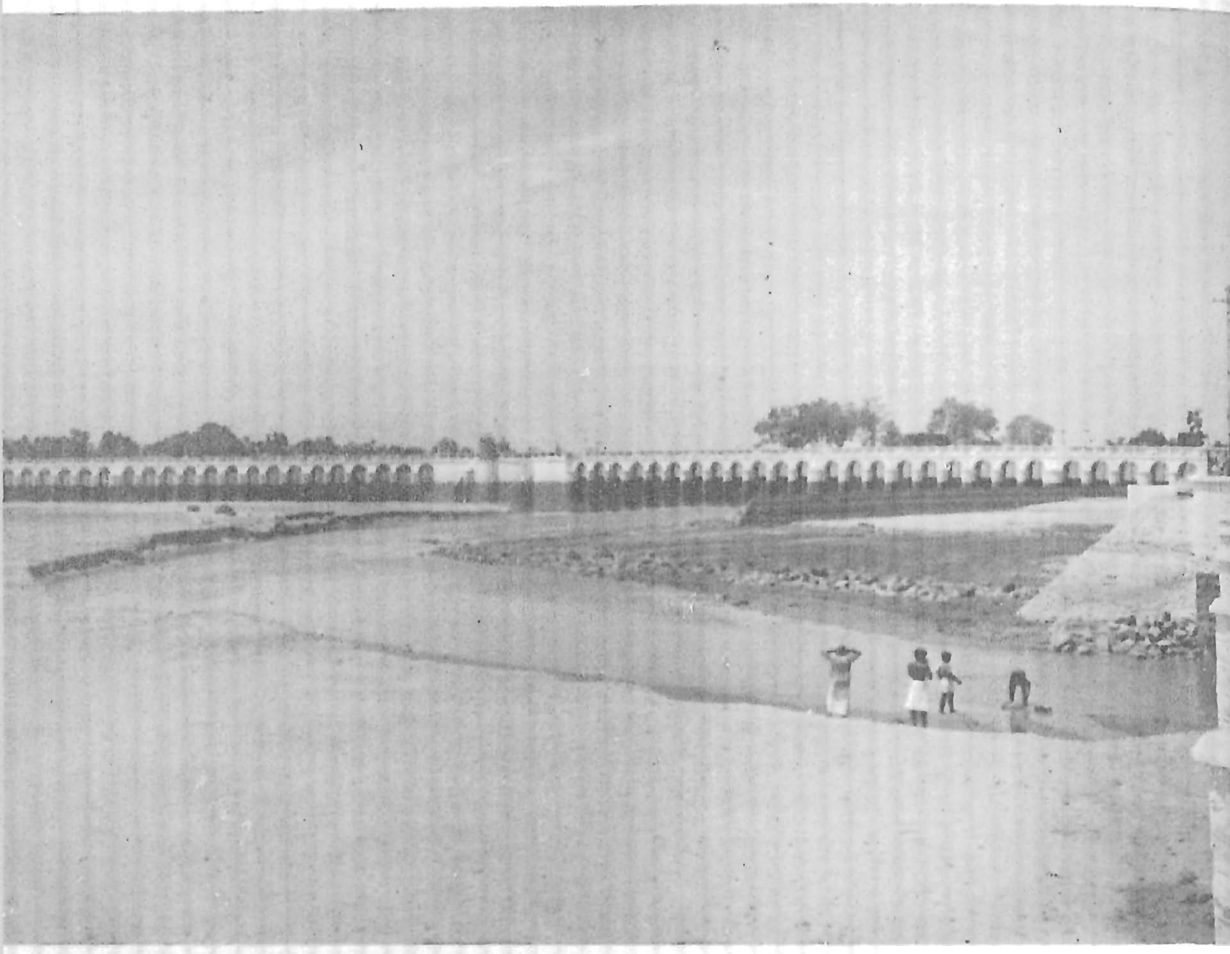

FIG. 17. Upper anicut (weir) on the Cauvery, constructed by Sir Arthur Cotton in 1836
(Courtesy : Press Information Bureau)

on, in 1897, a surplussing dam, known as the Hardwar Dam, was constructed to divert surplus water from the supply channel back into the river. It was designed for escaping up to 60,000 cusecs (1,699 cumecs). The construction of a permanent headworks was undertaken in 1913 and completed in 1920. It consists of a weir 1,800 feet (548.6 m) long, fitted with 6-foot (1.8-m)-high falling shutters, 6 undersluices of 50-ft (15.2-m) span each and a head bridge without gates of 10 spans of 20 ft (6.1 m) each. A training embankment faced with boulders extends for some 3 miles (4.8 km) along the right bank of the river, above and below the headworks. The permanent headworks are situated nearly 2 miles (3.2 km) upstream of the old head-regulator of the canal, which still serves as its head-regulator. The permanent headworks divert the river supply into the old supply channel, whence the canal takes off (Fig. 15).

These arrangements were made in deference to the sentiments of the Hindus, who desired that the water flowing along the sacred bathing *ghats* on the old supply channel should be allowed to flow down freely, unfettered by mechanical obstacles and a head bridge without gates had perforce to be substituted for a conventional head-regulator.

These headworks were the first work in the United Province of Agra and Oudh, where labour-saving machinery was used on a large scale. This was made possible by the construction of a hydro-electric power-station on the main canal at Bahadarabad, 10 miles (16.1 km) from the site of the headworks, where a fall of 19 feet (5.8 m) was available and from where power was transmitted to the works.

Hydro-electric Power-stations

Hydro-electric power-stations were later introduced on the canal to utilize the energy available at several falls. These hydro-electric power-stations were linked by means of a power grid, known as the Ganga Grid. The grid is also fed by thermal power-stations at Chandausi and Harduaganj. The linking of the thermal stations with the hydro-electric system provides facilities for the closure of the canal, when necessary, for the examination of works, without seriously interrupting the power-supply.

The area irrigated by the canal in 1960-61 was 1,579,000 acres (639,002 hectares) and the project yields an annual return of nearly 22 per cent on the capital outlay.'[4]

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[4] *Development of Irrigation in India*, pp. 64-65

CHAPTER 14

SIR ARTHUR COTTON AND THE CAUVERY DELTA SCHEME

1836-1838

THE Cauvery is the most remarkable river of the Peninsula. It is 475 miles (765 km) long and drains about 28,000 square miles (72,520 km^2). A few miles above Tiruchirappalli, the river bifurcates around the sacred island, Srirangam, the northern (Coleroon) branch being the larger. From here on is deltaic country, mainly in Thanjavur District, the rice bowl of South India. From the Grand Anicut (weir) the river divides into several main canals, which themselves again subdivide into smaller channels until the water is spread across the delta in hundreds of distributaries, and ultimately flows down to the sea.

The first engineering problem in the Cauvery delta was to so divide the available water between the main river and the Coleroon as to adequately supply, without flooding, the irrigation channels in the delta. This was effected by five engineering works, the Upper Anicut, the '150 yards (137.16 km) calingula', the Cauvery-Vennar regulators and the Vadavagudi surplus.

THE GRAND ANICUT

Historically speaking, the first difficulty which seems to have occurred in the regulation of the flood-water between these two rivers was that much of the Cauvery water was carried off by the Ullar channel into the Coleroon, which runs in a lower bed. This difficulty was surmounted by the Chola kings by building the Grand Anicut, 'the bulwark of the fertility of the Thanjavur country' across the outlet into the Coleroon at this place. It formerly consisted of a solid mass of rough stone in clay 1,080 feet (329.10 m) in length, 40 to 60 feet (12.19 to 18.29 m) in breadth and 15 to 18 feet (4.57 to 5.49 m) in depth stretching across the outlet in a serpentine form. It was raised by the British engineers in 1806, and provided with sand scouring sluices in 1830.

UPPER COLEROON DAM (UPPER ANICUT)

Credit is due to Sir Arthur Cotton, a great engineer, whose name still commands respect in India, who first conceived the idea of building a weir (Fig. 17) known as the Upper Anicut (Upper Coleroon Dam). He commenced the construction of the Upper Coleroon Dam against much opposition. Born in 1803, he had come out to Madras in 1821. In 1832 he was given separate charge of the Cauvery Irrigation, which formed a part of the

Southern Division. It was thus that he became familiar with the problems of the Cauvery River and the moods of the Coleroon. Before his final retirement from India in 1860, he had won for himself a reputation higher than that of any other engineer who has ever worked in India. "The permanent prosperity of Tanjore," wrote Baird Smith, the great irrigation man of northern India, "is without doubt to be attributed in a large measure to that first bold step taken by Colonel Cotton in the construction of the Upper Coleroon Dam, under circumstances of great difficulty, with restricted means, against much opposition, and with heavy personal responsibilities."[1]

It was in the period 1836-1838 that Sir Arthur Cotton constructed across the head of the Coleroon the great work known as the Upper Anicut, which was designed to prevent too much water from flowing down that river and to adequately fill the Cauvery. The weir constructed was 2,562 ft (780.9 m) in length and from 5 to 7½ ft (1.5 to 2.3 m) in height resting on wells, with an apron in its rear, and with twenty-two sluices distributed throughout its length. This weir is located about 20 miles (32.2 km) upstream of the Grand Anicut. The sluices were meant to wash down deposits of silt upstream of the weir, in order to avoid the weir being masked by such deposits with consequent reduction of supplies into the Coleroon beyond the specified limit. The sluices proved inadequate and, in due course, the position was reversed and the Cauvery started drawing a major portion of the river supplies. Consequently, in 1843-45, it became necessary to increase the number of sluice-ways in the Upper Anicut, to lower its crest in a considerable portion of its length and to construct a masonry bar known as the Cauvery Dam across the head of the Cauvery to obviate a further regression in its levels. These measures proved successful and, with a few modifications, remained in operation till the end of the last century.

The cost of the work and its subsequent improvements up to 1844 amounted to Rs 170,000. It was a solid brick-and-cutstone dam with scouring sluices at intervals. It was soon found that too much water was forced down the Cauvery by this anicut and that the bed of that river was being deepened by the unusual floods. A dam was accordingly thrown across the Cauvery in 1845 to prevent the scouring of the bed, and the '150 yards (137.16 m) calingula' was constructed on the lower bank of that river to let out a portion of the surplus water into the Coleroon below the Upper Anicut. For many years however the general difficulty was to prevent the Cauvery receiving more water than it could carry, and the many serious floods that occurred in the delta in the latter half of the last century were chiefly due to this difficulty. Later the regulation of the supply between the two rivers

[1]Lady Hope, *General Sir Arthur Cotton, His Life and Work*, p. 52

was rearranged by the entire reconstruction (between 1890 and 1904) of the Upper Anicut itself at a cost of some 650,000 rupees. It now consists of a bridge across the Coleroon of 55 bays of 40 feet (12.19 m) span, each fitted with Colonel Smart's counterbalanced lift shutter. Each shutter weighs eight tonnes but is so geared that it can easily be raised by one man. The shutters, when down, hold up water to full-supply level in the Cauvery. All water in excess of this, except in the highest floods, is 'surplussed' down the Coleroon, which is now theoretically the safety-valve of the Cauvery, by raising the shutters to the required extent.

The danger of inundation was to some extent transferred to the Coleroon, to which the more recent inundations were generally due, and special attention was paid to that river. Millions of rupees were spent on raising and widening its 200 miles (321.87 km) of flood embankment, which involved the reconstruction of many of the large drainage inlets, while elaborate and costly training works were carried out to prevent erosion of the banks. A special charge was constituted for the conservancy of this capricious river.

Cauvery-Vennar Regulators

Assuming, however, that proper amount of water is admitted into the delta, there still remains the great problem of its distribution among the vast network of large and small channels which feed the irrigated land. The control of the supply among the main distributaries was effected by the important regulators built by the British Engineers. Immediately below the Grand Anicut the main river divides into the two principal branches of the Vennar and the Cauvery, forming thereby the head of the delta proper; and it is here that the most important of the controlling works, the Cauvery-Vennar regulators, were erected. Built originally in 1851, four miles (6.43 km) above the present head, they were reconstructed in 1886 at a cost of nearly 700,000 rupees. The first few miles of the old Vennar course was then blocked up and a new cut made to that river from the new head. The regulators are fitted with the ordinary screw-geared shutters. The Vennar-Vettar regulators which were built in 1876 cost over Rs 97,000; those at the Kodamurutti-Tirumalairajan head (1882), Rs 48,000, and the remodelling of the Cauvery-Kodamurutti dam (1902), Rs 110,000.'[2]

In 1852 Arthur Cotton became Chief Engineer of the Madras Presidency. In 1853 he was appointed advisor to the Government on Engineering subjects. He prepared a project of irrigation in Orissa, which was entrusted to the Madras Irrigation and Canal Company. He also proposed a dam across the Ganga at Rajmahal and a canal therefrom for irrigation, navigation and supply of water to Calcutta. He left for England in 1860. In 1862

[2]Hemingway, F.R. *Madras District Gazetteers, Tanjore*, pp. 105, 106

he was invited by the Government of India to report on a project for irrigation and navigation in the valley of the Sone River in Bihar.

An idea which obsessed him was to make the irrigation canals navigable by steamboats, which he regarded as cheaper than railways.

Provision for navigation locks at canal falls was made in the design of several canals. The more important of the irrigation canals which were provided with navigation facilities were the Godavari Delta and the Krishna Delta Canals in Andhra Pradesh, the Upper Ganga Canal in Uttar Pradesh, the Western Jamuna and the Sirhind Canal in the Punjab and Jamuna Canal in Haryana. The navigation aspect of these canals did not prove successful or remunerative and it was gradually relegated to the background, as a secondary and unimportant function of the canals, till it was almost entirely abandoned. It was realized through actual experience that, except for a few isolated cases, the combination of irrigation and navigation could not be successfully effected. The principal factors which militated against the use of irrigation canals for navigation were: the best alignment of a canal from the point of view of command of the area to be irrigated need not be suitable for the development of traffic, as the canal may not be located anywhere close to the centres of trade. The indigenous mode of transportation by means of bullock carts would, in most cases, be found cheaper than water transport, especially during the off-season when ploughing of land was not in progress. The maximum permissible velocity in a navigation channel is usually lower than the critical velocity of a canal, resulting in upsetting the regime of the canal. The wave action due to navigation craft has a deleterious action on the berms and inside slopes of a canal.

Consequently, in the later irrigation projects no provision was made for navigation works and the two functions of a waterway, viz. irrigation and navigation, were separated. Some purely navigation canals were, however, constructed in Bengal, Orissa and Madras, such as the Buckingham Canal in Madras, the Orissa Coast Canal and the Hajili Tidal Canal, the Calcutta and Eastern Canals and the Grand Trunk Canal in Bengal.[3]

It is, however, dangerous to have a one-track mind. Cotton regarded the construction of railways in India as a colossal waste. He did not realize that foodgrains could not be moved all over India by canals in the times of famine. Sir George Campbell, who had entered Parliament after retiring from his high office in Bengal, sneered at him, and 'thought there was some truth in the saying regarding him, that he had water on his brain'. But General Sir George Balfour spoke of the great irrigationist with esteem and admiration. Standing up before the House he said that he did not believe that a single work that Sir Arthur Cotton had executed had ever been a

[3]*Development of Irrigation in India*, p. 82

failure. 'Sir Arthur Cotton was a man of mighty genius; he was a man who had done much for the people; he had been a great benefactor to India; and his name would go down to posterity as one who had done great things for that country.'[4]

[4]Dutt, R. C. *The Economic History of India*, Vol. II, p. 265

CHAPTER 15

ARTHUR COTTON AND THE GODAVARI AND THE KRISHNA DELTA SCHEMES, ANDHRA PRADESH

1846-1855

THE River Godavari flows from west to east across the peninsula. It has a catchment area of about 115,000 square miles (297,849 km^2) and a high flood discharge of nearly 1,050,000 cusecs (42,475 cumecs). Towards the end of its course, it pierces the Eastern Ghats and flows into the plains between the ghats and the sea. At Dowleshwaram, the river attains a width of about 4 miles (6.4 km). Below this point, it divides into two branches, the Gautami Godavari being the eastern and the Vasiṣta Godavari being the western branch.

In the Godavari delta below Dowleshwaram, 'the country is a vast expanse of rice fields, dotted with gardens and villages. During the rains, the greater part of this tract becomes one sheet of water, only village sites, canal banks, roads and field boundaries appearing above it. Later in the year, as the rice grows higher, the dividing boundaries are hidden; and the whole country looks like a single rice field, the groves around the villages, the road avenues and the white sails of the boats gliding along the main canals, breaking the uniform sea of the waving green crop.

In the strictly delta districts of West Godavari and Krishna, the net sown area is over half the total area and double-cropping adds 20 to 40 per cent to it. In West Godavari, rice covers over 80 per cent of the net sown area, and everywhere it is by far the dominant crop. The second-ranking crop is usually either sorghum or sesamum, and groundnut is strong in East Godavari and Krishna districts. Tobacco covers at least 200,000 acres (80,900 ha), the best being grown on temporary sand-islands in the larger streams. Some sugarcane is grown, protected from cyclones by fencing with bamboos.[1]

In 1961, the West Godavari District was one of the seven districts selected for the Intensive Agriculture District Programme (I.A.D.P.), popularly known as the Package Programme. The yield of rice in this District increased by 33 per cent consequent upon the cultivation of high-yielding varieties of rice, reinforced with all the inputs. As a result of this effort, the West Godavari District became the bread-basket of Andhra Pradesh.

The foundation of all this prosperity was, however, laid in 1845, when

[1]Spate, O.H.K. and Learmonth, A.T.A. *India and Pakistan—A General and Regional Geography*, London, 1967, p. 736

Arthur Cotton took charge of the District as its engineer and prepared the scheme of anicut on the Godavari. 'The Godavary Anicut, is, perhaps, the noblest feat of engineering skill which has yet been accomplished in British India,' observed Morris. It is a gigantic barrier, thrown across the river from island to island, in order to arrest the unprofitable progress of its waters to the sea, and to spread them over the surface of the country on each side, thus irrigating copiously the land which had previously been dependent on tanks or on the fitful supply of water from the river. Large tracts of land that had hitherto been left as arid wastes were thus reached and fertilized by innumerable streams and channels.

The first idea of the scheme, however, originated with Mr Michael Topping, who, before the close of the 18th century, brought to the notice of the Government how desirable it would be to throw a dam across the Godavari, so as to raise the water, and thus make it available for irrigating the country near its banks.[2] This project was permitted to slumber for half a century; but, in 1844, it was revived under the following circumstances. About that time, the District had fallen into a state so far below even the then generally sad state of the northern districts that Sir Henry Montgomery was deputed as special Commissioner to take charge of the District and to report what could be done to raise it from its lamentable state of depression. That experienced officer came from Tanjore where he had seen the great results of irrigation. After he had put the revenue arrangements into better order, he strongly urged the examination of the delta by an experienced irrigation engineer, with a view to executing such a complete system of works for irrigation, flood control and navigation. On this report, Captain Arthur Cotton was ordered, in 1845, to take charge of the District as engineer, and to report professionally upon the matter. Upon his representation, the Governor of Madras, the late Marquis of Tweeddale, strongly recommended the project to the Court of Directors who sanctioned it. The models which Captain Cotton proposed to follow were the Anicuts across the Coleroon in the District of Tanjore, and his first suggestion was that a barrier of the same kind should be thrown across the River Godavari above the town of Rajahmundry; but, in a subsequent and fuller report, he stated that he had selected the present site, which was manifestly better and more suitable for his purpose.

In his first report, Captain Cotton drew attention to the neglected state of the District of Rajahmundry, and its lack of works of irrigation. In his second report, he entered more fully into detail, and thus describes the project.[3]

[2]*First Report of the Public Works Commission at Madras*, 1852, p. 100

[3]*Professional Papers of the Madras Engineers*, Vol. III. *Copies of Documents Relating to the Works of Irrigation on the Godavary River*, & c., Printed by order of the House of Commons, April 1853

'The magnificent river which was thus about to be utilized, after a course of several hundred miles across the Peninsula, enters at about sixty miles (90.56 km) from the sea the alluvial country which it has itself formed. "This alluvial land does not immediately expand to a great width from the point at which the river leaves the main range of the hills, there being still rising grounds and detached patches of hills at a distance of from half a mile to five miles (0.80 to 8.05 km) from the river for the distance of twenty-three miles (37.01 km) further; at the end of which distance, two or three detached hills come close to it, the river divides into two streams, the alluvial country spreads out on both sides, and the Delta may properly be said to commence, extending on the west side till it meets that of the Krishna at the Colair Lake, about forty miles (64.37 km), and on the east side about thirty-two miles (51.50 km) to the shore of Coringa Bay." This was the Delta which was to benefit by the projected increase of irrigation.'

The slope of the Delta towards the sea is gradual and regular. It commences near the hills with a foot-and-a-half per mile (42.6 cm/km), and diminishes to one foot per mile (27.1 cm/km) as it approaches the sea. There is also another slope, which is rather more rapid, namely a fall from the river perpendicular to its course. It was moreover ascertained by examining the levels that the highest part of the Delta in the immediate neighbourhood of the river was only eight or ten feet (2.44 or 3.05 m) above its bed.

The breadth of the river, Major Cotton reported, varied from about two thousand yards, or one mile and one furlong (1,828.8 m), to seven thousand yards, or nearly four-and-a-half miles (6,400.8 m), which, however, included islands to the extent of about one thousand or fifteen hundred yards (914 or 1,371 m). Notwithstanding this great breadth, there were everywhere great facilities for constructing an anicut (Tamil *anaikattu*) from the vicinity of the hills containing good stone and lime, especially at the head of the Delta, where there was a hill of a most suitable kind of stone, and hydraulic limestone of excellent quality in the immediate neighbourhood. From these advantages, and the low price of labour in the District, a vast mass of masonry might be executed for a comparatively moderate sum.

On a consideration of the capabilities of the land and of the resources of the river, Major Cotton was of the opinion that three fundamental points had been established; that there was an ample supply of water for a rice crop in all the land forming the Delta of the Godavari, and there was certainly water enough in the river for a very large extent of cultivation, probably not less than 100,000 acres (40,468 ha), all through the dry season; that there was a vast extent of fertile soil not less than 820,000 acres (331,842 ha) within the District of Rajahmundry, and nearly as much in Masulipatam, to which the water might be applied; that by means of an anicut of a very moderate height, and the main channels only two or four miles (3.22 or 6.44 km) in length, the last drop of water in the river might be brought to the surface of the country at a level which would command the whole tract.

The only canal system which had permanent diversion works was the Cauvery System of canals in the south. It was the success which had attended the construction of the diversion work for the Cauvery System which led Arthur Cotton to propose permanent headworks for the Godavari System also. The diversion works were boldly conceived on a large scale and were the largest in the world at the time. On the left flank of the river was the head regulator of the Eastern Delta System, with a navigation lock and undersluice. Two weirs, the Dowleshwaram Weirs, 4,940 ft (1,506 m) long and the Ralli Weir, 2,859 ft (871.3 m) long, joined by an embankment with its top 21 ft (6.4 m) above the crest level of the weirs, spanned the Gautami Godavari, the eastern branch of the river. At the western end of the Ralli Weir were the undersluices, the navigation lock and the head regulator of the Central Delta System of canals. The Vasiṣṭa Godavari or the western branch of the river was similarly crossed by two weirs 1,548 ft (471.8 m) and 2,598 ft (791.8 m) long, respectively, and from the eastern end of the latter an embankment led to the head regulator and the lock of the Western Delta System.

The diversion works thus comprise about 2½ miles (4 km) of weir, 1½ miles (2.4 km) of embankments and three sets of canal headworks, the largest set of diversion works in the world at that time.

Benefits of the Scheme

Major Cotton thus summarized the benefits which he anticipated from the scheme. "We may consider the Anicut as laying the foundation for the complete irrigation, for rice crop, of the whole Delta of the Godavari, and part of that of the Krishna, in all 3,000 square miles (1,158 km^2), or nearly 2,000,000 acres (80,937 ha); and providing for leading out on the land of every drop of water of the Godavari, in the low freshes, and thus making use of what is now totally lost. Thus the produce of this tract, which at present probably does not exceed Rs 3,000,000, would, when full advantage is taken of the water thus distributed over it, be increased to at least Rs 20,000,000 lacs. This tract, which now pays with great difficulty about Rs 2,220,000, would then, with great ease, pay Rs 6,000,000. A complete system of internal navigation, intersecting the whole Delta, would be established throughout the year. Every village would be furnished with a stream of pure water for the people and cattle at all seasons. The present estimate provides for the full irrigation of all the tracts at present partially irrigated by the principal channels of the Godavari. It will give us at once the use of a large portion (about one-third) of the water of the low freshes during the whole of the hot weather, thus providing for sugar cultivation to the extent of about 30,000 acres (12,140 ha). It will give a constant supply of water to those tracts which are situated near the present channels, but which receive no benefit from them at all. It will put a famine in this or the neighbouring districts out of the range of probability. It will provide immediately two or three most important lines of water communication from Rajahmundry through the heart of the Delta to the sea, available at all seasons. It will have the important effect of showing the people what can be done for them. At present they have no idea of the water being thrown into the channels during the hot season; and, from the first moment that water is seen passing through any villages in the low freshes, the whole people of the Delta will be awakened to its great capabilities, and will be prepared to welcome the opening of channels throughout the whole tract, and to extend the cultivation, which is at present limited by the want of water. It may be estimated to yield 100,000 rupees, or 20 per cent on the outlay, in the first year, and at least 500,000 rupees or cent per cent, within ten years.

"Upon the whole, we have almost everything that the most timid could desire to encourage us to prosecute this undertaking. On the one hand, the most perfect success, and almost unprecedented results, from precisely similar works in Tanjore; and, on the other, immediate returns for what has already been done in this District, more than ten times as great as would have been an ample return for the expenditure. What this District may become if this matter be taken in hand with only a small part of the energy it deserves, it is not eay to conceive. The unfailing river, an immense expanse of the richest soil, a safe and accessible port, a complete internal water communication with teak forests, and abundance of labour at 1½ d. a day, form such a combination of advantages as, I suppose, cannot be found in the world, and certainly not under such a Government as ours."

EXECUTION OF WORK

A few months afterwards, the work was in vigorous progress. A staff of engineer and other officers were employed on it. A detachment of the corps of Sappers and Miners was posted at Dowleshwaram, in the immediate vicinity of the works. A civilian was appointed to the District as Sub-Collector, whose principal duty was to superintend the employment and payment of labourers, and to procure the necessary supplies. A quarry was opened. Tram-roads from the quarry to the river were nearly completed. A small steamer was obtained from Calcutta. Thousands of labourers were assembled. The hitherto quiet little village of Dowleshwaram was converted into a busting town.

In August 1847, Major Cotton, prostrated by exhaustion, was compelled to leave the District, and Captain Orr was appointed to act in his stead. One of the first objects to which he turned his attention after assuming charge of the works, was the excavation of a portion of the main channel to lead from the Anicut down the central tract of the Delta.

Report of Forbes, the Sub-Collector

Mr Forbes, Sub-Collector of the District with civil charge of the works, thus reported on 8 June 1850, when he left Dowleshwaram, the progress of the Anicut: 'Operations were first vigorously commenced in April 1847; and, although all that was then done was but in preparation for the actual building of the Anicut and its works, yet these preparations were of necessity so vast that at no subsequent period were so many labourers and artificers employed as between April and July of that year. The quarry had to be opened, and two lines of double railway were formed from it to different points on the river bank; the embankments on the islands were thrown up, the head of the Dowleshwaram main channel formed by an extensive embankment to the head of the Vemagiri island; many boats were built, and railway waggons completed. During the progress of these preparatory works, there were at one time present as many as 10,200 labourers, 500 carpenters, and the same number of smiths. The preceding season had not been a good one, and the pressure of want sent a large number of labourers to the work; many of them, however, were women and children, who, although able to perform the common earthwork then required, could not be employed when building operations commenced. Since the first season, therefore, men alone have generally been employed, and the average number at work during the seasons of 1848, 1849 and 1850, has been 6,500.

"In the season of 1848, the Dowleshwaram and Madduru Annicuts were built, the former 1,400 yards (1,280 m) in length" (April 14, 1852).

Soon after receiving this report through the Board of Revenue, the Government of Madras passed the following congratulatory order:

"The Right Honourable Governor in the Council has received with much satisfaction the Report of Colonel Cotton on the state of the Godavari Annicut, which may now be said to have arrived at completion through the unceasing exertion and energy of Colonel Cotton and the officers associated with him in this great undertaking.

"It must be a highly gratifying termination of Colonel Cotton's immediate connection with the 1st Division that he should have been enabled to notify to Government the complete stability of the Annicut, and the success which has up to this period attended his plans; and in congratulating that officer on these happy results, the Governor in Council has much pleasure in recording his obligations to Colonel Cotton, Captain Orr, and the officers of the Department under their orders, for their services on this occasion; and it will be his agreeable duty to bring the same to the notice of the Honourable Court of Directors.

"The Right Honourable Governor in the Council has not failed to remember the very valuable aid rendered by Mr Forbes, late Sub-Collector of Rajahmundry, during the progress of the work. By the vigorous execution of the responsible duty assigned to him, the constant requirements of the Engineering Department were supplied; and, by his judicious arrangements, order and regularity were preserved among the vast assemblage of artisans and labourers congregated at Dowleshwaram."[4]

The total cost of these works up to January 1853 was Rs 1,534,952.

The works have, no doubt, been considerably altered and added to, from time to time, but the execution of the project was certainly a great achievement and a notable landmark in the history of irrigation in India. The Godavari Delta System has proved very valuable in protecting the area served by it against scarcity and famine. In 1958-59, it irrigated 935,000 acres (378,394 hectares).

THE KRISHNA DELTA SYSTEM, 1851

The necessity for the construction of irrigation works in the deltaic region of the River Krishna was felt from time to time during the periods of famine or scarcity. The famine of 1832-33 devastated this tract and, although several suggestions for irrigating the area were made, it was not until Arthur Cotton (in 1844) showed in his report on the Godavari Delta Scheme the feasibility of such works that the matter was again taken up. A committee of experts was appointed in 1848 and, on its unanimous recommendation that the work should be undertaken, the Krishna Delta Irrigation Project was sanctioned in 1851.

The Krishna, like the Godavari, rises in the Western Ghats and flows across the peninsula into the Bay of Bengal. It has a catchment area of over 97,000 sq. miles (251,230 km^2) and its flood discharge on entering the delta may be as high as 1,250,000 cusecs (35,396 cumecs), which, however, dwindles down to only about 100 cusecs (12.8 cumecs) during the dry season. The site selected for the headworks was about 60 miles (96.6 km) from the mouth of the river at Bezwada, where the river flows between two gneissic hills only three quarters of a mile (1.2 km) apart.

Construction was commenced in 1852 by C.A. Orr, of the Madras Engineers, and was completed successfully in 1855. The weir, as constructed, is 3,350 ft (1,021 m) long with undersluices, head regulators and locks at both its ends, for the eastern and the western canals. The cost was originally estimated at £155,000; and an increase of £50,000 in the land revenue, or 39 per cent, on the outlay, was expected per annum.[5] The

[4]Morris, H. *A Descriptive and Historical Account of the Godavery District*, pp. 110-116
[5]Dutt, R. C. *The Economic History of India*, Vol. II, p. 125

Godavari and Krishna projects were the principal irrigation works undertaken by the East India Company before 1858, when it ceased to exist.

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CHAPTER 16

RYOTWARI SETTLEMENT OF LAND TAX IN THE MADRAS AND BOMBAY PRESIDENCIES AND IN THE PUNJAB PROVINCE

Sir Thomas Munro has left a name in the history of India for the *Ryotwari* Settlement of Land Tax, which gave security and dignity to the cultivators *(ryots)* of the Madras Presidency. Later on, this system was adopted in the Bombay Presidency by Mountstuart Elphinstone, and in the Punjab by Sir John Lawrence.

Thomas Munro was born in Glasgow on 27 May 1761. His father, Alexander Munro, was a merchant trading with Virginia (USA), and his mother was the sister of Dr Stark, a well-known anatomist. At college, he distinguished himself in Mathematics and Chemistry, and was, besides, a great reader of history and literature. Tall and robust, he excelled in athletic sports, had high courage, extraordinary agility, great presence of mind and powers of self-denial. He has been described as brave, wise, and kindly. According to Mountstuart Elphinstone, Munro had 'strong practical good sense, simplicity and frankness, perfect good nature and good humour, real benevolence unmixed with the slightest cant of misanthropy, activity and truthfulness of mind. He was easily pleased with anything, and delighted with those things that in general have no effect but on a youthful imagination.'

Munro came to India as a young soldier in 1780. He fought in the wars with Hyder Ali, and distinguished himself in the revenue settlement made in the tracts of country acquired from Mysore and from the Deccan in 1793, 1799, and 1800. He came to India a second time in 1814 as the head of a commission to revise and improve the judicial system of Madras, and passed those famous regulations which gave a wider employment to the people of India in responsible administrative work. Munro came to India for the third and last time as the Governor of Madras in 1820; he effected the *Ryotwari* Land Settlement of Madras; and he died in India in July 1827, loved and lamented by the people for whom he had worked all his life. His name is still respected in the southern provinces where he worked.

Munro trusted Indians and desired their participation in administrative services. 'With what grace', he asks, 'can we talk of paternal government if we exclude the natives from every important office, and say, as we did till very lately, that in a country containing fifteen millions of inhabitants no man but a European shall be entrusted with as much authority as to order the punishment of a single stroke of a rattan?... Let Britain be subjugated by a foreign power to-morrow, let the people be excluded from all share in the government, from public honours, from every office of high trust and emolument, and let them in every situation be considered as unworthy of trust, and all their knowledge and all their literature, sacred and profane, would not save them from becoming, in another generation or two, a low-minded, deceitful, and dishonest race.'[1]

As Collector of Baramahal Chengalput

In the Baramahal, Munro spent the seven years of his service from 1792 to 1799. It consisted of the *taluks* of Krishnagiri, Dharmapuri, Utankarai, and Tirupatur; these, with Hosur, which was acquired in 1799, form the most beautiful part of the Salem District, which is the most picturesque in the Madras Presidency.

The Ryotwari System

The administration of Baramahal under both Hyder Ali and Tipu had been oppressive in the extreme; and the first thing that Read and Munro had to do was to settle the amount and the mode of the collection of the revenue, and this was done in such a way as to result in the permanent welfare of the people and benefit to the State. The system adopted was that which, with some modifications, was afterwards extended over the Madras Presidency, and is known as the *Ryotwari* System. Under it, the revenue was collected by the Government officers direct from the *ryots* (cultivators); an annual enquiry was made as to the extent of such holding, as the *ryot* had the option to give up, or diminish, or extend his holding from year to year. The *ryot* under this system was virtually a proprietor with a simple and perfect title. Every registered holder of land was recognized as its proprietor, and paid the revenue assessed upon his holding direct to the Government; he was at liberty to sublet his property or to transfer it by gift, sale, or mortgage; and he could not be ejected by the Government so long as he paid the fixed assessment. In unfavourable seasons, remissions were granted for the entire or partial loss of produce. The assessment was fixed in money and did not vary from year to year, except where water was drawn from a Government source of irrigation, nor was any addition made to the assessment for improvements effected at the *ryot's* own expense. He received assistance in bad seasons, and was not evicted as long as he paid his dues.

Revenue Settlement, 1801-1802

Munro's first settlement for revenue purposes was a village one; each village was assessed at a certain valuation, and the cultivators were held

[1]Bradshaw, J. *Sir Thomas Munro and the British Settlement of the Madras Presidency*, p. 191

responsible for that sum. His next settlement was a step towards a *ryotwari* one, but though it was made individually with the cultivators, the village headman was held responsible for the defaulting or absconding *ryots*; but before the cultivation of 1801-2 could commence, it was necessary to make advances for the purchase of seed, of implements, of bullocks, for the repair of old wells or for digging new ones, for husbandry and even for the subsistence of the *ryot* till his grain was ready for cutting. In 1802, Munro commenced his new survey settlement, which lasted for five years. The whole of the cultivable area of the District was surveyed, a number was given to each field, the name of the holder was registered, and the assessment was fixed.

Interest in Agriculture—Observations on Pepper Gardens in the Kanara District

In 1813, Munro suggested the introduction of American and other foreign cottons into India. Besides, he was the earliest British administrator to notice pepper cultivation in Kanara. 'The western part of Sonda, towards the Ghats, is an endless heap of woody hills without a single plain between them, that never have been nor probably ever will be cultivated, on account of their steepness. It is among them, in the deepest glens shaded by the highest hills and thickest woods that the pepper gardens are formed. The plant is everywhere to be met with in its wild state, but its produce is inconsiderable. It is from the cultivated plant that the markets of India and Europe are supplied. The cultivators are, with very few exceptions, a particular caste of Brahmins, who pass the greatest part of their solitary lives in their gardens, scarcely ever more than two or three families together; their gardens are but specks in the midst of the pathless wilds with which they are surrounded. They are dark even in the sunniest days, and gloomy beyond description when they are wrapped in the storm of the monsoon.'[2]

Montstuart Elphinstone (1779-1859)

Montstuart Elphinstone was the fourth son of General Lord Elphinstone, the eleventh baron in the peerage of Scotland; and his mother was a daughter of Lord Ruthven. He came to India at the age of seventeen in 1796. His first posting was at Benares, which was then the frontier-station towards the north-west, and an important centre of political affairs. Elphinstone's chief was Samuel Davis, a civil servant of repute and a Sanskrit scholar.

Elphinstone was a voracious reader, and in his tours he used to travel

[2]Bradshaw, J. *Sir Thomas Munro and the British Settlement of the Madras Presidency*, pp. 109, 119

with two camel-loads of books, so packed that he could lay his hand on any volume he wished. He distinguished himself in his work and was a sort of political secretary to the Duke of Wellington when he won the battle of Assaye in 1803. His great experience in Maratha affairs led to his appointment as Governor of Bombay in 1819, after the Maratha dominions had been annexed. For eight years, he performed the duties of this high office; he codified the Regulations of Bombay, gave a wider employment to the people of India in administrative work and spread education in the province. The Elphinstone College in Bombay is named after him. He retired from Bombay in November 1827, a few months after the death of Sir Thomas Munro.

Revenue System

His general instructions to the collectors were: 'maintain the native system; levy the revenue according to the actual cultivation; make the assessments light; impose no new taxes, and do away with none unless obviously unjust; above all, make no innovations.'

Introduction of the Ryotwari System into the Bombay Presidency

The system of fixing the amount due from each cultivator, which had already been introduced into Madras by Munro, as opposed to the *Zamindari* or Landlord System of Bengal, was introduced by Ephinstone in the Bombay Presidency.

Impact of Land Revenue on the Cultivators

No doubt the *Ryotwari* System was better than the *Zamindari* System of Bengal, Bihar and Orissa, which was perpetrated by Cornwallis, as it gave greater independence to the actual cultivators, but what is more important is the impact the land revenue demand made on the cultivators. What was their gross income? What was their expenditure on cultivation, and how much did they save after meeting their dues?

Romesh Chander Dutt, who made an exhaustive study of this problem, came to the following conclusion:

'The Land Tax levied by the British Government is not only excessive, but, what is worse, it is fluctuating and uncertain in many provinces. In England, the Land Tax was between one shilling and four shillings in the pound, i.e. between 5 and 20 per cent, of the rental, during a hundred years before 1798, when it was made perpetual and redeemable by William Pitt. In Bengal, the Land Tax was fixed at over 90 per cent of the rental, and in Northern India at over 80 per cent of the rental between 1793 and 1882.

'In Madras, the Land Tax first imposed by the East India Company was one-half the gross produce of the land! In Bombay, the land revenue of the territory conquered from the Marathas in 1817 was £800,000 in the year of the conquest; it was raised to £1,500,000 within a few years of British rule; and it has been continuously raised since. "No Native Prince demands the rent which we do," wrote Bishop Heber in 1826, after travelling all through India, and visiting British and Native States. "A Land Tax like that which now exists in India," wrote Colonel Briggs in 1830, "professing to absorb the whole of the landlord's rent, was never known under any Government in Europe or Asia."

Dutt concludes, 'In the benighted Province of Madras, they raised the land revenue as much as it was possible to raise it, leaving the unfortunate cultivators as permanently poor as they were before. This policy would scarcely be considered wise or generous in a landlord dealing with his tenants; it was distinctly ungenerous and unwise in the Government of a great country dealing with a vast agricultural population.'

Francis Brown was even more emphatic. 'The Madras cultivator obtains no profit whatever beyond his food, after paying his assessment.' There were millions of human beings who were cultivators in Madras, and they realized nothing beyond a mere existence or the means of existence. The pressing wants of nature, the necessity of getting food, drove them to cultivation, and wherever they planted their feet they came under the Government assessment. And the assessment was so high that it could never be realized in full. "The estimation," said Brown, "in which a native has always appeared to me to be held is that he is a creature born to pay to the East India Company."

'In Bombay things are worse,' commented Dutt. 'The British Government declared its intention in 1864 of realizing as Land Tax about one-half of the economic rent. But what the British Government does take as Land Tax at the present day sometimes approximates to the whole of the economic rent, leaving the cultivators little beyond the wages of their labour and the profits of their agricultural stock. The Land Tax is revised once every thirty years; the cultivator does not know on what grounds it is enhanced; he has to submit to each renewed assessment, or to leave his ancestral fields and perish. This uncertainty of the Land Tax paralyses agriculture, prevents saving, and keeps the tiller of the soil in a state of poverty and indebtedness.'

'It will appear from the facts stated above that the Land Tax in India is not only heavy and uncertain, but that the very principle on which it is raised is different from the principle of taxation in all well-administered countries. In such countries the State promotes the accumulation of wealth, helps the people to put money into their pockets, likes to see them prosperous and rich, and then demands a small share of their earnings for the expenses of the State. In India the State virtually interferes with the accumulation of wealth from the soil, intercepts the incomes and gains of the tillers, and generally adds to its land revenue demand at each recurring settlement, leaving the cultivators permanently poor.

'Taxation raised by a king, says an Indian poet, is like the moisture of the earth sucked up by the sun, to be returned to the earth as fertilizing rain; but the moisture raised from the Indian soil now descends as fertilizing rain largely on other lands, not on India.'[3]

PUNJAB, THE LAND OF PEASANT PROPRIETORS

What Punjab agriculturists were in the early days of British rule is well summed up in the *Administration Report of 1855*. 'The cultivators,' the Chief Commissioner wrote therein, 'are essentially "peasant proprietors". There are no middlemen, and generally no great landlords. As a rule, each man owns and tills his own glebe, upon which he pays the revenue and pockets all the profits.... He is saddled with no rent. He has to provide for the cost of cultivation and for the Government demand; the rest of the produce he may devote to the maintenance of his family and the accumulation of his capital.' Describing the *bhai-chara* system, the Report mentions, 'A village is inhabited by a number of persons of common descent, forming one large brotherhood, having their own headmen, accustomed to joint action and mutual support.... The Punjab system.....is therefore the village system.'

LAND REVENUE SYSTEM OF JOHN LAWRENCE, 1853-1858

The Sikh system was replaced by a new scheme initiated by John Lawrence during the regency period. Settlement officers were instructed to estimate the average annual yield in all villages, convert the totals into their rupee equivalents, and assess from a quarter to a sixth of the product as the land-tax to be paid by each village community on certain dates, corresponding with the time of harvest, but irrespective of the character of the outturn. Thorburn comments, 'the change was at first welcomed by the peasantry as emancipation, and, so long as the harvests were normal to bumper and markets were steady, the new departure worked admirably. Those happy conditions lasted for two years, and then prices began to fall owing to over-production and the immense disbursements of the Government. The drop continued until grain sold at 50 per cent below its commutation valuation, then soon afterwards the rains failed, and for a harvest or two, there was no production at all. The peasantry, however, had already converted their previous yields into rupees, and had spent the money on their domestic requirements, in which in many families marriage expenses were a considerable item. Having nothing in hand wherefrom to pay the tax-gatherer, the cry of over-assessment was raised, and the Government, perceiving the general distress and having no exact data

[3]Dutt, R.C. *The Economic History of India*, Vol. I, pp. xxvi to xxviii

wherefrom to base conclusions, accepted the popular view and lowered the assessments. With reduction and the return of normal seasons the clamour subsided, and the busy Administration congratulated itself that the root-cause of present and future agrarian difficulties had been reached and removed. Any other conclusion would at the time have been rank heresy. The civilians in the Punjab Commission had been recruited from the North-West Provinces—a country with usually a regular and heavy monsoon, a blessing not vouchsafed west of Ambala—and in those provinces, the creed of fixity with moderation was a cardinal article of faith. In that hurrying period, the day's work absorbed all energies; no one had time for thought or investigation; antecedentally, the gospel, according to Thomason, was accepted by every Punjab revenue officer; as a consequence, no Government servant questioned it, or even suspected that the inability of the peasantry to pay their revenue instalments after a bad harvest was due not so much to over-assessment, as to fixity of demand in spite of yields varying from nil to a hundred-fold. Thus, by 1852 the change from elastic extortion in kind to moderate fixity in cash was riveted on the Punjab.'[4]

To prove the lightness of his assessments, John Lawrence said he had 'ascertained that the Government demand does not exceed one-fifth of the gross value of the produce in rich tracts and one-sixth to one-eighth or even less in poor tracts, and that taking £10 a year as the standard income of a peasant-proprietor "from his little patrimony", and deducting £2 for his land-tax and £2 more for cost of production, he had a balance of £6 worth of produce, with which he may maintain his household and save a small surplus as capital.' In the calculation, be it noted, Lawrence allowed nothing for bad seasons, cattle diseases, deductions from the threshing-floor heap for village services, interest on debts, and the like.

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[4]Thorburn, S.S. *The Punjab in Peace and War*, pp. 173, 174

CHAPTER 17

FROM ELLENBOROUGH TO HARDINGE

1842-1848

EDWARD Law, Earl of Ellenborough (1770-1871) entered the House of Lords of the British Parliament in 1818. In 1828 he became the President of the Board of Control for India and had three terms of this office up to 1841. In 1832 he sent Sir Alexander Burnes to Lahore and to Central Asia to reconnoitre. He became Governor-General of India in February 1842.

When he was in London as the President of the Board of Control for India, he sought to improve communication of England with India, and pressed for a steamship service to Alexandria and thence through the Red Sea to Bombay. About a year from his arrival in India, the *Hindustan,* the first P and U steamer arrived at Madras in December 1842, and his dream was realized. With improved means of communication, Ellenborough felt that India could be a supplier of agricultural raw materials to the British industry and a market for British manufactures. He also felt that the Indus River, with steam navigation, could carry British trade with Central Asia and also check Russian expansion. In 1843 he sent the expeditionary force into Sind under Sir Charles Napier. The Amirs were defeated and Sind was annexed to the British Empire.

To encourage trade, Ellenborough relaxed tolls and duties throughout Sind, Bahawalpur, the North Western Provinces, Madras and Bombay. In 1842 Proby T. Cautley started work on the Ganga canal. This is described in detail in Chapter 13.

In 1843 Ellenborough abolished slavery in India. For this he adopted the simple method of declaring that the status of slavery did not exist. Thus the vexed problem of compensation was circumvented.

In December 1843, he defeated the army of Scindia of Gwalior. This act coupled with annexation of Sind, and his general behaviour, were responsible for his being recalled by the Directors of the East India Company in June 1844. This was the first instance of recalling of a Governor-General.

Ellenborough was succeeded by his brother-in-law Viscount Henry Hardinge (1785-1856), a soldier and statesman. He had served with distinction as a staff officer in the Peninsular war (1808-1814). In the Hundred Days (1815), he served as Brigadier-General with the Prussian army at the Battle of Ligny, and had his wounded left arm amputated. That is why he was called *Tundi Lat* by the Sikhs.

After the death of Maharaja Ranjit Singh in 1839, a period of anarchy followed in the Punjab. Khark Singh, the eldest son, was the first to die.

Then followed Nao Nihal Singh. Sher Singh, who became Maharaja, was assassinated on 15 December 1843. Eventually Rani Jindan, a widow of Ranjit Singh, emerged as the ruler of the Punjab.

Jawahar Singh, Rani Jindan's brother and chief adviser, was executed by the army on 21 September 1845 on the charge of murdering Peshaura Singh, a son of Maharaja Ranjit Singh, who was favoured by the army in preference to her own son, Dalip Singh. Raja Lal Singh was the Chief Minister and Tej Singh was the Commander-in-Chief of the Sikh army. The Sikh army was hostile to the Durbar as well as to the British. The Rani was virtually a captive of the army. The army obeyed only its Panchayat, and officers were looked upon as servants rather than as commanders. By repeated demands for increase in pay, the finances of the Durbar were in shambles. Thus the chief concern of the Rani and her Chief Minister and Commander-in-Chief was to get the rebellious army destroyed. They thought that the best way to achieve this was to arrange a collision with the British army.

THE FIRST ANGLO-SIKH WAR, 1845-1846

THE BATTLE OF FEROZESHAH

The British had realized that after the death of Ranjit Singh in 1839 the days of the Sikh Kingdom were numbered. Poised on the frontier of the Punjab, at the cantonments of Ambala, Ludhiana and Ferozepur was an army of 40,000 men and 94 guns. Sir Hugh Gough was the Commander-in-Chief of the British army.

The Sikh army under Tej Singh crossed the Sutlej near Hari-ke-Pattan on 11 December 1845. The first thing traitor Lal Singh did on crossing the Sutlej was to write to Captain Nicholson at Ferozepur: "I have crossed with the Sikh army. You know my friendship for the British. Tell me what to do." Nicholson replied: "Do not attack Ferozepur. Halt as many days as you can, and then march towards the Governor-General". On 13 December Lord Hardinge declared war on the Sikhs.

The British suffered heavy casualties and there was every likelihood of defeat. "Measures were concerted to make an unconditional surrender to save the wounded," wrote Robert Cust in his diary.

Sir Hope Grant, one of the British Generals who fought in the Anglo-Sikh Wars, thus wrote about the Battle of Ferozeshah, "Truly that night was one of gloom and foreboding and never perhaps in our annals of Indian warfare has a British army on so large a scale been nearer to a defeat which would have involved annihilation. The Sikhs had practically recovered the whole of their entrenched camp; our exhausted and decimated divisions bivouacked without mutual cohesion over a wide area...."

Hardinge lost five aides-de-camp, and sent his son Arthur back to Mudki with a sword he had been given for his services in the Napoleonic campaigns, with the instructions that in the event of a defeat all his private papers were to be destroyed.

Now Tej Singh's army from Ferozepore appeared on the scene. The artillery ammunition of the British was finished and there was dismay all around. The fate of India seemed to hang upon a single hair. Captain Cumming observed, "I believe there were few among us who did not feel that the field would be their burial ground."

The Sikh infantry began to advance, so the cavalry reformed for their charge. At this juncture the traitor Tej Singh asked the buglers to sound retreat. The Sikh infantry and cavalry hesitated for a while and then to the great relief of the astonished British soldiers marched towards the Sutlej. Thus a sure victory was turned into defeat."

The British suffered 2,415 casualties including 694 killed. Five of the Governor-General's staff were killed and two wounded. A Brigadier was killed and two seriously wounded. This was the most costly victory to the British. The treachery of the Sikh Commanders Lal Singh and Tej Singh led to the victory of the British over the Sikh army which in fighting stamina and technique was more than their match. The Punjabi poet Shah Muhammad correctly observed, "The Sikh army after winning lost the war in the end."

Battle of Sabraon, 10 February 1846

The British guns took a fearful toll. The bridge over-crowded with guns, horses and soldiers was exposed to artillery fire, and large numbers were killed or drowned. The Sikhs lost 10,000 soldiers and 67 guns. The British losses were much lighter—2,063 wounded and 320 killed. The British won decisive victory. Sir Hugh Gough described Sabraon as the Waterloo of India. The Sikh soldiers though defeated never ran, none surrendered, and fought with their *talwars* to the last.

By the first treaty of Lahore (8 March 1846), the Sikh empire was curtailed. As a part of the war indemnity, Hardinge sold Kashmir for £ 1,000,000 to Gulab Singh, Raja of Jammu. Sikh independence, however, was preserved. Dalip Singh was maintained as a Maharaja, but as an insurance against anarchy, Henry Lawrence was made resident at Lahore and British garrisons were posted to the Punjab.

Though Hardinge's main pre-occupation was the First Anglo-Sikh War, in his later years he gave attention to development plans. Construction of the Ganga canal made progress and he developed plans for an Indian railway system. He encouraged education among Indians. In 1847, a College of Civil Engineering was founded at Roorkee, and in 1848 work on Godavari Anicut delta scheme was started.

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CHAPTER 18

CREATION OF BOTANICAL GARDENS AT OOTACAMUND AND BANGALORE IN SOUTH INDIA

JUTE AND TEA CULTIVATION IN EASTERN INDIA 1849-1857

WHILE Viscount Hardinge was busy with problems in the aftermath of the First Anglo-Sikh War, a botanic garden was created in Ootacamund at the initiative of the European residents in the Nilgiris. On account of temperate climate, the Nilgiris had the same attraction for Europeans settled in South India as Simla for those in the north. In 1845, they made a co-operative arrangement to raise temperate-zone vegetables on the site of the present garden.

Early in 1847, at the instance of Marquis of Tweedale, who was then Governor of Madras, a fund was raised by donations and subscriptions to start a public garden and form a Horticultural Society. Shortly after the formation of this Society, the committee requested the State Government to provide a practical gardener from the State Fund and, in response to this request, the Court of Directors, on the recommendations of Dr Royle and Sir William Hooker, appointed Mr G. W. McIvor Superintendent of the Government Botanic Gardens in March 1848. At the time when McIvor took over charge of what was then a patch of vegetable garden, the upper portion of the garden area was a wilderness of shola and scrub and the lower a swamp, traversed by deep ravines. In about a decade, McIvor, who had his training at the Royal Botanic Gardens, Kew, was able to transform the steep slopes into walks and terraces, lawns and flower-beds growing a choice selection of plants. He improved ways and means by which he could reclaim the lower part of the garden and converted the area into undulating and sloping lawns with pockets of ponds left at convenient places to add charm to the landscape. He completed the layout in 1867. It was during this period that an Italian parterre was laid out, with a large octagonal bower in the centre, to be used as bandstand. Dwarf walls also were erected with vases placed at regular intervals and planted with suitable plants. This parterre is now known as the Bandstand. McIvor adopted Lindley's natural system in laying out these Gardens, particularly on the upper portion.

The Gardens lie in a beautiful ravine in a nook, not far off from the town and are easily accessible to visitors. They cover 51 acres (20.64 ha), ascending on the slopes of the hill at an elevation of 7,250-7,600 feet (2,210—2,317 m) above sea level.

ROLE OF THE GARDENS IN THE ECONOMIC DEVELOPMENT OF THE NILGIRIS

Since their inception in 1847, the Gardens have contributed much to the economic development of the Nilgiris through the introduction of most of the economic plants which are now grown on a commercial scale. Most of the commercial crops on the Nilgiris are exotic, and were first introduced into these Gardens, and the promising ones multiplied and distributed. The most striking introductions which revolutionized the economy of the Nilgiris are detailed below.

Potato: This crop was unknown in the Nilgiris before 1829. It was first introduced into these hills by Sulavan in 1830. The Government Botanic Gardens, Ootacamund, took up further work on the introduction of various varieties and conducted research on the different aspects of potato cultivation. The research was transferred to the Agricultural Research Station established at Nanjanad in 1917. The potato is the main commercial crop of the Nilgiris, grown over 20,000 acres (8,094 ha). The cultivation of potato revolutionized the economy of the Nilgiris without which it would have been a backward and poverty-stricken district.

Vegetables: The cultivation of vegetables, like cabbage, cauliflower, carrot, beet-root, turnip, radish, knol-kohl, etc., on systematic lines was done in the first instance at the Government Botanic Gardens, Ootacamund. They served as the main source of supply for seeds and seedlings and vegetables to house gardens. When the horticultural work of the Botanic Gardens expanded in course of time in the entire district of Nilgiris, the work on vegetables was also extended to the Pomological Station, Coonoor, and the Agricultural Station for vegetables at Wellington. Considerable information was gathered on the cultivation of vegetables at these stations. In short it is the fillip given by the work done initially at the Botanic Gardens that has contributed to the expansion of vegetable growing in the Nilgiris.

Fruits: The introduction, testing, establishment and expansion of several varieties of temperate fruits were done during the early years of the establishment of the Government Botanic Gardens. The most popular and commercially profitable among the temperate fruits is the pear, first introduced into the Gardens by McIvor in 1848. The mulberry tree was introduced for the first time in 1871. The first successful introduction of plum was done here.

Continued work on fruits at the Government Botanic Gardens, Ootacamund, led to the establishment of separate fruit research stations, like the Pomological Station, Coonoor, and the Fruit Research Stations, Kallar and Burliar, under the guidance of the staff of the Gardens. The credit for having established a wide range of varieties of fruits in the Nilgiris, which include the various temperate fruits like apples, plums, pears, strawberries, etc., and tropical fruits like mangosteen, litchi, durian, avocado, grapefruit and a host of other fruits, goes to the Ootacamund

Gardens. The introduction of these fruits enriched the economy of the Nilgiris.

Cinchona: Cinchona, popularly known as the quinine-tree, is widely known in the medical world. This tree was first introduced into the Botanic Gardens, Ootacamund, in 1860 by McIvor. Within six years of its introduction, cinchona plantation had increased to 50 acres (20 ha) in the Nilgiris. Much work on the propagation, multiplication and acclimatization was done at these Gardens. McIvor introduced improved methods of germination and evolved suitable techniques for the propagation of trees by layering and cuttings with the aid of hot frames. The initial work done on the introduction and further multiplication of cinchona in the Gardens has been responsible for the creation of, separate department for work on this crop.

Eucalyptus: Eucalyptus, particularly the variety *Eucalyptus globulus*, commonly called the blue-gum tree, has become a holy tree in the Nilgiris because of its wide range of utility. It is the chief source of firewood within the Nilgiris and outside. The wood is widely used as timber for building construction. The distillation of eucalyptus oil from the leaves of the trees has become an important cottage industry. The introduction of this tree has added to the wealth of the Nilgiris. In addition to the above varieties, the Ootacamund Gardens pioneered the introduction of various types of eucalyptus. The Gardens are now maintaining a collection of 36 varieties, of which *Eucalyptus citriodora* is valued for its highly scented oil.

Wattle: The cultivation of wattle has now assumed commercial importance, as the bark is useful in the tanning industry.

Essential-oil plants: Among the introductions of the essential-oil-yielding plants, the scented geranium is the most striking recent introduction. The geranium oil extracted from its leaves is highly scented and is valued much in the perfume industries. Geranium cultivation has extended on a commercial scale in the Nilgiris. It could also be grown profitably on waste-lands, field bunds and on terraces, as it prevents soil erosion. *Lippia citriodora, Mentha piperita, Anthemis nobilis, Angelica archangelica, Rosmarinus officinalis* and *Caultheria fragrantissima* are the other essential-oil-yielding plants introduced into the Gardens. There is ample scope of growing these plants on a commercial scale.

Chicory: Its usefulness in the blending of coffee powder is well known. Chicory was first introduced into the Gardens and considerable work on the varietal collection, acclimatization and seed production has been done.

GOVERNMENT BOTANIC GARDEN, LALBAGH, BANGALORE, 1846

The credit for making the Lalbagh a Botanic Garden under State control goes to Dr Cleghorn, the Chief Conservator of Forests in southern India. In August 1856, Dr Cleghorn, along with Mr Jeffrey, Superintendent of the

Madras Agri-Horticultural Society, visited Bangalore to confer with Sir Mark Cubbon, the Chief Commissioner, regarding the establishment of a horticultural garden in the State. Cubbon was very much interested in the development of horticulture and welcomed the idea. The Lalbagh was selected as well-suited for the purpose. It had then an area of 40 acres (16 ha) gently sloping towards the north, and possessed a good soil. It was thus made the Government Botanic Garden, a Government establishment, in August 1856, to carry out the higher objects of horticultural pursuits designed for the improvement of indigenous plants, and for the introduction of exotic plants of economic importance, and supply these to garden-growers in the hills and plains. Another function of the garden was to promote improved cultivation of horticultural plants and to demonstrate the successful cultivation of fruits and vegetables to the people. In Dr Cleghorn's words, "It should be borne in mind that it is not designed as a commercial speculation, that far higher objects are in view, and that injury instead of advantage will ultimately but certainly accrue if the gardens be suffered to enter into competition with the market gardener and drive him out of the field."

Immediate action was taken to set the garden right. In the early part of 1856, Sir William Hooker, Director of the Royal Botanic Gardens, Kew, and Dr Royle were solicited to assist in procuring the services of a skilled superintendent for the gardens. A head gardener by the name of Heeralal was appointed at a salary of Rs 25 to carry out certain works as per the instructions of Dr Cleghorn. A committee consisting of the Secretary to the Commissioner, the Superintendent, Bangalore Division, and Dr Kirkpatrick was set up to take measures to preserve interesting botanical specimens and to make the ground attractive. In two years, much work was done, the drives were broadened and gravelled, an elegant cottage to serve as the dwelling and office of the Superintendent was completed at a cost of Rs 2,000 and the garden wall was built.

After two years, Sir W. Hooker selected Mr William New, who had been in charge of a certain portion of the Kew Gardens and possessed testimonials from the committee of management of the Belfast Garden. He reached Bangalore on 10 April 1858 and assumed charge. Under his superintendence, each succeeding year witnessed improvements; the collection of indigenous and exotic plants was expanded and it became one of the greatest attractions in Bangalore.

New began an organized scheme for the introduction of plants into the Lalbagh. An exchange of plants with other botanical institutions in India and abroad was arranged. A set of fruit-plants—apples, pears, vines, oranges and lemons—was received by New from Ootacamund in 1858. Cleghorn, in his memorandum on the Government Gardens, Ootacamund, on 1 August 1857, writes: "The best varieties of English apples and pears are cultivated. Figs and vines grow well.... Oranges and lemons are bearing fruits. A complete set of trees is about to be supplied to the Bangalore garden, from which, by reason of its central position, I expect there will be a most abundant distribution of valuable products radiating over the country."

New, in his report in 1858-59, writes: "Many of the best kinds of fruit-trees, such as apples, pears, peaches, nectarines, apricots, plums, oranges, strawberries, grapes, figs and limes have been obtained and an adjoining piece of ground set apart for their cultivation." Further, he states: "A set of spice plants have been presented by E.B. Thomas, C.I., Coimbatore. Sir W. Hooker gave a collection of seeds and two cases of plants from North Africa, Teneriff, Madeira and the Azores. Cape plants and the Australian plants are doing well."

To conserve water, the open channels for conveying water from the tank to the lower parts of the garden were bricklined in 1859. The tank bund was improved, and the walk on the bund was formed and extended. As the tank used to dry up in summer, he made three more additional wells and stoned them to supplement the water-supply to the garden. Australian eucalyptus-trees planted by New by the side of the carriage drive, just behind the tank bund, are still growing vigorously. New started the grafting of fruit-trees in the garden, and grafts were made available to growers to encourage fruit cultivation. A library of horticultural books was also assembled.

On Cleghorn's suggestion, for the first time in 1861, New prepared a complete list of the plants in the garden and communicated the same to the Botanic Society of Edinburgh on 11 July 1861. The Society published the list in the same year in its journal.

From this list it is found that the exotic plants introduced before 1861 are numerous, but authentic details as to the time and manner of their introduction are lacking. The following species are included: *Grevillea robusta* (1857, presented by Y. Rhode), *Araucaria excelsa* (1857), *Amherstia nobilis* (1859), *Annona muracata, Averrhoa bilimbi, Poinciana regia, Cassia florida, Carica papaya, Parkinsonia aculeata, Eriobotrya japonica, Casuarina equisetifolia, Castanospermum australe, Araucaria bidwillii, A. cookii, A. cunninghamii, Cupressus* sp., *Dammara robusta, Bixa orellana, Hibiscus rosa-sinensis, Gossypium barbadense, Coffea arabica, Vanilla aromatica, Pisum sativum, Arachis hypogaea, Medicago sativa, Daucus carota, Brassica oleracea, Lactuca sativa, Solanum tuberosum, Beta vulgaris, Myrtus communis, Corypha umbraculifera, C. australis, Amomum angustifolium, Macadamia* sp., *Podocarpus longifolia, Pinus longifolia, P. sylvestris, P. pseudo-strophilus, Allamanda cathartica, Achras zapota, Persea gratissima,* Java fig, mahogany, litchi, guava, pineapple, tobacco and so forth.

New's engagement expired in 1863-64 and, on the recommendation of Sir W. Hooker, the services of A. Black, for some years Keeper of the Kew Herbarium, were secured, and he took charge of the garden in January 1864. He carried out New's plans and policies and kept up the exchange list with other gardens. Dension presented to the garden, in 1864, Australian vines and English strawberry seeds, out of which plants were raised in the garden. Cleghorn gave to the garden, the Chinese varnish tree *(Elaeococca vernicea)*. Kirkpatrick of the Mysore Commission brought to the garden a case of plants—pears, strawberries, quince, Spanish chestnut—and also a collection of seeds from Cape Town, the Natal Gardens, South Africa and Mauritius in 1864. Beddome contributed seeds of rare and interesting plants. A collection of 150 kinds of flower seeds was received from Kew in 1864 during his time. A few very important plants which were introduced into the garden between 1861 and 1874 are : *Averrhoa carambola, Swietenia mahogani, Parkia biglandulosa, Jonesia princeps (Anda gomesii), Kigelia pinnata, Crescentia alata, Filicium decipiens, Caesalpinia pulcherrima, Ceratonia, Magnolia grandiflora, Theobroma cacao, Lantana odorata, Fragaria vesca, Prunus persica, Prunus communis, Pyrus malus, Pyrus communis, Eugenia jambos*, etc.

John Cameron took charge of the garden in 1874. Vigorous and systematic plant introduction and expansion of the garden took place in his time.

Krumbiegel, like Cameron, did experimental cultivation in the field of economic plants, fruits, vegetables and ornamental plants. After Krumbiegel, Rao Bahadur H.C. Javaraya, trained under Krumbiegel and also at Kew, took charge of the garden and improved it.

The birth and growth of the Lalbagh garden led to the development of ornamental gardening and horticulture in the Mysore State. A big collection of ornamental and other horticultural plants, both indigenous and exotic, was made.

Experimental cultivation in the Lalbagh during Cameron's time was carried out on crop plants of economic value. These are mentioned below.

Cotton—Bamiah cotton, American Uplands cotton, Fiji cotton, Egyptian cotton, Nankeen, South Sea Island and Peruvian cottons. *Rubber*—Ceara rubber, Para rubber, African rubber and India-rubber were all tried and multiplied for distribution. *Grape*—Black Hamburg, Gros Colman, Muscat, Black Alicante and Kabul. *Fruit-plants*—apple, apricot, peaches, nectarines, plums, litchi. *Groundnut and potato. Dates and coconuts*, like Siamese and Negro, golden cocoa and green cocoa. *Coffee*—Liberian and Arabian coffees were cultivated, and grafting experiments (Liberian on Arabian stock) were tried.

Jute Cultivation and Jute Industry in Bengal, 1855

In 1793, English traders first shipped 100 tons of jute to England from India to try if it could be used as a substitute for flax and hemp. The mill-owners of Dundee found it a good substitute and further consignments were in demand on a moderate scale. Hand-woven Indian jute good had moreover acquired considerable popularity in Java, Borneo and USA, and the cottage industry continued to flourish till the middle of the 19th century when the powerloom product captured the market.

The year 1855 heralded a new epoch in the history of Indian jute industry, when the first Indian spinning mill was set up at Rishra in West Bengal. In 1859, a power-driven factory with 192 looms was started at Baranagar near Calcutta. By 1885, the number of mills increased to twenty with a total of 6,700 looms, and the demand for raw jute was increasing rapidly. In 1885-86, 897,863 tons of jute valued at Rs 323,491,538 was exported from India. Stimulus to jute cultivation and jute industry was provided by improved communications, viz. railways and steamships.

Cultivation of Tea in North-East India

The honour for the discovery of tea plant in Assam is usually attributed to R. Bruce, who saw the plant growing wild on some hills near Rungapore (Sibsagar), then the capital of Assam, which he visited in 1823 to prosecute certain botanical researches. At the same time he had made an arrangement with one of the Singphos chiefs for a supply of tea plants. Another story attributes the discovery to an Assamese named Moniram Dewan.

At that time Assam was included in the Burmese dominions, and in 1824 the Burmese war broke out and C.A. Bruce, brother of R. Bruce, was ordered to Sadiya in charge of a division of gunboats. On the capture of Rungpore, C.A. Bruce interviewed the Singphos chief who supplied him with tea bushes and seeds, which he planted in his garden at Sadiya. The leaf of these plants was sent to the Botanical Gardens in Calcutta, but whilst it was pronounced to belong to the *Camellia* family and was thought to be a veritable tea plant, it was considered improbable that the Assam species would yield the tea of commerce.

So the matter was dropped until 1833 when C. Bruce took up the question again, and a committee was appointed to journey to Assam and report on the tea growing wild there. The report of this committee stated that the tea plant as it flourished wild in Assam had degenerated and that the importation of China plants was advisable.

Accordingly an experimental plantation was started at Sadiya with seed imported from China. The first tea was planted on a river sand bank near the Brahmaputra and the result was a failure. The next area planted with China seed was at Chabwa in the Dibrugarh District, because near here the Assam bush flourished wild. The result was a success, and Chinese were imported to work the gardens.

Bruce followed up his earlier discovery and later found tea in many tracts, the largest being at Namsang in the Naga Hills. Other big tracts were at Tipam and Gabru.

About the time Chabwa was planted, other small gardens round Tinsukia came up. In 1839 Lakhimpur and Sibsagar became part of the

British Empire, and, soon after, the Government made over all its tea areas, with the exception of Chabwa, which had been sold to a Chinaman, to the Assam Company. In 1852 this company, the first tea company in India, paid its initial dividend. From this time on, the number of tea companies increased rapidly.

Meanwhile in 1855 indigenous tea was found in the Chankhani Hills in Sylhet and tea was planted in Cachar and Sylhet. Later on tea was found wild all along the Khasi and Jaintia Hills, and for some time the presence of indigenous tea was taken as the sign that the area was suitable for tea growth. The first tea in Cachar was planted in village Barsanjan in 1856, on the hill tops which stretched from the Barail range to the Barak. The hillocks were next planted out and in 1875 the first *bheels* (swamps) were drained and planted. In Sylhet the first garden opened was Malnicherra in 1857.

About the same time Darjeeling embarked on the tea venture. By the end of 1856 tea plants had been cultivated at Tukwar, at the Canning and Hope Town plantations, on the Kurseong flats and between Kurseong and Pankhabari. After the industry was established as a commercial enterprise in the Darjeeling District, attention was paid to the Tarai, where Champta was planted in 1862. The land east of the Teesta was soon after explored and Gajaldhoba was planted in 1874, followed later by Phulbari (Leesh River) and Bagrakote. The tea area spread eastwards till it ultimately reached the Sankos, the boundary of Assam. Good *jat* indigenous tea was planted in place of the China bush with which the western Dooars and the Tarai were planted.

During the later decades of the nineteenth century many new gardens were opened out in Assam and were more or less family concerns. The later development has been in the direction of limited liability companies.

The length of the journey from England to India made tea-agency houses a necessity in the earlier days, and today, with improved methods of communication and the shortened journey, the agency system is still in force, for it combines the benefits of a steady policy in garden management and co-operation among sellers in shipping and marketing their crops. Most agency houses also have their holdings in the concerns they manage.

The Indian Tea Association, Calcutta, was formed at a meeting of Calcutta tea agency firms in 1881, the object and duty of the association being to promote the common interests of all persons concerned in the cultivation of tea in India.

The Association started with a membership of companies and estate owners representing a planted area of some 103,000 acres (41,683 ha). In addition, each district has its branch of the Association which deals with problems of local interest.

The tea industry in North-East India has an Association for managing its labour affairs and for recruiting labour. As early as 1859 it was realized that the importation of labour was essential and a Tea Planters' Association was formed for organizing a system of coolie emigration from Lower Bengal to Assam. The sudden expansion of the industry created a class of contractors who supplied labour to the tea gardens. The results were so disastrous owing to competition between contractors that in 1861 Government appointed a committee to enquire into the system under which the emigration of labour was conducted. As a result of this and other enquiries, various emigration acts were passed and finally recruitment by contractors was abolished. At present the only legal form of recruiting is done by garden sirdars working under a licensed local agent. A garden sirdar may be described as an individual employed on an estate as a labourer. The ideal is that such sirdars should recruit in their home district, preferably in and around their own villages. The duty of the local agent is to look after the interests of the garden sirdar.[1]

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CHAPTER 19

LORD DALHOUSIE
1848-1856

THE SECOND ANGLO-SIKH WAR
THE UPPER BARI DOAB CANAL
RAILWAYS, TELEGRAPH AND HALF-ANNA POSTAGE
THE SETTING UP OF PUBLIC WORKS DEPARTMENT, AND THE CONSTRUCTION OF ROADS
SIR CHARLES WOOD'S EDUCATIONAL DESPATCH

Dalhousie was a Scottish noble, who by his practicality and common sense made a mark in Peel's Ministry. He was only thirty-five when he landed in Calcutta in January 1848. 'Small of stature, but with a noble head, a most penetrating glance, and a haughty demeanour, "the little man" of Government House first inspired awe in those with whom he came in contact; then trust; and finally an ardent admiration, in which loyalty to the master mingled strangely with personal love,' observed W.W. Hunter, his biographer, who had served under him.

'The official documents and private papers in which he recorded the results prove that no detail of administrative importance escaped his keen eye while on his tours through the Punjab—from the constitution, distribution, and commissariat of the troops, in regard to which he showed a more exact knowledge than the fiery old Commander-in-Chief, Lord Napier, to the composition of the police, the discipline of the jails, the planting of trees (which led to the true commencement of the Indian Forest Department), the creation of a great system of roads and canals, the provision of schools and hospitals, the abolition of cruel rites, and the reform of the domestic and marriage customs which lay at the root of infanticide in Northern India. Sailing down the Indus, he circled round by Bombay, the Straits Settlements, and Tenasserim back to Calcutta in March 1850.'[1]

The Second Anglo-Sikh War, 1848-49

When Lord Dalhousie came to Calcutta, the Punjab was ruled by a Council of Regency, composed of eight leading Chiefs, with the British Resident, Sir Henry Lawrence, as its Chairman. Rani Jindan, the widow of Maharaja Ranjit Singh, who was suspected of conspiring against the British, was placed under house arrest in the Sheikhupura Fort, and later on was taken to Benares. The Sikh soldiers, who regarded Jindan as the

[1]Hunter, W.W. *Marquess of Dalhousie* (*Rulers of India*), pp. 31, 43

'mother of the Khalsa', were angry at the treatment given to her by the British imperialists. A number of them were dismissed from service by the British and the *jagirs* of some were confiscated. Among the disgruntled Sardars was Chattar Singh Attariwala, the Nizam of North-West Frontier, whose daughter had been betrothed to Maharaja Dalip Singh. The British Resident was reluctant to permit the marriage which would link two influential families. Sher Singh Attariwala, his son, was a member of the Council of Regency. At Multan the patriotic Dewan Mulraj revolted against the British. On learning that his father Chattar Singh's *jagir* had been sequestrated and he had been suspended from the post of Nizam, Sher Singh too revolted against the British.

Battle of Chillianwala—13 January 1849—the Defeat of the British Army

Chattar Singh Attariwala liberated Attock from the British and sent whatever troops he could spare to assist Sher Singh. On 18 December 1848, Sir Hugh Gough, the Commander-in-Chief of the British army, crossed the Chenab with his army. The Sikh and the British armies confronted on 13 January 1849 near the village of Chillianwala. The British launched their attack impulsively. Brigadier Pennicuick's brigade was badly cut up by the Sikhs and flung back. The British charged the Sikhs with their bayonets, and the Sikhs charged the British with their swords and fought bravely. It was a bad day for the British army. The British General, Thackwell, records: "Prince Albert hats and military shoes might be seen in all directions strewn on the ground in great abundance and the camp next day was overspread with general gloom." Nearly 3,000 British lay dead or wounded in the ravines and brushwood. Chillianwala was regarded by the British as a 'wasted battle'. "Chillianwala was the worst defeat suffered by the British since their occupation of India", comments Khuswant Singh. The British pulled out of Chillianwala and retreated across the Chaj to the bank of the Chenab.

George Bruce records, "Dalhousie had decided to sack Gough as Commander-in-Chief in India if he failed again to destroy Sher Singh's army". But such was the outcry in England when the news arrived that at Chillianwala a British army had been fought to a draw by 'a wild Indian people' that the Government forced the directors of the East India Company to act at once and appoint General Sir Charles Napier to replace Gough. Even the eighty-year-old Duke of Wellington said he would go out to India and fight the Sikhs if Napier was unwilling. 'If you do not go I must', he told Napier.

Battle of Gujarat

Before Sir Charles Napier could arrive, Lord Gough, on 20 February

FIG. 18. Earl (Marquess) of Dalhousie. During his tenure as Governor-General, the first railway line was laid near Bombay in 1853, and the telegraph from Calcutta to Agra was laid in 1854. In the same year, the Ganga Canal was opened

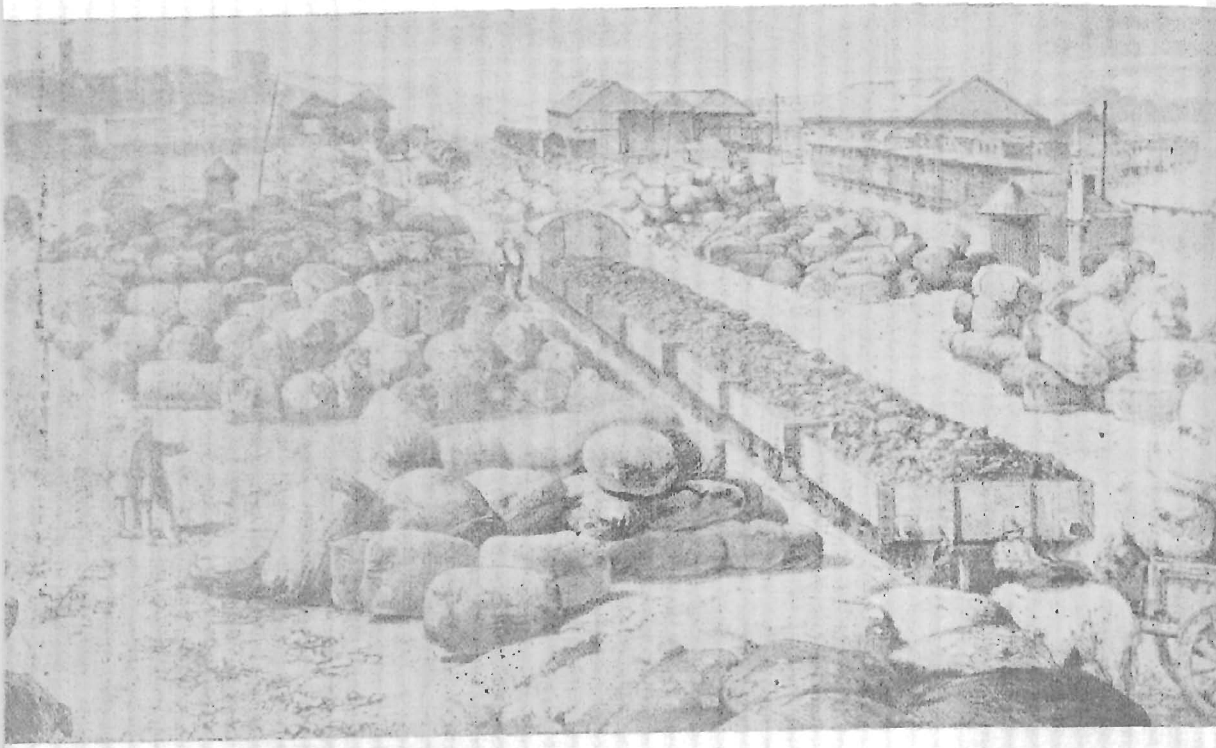

Fig. 19. Cotton bales lying at the Bombay terminus of the Great Indian Peninsular Railway, ready for shipment to England, 1862
(Courtesy: *The Illustrated London News*)

1849, retrieved his reputation, and ended the war by the victory of Gujarat. On 12 March 1849, General Gilbert received the submission of the entire Sikh army at Rawalpindi and the Punjab was annexed outright by Dalhousie.

THE UPPER BARI DOAB CANAL, 1831

To Lord Dalhousie, the Punjab farmer is indebted for the construction of the Upper Bari Doab Canal, whose headworks are at Madhopur, near Pathankot. It was designed to irrigate Majha, the districts of Lahore and Amritsar, the cradle of the Sikh faith. After the annexation of the Punjab by the British, the problem of settling large bodies of disbanded Sikh soldiery became a matter of urgent political necessity. John Lawrence, the Chief Commissioner of the Punjab, continually pressed on the Government of India the expediency of constructing roads and canals, promising that such expenditure would soon return itself tenfold in increased revenue. "If we wish to feed the thousands of human beings," wrote the Lahore Board, "whom the change of rule must necessarily throw out of employment, we cannot more readily do so than by cutting new canals, and improving the beds of the old ones." "Everywhere", responded Lord Dalhousie, "I found lands of vast extent, fertile properties now lying comparatively waste, but wanting only water to convert them into plains of the richest asset to the undertaking"—the Bari Doab Canal—but with a caution that the work should be carried out with "due regard to economy".

'Baird Smith, who had become the most distinguished authority on irrigation in Northern India, was entrusted with the execution of this project. He took advantage of a furlough to Europe to visit Italy, and examine the great canal works of Lombardy and Piedmont. And the East India Company paid his expenses for a similar visit to the United States of America.'[2]

Dyas of the Bengal Engineers was deputed to carry out the field work and to prepare the project estimates, which he submitted at the end of 1850. Work was started on the project in 1851 and was completed in 1859.

The original idea was to utilize, as far as possible, the old Hasli Canal, which had been built by Emperor Shah Jahan, but eventually it was decided that the alignment of the old canal could not be extensively used. Excavation was begun in 1851, but for some years the progress was slow and the results were unsatisfactory. At the time, river hydraulics was a novel science in India, the Ganges Canal—the prototype of all its successors—was still under construction, and on it, as well as on the Bari Doab, the British engineers had to acquire knowledge from the teachings of their mistakes. On the Ravi, the heavy nature of the cuttings, the necessity for a series of falls to regulate a drop of 326 feet (99 m) in the first twenty

[2]Dutt, R.C. *The Economic History of India*, Vol. II, pp. 122, 123

miles (32 km) of the main, and a futile attempt by means of locks to make the canal navigable, added greatly to the difficulties and expenses of the undertaking. However, by 1861, irrigation began, and by 1889 the interest account was cleared, a remarkable achievement for the pioneer canal of the Punjab; commercially its ultimate success had been assured early in the 1860s. With an irrigating capacity of 800,000 acres (423,749 ha), paying on an average five shillings an acre, the net annual return on the capital invested, a million and threequarters sterling, is now 12 per cent.[3]

Later on, some modifications were made in the original project and the canal was opened in 1859. No permanent headworks for the canal were provided, nor were any distributary channels proposed or constructed. As in the case of the Upper Ganga Canal, a temporary weir made of wooden crates filled with boulders was constructed every year after the floods, but it proved ineffective owing to the torrential nature of the river.

The work of construction of a permanent headworks at Madhopur was undertaken in 1868. But before the headworks could be finally stabilized and commissioned in 1876, the structure had been seriously damaged a number of times on account of the violence of the floods in the river. The whole project was revised in 1874 and its scope was extended so as to provide a properly designed distributary system, which had been considered unnecessary to begin with.

An interesting work in connection with the construction of the main canal is the diversion of the Chakki torrent, which originally flowed into the River Ravi and intercepted the canal alignment. In order to obviate a large cross-drainage structure on the canal, it was decided to divert the torrent into the River Beas by cutting through the watershed between the rivers Ravi and Beas. This scheme involved a deep cutting through a hill about 200 feet (61 m) high. The torrent now takes a sharp turn to the left and flows through this enormous artificial gorge to join the River Beas lower down.

The countryside has a steep slope in the first 30 miles (48.3 km) of the main canal, and numerous falls, designed as rapids with a sloping glacis, had to be introduced in order to reduce the slope of the canal.

Owing to the partition of the country in 1947, a substantial part of the area irrigated by the Upper Bari Doab Canal system and the portions of some of its channels were included in the newly created State of West Pakistan. In 1960-61, the canal irrigated 951,000 acres (384,000 hectares), yielding a net return of about 18.3 per cent on the capital invested.[4]

[3]Thorburn, S.S. *The Punjab in Peace and War*, pp. 264, 265
[4]*Development of Irrigation in India*, pp. 69, 70

INDUSTRIAL REVOLUTION (1830-70) IN ENGLAND

To understand the work of Dalhousie in India, his passion for modernization on the Western pattern, it is necessary to know what was happening in England in the first half of the nineteenth century. The Industrial Revolution had entered its second phase. Vast new cities shot up in England and got filled with rapidly multiplying populations. Besides the growth of industry, radically new means of transport had been developed; the railways, which linked up the centres of industry, and the steamships, which collected raw materials and distributed the products far and wide. 'Indeed, where the eighteenth century had found the key to *production*, the nineteenth was to find that of *communication*,' observed Bernal.[5]

The railways and early engines of all sorts were the first triumphs of the new metallurgical methods. Presently came ships of iron and steel, vast bridges, and a new way of building with steel upon a gigantic scale. The steamboat was a little ahead of the steam-engine in its earlier phases. There was a steamboat, the *Charlotte Dundas*, on the Forth and Clyde Canal in 1802; and in 1807, an American, named Fulton, had a playing steamer, the *Clermont*, with British-built engines, upon the Hudson River above New York. The first steamship to put tc sea was also an American, the *Phoenix*, which went from New York (Hoboken) to Philadelphia. So, too, was the *Savannah* (1819), the first ship using steam (she also had sails) to cross the Atlantic. As late as 1847, English steamships were few and small, with a total tonnage of 116,000 out of the three million tons of the whole merchant service. But in the fifties and sixties, the great ocean-going ships were increasingly propelled by steam, and built first of iron and then of steel. The change coincided with the enormous development of English iron and steel output, and the increased use of steam and metal in every sort of manufacturing process and product. In 1848, British already produced about half the pig-iron of the world.

RAILWAYS

RAILWAYS IN EUROPE AND THE USA

In 1804, Trevithick adapted the Watt engine to transport, and made the first locomotive. In 1825, the first railway, between Stockton and Darlington, was opened for traffic. The original engine (Locomotion No. 1, 1825) of George Stephenson still adorns the Darlington platform. In 1830, the first railroad line, between Liverpool and Manchester, was opened up; and Stephenson's "Rocket", pulling a train weighing 13 tons, achieved a speed of 44 miles (70.81 km) per hour.

In France, railways started in 1829, in Germany in 1835, in Holland and Italy in 1839 and in Spain in 1848. The construction of the first rail-

[5]Bernal, J.D. *Science in History*, p. 386

way from St Petersburg, now Leningrad, to the suburbs of Pavlovask was completed by a private company in 1837. The first railway in the United States was opened on a section of 15 miles (24 km) of the Baltimore-Ohio line in May 1830. Initially, it was operated by horses, and later locomotives were employed.

Like any other invention in the early stages, the railways had to overcome a great deal of prejudice, opposition and criticism. It was difficult to convince the common people that a journey by rail was safer than by stage-coach. There is the story of a German doctor who declared that 'it would be impossible for people to watch the trains pass along without going mad, and unless hoardings were erected, cow's milk would turn sour.'

It was not till 13 June 1842, seventeen years after the opening of the first railway line in England, that Queen Victoria advised by her Ministers deemed it safe to take a journey from London to Slough.

In England, as late as 1835, *John Bull* denounced the railways as a menace. "If they succeed', wrote the paper, "they will give an unnatural impetus to society, destroy all the relations which exist between man and man, overthrow all mercantile regulations, overturn the metropolitan markets, drain the provinces of all their resources, and create at the peril of life, all sorts of confusion and distress. If they fail, nothing will be left but the hideous memorials of public folly.'

There were two distinct periods of railway investment and speculation in England, in 1836-7 and in 1844-81.

The original *Bradshaw's Railway Time Table* was issued in 1839 by a friend wishful to help mankind. In 1843, there had been about 2,000 miles (3,219 8m) of railway in Great Britain; in 1848 there were 5,000 (8,047 km).[6]

RAILWAYS IN INDIA, 1853

Credit goes to Lord Dalhousie for providing India with a network of railways. Before coming to India, he was Vice-President of the Board of Trade in Peel's Cabinet, and was actively associated with the railway boom in the United Kingdom. When he mooted the policy of railway construction in India, many people felt that it was a fantastic proposal, and opposed the introduction of railways as a 'hazardous and dangerous venture,' or at best a 'premature and expensive undertaking.' There were many among Britishers in England and in India who felt that even if the railways could be started it would be difficult for them to get any passengers. Doubt was expressed 'whether people would be attracted from the bullock cart to the rail and whether religious mendicants, fakirs, agricultural labourers and other more or less destitute folk who did not "possess an anna" could be

[6]Trevelyan, G.M. *Illustrated English Social History*, p. 133

persuaded to pay a train fare rather than prefer to meander without any sense of time.'

Lord Dalhousie, in a historic minute written in July 1850 from the *hill-station of Chini, in the Himalayas, stated that while he had doubts* 'as indeed every one at that time,' as to whether the railways could be made to pay in India, he was most anxious that 'this so-called "experimental" line should prove a success.' He was then referring to the proposed East Indian Railway line between Calcutta and Rajmahal. He said that its object 'is to prove, not only that it is practicable to construct railways in India, as engineering works, but that such railways, when constructed, will, as a commercial undertaking, offer a fair remunerative return on the money which has been expended on their construction."

BOMBAY PROVINCE

On 16 April 1853, the first railway ran over a stretch of 21 miles (34 km) from Bombay to Thana. The idea of a railway to connect Bombay wit Thana, Kalyan and with the Thal and Bhore Ghats inclines first occurred to Mr George Clark, the Chief Engineer of the Bombay Government, during a visit to Bhandup in 1843. A meeting of prominent citizens was later held at Bombay on 13 July 1844, Sir Erskine Perry, Chief Justice, presiding, 'to consider the advisability of having a railway to be named the Bombay Great Eastern Railway, constructed from Bombay to the Thal Ghats and Bhore Ghats *via* Salsette, in accordance with Mr Clark's scheme.'

Mr George Clark, in the mean time, had prepared detailed plans for a line from Kurla to Thana. This scheme was investigated by a special committee, headed by the Chief Secretary, Mr Henry Conybeare, and was approved by a meeting of the citizens of Bombay held at the Town Hall on 19 April 1845. A railway association was formed for carrying out the scheme.

At the same time, through the efforts of John Chapman and Messrs White and Barnett, Solicitors, Whitehall Place, London, a fresh company was formed in England, called the Great Indian Peninsula Railway Company, and its first prospectus was issued on 15 July 1844. According to a manuscript record left by Sir Jamsetjee Jeejeebhoy, one of the first Indian Directors of the Great Indian Peninsula Railway Company, George Stephenson, the great British locomotive-inventor (1781-1848) was among the first directors of the Company. His son, Robert Stephenson (1803-59), was appointed Consulting Engineer. Later, an influential committee was formed in Bombay to work in conjunction with the London Committee to give effect to the scheme. The Great Indian Peninsula Railway Company was thereafter incorporated in England by an Act of 1 August 1849, and the contract between the Court of Directors and the Railway Company requesting the company to raise a capital of £ 500,000 was made on 17 August

1849. On 14 November 1849, Mr J.J. Berkeley was appointed Chief Resident Engineer. He arrived in India in February 1850, and devoted full twelve months to survey the line.

From then onwards, events moved at a fast pace. On 31 October 1850, the ceremony of turning the first sod for the Great Indian Peninsula Railway from Bombay to Kalyan was performed by Mr J.P. Willoughby, Chief Justice of Bombay, at a place near Sion, in the presence of a large number of notable citizens. This was the first ceremony ever performed in India of laying a railway line, or for that matter in any country in the Middle and Far East. In 1851, a contract was entered into with Messrs Fariell and Fowler, an English firm, for the construction of the railway line to Thana. The firm employed as many as 10,000 workers on construction work.

On 18 February 1852, the first locomotive was witnessed shunting near Byculla flats in Bombay. The engine made its start from a coppice, then known as 'Phips O'art', and the scene of its daily shunting became a perfect fair for large crowds of men, women and children. The locomotive was later named 'Falkland' after Lord Falkland (1848-53), the then Governor of Bombay. On 18 November 1852, the Company's Directors with some of their friends travelled in the first railway train from Bombay to Thana, covering the distance of 21 miles (34 km) in 45 minutes.

The formal inauguration ceremony was performed on 16 April 1853, when 14 railway carriages carrying about 400 guests left Bori Bunder at 3-30 p.m. 'amidst the loud applause of a vast multitude and to the salute of 21 guns.'

Lord Elphinstone performed the opening ceremony on 1 May 1854 of the railway to Kalyan. This extension, according to engineering standards then existing, was a difficult and an outstanding achievement. The railway line from Kalyan to Khopoli was opened on 12 May 1856, whereas the line from Khandala to Poona was opened to traffic on 14 June 1858.

Howrah to Hooghly

The first passenger train steamed out of the Howrah Station destined for Hooghly, a distance of 24 miles (38.6 km), on 15 August 1854. Thus the first section of the East Indian Railway was opened to public traffic, inaugurating the beginning of railway transport on the eastern side of the subcontinent. Mr (later Sir) Rowland Macdonald Stephenson, who became the first Agent of the East Indian Railway Company, brought the Company into being in London in 1844. In the cold weather of 1845-46, a trial survey was made by him from Calcutta to Delhi. After three years of discussion and exchange of notes between the various authorities concerned, the building of the railway to Raniganj was sanctioned as 'an experimental measure'. Of this period Stephenson wrote when he returned to India in 1850: 'Active operations have now at the close of 1850 scarcely commenced. The interval has been occupied with discussions, doubts, objections and their solution and removal.'

By the end of 1853, through the efforts of Macdonald Stephenson, the line was ready up to Pundooah (38 miles=61 km), but two serious mishaps prevented the running of the first train till a year later. The ship bringing the first models of railway carriages, *HMS Goodwin* sank at Sandheads.

South India

In South India, the first line was opened on 1 July 1856 by the Madras Railway Company. It ran between Veysarpaudy and Walajah Road (Arcot), a distance of 63 miles (101 km).

Northern India

In the north, a length of 119 miles (207 km) of line was laid from Allahabad to Kanpur on 3 March 1859 and three years later the Amritsar-Atari section, the northernmost part of the line, between Amritsar and Lahore was opened to traffic. At this stage, the construction of lines, now constituting the North Eastern Railway, was just beginning. The first section from Hathras Road to Mathura Cantonment was opened to traffic on 19 October 1875, to be followed by the section Kanpur to Farukhabad in the winter of 1880-81. Next came the section in the extreme east. Dibrugarh Town to Dinjan opened on 15 August 1882. Construction was also going on farther inland by the Bengal and North-Western Railway where the first section to be opened was Darbhanga to Jhangjharpur on 1 February 1883, to be followed three months later by the sections Bachhwara to Barauni and Barauni to Semaria Ghat.

These were the small beginnings which, in due course, developed into a network of railway lines all over the country. By 1880, the Indian Railway System had a route of about 9,000 miles (14,484 km).[7]

In 1959, when the Government of India celebrated the centenary of its railways, the Indian railways covered 34,000 route miles (54,718 km), of which a fairly large portion is laid with double track. The Railways represent a capital investment of Rs 8,620 million. Their gross earnings in 1951-52 were Rs 2,940 million as against the working expenses of Rs 2,280 million. The annual train mileage covered was 188 millions (302.557 million kilometres), being 14 million miles (22.531 million kilometres) more than the distance between the Sun and Mars. During the same year, railways carried 98 million tons of goods and nearly 1,232 million passen-

[7]Sahni, J.N. *Indian Railways, One Hundred Years—1853 to 1953*, pp. 2-5

gers. The cost of coal alone consumed by railways during his period was Rs 304 million, representing a tonnage of 10.8 million.

'The Railways may do for India what dynasties have never done—what the genius of Akbar the Magnificent could not effect by government—they may make India a nation', wrote Sir Edwin Arnold in 1865. This observation was prophetic, railways, roads and telegraph lines welded a heterogeneous mass of people into the Indian nation in due course.

TELEGRAPH

Concurrently with the development of steam transport upon land and sea, a new and striking addition to the facilities of human intercourse arose from the investigations of Volta, Galvani, and Faraday into various electrical phenomena. The electric telegraph came into existence in 1835. To Lord Dalhousie belongs the credit of introducing and energetically pushing telegraphy in India. By 1857, he had given the country 4,000 miles (64,374 km) of instantaneous communications, including an excellently equipped line from Calcutta to Peshawar.[8]

Half-anna Postage, 1854

In England, penny post was established by Rowland Hill as soon as railways were built. This system of pasting a cheap adhesive stamp on an envelope enabled the poor, for the first time in the history of man, to communicate with their relations and friends from whom they were separated. When Dalhousie came to India, it cost a rupee to send a letter from Calcutta to Bombay. In 1854, Dalhousie reformed the postal system and a uniform half-anna rate was provided for letters, and stamps were substituted for cash payments.

The Setting up of the Public Works Department, 1854

Right up to 1854, the construction and management of all public works, except railways, was entrusted to army engineers (known as Royal Engineers) under the superintendence of a Military Board. Military engineers were employed to carry out the construction of civil works, because in those days it was considered that 'the training obtained in carrying out large railway or irrigation works is that in which Royal Engineers are most likely to gain experience which will make them useful and efficient with an army in the field.' These engineers marched only occasionally to war and, when the fighting ended, most of them returned to continue to do their civil work.

The expenditure incurred on public works, including large irrigation projects, was treated as 'ordinary expenditure', which meant that it was not out of the current revenues of the relevant year and no separate capital

[8]Thorburn, S.S. *The Punjab in Peace and War*, p. 187

or revenue accounts of the various projects were maintained. It was, therefore, not possible to gauge with any degree of accuracy the financial position of such projects or their performance. The defects of this system of financing large productive works from the yearly revenues were soon recognized and it was decided that only public works of a non-remunerative character, such as those relating to the erection and maintenance of civil and military buildings, the construction and maintenance of roads and other such works were to be charged against yearly revenues, whereas works calculated to increase the wealth and promote the prosperity of the country, such as railways, canals and harbours, were to be constructed from borrowed funds and treated as commercial undertakings and for such works separate capital and revenue accounts were to be kept.

The Public Works Department was organized in 1854 and, as there was a dearth of civil engineers in the country, the burden of shouldering the civil engineering works fell on the military engineers. Thus, a number of military engineers were assigned to the P.W.D. on a permanent basis. With the demands of civil engineering increasing progressively, the Public Works Department was divided into two branches in 1866, viz. the Civil Works Branch, including irrigation, roads, etc., and a Military Works Branch.

By 1895, however, the Military Works Branch grew to such a size that it was organized into a separate Military Works Department, so that the Public Works Department became purely civilian. Even so, most of the top engineers of the Public Works Department continued to be drawn from the cadre of military engineers. Gradually, the military engineers were replaced by civil engineers, as the latter grew in number and gained experience.[9]

The Construction of Roads

To the British administrators, the Punjab in 1850, with its thirsty plains, unutilized rivers, and thin population, was like a newly discovered country with great natural resources awaiting development. Guided by the Lawrences, John and Henry, the business of administration, the foundations of which had been laid during the later period of the regency, went on apace. In the domain of public works, the impress of the directing minds and hands naturally began to show results. Roads were laid out, bridged, and policed between all important centres, and the continuation of the Grand Trunk Road, already indifferently made from Calcutta to Delhi—a distance of 1,000 miles (1,609 km)—was planned, and the construction begun in sections for the remaining 520 miles (836.9 km) to Peshawar. The new work—wider, smoother, harder, straighter for longer distances, and better and more durably bridged than any Roman road—was the greatest undertaking of the kind heretofore

[9] *Development of Irrigation in India*, pp. 44, 45

attempted in Asia. Lord Dalhousie was essentially the great road-maker of India. Before him, the East India Company had cared little for roads—in the rainy season "the roads that run," as the navigable rivers are called in Russia, were thought good enough for trading purposes, and at other times, the whole country was a highway, for bullock-carts were not much used and pack-carrying animals could take a bee-line in any direction. Even the Grand Trunk Road from Calcutta to Delhi, though aligned in 1795, was until 1849 rough and unsatisfactory, without a single masonry bridge throughout its whole length. During Lord Dalhousie's eight years of office (1848-1856), crores of rupees were spent on the neglected arteries of commerce; probably his most useful achievement was his completion of Asia's greatest highway to and beyond Delhi, and the planning, cutting, and opening of some of the sections of its extension to Peshawar.[10]

EDUCATION—WOOD'S DESPATCH

Lord Hardinge gave support to the cause of English education in India by making a knowledge of it essential for prospects in Government service. His Educational Despatch of 10 October 1844 declared that "in every possible case a preference shall be given in the selection of candidates for public employment to those who have been educated in the institutions thus established and specially to those who have distinguished themselves therein by more than ordinary degree of merit and attainment.

In Bengal, the number of schools under the control of the Council of Education rose from 28 in 1843 to 151 in 1855, and the number of pupils from 4,632 in 1843 to 13,163 in 1855.

Lord Dalhousie took interest in mass education. He desired to "establish a complete class of vernacular schools, to extend throughout the whole of India, with a view to convey instruction to the masses of the people." He also proposed to place the higher education of the people, on "a footing adequate to the wants of the community, and worthy of the Government of of the Hon'ble Company." With the encouragement of the Governor-General, the local Government in Bengal, Bombay and the Punjab extended encouragement to vernacular education.

A highly significant step regarding education in India was soon taken by the Company's Government. The Educational Despatch No. 49, dated 19 July 1854, drafted by Sir Charles Wood, President of the Board of Control, imposed upon the Government the duty of "creating a properly articulated system of education, from the primary school to the University."

This Despatch is described as the "Magna Carta of English Education in India", and formed a landmark in the history of education in modern India. It outlined a comprehensive plan which supplied the basis for the

[10]Thorburn, S.S. *The Punjab in Peace and War*, pp. 162-163

subsequent development of educational system in the country. This Despatch recommended the following measures for the attainment of these objects: (1) the constitution of a separate department of the administration for education; (2) the institution of universities at the Presidency towns; (3) the establishment of institutions for training teachers for all classes of schools; (4) the maintenance of the existing Government colleges and high schools and the increase of their number when necessary; (5) the establishment of new middle schools; (6) increased attention to vernacular schools, indigenous or others, for elementary education; and (7) the introduction of a system of grants-in-aid. The attention of the Government was "specially directed to the importance of placing the means of acquiring useful and practical knowledge within reach of the great mass of the people. The English language was to be the medium of instruction in the higher branches, and the vernacular in the lower. English was to be taught wherever there was a demand for it, but it was not to be substituted for the vernacular languages of the country. The system of grants-in-aid was to be based on the principle of perfect religious neutrality.... A comprehensive system of scholarships was instituted so as to connect lower schools with higher, and higher schools with colleges. Female education received the cordial support of Government."

A Director of Public Instruction was appointed in each Province, with a staff of Inspectors and Deputy or Assistant Inspectors. The Education Department in each Province came directly under the Provincial Government.

It was noted in that Despatch that the time had arrived for the establishment of universities in India, which may encourage a regular and liberal course of education, by conferring academical degrees, as evidence of attainments in the different branches of arts and science.

The University of Calcutta was incorporated by an Act, passed on 24 January 1857; the University of Bombay by an Act passed on 18 July 1857; and the University of Madras, by an Act passed on 5 September 1857.

Each of these universities had at first the four Faculties, namely those of Arts-cum-Science, Law, Medicine and Engineering, to which was added subsequently a separate Science Faculty. These universities remained affiliating and examining bodies. As regards technical colleges, there were two colleges of Engineering, one started at Roorkee in the North-Western Provinces in 1847, and the other was the Calcutta College of Engineering, opened at the Writers' Buildings, Calcutta, in November 1856. The Overseer's school of Poona was raised to the status of the Poona College of Engineering and affiliated to the Bombay University in 1858. In the Madras Presidency, the industrial school attached to the Gun Carriage Factory became Guindy College of Engineering and was affiliated to the Madras University in 1858. Medical training was being imparted in the medical colleges in Calcutta, Bombay and Madras, and in the Lahore Medical School. The Law Department was attached to arts colleges, and separate law colleges came into existence later.[11]

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CHAPTER 20

CANNING TO LAWRENCE

1856-1869

THE BENGAL RENT ACT, 1859
INDIGO PLANTERS AND DISCONTENT AMONG THE GROWERS OF BENGAL AND BIHAR
TENANT ACT OF 1869 FOR THE PUNJAB
MADRAS DEPARTMENT OF AGRICULTURE
TEA CULTIVATION IN KANGRA VALLEY
BRITISH ORCHARDISTS IN KULU VALLEY
IRRIGATION POLICY
INDIAN CATTLE PLAGUE COMMISSION

EARL Charles John Canning (1812-1862), the youngest son of George Canning, was a member of the British Parliament from 1836. He joined the Cabinet of Sir Robert Peel in 1841 as Under Secretary of State for Foreign Affairs. From 1846, he was Commissioner of Woods and Forests. Lord Aberdeen appointed him Postmaster-General in 1853. After three years, Palmerston's Government appointed him Governor-General of India in 1856.

On 10 May 1857, Indian soldiers revolted at Meerut. They shot their British officers and marched off to Delhi, where the Indian garrison joined them. Thus began the Indian Revolt of 1857. Ultimately, the British were able to suppress the uprising. On 8 July 1858, Canning proclaimed peace. He followed a policy of reconciliation, when the other Britishers were for seeking vengeance and unbridled repression. While others were angry and mad, Canning kept calm.

REORGANIZATION OF FINANCE

James Wilson, a sound political economist, and for some time Financial Secretary to the Treasury, was sent out as the first Financial Member of Governor-General's Council. He created a State paper currency and imposed a licence tax and Income-tax to meet the growing expenditure. He also introduced the practice of annual budgets and statements of accounts. Wilson was succeeded by Samuel Laing, who enhanced the salt duty. Laing also made the discovery that the revenue of India was buoyant and elastic to an exraordinary degree. Helped by good rainfall, the annual deficit disappeared in 1864.

Canning encouraged the Indian princes to take interest in the economic development of their States. Roads and railways were built, and industries and education were promoted in backward and stagnant areas.

Law

The Indian Penal Code was enacted in 1860 and the Code of Criminal Procedure in 1861. These Codes form the basis of the Indian legal system.

The Bengal Rent Act, 1859

'In no period of modern Indian history—except under the beneficent rule of Lord William Bentinck—were so many great reforms crowded within so short a period as during the administration of Lord Canning', observed R.C. Dutt. 'The greatest of his tasks was to promote the agricultural wealth of India—to secure to the tillers of the land the profits of cultivation.'

The Bengal Rent Act of 1859 gave occupancy rights to all cultivators who could prove the possession of land for twelve years, and limited the raising of rents. The Act applied to the whole of the north-west, except the Punjab and Oudh. The Act not only gave an adequate protection to the cultivators of Bengal, but helped his successors to pass similar Rent Acts for other provinces of India.

Reorganization of Government Machinery

Drastic changes took place in administration after the great uprising had been suppressed. The Government of India Act of 1858 deprived the Company of the Indian Government. The Secretary of State for India took the place of the President of the Board of Control. The Governor-General, as Viceroy, became the personal representative of the Sovereign. The Executive Council was expanded and the portfolio system was introduced, with members in charge of specific departments. Next came the reorganization of finance. With the railways and steamships, India passed from the self-contained rural economy into the orbit of world economic forces. Now expert advice was needed to restructure the finances.

Indigo Cultivation and Discontent among Growers in Bengal and Bihar

The importation of indigo from India into England commenced about 1790, and had so greatly increased by 1830 as to supersede all other indigos. The cultivation was carried on from Dacca to Delhi, and the exportation was £ 9,000,000. The amount annually paid as rent and labour by the British planters was £ 1,680,000; the commodity on its arrival at Calcutta was valued at £ 2,403,000 and was realized in England to the tune of £ 3,600,000. There were 300 or 400 factories in Bengal, chiefly in Jessor, Krishnaghar and Tirhoot, and in the Champaran District of Bihar. The best soils for growing indigo were those subject to inundation from the Ganges.

As the old Indian method of manufacturing indigo was imperfect, the

East India Company advanced money to European planters for the production of the article, and began making large remittances of indigo to England in 1819. What caused the great and sudden prosperity of the indigo trade in Bengal was the destruction of St Domingo in the West Indies, which had supplied nearly all the world with indigo previous to the French Revolution, and did not produce a single pound of indigo after the rebellion of the black population, who destroyed the indigo factories.

The indigo-planters and the traders of Bengal and Bihar were a low type of whites, who thought that they were above the law and could do as they liked. They committed acts of violence against the poor growers and treated them like animals. They used to confine them in stocks to recover balances. They also resorted to rattan. In 1810, the Government was compelled to issue a circular, which directed magistrates to cause the destruction of the stocks, to report cases of flogging and inflicting corporal punishment on the cultivators, and to prevent the European planters from residing in the interior unless they conformed with the spirit of the Government orders. A further circular, issued on 20 July 1810, directed magistrates to report cases in which the indigo-planters compelled the cultivators to receive advances, and adopted illicit means to compel them to cultivate indigo.

John Beams, who had come to Bihar as the Collector of Champaran after serving in the Punjab, thus describes how the indigo-planters functioned in Bihar, about the middle of the nineteenth century.

'The original founders of the Champaran 'concerns', as they were called, had made their fortunes and retired to England, leaving their concerns in the hands of managers, many of whom were rough, uneducated men, hard drinkers, loose livers and destitute of sympathy for the natives. The concern had been built up on this wise. The Maharaja of Bettiah, a very wealthy zamindar, owned the land of the whole district, with very few and petty exceptions. His practice was to let out the villages in his estate for long terms of years to farmers called '*mustajirs*', who agreed to pay him a fixed yearly rent, recouping themselves by levying the rents from the villagers. An Englishman would obtain from the Maharaja a long lease of a group of contiguous villages—fifteen or twenty perhaps. In this area, which he called his *dihat* (a Persian word meaning villages), he built one principal and several subordinate factories. Then he sent for the headmen of each village and compelled or coaxed them into signing a document by which they agreed for themselves and all the cultivators to grow indigo on a certain proportion of their lands, generally four cottas in every bigha, that is to say, one-fourth of the whole area. When the season for sowing came round each ryot received a quantity of seed sufficient to sow his land, also a small advance of money for expenses of ploughing, sowing, weeding, etc. At the harvest time the ryot had to cut the indigo and carry it to the factory where it was duly measured and paid for at a certain rate, after deducting the amount previously advanced. If the amount of indigo plant delivered by the ryot fell short of the quantity which, according to the planter's estimate, ought to be the outturn of the seed sown, a proportionate sum of money was deducted from the payment. In this way the ryot was always in debt to the factory, and it was the planter's interest to keep him so.'[1]

The oppression of indigo-planters in Bengal and Bihar continued for half a century. Dina Bandhu Mitra, the dramatist of Bengal, exposed the oppression of the planters in his memorable drama, entitled *Nil Darpan*, the Mirror of Indigo. The Rev. James Long, who translated this work into English in 1860, was fined and imprisoned by the High Court of Calcutta. Such were the feelings of the English judges, who desired that this evil should remain unexposed. Ultimately, the people of Bengal rose and resisted. The cultivation of indigo by the European planters terminated in most parts of Bengal after the Indigo disturbance of 1859-1860. Canning, with the support of the Home Government, put a stop to the oppression of the indigo-planters, and the cultivators of Bengal and Bihar were no longer compelled to grow indigo against their will or interests.

The indigo cultivation in India collapsed in 1897 owing to competition with German aniline dyes.

JAMES BRUCE ELGIN I

James Bruce Elgin I (1811 to 1863) was elected to the British House of Commons in 1841. In 1846, he was appointed Governor-General of British North America. He was the Postmaster-General of England from 1859 to 1860. He was appointed Governor-General and Viceroy of India in 1862.

In 1862 the Agri-Horticultural Society of Nagpur was established. In January 1863 the first Agricultural Exhibition was held at Calcutta. What was the role of Elgin I in this work is not clear.

Elgin's tenure was brief. He died on 20 November 1863 at Dharmsala in the Kangra District (now in Himachal Pradesh).

MADRAS DEPARTMENT OF AGRICULTURE, 1863

To Sir William Denison, Governor of Madras, is to be ascribed the credit of founding in 1863 the Madras Department of Agriculture. But his Government fell into the mistakes of turning for aid to the West, and their first act was to order from England a steam plough, some harrows and cultivators, seed-drills and horse-hoes, threshing-machines and winnowers, chaff-cutters and water-lifts.

To find employment for this elaborate consignment Saidapet farm was

[1]Beams, John. *Memoirs of a Bengal Civilian*, pp. 172, 173

started in 1864, and entrusted, as a "model farm", to a committee of amateur enthusiasts, who boldly undertook to conduct

(i) a full trial and exhibition of the agricultural implements received from England;

(ii) a full trial of artificial manures;

(iii) an exhibition to the people of the improved system of agriculture.

This committee laboured on heroically at its great task till 1871, when it was dissolved and the farm passed to official control.

A farm was opened in 1904 for the study of groundnuts in South Arcot district and another on the West Coast to investigate the diseases of pepper. These farms were managed by revenue inspectors trained by, and working under, Benson, Deputy Director of Agriculture, a trained European expert.

The Madras Irrigation Company

This company was formed in 1863 under the 'guarantee' system with a capital of one million pounds, upon which the Government of India guaranteed a return of 5 per cent. The Government was to collect water charges from the cultivators and hand over the receipts to the company. It kept half the profits in excess of 5 per cent and retained the right to purchase all the shares, after 25 years, at their average market price.

The scheme which was taken up first, consisted of a main irrigation-cum-navigation canal fed by three reservoirs upon three tributaries of the River Tungabhadra in south India. The canal, extending from the River Tungabhadra near Hospet to Kistnapatam on the east coast, was to be built in three sections, but only the central section of the canal from Sunkesala to Cuddapah, now known as the Kurnool Cuddapah Canal, was ever taken in hand. The expenditure on this section of the canal sky-rocketed and the Secretary of State for India had to advance a loan of £ 600,000 to complete the work on this section. Further work was stopped for want of funds. The revenue returns were insufficient even to meet the working expenses and the Government ultimately had to buy out the company in 1882, for £ 1.18 million. In addition to this amount, the Government had to write off the recovery of £ 1.50 million of loans given to the company. The entire operation showed great carelessness and inefficiency on the part of the company and the canal had to be classified as unproductive, although a yield of 20 per cent on capital outlay was envisaged when the work was taken in hand. The company had also started the construction of the Sone Canals Project in Bihar but, as it failed soon after, the project was taken over by the Government.[2]

JOHN LAIRD MAIR LAWRENCE

John Lawrence (1811 to 1879) had the background of administrative

[2] *Irrigation Development in India*, pp. 46, 47

experience in Delhi and the Punjab. In 1830 he was put in charge of Panipat Division, where he acquired a deep understanding of the plight of the cultivators. In 1846 he was appointed administrator of the Punjab, and from 1853 to 1859 Chief Commissioner of that Province. He was appointed Governor-General at the end of 1863 and he arrived at Calcutta in January 1864. He knew the people of India as few Englishmen ever knew them and he was fortunate in his Councillor. Henry Sumner Maine, the greatest English jurist of the time, was his Legal Member. Sir Charles Trevelyan, who had been the colleague of Bentinck and Macaulay thirty years before, was his Finance Minister.

India was visited by a number of calamities during his five years' tenure. In 1864, about thirty-thousand people perished in Bengal on account of a cyclone. In 1865 there was famine in Orissa, which claimed 1.5 million lives. In 1868-1869 there was famine in Rajputana and the Upper Provinces.

In 1867 Lawrence secured the sanction of the Home Government for the financing of productive works by means of loans and this measure became a recognized feature of financial policy, which promoted the construction of irrigation works and railways. Besides, fixed yearly grants were made to the provinces, subject to revision every five years.

There was improvement in communication during his tenure. The European Telegraph from Turkey, Iran and Karachi was opened, and Delhi and Ambala were linked by a railway. In 1867, the Indian Museum was opened at Calcutta.

Land Policy

The land question was eternally before the Government. Lawrence pursued the same policy in Oudh and in the Punjab as Canning. Agreeing with Canning, Lawrence recommended a Permanent Settlement of the State demand from the soil in all provinces of India. His aim was to form a strong rural middle class, and to promote the agricultural wealth of the people.

The Tenant Act (Act xxvii of 1868) saved the cultivators of the Punjab, while recognizing the claims of the landlords. "The Act regulated and defined the position of tenants with rights of occupancy; it protected them against enhancement, except under peculiar conditions; it recognized their power to alienate tenures; it limited the privilege of the pre-emption and gave the option to the landlord; and, with almost prophetic apprehension of the points at issue in Ireland, it defined the improvements which might be made by the tenant, and specified the compensation which he might look to receive."

Tea Cultivation in Kangra Valley, 1850

In 1849, Dr Jameson, Superintendent of the Botanical Gardens, North-

West Provinces, Saharanpur, visited Kangra District to ascertain its fitness to grow tea. His opinion being very favourable, three Government nurseries were started with young plants from Almora and Dehra Dun at Kangra, elevation 2,500 feet (762 m), Nagrota, 2,900 feet (883.9 m) and Bhawarna 3,200 feet (975.4 m). For a variety of causes the Kangra nursery did not succeed, but in the other two the plants flourished. It was China plant (*Camellia sinensis*) which was introduced in Kangra valley, and it thrived.

The next step was the establishment in 1852 of a Government plantation at Holta near Palampur at an elevation of 4,200 feet (1,280.2 m), and its success led in 1859-1860 to the introduction of private enterprise and capital. In 1860 the Holta plantation produced 29,312 lb (13,296 kg) of tea.

The area under tea in the District in 1892 amounted to 9,537 acres (4,859.5 ha); of which 8.047 acres (3,256.5 ha) were in Tahsil Palampur, 1,400 acres (566.5 ha) in Tahsil Kangra, 89 acres (36 ha) in Tahsil Kulu, and one acre(0.4 ha) in Tahsil Nurpur. Of the whole about 3,943 acres (1,595.6 ha) were owned by European proprietors and the remaining 5,594 acres (2,263.8 ha) by Indians. There were altogether 34 gardens owned by Europeans, varying in size from 10 acres (4 ha) to 612 acres (247.7 ha) of tea. Of these 34 gardens, three were owned by large Companies registered under the Limited Liability Act, two were large unregistered Companies, and the remainder were smaller estates each owned by one or more proprietors—the outturn of gardens owned by Europeans in 1892 was slightly over 1,000,000 lb (453,592 kg). The average production of the whole district increased from 1,799,603 lb (816,286.5 kg) per annum in 1890-94 to an estimated quantity of 2,000,000 lb (907.184 kg) in 1918. Of this latter quantity some 300,000 lb (136,078 kg) was black tea and the remainder green. The Kangra Valley produces nearly half the green tea manufactured in the whole of India, and it is exported to Afghanistan and Iran.[3]

BRITISH ORCHARDISTS IN KULU VALLEY, 1870

The pioneer of the Kulu fruit industry was Captain R.C. Lee, who retired from his regiment, the Royal Sussex, in 1870, bought some land at Bundrole half-way up the valley, and built himself a comfortable house. He was a Devon man and noticed that the warm climate together with the heavy rainfall of the sub-division was not unlike that of the West Country in England, so he sent for fruit trees from his father's estate: apples, pears, plums and cherries. Though some of his land, according to the custom of the country, had to be worked by tenant farmers, he managed to cultivate a part of it himself and planted the first of the Kulu orchards, now famous throughout India.

[3]*Punjab District Gazetteers*, Vol. VII, Part A, Kangra District, 1924-1925

A few years later an Irish friend of his, Captain A.T. Banon, retired from his regiment, the Munster Fusiliers, and also settled in Kulu, bought land in what is now the great tourist centre of Manali near the northern end of the valley. He, too, planted orchards and the example of these officers was soon followed by the British families already settled in the valley such as the Minnikin's and the Rennick's, by subsequent planters, and eventually by the Kulu cultivators themselves.

In those early days the favoured varieties of apples were Cox's, Blenheim orange, Newton and Russet; and Marie Louise and William pears.[4]

Irrigation Policy, 1866

In 1863 the East India Irrigation and Canal Company started its operations in the coastal plains of Orissa and adjoining areas, to construct a series of canals. However, this venture failed and Government of India had to take over the incomplete works.

On the initiative of Lord Lawrence, in 1866, radical changes were made in the principles and the policy governing the execution and financing of irrigation projects.

Three major policy decisions were taken:

(1) Irrigation projects would, in future, be constructed by the State through its own agency,

(2) Irrigation projects would be financed from public loans raised specifically for the purpose, and

(3) Political boundaries would not be allowed to come in the way, when the best possible utilization of water of a river for irrigation purposes was being considered. It was stated that only those projects should be entertained by Government of India which are "the best that can be devised irrespective of the territorial boundaries of British and native States, in the benefits of which the native States should be allowed to participate on like terms with our own subjects."

These decisions gave a great fillip to construction programmes all over India. As a result of the acceptance, by the Secretary of State for India, of the principle of financing productive works by loans raised in the open market a number of projects were taken in hand, the five larger projects being the Sirhind Canal in the Punjab; the Lower Ganga and Agra Canals in United Provinces (now Uttar Pradesh); the Lower Swat Canal in the North-West Frontier Province (now in Pakistan) and the Mutha Canals in Bombay Presidency (now Maharashtra).

Appointment of a Select Committee on Indian Public Works, 1879

In order to safeguard the loan capital raised for the execution of irri-

[4]Penelope Chetwode, *Kulu—The End of the Habitable World*, pp. 128, 129

gation projects, the Parliament of England appointed a Select Committee on Indian Public Works in 1879 to suggest specific measures for the purpose. As a result of the recommendations of this committee, the Parliament in 1879, decided that the results of irrigation works in India should be tested by their financial returns. It was stated that "the financial results of works of irrigation are in the opinion of the Committee the best test of their utility". In other words, an irrigation project should be able to earn sufficient revenue so as to pay a certain minimum return, after deducting all working expenses, on the sum at charge by the tenth year of its completion. This criterion has come to be known as the 'Productivity Test' for a major project. If a major project satisfied the 'Productivity Test', it was classed as 'productive', otherwise it is classified as 'unproductive'.

Indian Cattle Plague Commission, 1869

A problem which attracted the attention of Lord Lawrence was that of rinderpest, which was then known as cattle plague, and caused heavy mortality among cattle. Interest in the problem was roused by the report of Dr K. McLeod, Civil Surgeon of Jessore, who showed interest in the diseases of cattle in the Bengal Presidency. Stirred by his report, in 1869, the Government of India announced the appointment of an Indian Cattle Plague Commission with joint veterinary, medical and lay personnel. Bombay Government was asked for the services of Hallen, first as a member and later as President of the Commission; and his colleagues were McLeod, A.C. Mangles, a Bengal civilian, Babu Hem Chander Kerr and Mirza Mohammad Ali Jan. McLeod consented to act as Secretary, and a great deal of the credit for compiling this monumental work goes to him.

Originally, it was intended that the enquiry should be restricted to Bengal, N.W. Provinces and Oudh, but the Commission was able to extend it to cover the whole of India. Both in a qualitative as well as in a quantitative sense, the enquiry was exhaustive and, in addition to epidemic diseases, dealt with the supply of meat and milk to Calcutta, the hides industry, cattle-poisoning, veterinary education and cattle-breeding.

The list of diseases of horned stock, as requiring special attention, and included by the Commission in their report was as follows: rinderpest, foot-and-mouth disease, hoven, quarter ill, pleuro-pneumonia, purging, cystic disease and malignant sore throat (haemorrhagic septicaemia).

The most important recommendations of the Commission are enumerated below:

When a disease breaks out, it should be the subject of a special enquiry by committees or skilled agents. An accurate census should be taken before and after the outbreak. Systematic storage of fodder and the preservation of pasture lands are important. Herding and moving cattle during an outbreak should be regulated. Large fairs should be subject to skilled inspection and sanitary precautions. The hide trade is a source of danger and should be regulated. Slaughterhouses should be under skilled supervision. Government cattle should be placed under veterinary charge. A law should be enacted for the repression and prevention of the spread of disease. A veterinary school for the training of a skilled subordinate agency should be organized. Such agents should be attached to municipalities and collaborate to investigate disease and apply preventive and remedial measures. A yearly summary of all the information collected should be prepared and the preparation of this report should be the duty of some particular individual office or department.'[5]

Development of Silk Industry

In 1868, Madras Government opened a silk factory at Hosur. In 1869 sericulture was taken up in Kashmir and manufacture of silk was made a state monopoly.

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CHAPTER 21

EARL OF MAYO

1869-1872

CONSTRUCTION OF RAILWAYS, DIGGING OF CANALS ORGANIZATION OF A DEPARTMENT OF KNOWLEDGE AND STATISTICS ANIMAL HUSBANDRY, FISHERIES, AND DEPARTMENT OF FORESTS

On the retirement of John Lawrence, the Earl of Mayo, who was Disraeli's Chief Secretary for Ireland, was appointed Governor-General and Viceroy of India. He took charge of the Indian Administration at Calcutta on 12 January 1869. At that time, he was aged forty-six. An Irish nobleman of ancient descent, he had great interest in agricultural development. Out of the Governors-General of India, he was the only one who had been a practising farmer. A squire's son, he lived at Hayes, about twenty-two miles (35.4 km) from Dublin. As a boy, he was interested in Natural Science, collected fossils and made a small private museum. When he grew up, his father gave him a farm to manage. He set about in right earnest, draining and improving the farm, attended markets, selling cattle, and took interest in stock-breeding and farmers' clubs.

'He possessed all the kindly sympathies and generous impulses of his countrymen. His genial and affable disposition disarmed opposition; his strong capacity for work secured efficient administration; and his faithful adherence to the interests of peace enabled him to continue the policy of his predecessor. His dignified demeanour impressed all,'[1] observes Romesh Dutt.

His first task was to improve the finances. The financial deficit left by Lawrence was wiped out by increasing the salt duty and income tax, and by enforcing economies. Annual grants to the provinces were substituted by fixed block grants over a period of five years. Thus an incentive was provided for economy since savings in one department in a year could be used in another, instead of reverting to the central exchequer. Rigid economies were enforced in the administration of the Department of Public Works. Having made these economies, he felt, he was then in a position to launch development projects.

Famines

One of the scourges of India which occurred periodically was the famine. Mayo believed that famine in India is not to be dealt with spas-

[1]Romesh Dutt. *The Economic History of India, In the Victorian Age, 1837-1900,* Volume II, p. 182

modically, but ought to form a subject of continuous and effective measures on the part of the Government. 'By the construction of railways and the completion of great works of irrigation,' runs one of his earlier notes, 'we have it in our power, under God's blessing, to render impossible the return of those periodical famines which have disgraced our administration and cost an incredible amount of suffering, with the loss of many millions of lives'. The three weapons by which Lord Mayo came to the aid of the Indian population in its struggle against the physical calamities of nature, were roads, railways, and canals.

Railways

From the end of 1853, India had 21½ miles (34.6 km) of railway. Until the beginning of 1869, when Lord Lawrence left the country, about 4,000 miles (6,437.4 km) of railway had been opened. At the end of Mayo's rule, India had 5,073 miles (8,164 km) of railways. The mileage of Indian railways increased by more than twenty-five per cent during his regime.

Canals

The Ganga Canal was extended, and after seventeen years of deficit took its place as a work no longer burdensome to the State. A new irrigation system, starting from the Ganga opposite Aligarh, and which irrigated the whole lower part of the Doab from Fatehgarh to Allahabad, was commenced. The eastern half of Rohilkhand and the western districts of Oudh were protected from famine by the Sarda Canal. Similar works for western Rohilkhand were carried out by a canal from the Ganga. Plans were prepared, and the sanction of the Secretary of State was obtained for a project which would bring the waters of the Jamuna to the arid tracts on the west of Delhi. Whereas the Western Jamuna Canal was thus to receive a vast extension, the Lower Jamuna Canal was pushed forward in the districts to the south-east of Delhi. Proceeding farther down the Gangetic Valley, works of equal promise were carried on from the Sone River through the province of Bihar. On the sea-board, in Orissa, a vast system of canals was developed. Whereas in the far west, projects for the drought-stricken districts of Sind were drawn up and investigated, in the Bombay and Madras Presidencies and in the provinces, many works of great local utility, although of less conspicuous extent, were initiated, pushed forward, or matured.

Compulsory Water-rate

A problem, which rose with the construction of the canals was that, while the land-owners made good use of canal water during the drought years, in the years of good rainfall, they made little use of canal water. Mean-

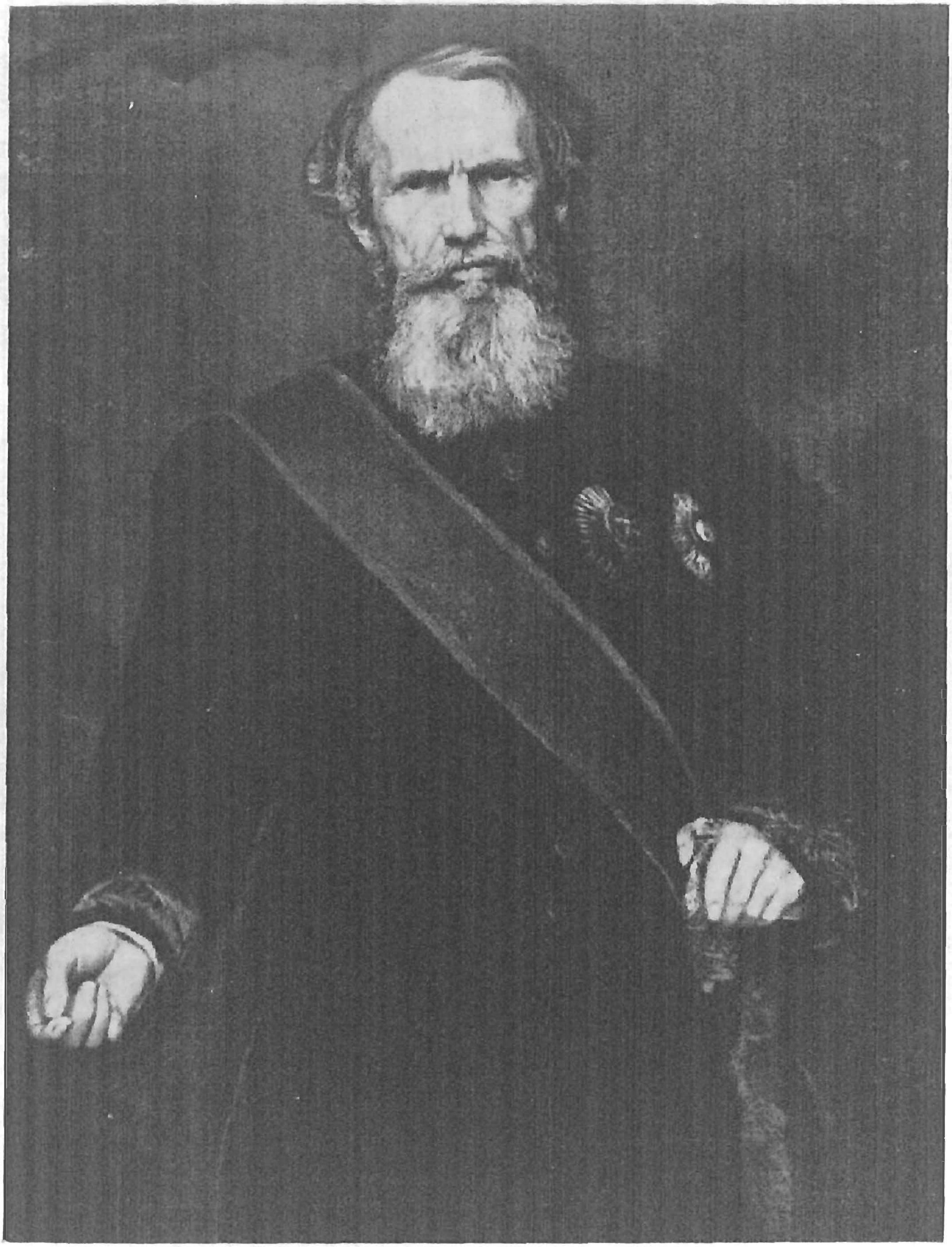

FIG. 20. Sir John (Lord) Lawrence, Governor-General of India, 1864-1869. During his regime, the Punjab Tenancy Bill was passed in 1868 to protect the interests of the tenants. He appointed the Cattle Commission in 1869
(Courtesy: Rashtrapati Bhavan, New Delhi)

Fig. 21. A photograph taken in 1897 at Mukteswar on the occasion of the visit of Robert Koch. *Sitting*, L to R: Alfred Lingard, Robert Koch, Pfeiffer, G. Gaffky. *Standing*, L to R: F.H.S. Baldrey (second from left), H.T. Pease (third from left). Lingard was the first Imperial Bacteriologist, with the responsibility of research on rinderpest and other animal diseases. He acquired research experience under Koch, the famous German bacteriologist, who discovered the vibrio that causes cholera and formulated rules for control of cholera. He worked in India on malaria, blackwater fever and the surra disease of cattle and horses

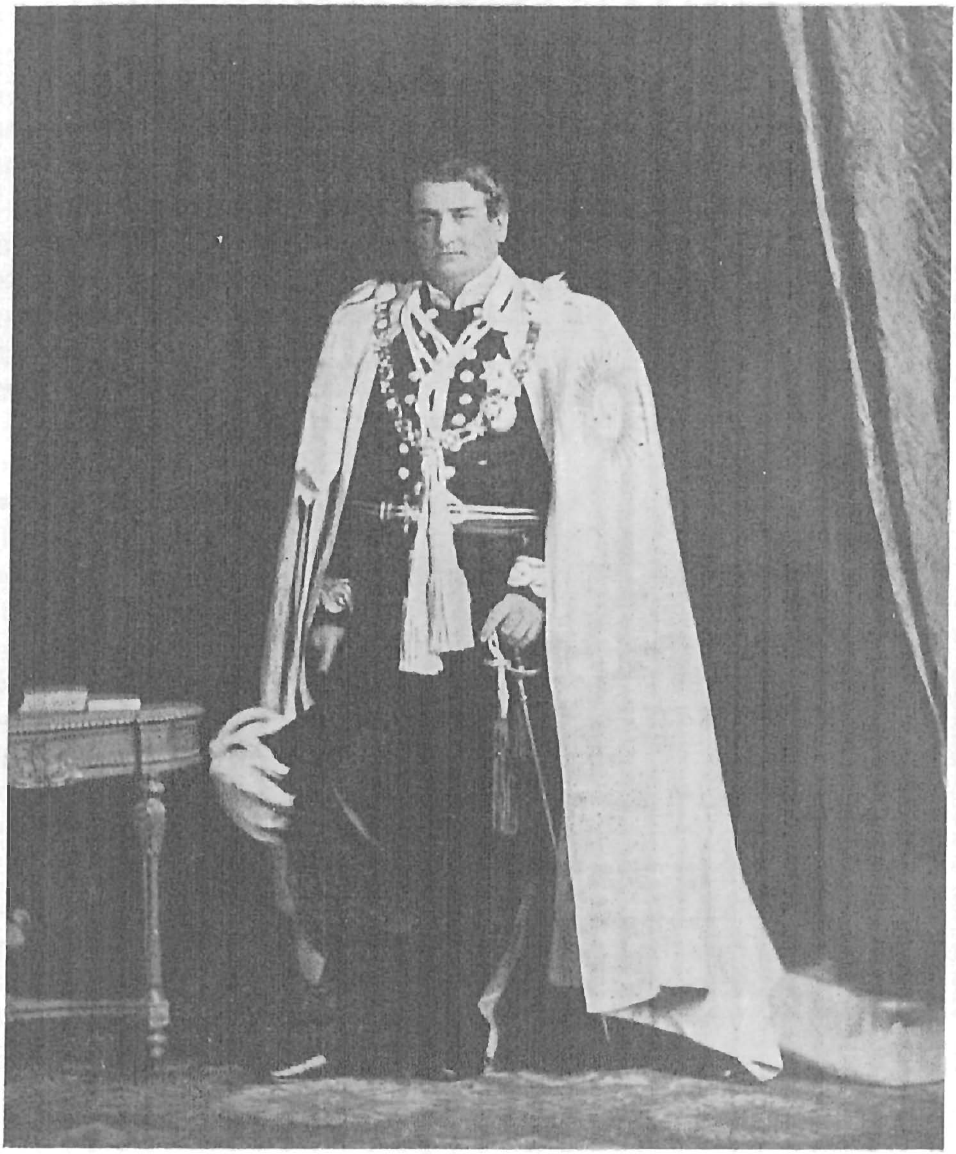

FIG. 22. Earl of Mayo, Governor-General of India, 1869-1872. He had practical experience of farming and attempted to create the Department of Agriculture in the Government of India
(Courtesy: Victoria Memorial, Calcutta)

FIG. 23. Allan Octavian Hume (1829-1912), scientist and administrator, an authority on the birds of India, was Secretary of the Department of Revenue, Agriculture and Commerce, in Lord Mayo's Government. In 1883 he founded the Indian National Congress, and in 1894 the South London Botanic Institute

while, during the long intervening years, the neglect of the husbandmen to use the water disabled the canals from yielding a return on the capital invested in their construction, and forced the Government to levy the annual interest, together with the cost of keeping up the works, by some unpopular impost on the general tax-payer.

'The case stands thus', states Hunter : 'Protective works on a great scale are admitted in India to be an absolute necessity to save the people from famine; and until they are constructed, the British Government goes in yearly peril of being called to witness the extermination of its subjects. After they have been constructed, the peasantry long delay to make use of them, and meanwhile their cost, both of construction and maintenance, has to be borne by the Central Exchequer.' This was the difficulty for which the Earl of Mayo had to find a practical solution. No Indian ruler will hereafter be permitted to stand by and see his people starving by hundreds of thousands to death. Yet, in the present state of rural India, the Government cannot construct the requisite protective works without the risk of future insolvency. Lord Mayo thought he had found a solution for this problem in a compulsory water-rate. He and his administrative chiefs held that a local community, for whose local protection a canal had been found absolutely necessary and had been made, should not be allowed to shift its cost to the shoulders of the tax-payers in distant provinces.

Canal Cess

For the Punjab, Mayo passed a Canal Act, by which the cost of a local irrigation work would be levied, under careful restrictions, by a compulsory cess from the land-owners to whose fields the water was brought. 'We must', he said, 'establish a system of irrigation and finance which will throw the main burden of the cost of these works upon the land that benefits by them. We must follow the same principles which have been adopted by all other countries in the world in which similar works have been constructed. Everybody seems to wish for irrigation, but many appear to desire that somebody else should pay for it. We must take such measures as will oblige the people whose lives are preserved, and whose wealth is augmented by these works, to contribute in a fair proportion to the cost of their construction. If a work is not sustained by local resources, it can only be sustained by the enforced contributions of the general tax-payers.'[2]

District Gazetteers

Mayo observed, 'one chief source of our past errors and future dangers in India lies in our ignorance of the people.' He, therefore, organized a system by which he hoped that the facts of each district throughout the

[2]Hunter, W.W. *The Life of the Earl of Mayo*, pp. 293, 295

Indian Empire would be accurately ascertained, minutely recorded, and rendered available alike to the officers of the Government and to the public.

Organization of a Department of Knowledge and Statistics

Mayo organized a Department of Knowledge and Statistics in the Government of India. In redistributing the work of internal administration, he concentrated under the new Department every branch of inquiry into the country and its people. The trigonometrical measurement of India, the topographical mapping of its provinces, the revenue survey of its districts, the explorations of its coasts and seas, the geological scrutiny into its mineral wealth, the observation and record of its meteorological phenomena, the exploitation of its agricultural products and its commercial capabilities, the minute researches of the settlement officers into the details of rural life—all these and other isolated branches of inquiry he gathered up into a firmly concentrated whole. Where he found the search after knowledge already going on, he systematized it, and he endeavoured to complete the missing limbs by organizing a statistical survey of each district of India. A single one of the pieces of work executed under the new Department was the first census ever taken of the people of India. Papers of the utmost importance have been from time to time prepared by it and given to the public, on that large class of Indian products which possess commercial capabilities, not yet fully developed—such as the rhea fibre destined to change the textile industries of the world, silk, tobacco and lac. In agriculture, he believed that the rulers had something to teach, but had still more to learn. In developing the trade and exploring the products and capabilities of the country, he held that the duty of the Government ceased when it had by practical experiments pointed out the way and removed the obstacles from it. For the fruits of his efforts, whether in agriculture or in commerce, he looked to private enterprise. But he held that it was a proper function of the Government, situated as the Indian Government was, to supply the initial knowledge, without which private enterprise in India, did not come into play.

Takavi Loans to Farmers

The system of giving *takavi* loans to landowners dates from 1793. During the rule of Mayo, such loans were given for (1) the digging of wells and other works for the storage, supply, or distribution of water for agricultural purposes, and the preparation of land for irrigation; (2) drainage; (3) the reclaiming of land from rivers; (4) the protection of land from floods; (5) the reclaiming, cleaning, and enclosing of wastelands for agricultural purposes; and (6) the clearing of land from stones or other obstacles to cultivation.

Improving the Breeds of Horses and Cattle

Mayo believed that much might be effected through the new Department towards improving 'the breeds of horses and cattle'. 'The Government studs', he said, 'have hitherto done little in this respect for the benefit of the country at large. They have been maintained primarily for military purposes, and have been managed on a very costly system, under which little advantage has been obtained for the agricultural or other interests. Measures were also urgently required for preventing and alleviating the cattle-plague which so frequently occurs in this country, and which is lamentable and ruinous cause of injury to Indian agriculture.'

Fisheries

Mayo also pointed out the importance of fisheries, a subject which had been neglected and which he felt was likely to prove of considerable economic importance.

Forest Department

'The ruling power is a great forest proprietor, and it had not up to that time been a very successful one', observed Mayo. The forests had been handed over to the Public Works Department, 'in the absence of any special branch of the administration to supervise them. Mayo resolved that their efficient management should be one of the distinct duties of his new Department.

Mayo took a compassionate view of the practice of *jhuming* by the tribals. The forest tracts were in many parts of India inhabited by wild tribes who still cling to the nomadic stage of husbandry—burning down a spot here and there in the jungle, and after exhausting it with a rapid succession of crops, deserting it at the end of three years for fresh clearings. This form of cultivation is a wasteful one, but it is a natural stage in the progress of agriculture, and where virgin soil is abundant and the population is sparse, it rests not only on deeply rooted tribal tradition, but on economic grounds. Any rough interference with it caused discontent and misery. Mayo criticised the zeal of the Forest Administration in this respect. Similar effects had sometimes resulted from other improvements. Even irrigation itself occasionally displaced a population, and in several parts of India created a safeguard against dearth only at the cost of desolating the villages by malaria. Mayo held that the new Department should be responsible for seeing, not only that work was well done, but that it was done without sacrificing the pre-existing interests of the people. In the single instance of serious mismanagement of this sort which came to his notice, he recorded his opinion in unmistakable terms.'[8]

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[8]Hunter, W.W. *The Life of Lord Mayo*, pp. 291-93, 318, 326

CHAPTER 22

LORD MAYO AND ALLAN OCTAVIAN HUME

AN ATTEMPT TO CREATE A DEPARTMENT OF AGRICULTURE

IT was Lord Mayo's ardent desire to create a department of agriculture in the Government of India, with counterparts in the provinces. When he came to India, he wrote to Lord Napier: 'The time is come when we ought to start something like an agricultural department in the Government of India, with branches in the Presidencies and the Lieutenant-Governorships. Agriculture, on which every one here depends, is almost entirely neglected by the Government. I have seen enough already in my wanderings to know that there is an enormous field, not exactly for the reform, but for the investigation of husbandry in India.'[1] The administrative set-up in the Government of India was dominated by British bureaucrats trained in Revenue. Their education was mostly in Greek and Latin Classics, Law, English Literature and Mathematics. Few among them had knowledge of Natural Science and aptitude for dealing with agricultural questions. The stock argument put forward was that the farmer knew his business, and was not in any need of guidance or help. Hence the need of experts in agriculture was not recognized. The only official who shared Lord Mayo's ideas and enthusiasm for agriculture was a civilian of the Bengal Civil Service, Allan Octavian Hume. An unconventional civilian, Hume was a naturalist who had specialized in the study of birds, and later on turned theosophist under the influence of Madam Blavtastasky and Col. Olcott.

Allan Octavian Hume (1829-1912) was the son of a fearless and sturdy Scottish patriot and reformer, Joseph Hume, who had served in India as a surgeon in the service of the East India Company. In 1812, the elder Hume, on returning to England was elected to the Parliament. For thirty years he was the leader of the Radical Group, and championed the cause of the Indian people.

Allan Hume entered the Bengal Civil Service in 1849. From 1849 to 1867, he served in the districts. In 1857, he was the Collector of Etawah in Northern Provinces, now Uttar Pradesh. He promoted education and established 181 schools in that district. His zeal for educating the Indians was not liked by his superiors, and on 28 January 1859, he was warned not to attempt to persuade the people to send their children to the schools or to contribute to their maintenance.

Hume built a hospital at Etawah and constructed roads. The market-

[1]Hunter, W.W. *A Life of the Earl of Mayo, Fourth Viceroy of India*, Vol. II, p. 320

place was named Humeganj after him and the High School is also named after him. At Etawah, he also farmed himself as a hobby and thus acquired a practical experience of agriculture.

From 1867 to 1870, Hume served as Commissioner of Customs for the North-West Provinces. Even in that capacity, he thought of the welfare of the peasant cultivators.

Hume came into contact with Lord Mayo in 1869 who shared his zeal for the betterment of the lot of the cultivators. While Hume recognized the skill of the farmer in raising crops, he also realised the shortcomings of traditional agriculture.

'The tradition and experience of three thousand years have given them minute knowledge with regard to their own ancestral holdings; and he points out that they know to a day when it is best to sow each staple and each variety of each staple; they accurately distinguish every variety of soil, and the varying properties and capacities of each; they fully realize the value of manures; they know the advantages of deep ploughing, and thoroughly pulverizing the soil; but they also realize where, with a scanty supply of manure, it would be folly to break the shallow-lying pan. As for weeds, their wheat-fields would, in this respect, shame ninety-nine hundredths of those in Europe. So far therefore as what may be called non-scientific agriculture is concerned, there is little to teach them....On the other hand, we must not overrate their knowledge; it is wholly empirical, and is in many parts of the country, if not everywhere, greatly limited in its application by tradition and superstition....'

As regards feed, fodder and disease problems of the Indian cattle, Hume noted the hardship they suffered from lack of a summer fodder.

'Over a great portion of the Empire, the mass of the cattle are starved six weeks every year. The hot winds roar, every green thing has disappeared, no hot weather forage is grown, the last year's fodder has generally been consumed in keeping the well-bullocks on their legs during the irrigation of the spring crops, and all the husbandman can do is just to keep his poor brutes alive on the chopped leaves of the few trees and shrubs he has access to, the roots of grass and herbs that he digs out of the edges of fields, and the like. In good years he just succeeds; in bad years the weakly ones die of starvation. But then come the rains. Within the week, as though by magic, the burning sands are carpeted with rank luscious herbage, the cattle will eat and overeat, and millions die of one form or other of cattle disease, springing out of this starvation, followed by sudden repletion with rank, juicy, immature herbage.[2]

Referring to cattle mortality due to diseases, he estimated the average annual loss of cattle in India by preventible cattle disease at fully ten million

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[2]Wedderburn, W. Sir. *Allan Octavian Hume, C. B. Father of the Indian National Congress*

beasts, roughly valued at £ 7,500,000. 'And be it noted that it is not only the supply of manure that this fearful mortality amongst the cattle and their resulting paucity, so greatly restricts; it is the little hoarded capital of the peasant, the very mainspring of agriculture in India, that is thus flung away.' Village plantations for fodder, the establishment of veterinary colleges, the spread of useful information among the people, and other well considered measures, organised by a competent agricultural department; these were the practical remedies advocated by Hume.

Agricultural Research and Education in the United Kingdom, 1831-1845

Hume kept in touch with advances in agricultural research and education in the United Kingdom. Charles Babbage (1792-1871) founded The British Association for the Advancement of Science in 1831. This Association organized its meeting in every city in the United Kingdom and even in some of the colonies. One of the Association's actions that had the largest consequence was its request to Justus von Liebig (1803-73) to prepare a report on agricultural chemistry, a task which turned that great chemist's attention to the practical problems of food production and which was the starting point of the sciences of soil chemistry and nutrition.[8]

In 1840 The Royal Agricultural Society of England was incorporated by Royal Charter. It encouraged practical farmers to use science, and scientists to proceed on practical farming lines. Through its *Journal* it gave farmers the opportunity of keeping in touch with the latest results of scientific work in England and abroad. By money grants it encouraged new discoveries and inventions, and it suggested standards of results that could be attained by good farming. A laboratory was established in Edinburgh in 1842 by the Agricultural Chemistry Association of Scotland, a voluntary agricultural society. The laboratory was dissolved in 1848 due to its inability to respond to the association members' demands for immediate practical results. In 1843 an experiment station was established at Rothamsted, near London, by Sir John Bennet Lawes on his ancestral estate. Lawes, who had been engaged in the manufacture of phosphate fertilizer from bones, also began the manufacture of superphosphate in a nearby village in 1843. Sir Henry Gilbert, a student of Liebig's, was placed in charge of the experimental work. In 1845, the Cirencester Agricultural College was founded. All classes of scientists worked to reduce the risks and increase the output of the farmer. 'Practice with Science' became the watchword of thousands of farmers all over the country.

Hume's Interest in German Agricultural Science

Hume was also in touch with German agriculture. By the middle of

[8]Bernal, J.D. *Science in History*, p. 392

nineteenth century, Germany led in the application of science to problems of agriculture. On the other hand, in Britain the strong laissez-faire tradition was a major obstacle to the institutional innovations. In contrast, the German States generously financed a gamut of institutions, erecting buildings, installing laboratories, and above all, maintaining compètent and, at the highest level, distinguished faculties.

The publication in 1840 of *Organic Chemistry in its Relation to Agriculture and Physiology* by Justus von Liebig is a great dividing line in the evolution of agricultural research. Liebig's great accomplishment as a scientist was to bring together and interpret considerable mass of chemical and related data pertaining to plants and soils that had accumulated up to that time. His refutation of the humus theory of plant nutrition and his proposed mineral theory represented a major success of his approach. His great achievement as a teacher was the establishment at Giessen of a laboratory for training research students in organic chemistry. Students from all over the world were attracted to it.

The demonstration of the power and value of Liebig's approach to the organization of scientific research led to the establishment of specialized agricultural research laboratories and experiment stations in Germany. The first publicly supported agricultural experiment station was organized at Mockern, Saxony in 1852. The German farmers drafted a charter for the station, which the German Government legalized by statute, and secured an annual grant from the government to finance the operations of the experiment stations. During the next 25 years, 74 publicly supported agricultural experiment stations were established in Germany. The German model was adopted in Austria, Italy, the United States and Japan.

The modern research university was also a German invention. The founding of the Friedrich-Wilhelm Universitat at Berlin (now Humboldt Universitat zu Berlin) by Wilhelm von Humboldt and his associates in 1809 represented the beginning of a new type of university. The traditional European university was devoted to education, primarily in the classical professions such as Theology, Medicine and Law. Von Humboldt's objective was to create a university that could nurture the development of the new laboratory-based science such as Chemistry, Physics and Biology.

When Hume looked at the Indian scene, he realized how far behind was India! He felt there was scope for many innovations in the field of agriculture.

Demand for the Departments of Agriculture

A demand for establishing departments of agriculture in the provinces came not from Indians, but from British industrialists. The textile industry of Manchester was facing a crisis owing to the stoppage of cotton-supply from the United States of America on account of the Civil War which ravaged that country during 1863 and 1864. The Cotton Supply Association of Manchester exerted pressure upon the Secretary of State for India to devise ways and means to improve the supply of cotton to the textile mills of Manchester from India, so that dependence on the USA might be minimized. They submitted a Memorial to Duke of Argyll, the Secretary of State for India on 12 March 1869, in which they prayed:

'Notwithstanding the renewed exertions of the United States since the close of the Civil War, we have still to deplore the long-continued scarcity of cotton and the consequent losses and sufferings experienced by our manufacturers and the operative dependent upon them for employment. There appears to be little probability that the production of cotton in America will, for many years to come, be adequate to the requirements of this and other countries. Your memorialists, therefore, believe that India is the great source to which they must look for the large supplies that are so urgently needed, and the best and speediest means of obtaining them is now engaging their anxious consideration. The Association has, upon previous occasions, pressed upon the Government the establishment of a department of agriculture in each of the Provinces of India. They would now again urge the establishment of such a department, to which the reports of Collectors or Cotton Commissioners would be made, which reports would afterwards be communicated by it to the public. By this means information of great value and importance would be obtained, and the interests of the agriculturists and the manufacturer alike be benefited.'

The memorial concluded with the remarks:

'....The present state of the cotton trade in Lancashire and other districts is an urgent argument for the immediate adoption of the measures suggested by the Association. The inadequate supply of cotton has raised the price so high, that the manufacturers find it impossible to escape from great loss in their operations, and mills are gradually closing or going upon short time, while the operatives are driven to emigrate or become a burden upon the local rates.'

The lobby of the Cotton Association was powerful and the Secretary of State could not ignore what the Association had suggested in the Memorial. Hectic consultations followed between the Secretary of State and Lord Mayo, which resulted in the formulation of a despatch by the Governor-General on 9 April 1870, addressed to the Secretary of State. A part of this despatch ran as follows:

'*The experience of the last few years has led us to the belief that much* administrative and material advantage would be obtained for our Indian possessions, if more systematic measures were taken for securing constant and intelligent efforts, on the part of this Government, for the improvement and development of the agriculture, commerce, and industrial arts of India. We are satisfied that closer attention should be given to the great products which constitute the staples of our agricultural and manufacturing industry, and of our export trade.

'Of all branches of Indian industry, agriculture, which constitutes the occupation of the great mass of the people, is by far the most important. We believe it to be susceptible of almost indefinite improvement. It is not necessary to dwell upon the obvious and vital necessity of increasing, in every practicable way, the supply of food available for the people of India. How this consideration affects all the prospects of the permanent material advancement of the country has of late years been painfully and repeatedly shown by the terrible famines which have taken place, and to the recurrence of which we shall ever be liable until the production of cereals is rendered more certain and the facilities of conveyance immensely developed. For many generations to come, the progress of India in wealth and in civilization must be directly dependent on her progress in agriculture. In India agricultural and commercial progress go together. Agricultural products must long continue to constitute the most important part of our exports; and the future development of Indian commerce will mainly depend on the improvement in the quantity and quality of existing agricultural staples, for on the introduction of new products which shall serve as materials for manufacture, and for use in the industrial arts.

'The efforts of the Government of India and of English enterprise in such a direction have doubtless been very beneficial in their results. Thus important progress has been made in regard to cotton. Large sums were spent in former years, in attempts to improve its cultivation but with little useful result, owing to the mistaken system under which they were made. Renewed attention has been more recently given to this subject with much better effect, and the extreme importance of doing all that is possible to improve and develop the cultivation of this great staple is fully recognized by the Government. Jute, which not long ago was hardly used, has become an article of first-rate commercial interest. The partial success of our tea, coffee, and cinchona plantations shows what has been and may be done in introducing into India new and valuable products; the world derives from India nearly the whole of its supply of indigo. Other illustrations might be given to the same effect, but, speaking generally, it cannot be denied that Indian agriculture is in a primitive and backward condition, and we think that it must be admitted that the Government has not done for its improvement all that it might have done.

'To state exactly what measures the Government ought to have taken in the past, or what course it should follow in the future, is undoubtedly not easy. It is hardly too much to say that scientific knowledge of agriculture in India has at present no existence. The common belief has been that the natives of this country can, in respect to the processes of agriculture, derive little or no benefit from any instruction which European science can give them. Such a belief rests, perhaps, upon observation of the obvious progress which has been made in many of the elementary requirements of agriculture, in regard to tillage, rotation of crops, and so forth. But it has often been lost sight of that this sort of knowledge is only rudimentary and empirical, and that recent experience in all parts of the civilized world shows conclusively that there is no branch of industry in which the effects produced by the intelligent application of science are more certain or more remarkable. We cannot doubt, that, when the light of science has been properly brought to bear upon Indian agricultural experience, the results will be as great as they have been in Europe.

'The improvement of Indian cotton by the introduction of exotic seed has been attempted by the Government, but hitherto without much practical effect. It has become manifest that the results that are so much desired can only be secured by careful and prolonged experimental cultivation, and there can be little doubt that this may be more effectively conducted under Government supervision than by any other means. Similar remarks will be applicable to the improvement of other Indian fibres, for which a very large demand might be established in the markets of Europe. We have, as Your Grace is aware, within the last few months, taken special measures with the object of improving and facilitating the preparation of rhea fibre, which has such remarkable capabilities for use in textile fabrics.

'The cereals of this country demand similar attention. Rice, wheat, and other grains, are frequently of an inferior description, and by the careful introduction and continued use of selected seed of a superior character great improvements might unquestionably be made. The same may be said of the oilseeds, the pulses, and other products.'

In their well-known despatch of the 19 July 1854, on the subject of education in India, the Court of Directors referred with approval to proposals that had been made for teaching practical agriculture. Quoting the words of Dr Mouat, they said that there was "no single advantage that could be afforded to the vast rural population of India that would equal the introduction of an improved system of agriculture." Unfortunately, the means of obtaining agricultural instruction are no better now than they were when this despatch was written fifteen years ago. We do not disguise from ourselves the difficulty of affording to Indian landlords and cultivators the means of obtaining scientific and practical knowledge for the improvement of agriculture. But the difficulty of the work ought not to discourage the Government from doing everything in its power to develop this important branch of education.

'In Europe, progress in the direction to which we have referred has been mainly based on private effort, and on the application of the intelligence of the agricultural classes themselves to the ends in view. In almost all civilized countries, however, in which, unlike England, the form of government is centralized, the efforts of the people are powerfully aided by the co-operation of a state department of agriculture, which works in part directly through its own agency, and in part through agricultural and other societies. Even in India such societies have been extremely useful, and they might properly receive more encouragement from the Government than has hitherto been given to them. But we cannot expect to obtain in this way any great results. The work that is performed by the great agricultural societies of Europe must be performed in India by the Government, or not at all.

'We are thus brought to the conclusion that the formation of a separate department of the Government for the care of these great interests ought no longer to be delayed. Such a department would take cognizance of all matters affecting the practical improvement, and development of the agricultural resources of the country."[4]

Sir H.M. Durand, the Military member, after examining Lord Mayo's proposal for the creation of a department of agriculture stated, in his note dated 18 December 1869:

'The conclusion at which I arrive is that the present is not a favourable juncture for the creation of the new department, even if the necessity for the ultimate establishment of such a department be admitted.

'The Government of India is pledged to very large military and civil reductions of expenditure, and under such circumstances any proposal for the erection of a new and costly department will be certain to stimulate severe criticism both in India and in England'.

Sir Richard Temple, the Finance Member was in favour of enlarging the Cotton Department into an agriculture department. He stated in his note, 'At this moment one of the first agricultural needs of India is the improvement of the culture of cotton. The object is that, by such culture, the area under cultivation may be made to yield double the supply of the staple. Great interest is felt in England regarding this. Let us see whether we can accomplish something in this direction. Let us, in the event of any success regarding cotton culture, gradually strengthen and enlarge the department, and make it try its hand on other products.

'I think that these and other cognate points should be considered before we undertake to recommend the creation of a new appointment.

'Further, I believe that the formation of schools, whereby instruction in agricultural knowledge can be afforded, would be worthy of considera-

[4]Publication of the Home Department, Proceedings, 9 April 1870, No. 40, dated 6 April 1870 from the Government of India, to Her Majesty's Secretary of State for India, National Archives, New Delhi

tion. It is a question whether we should or should not undertake the establishment of such institutions. Perhaps it may be found that the cost would be too great.'

Irritated by the negative attitude of the Military and Finance Members of his Council, Lord Mayo, in his minute, dated 28 March 1870, stated, 'I must dissent from the statement that the proposal is in any degree premature. My astonishment is that it was not made 20 years ago, and I believe that the proposal will neither be difficult to carry out nor costly in its operation.

'I cannot agree in the opinion that the practical effect of scientific research on agriculture has been very moderate in Europe and America, and I believe that the development of agricultural industry and the increase of produce in England (which has been almost co-equal with her advance in other respects) is entirely due to the application of science to husbandry and the spread of education.

'Contrast the modern Scotch plough, which is everywhere in use, with the old wooden concern drawn by six horses in single file; see the extraordinary result of the application of artificial manures to the growth of the turnip and the manuring of the ground by fending it off with sheep penned upon the land; witness the results of thorough draining and its marvellous effects from one end of the country to the other; look at the peripatetic steam threshing machine which is used in every farm in Sussex, Lincolnshire, Norfolk and other countries where high farming is practised—the mowing and reaping machines now in universal use; see the results of box and stall feeding with oil cake; look at the extra-ordinary improvement in farm buildings. All this has taken place almost within my memory, certainly within the last 40 years, and it is really to the spread of the knowledge of what I call agricultural science that the whole of this is to be attributed.

'I do not think that the Cotton Commissioner's Department will or ever ought to grow into a Department of Agriculture and Commerce such as the wants of the country demand.

'The existence and success of this Department, however, which will be subordinate to the other, shows how much can be done in a short time; and I believe that, so far from it being desirable that the Cotton Department of the Government of India should grow into a general agricultural branch of the administration, its success only proves how much more widely the system can be extended to other branches of agriculture under one general head.

'I should entirely object to the Cotton Department being entrusted with the supervision of any other description of agriculture at present; in fact it is over-worked as it is.

'I make this proposition with no other object than to supply what I believe to be a very great want in the public service—to create a department which exists more or less in every administration in the civilized world, and the absence of which from our Indian system of government has been, I believe, a very great evil.

'I believe that the intelligent portion of the public, both in England and India, already see its great necessity, and I cannot think that the objection that it will throw £3,000 or £ 4,000 a year additional charge upon our expenditure, ought to prevent its being carried into operation.'

Lord Mayo, embittered by the opposition from members of his Council, caustically concluded, 'At all events I shall make the proposal to the Secretary of State, and leave the responsibility of defeating a safe, easy, and cheap administrative reform to those who think it their duty to oppose it.'[5]

Mayo proposed the creation of a department of agriculture and commerce and the post of a director-general of agriculture and commerce. He stated, 'We propose to constitute a Department of Agriculture and Commerce as a separate branch of the Home Department and to place it under the supervision of a specially qualified officer, to be called Director-General of the Department of Agriculture and Commerce. We would give to this Officer a salary of Rupees 3500 p.m. He would hold a position in the Home Department analogous to that held in the Public Works Department by the Inspector-General of Irrigation. To this branch of the Home Department would be transferred all that portion of the business of the Home, Financial and other Departments which is connected with the subjects which have now been indicated. The functions of the Director-General of the new Department would embrace all matters connected with the administration of the land revenue, salt and opium, with the development of all branches of the material resources of the country, and with statistics of every description.

'We are satisfied that the measures which we desire to take would be highly beneficial to the country, and that we might reasonably anticipate that they would ultimately lead to an important increase of the revenue.'

An Agricultural Bureau

Lord Mayo's original conception of this department was as a purely agricultural bureau, presided over immediately by a director-general of agriculture and not by a secretary. He intended the director-general to be supreme in his own department. The man he had in view for this post was Hume. Hume explains:

'The Director-General was to have immediately under him a small

[5]Publication, 9 April 1870. *Minute by His Excellency, the Governor-General*, 28 March 1870, National Archives, New Delhi

staff of experts, and was to keep up only just such an office as was absolutely unavoidable. There was to be as little writing and as much actual work as possible. Directors of Agriculture were to be appointed in each province, also to be aided by experts. They were to work partly through the direct agency of farms and agricultural schools, and partly through the revenue officials of all grades down to the village accountants. The Director-General was to be moving about generally whilst the crops were on the ground. He was to confer personally with all the Provincial Directors and their Governments, go thoroughly with the aid of his staff into all their projects and schemes, make himself fully acquainted with local wants and wishes, and then during the hot season join the Government of India, and lay before it as succinctly as possible all that was desired with his (and his experts') opinions and recommendations.'

Department of Revenue, Agriculture and Commerce

The Secretary of State showed general agreement with the Governor-General on the creation of the Department but objected to the creation of the post of Director-General under the control of Secretary, Home Department. He remarked:

> 'The proposed department, if established, should be designated the 'Department of Revenue, Agriculture and Commerce'.

The Governor-General reluctantly agreed to the suggestion of the Secretary of State. In his letter of 22 February 1871, he informed the Secretary of States:

> 'In conformity with Your Grace's opinion that the new Department should have a separate and independent position, instead of, as originally proposed, being placed under a Director-General in subordination to the Secretary in the Home Department, we have come to the conclusion that it should be placed under a Secretary in the Department of Revenue, Agriculture and Commerce, whose position should be precisely analogous to that of other Civil Secretaries.' The Secretary of State approved the proposal formally made by the Governor-General on 27 April 1871. He wrote, 'It is with much satisfaction that I convey to your Government the approval of Her Majesty's Government of the scheme which you described in your despatch under reply.'

A scheme was prepared for agricultural development, including a director-general and seven directors, and their staff and offices, forty model farms with schools or colleges, etc. The net expenditure of this scheme was estimated at 25 lakhs of rupees, with another 25 lakhs for offices, buildings, etc. These funds were not provided.

The proposal to send out a specially trained officer as director-general of agriculture was not sanctioned, but in his place an additional secretary was added to the Government of India and placed in charge of revenue, agriculture and commerce. No scientific officers were employed either by the Government of India or by the provinces. Nothing in the way of agricultural development was achieved and attention was limited entirely to the collection of statistics.

The Department of Revenue, Agriculture and Commerce proved ineffective. Writing in 1879, Hume thus explains why it had not done anything material for the improvement of Indian agriculture. 'Though originally designated the Department of Agriculture, &c., this Department had never, from the first, been so constituted as to permit of its dealing either directly or efficiently with agricultural matters.'

Lord Mayo clung, however, to the idea of ultimately making this really a Department of Agriculture, but the Secretary of State did not approve of even this.

'Lord Mayo named it the Department of Agriculture, Revenue and Commerce. The Secretary of State objected to this, said that Revenue, and not Agriculture, was the main object of the Department, and ordered the name to be altered to "Revenue, Agriculture and Commerce".

Referring to himself, Hume stated, 'Lord Mayo selected as head of the Department, an officer whom, from his own thorough knowledge of the subject, he ascertained to be well versed in practical European agriculture, who had, for his own information and amusement, farmed in a small experimental way throughout his many years of service in India as a District Officer, and who was fairly conversant with all the then more modern German and English writings on the theory and practice of agriculture.

'The Secretary of State remarked that the next head of the Department was to be chosen for his knowledge of revenue and not of agricultural matters.

'It will be seen, therefore, that, as constituted, this Department never was, and never was intended by the Home Government to be, a Department of Agriculture. Lord Mayo hoped to convert it into this, but with his death India lost the warmest, most competent, and, at the same time, most influential advocate for agricultural reform. No change, such as he contemplated, has ever been made in the constitution of the Department, and succeeding administrations have only made the official bonds more rigid, and converted its chief more and more thoroughly into a mere desk-tied Secretary.

'A Secretariat is under no circumstances the form of organization best suited to the promotion of agricultural development. Still even a Secretariat might do much if it possessed three needful adjuncts :

(1) Competent advisers, not tied to an office, but able to move about, collect and digest the necessary facts, and put schemes before it in a shape in which sound decisions can be arrived at.

(2) A qualified agency, either of it own, or belonging to administra-

tions subordinate to it, to give effect to its decisions.

(3) Money to expend in giving effect to these and in experiments, &c.

The Department of Revenue, &c., has never had any one of these three requisites at its command.

The only person connected with it from first to last who has possessed any knowledge of both the theory and practice of agriculture has been the Secretary, who has had always from eight to ten hours a day (and often much more) office work, and who for ten years has barely seen a field, except from the train, on the occasion of the half yearly migration of the Government of India between Simla and Calcutta.

'It has never had any agency, though the creation of a Directorship of Agriculture in the North-Western Provinces in recent years had at last originated a nucleus, in one province, out of which such an agency will, it is to be hoped, develop. Last, but not least, it has had no money.

'How it comes that the Government should have no money to spend on improving the one branch of industry to which it chiefly owes its revenue? At present it is sufficient to say that it had not the money to give.'[6]

It was thus that Lord Mayo's excellent scheme was nullified by the combined opposition of officials at Simla and Whitehall. The Secretariat triumphed in diluting Mayo's scheme in such a manner that it lost all significance.

In July 1871, Lord Mayo appointed Hume Secretary of the Department of Revenue, Agriculture and Commerce. In 1872, on a visit to the Andamans, Mayo was assassinated by a Pathan criminal. Thus, Hume was deprived of the patronage of a Viceroy who had an excellent understanding of the problems of agriculture in India, and had a passionate concern for the betterment of the lot of the Indian cultivator. In 1878, in a long note, Hume proposed that a mixed farm of at least 1,000 acres (404.67 ha) should be set up in every district in India in order to demonstrate the advantage of better feeding and care of livestock.'[7]

Hume Demoted and Transferred to Allahabad

In 1879, Lord Lytton transferred Hume to the Board of Revenue at Allahabad. His fault was that he was too honest and too independent, and expressed his views with great freedom without regard to what might be the wishes or intentions of his superiors. His transfer to Allahabad not only closed a brilliant official career, but also dealt a disastrous blow to his scientific studies. An ornithological museum and library, he had set up at his residence in Simla, the Rothney Castle, at a cost of £20,000 could not be shifted. It led to the suspension of his great work on the *Game*

[6]Hume, Allan. *Hints on Agricultural Reforms in India* (Indian Reprint), pp. 12-14

[7]West, G.P. (Ed.), *A History of the Overseas Veterinary Services, India*, p. 25

Birds of India on which he had spent £4,000. In 1885, he donated this collection of birds and their eggs to the British Museum of Natural History, London. He donated his collection of the heads and horns of Indian big game animals to the Natural History branch of the British Museum.

FOUNDING THE INDIAN NATIONAL CONGRESS

Lord Lytton offered him the Lieutenant-Governorship of the Punjab, but he declined the appointment on the ground that such an appointment meant a great deal of entertaining, and for this neither his wife nor he himself cared. He retired from public service in 1882. He identified himself with the Indian people, living among them as one of themselves. He combined political insight with dauntless courage and untiring industry. He clearly saw that the ferment, the product of Western ideas, education, inventions and appliances, was at work, among the educated Indians with a rapidly increasing intensity. He realized that scattered individuals, however capable and well-meaning, are powerless singly. Knitted into an organization, they could be a power. In 1883, he founded the Indian National Congress. On 27 December 1885, the first session of the Indian National Congress was held at Bombay.

Years passed on, and yet there were no signs of any concessions being granted to the Indian people. In a pamphlet entitled *The Old Man's Hope*, Hume thus made an impassioned appeal to the comfortable classes in England: "Ah men! well fed and happy! Do you at all realize the dull misery of these countless myriads? From their births to their deaths, how many rays of sunshine think you chequer their gloom-shrouded paths? Toil, toil, toil; hunger, hunger; hunger; sickness, suffering, sorrow; these, alas! alas! are the key notes of their short and sad existences."

In no grudging spirit he acknowledged the benefits conferred by the British rule: the blessings of peace, and protection to life and property. But the *Pax Britannica* has not solved the economic problem, nor availed itself of the opportunity to preserve the debt-laden and despairing peasantry from the ravages of famine and disease. British rulers, he maintained, had failed, not from any lack of good intention, but from insufficient knowledge. The sufferings of the Indian masses from famine and disease arose from poverty; and this poverty was preventible, if the Government would take into their counsels experienced representative of the people, who know exactly where the shoe pinches.'

He noted two moral shortcomings among Indians: no adequate conception of the sanctity of the spoken word, and jealousy among fellow-workers. These are feelings which prevent effectual combination in the national cause. These defects, he believed, seriously harmed the progress of those whom he regarded as his children.

In 1890 Hume visited London where he had formed the British Committee of the Indian National Congress to influence the members of the Parliament in favour of the aspirations of Indians. He also started a journal *India* to supply trustworthy information regarding India to the British public.

SCIENTIFIC WORK

He left India in 1894 and settled in London. Now he started the study of botany and founded and endowed the South London Botanic Institute. It had a library and a herbarium which had 40,000 sheets of mounted plants. Up to the last, he was actively engaged in the scientific pursuits which were always his special joy.

On 31 July 1912, in his eighty-fourth year, he peacefully passed away. He was a true culture hero of the modern age. His death cast a deep gloom among educated Indians. Paying a tribute to him, Mr H.K. Gokhale referred to him as "one of those men who appeared from time to time in this world, under the dispensation of a wise Providence, to help forward the onward march of humanity, whose voice sounded like a trumpet-call, waking up whole peoples from the slumber of ages, and whose title to an honoured place in the history of nations no man could possibly challenge. Hume loved India passionately, as every one who knew him could testify, and he loved justice and freedom also passionately. Thus it was that, after the close of a distinguished official career, he came forward to devote his great gifts to guiding India along the path of justice and freedom and self-respect. He came forward to teach Indians to walk nobly along the path of nationhood.'[8]

Pandit Madan Mohan Malviya said, 'He was truly a great soul—one of the noblest Englishmen ever born. He was one of those benefactors of mankind who came to initiate movements of great potentiality for the good of their fellowmen.'

The Secretary of the Indian National Congress said, 'Indians deeply mourn the death of Allan Hume. In him the country has lost its more sincere and sympathetic friend, the like of whom it may never see again, and the Congress its most beloved and esteemed founder.'

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CHAPTER 23

RIPON TO ELGIN II

1880-1899

INSTITUTION OF THE REVENUE AND AGRICULTURAL DEPARTMENT
PROGRESS IN VETERINARY EDUCATION AND SCIENCE
LOCAL SELF-GOVERNMENT
ESTABLISHMENT OF IMPERIAL BACTERIOLOGICAL LABORATORY AT MUKTESWAR

George Frederick Samuel Robinson Ripon (1827 to 1909) was a member of the British Parliament from 1852 to 1859. In 1863, he became Lord Palmerston's Secretary for War, and in 1866, Secretary of State for India. On Gladstone's return to power, he succeeded Lord Lytton as Viceroy of India in April 1880.

He ended the Second Afghan War by recognizing Abdur Rahman Khan as Amir of Afghanistan, thus ending a venture which had proved so costly to improvement of local administration. Gladstone considered it to be a weakness of British rule in India that it had not been able to give India the benefits and blessings of free institutions. Ripon set out to remedy this shortcoming.

Local Self-Government

What was the type of administration when Ripon came to India is thus described by Sir William Wedderburn. 'When Lord Ripon was taking up the subject of local self-government, these great centralized departments, and their fatal encroachments, were thus described by one who knew: "Their names are legion: police, public works, forest, excise, salt, survey, irrigation, registration, sanitation, vaccination, and so forth. Each of these departments is represented in the rural districts by a swarm of ill-paid and hungry native subordinates, who prowl about the villages and gradually fatten themselves by plunder and oppression. Among all these departments and among all these petty oppressors, the life of the poor ryot may be likened to that of a toad under a harrow, so jarred is he and upset in all his dearest interests and prejudices. And it is the increasing irritation and unrest produced throughout the country by years of such a system which has hitherto constituted the real danger to our rule in India.

'And the special purpose of the decentralization and local self-government measures now being brought forward is to substitute the best kind of native agency for the worst; to revive the ancient activity of rural municipal life, and to entrust the village management to the decent quiet villagers themselves instead of leaving it to a swarm of greedy underlings attracted to the Government service, not by the scanty pay, but by the power they enjoy, and the unlimited opportunities for exaction. Octopus-like, these centralized departments extend their tentacles into every district and every village, paralysing the district administrators, and crushing the village organization. Decentralization is the remedy; and this remedy Lord Ripon sought to apply by the only right method, that is, not by the multiplication of local autocrats, but by building up local self-government on the solid foundation of the village community.

'I have likened the centralized departments, in their destructive action on the district and village organizations, to the grasp of the octopus. But if on the one hand the deadly tentacles have reached down to the ryot in his village, they have, with equally baneful effect, taken hold of the supreme Government at Simla and the Council of the Secretary of State at Whitehall, perverting to their own use the control of the House of Commons. They have thus been able to direct policy, and manipulate the Indian Legislature, which for many years has been simply an instrument for consolidating official authority. What is the object of the elaborate codes which, with ever-increasing stringency, govern the operations of the Land Revenue, the Forests, the Excise, and other great departments? Everyone knows that all these codes originate with the department directly interested, and that they are all directed to increasing "efficiency", which means the perfecting of the official machine, and completing its domination over the outside public. Indian public opinion has little or nothing to do with the course of legislation: it is only consulted after the supreme Executive has made up its mind under the direction of the department interested. Hence the government of India has been called a tyranny of office boxes, only mitigated by an occasional loss of the key. It is in these office boxes that projects of law are incubated, and that ingenious devices are matured to close all loopholes of escape, and effectually to curb the liberty of the subject.

'The Viceroy, being a statesman appointed from home, is the one powerful figure that is in a position to offer resistance, if so minded, to the coercion of the permanent departments. But he will not be so minded if he is tainted with the imperialistic spirit, or if he has not the necessary courage and ability. In any case the task of resistance is a hard one, as shown by what befell Lord Canning, Lord Mayo, and Lord Ripon; for the Viceroy stands almost alone among his councillors, who for the most part have themselves been the heads of departments; while in England he must count on secret hostility, instead of support, from the India Office, which is recruited from ruling official clique at Simla.'[1]

The main aim of Ripon's Resolution of 1882 on Local Self-Government was that experience of running the local bodies, e.g. *Panchayats*, municipali-

[1]Wedderburn, Bart. Sir William—Allan Octavian Hume, C.B. "*Father of the Indian National Congress*", 1829 to 1912, pp. 125-127

ties and District Boards, should serve as an instrument of political and popular education. It was laid down in the Resolution that the Local Boards, both urban and rural, must everywhere have preponderance of non-official members. In pursuance of the policy laid, Local-Self Government Acts were passed in the different provinces in 1883-1884.

Other Reforms

Ripon lowered the salt tax, and tried unsuccessfully to stabilize land taxes. Repealing the Vernacular Press Act of 1878, he allowed local language newspapers equal freedoms with those in English. In 1881, he passed an act providing for some minor improvements in labour conditions. His Ilbert Bill (1883) roused a violent reaction among the whites, because it proposed to allow Indian judges the same rights as European judges to handle cases of European defendants. 'An Anglo-Indian Defence Association was formed; the Volunteers were urged to resign; and attempts were made to seduce the loyalty of the Army. Gangs of planters were brought down to Calcutta to insult the Viceroy in the streets. The wife of the Chief Justice got up a "Ladies' Petition" against the Bill.'[2] The Bill was passed only when the controversial provision was removed.

Institution of the Revenue and Agricultural Department

In the field of agriculture, Ripon's achievement was the institution of the Revenue and Agricultural Department. The Government of India Resolution of July 1881 is reproduced below. 'The Famine Commission has now proposed the institution of an Agricultural Department in India. It lays stress upon the importance of rendering readily available the accumulated experience of past famines in different parts of India, and has urged that greater attention should be bestowed on the investigation of vital, economic and agricultural facts. Any effectual measures of agricultural and industrial development must, in the opinion of the Commission, tend at least to the mitigation of famines, both by promoting the increase of the food-supply amongst a growing population, and by directing industry into new and productive channels. Moreover, it is represented that the Government would obviously be strengthened, in its future dealings with scarcity, by a systematic classification of the experience gained in past calamities.

'Having regard to these considerations, the Governor-General in Council is pleased to direct that all matters connected with the subjects noted below, so far as they affect the provinces of British India, shall come under the cognizance of the new Department, viz. Land Revenue, including Settlements and Takavi Advances; Surveys, including Geological Surveys, but excluding

[2]Kincaid, D. *British Social Life in India*, p. 195

Archaeological and Marine Surveys; Agriculture and Horticulture, including Fibres and Silk, Fisheries, Cattle-breeding and Cattle disease; Minerals; Meteorology and Famine.'[8]

DIRECTORS OF AGRICULTURE IN THE PROVINCES

After the passing of this resolution, the administration of the provinces also moved forward. Here a reference may be made to the North-Western Provinces of Agra and Oudh (now the Uttar Pradesh). In 1874 the Lieutenant-Governor, Sir John Strachey, who had been a member of Lord Mayo's Government, established a Provincial Department of Agriculture. Sir Edward Buck was the first Director, and his name will go down to posterity as the pioneer of agricultural progress in India. The Cawnpore farm—one of the oldest farms in India—was extended; a tobacco farm was started at Ghazipur, a silk farm in the Dun, and a fruit farm in the Kumaon Hills. An Agricultural school was opened at Cawnpore.

BENGAL (INCLUDING BIHAR, ORISSA AND ASSAM), 1881

A Director of Agriculture with three assistants trained at Cirencester was appointed in 1881 and experimental farms were started on Court-of-Wards' estates. The Sibpur farm, started in 1887-88, unsuitable on account of variability of soil, was the central part of the scheme. It was abandoned in 1898.

BOMBAY, 1883

A Director of Agriculture was appointed in 1883, and, although his duties were for the first decade largely statistical, agricultural work was not neglected. In 1890 a Superintendent of experimental farms was sanctioned, and work on the improvement of agriculture on scientific lines was commenced. J. Mollison, a Canadian, was appointed to the post and under his capable administration the department was organized and the subordinate staff which he trained reached a high degree of efficiency. Another capable Director who left a mark was Dr Harold H. Mann. Dr Mann got his B.Sc. degree from Victoria University of Manchester in 1892. He was Chemical Assistant for Research under Dr J.A. Voelcker and organized the laboratory and pot-culture station at Woburn in 1898. He came to India as the first Scientific Officer of the Indian Tea Association in April 1900. In 1907 he was appointed Principal of the College of Agriculture at Poona. In 1921 he became Director of Agriculture, Bombay Presidency. His studies of Deccan villages are well known.

THE PUNJAB

The Punjab Government interested itself in the development of agricul-

[8] *Government of India, Revenue and Agricultural Department Proceedings*, July 1881, General, National Archives

ture after 1881, when the Famine Commission Report was published. When a Director of Agriculture was appointed he was mainly concerned with statistics and the organization of a subordinate revenue establishment. For the rest a number of disconnected agricultural experiments were carried out on a small scale, such as trials of exotic varieties of cotton, wheat and maize—practically all of which ended in failure. In 1901, 56 acres (22.7 ha) of land at Lyallpur was turned into a farm and in 1902 three agricultural assistants trained at Cawnpore started work there.

Reviewing the record of achievement in the provinces up to the beginning of the twentieth century, Mackenna observed, 'The vast problems of Indian agriculture were being attacked by a mere handful of isolated workers with no trained staff and no organization to give effect to their recommendations. The general impression one gets from the record of these early efforts is that men were groping in the dark. The problems were so numerous and over-whelming that they did not know where to begin.

'But from the failures which followed many amateur efforts, some useful lessons were learned. It was found that, in many cases, a more hopeful line was the improvement of indigenous varieties by selection rather than the introduction of exotics. If exotics were to succeed, the information at least had been gained that the effects of change of environment were matters of first importance.

'Where environment was suitable a few notable successes in the introduction of new crops were achieved: groundnut in Burma; potatoes and fruits in the Kumaon Hills; American cotton in the United Provinces. And the lesson also had been learned that the East had much to teach the West and that it was wrong to assume that the cultivator had not sound reasons for his practice. At any rate the fallacy of foisting western ideas on him, without reference to local conditions, was fully exposed and the fact emphasized that the true line of development was the improvement of indigenous methods.[4]

VETERINARY SCIENCE AND EDUCATION

Journal of Veterinary Science and Animal Management

In 1882 was started the *Quarterly Journal of Veterinary Science and Animal Management* in India, under an Editorial Board consisting of Charles Steel (Army Veterinary School, Poona), Fred Smith (Veterinary Surgeon, 12th Lancers), and J.H. Steele (Veterinary Surgeon, Royal Artillery). This journal was the first veterinary periodical to appear in India, and it also claimed to be the first veterinary journal in the world to deal with military science.

In 1882 a Veterinary College was established at Lahore. Veterinary

[4]Mackenna, J. *Agriculture in India*, p. 16

education was now a priority subject and, in addition to the school at Lahore, lectures in veterinary science were being given to civilians at the Agricultural College at Saidapet, near Madras, and at the College of Science at Poona. In 1884 the Bombay Government decided to accept the offer of the local S.P.C.A. to use their buildings at Parel for the establishment of a three-year course in Veterinary Science. The approval of the Secretary of State to this proposal was obtained the same year.

The Bengal Government appointed a committee consisting of McLeod (who had sat on the Cattle Plague Commission), Hallen and Greenhill to consider the question of opening a veterinary school in that Presidency. A comprehensive report was submitted on the subject of training, reporting disease and the necessity of establishing a civil veterinary department for district work.

The following recommendation is of great interest, when one remembers how largely the horse loomed in the veterinary mind of the time: '*In this school the cow should constitute the main or sole subject of attention, and the horse and other domestic animals will receive scant notice.*'

Pasteur Method of Vaccination against Anthrax

Meanwhile, interest in the Pasteur method of vaccination against anthrax was increasing in the Punjab and Madras, where a consignment of the vaccine had been received for trial. As Hallen was proceeding on leave to Europe in 1884 it was decided that he should visit Pasteur's laboratory in France and report on the possibility of introducing the vaccine on a large scale into India.

Hallen returned in 1885 and made his report. In 1886, Messrs Burnup and Lamphrey appeared on the scene and competed for the post of Pasteur's agent, with a view to setting up a laboratory in India for the production of anthrax vaccine. It was agreed that this work should be carried out at the Agricultural College, Cawnpore, and Lamphrey was selected, but before he took charge, the Secretary of State instructed the Government of India to cease negotiations with him, on the grounds that the object of Pasteur and his associates was to form a company in India with a view to commercial profit, if the experiments were successful. The case was closed by the payment of £800 to Pasteur in 1891 for consignments of anthrax vaccine supplied for use in India. Meanwhile, a veterinary surgeon, named Cooper, and a graduate in Agriculture, N.N. Banerji, had returned from a visit to Paris, where they studied Pasteur's technique of vaccine production.'[5]

EARL OF DUFFERIN (1884-1888)

During Dufferin's regime, the Bengal Tenancy Act was passed in 1885,

[5]West, G.P. *A History of the Overseas Veterinary Services*, pp. 26, 27

followed by similar Acts for Oudh and the Punjab. These Acts gave further protection to tenants. In 1886, a veterinary college was started at Bombay, and a school of agriculture was attached to the Agricultural Farm at Saidapet, Madras.

MARQUESS OF LANSDOWNE (1888-1894) and EARL OF ELGIN II (1894-1899)

Marquess of Lansdowne (1845 to 1927) was an Irish nobleman, who joined the Liberal Party and was appointed Lord of the Treasury by Gladstone in 1868. He was Governor-General of Canada from 1883 to 1888. Salisbury appointed him Viceroy of India in 1888. He founded the Imperial Library and Record Office. He extended railway and irrigation works.

RESEARCHES OF ROBERT KOCH ON PATHOGENIC BACTERIA

In the last quarter of the nineteenth century, interest developed in Europe in the study of pathogenic bacteria owing to the work of Louis Pasteur in France and Robert Koch (1843 to 1910) in Germany.

Louis Pasteur (1822 to 1895) was born at Dale in eastern France in a family of tanners. In 1863, he became the Dean of the Science Faculty at the University of Lille, where he began his studies on fermentation. In 1881-1882, he originated vaccines for rabies, anthrax and chicken cholera in France.

Robert Koch was a native of Clausthal in the Upper Harz Mountains near Hanover, Germany. The son of a mining engineer, he astounded his parents at the age of five by telling them that he had, with the aid of the news papers, taught himself to read, a feat which foreshadowed the intelligence and methodical persistence which were to be so characteristic of him in later life. He attended the local school and there showed an interest in biology. He began a study of algae and later on switched over to pathogenic organisms.

In 1862, Koch went to the University of Gottingen to study Medicine. Here, the Professor of Anatomy was Jacob Henle. Koch was influenced by Henle's view, published in 1840, that infectious diseases were caused by living, parasitic organisms. He took his M.D. in 1866 from the University of Gottingen, and went to Berlin for six months for chemical study and there came under the influence of Virchow.

Anthrax was prevalent among the farm animals in 1872-1880 in the Wollstein District, and Koch, although he had no scientific equipment and was cut off entirely from libraries and contact with other scientific workers, embarked on a study of this disease. His laboratory was the 4-roomed flat that was his home, and his equipment, apart from the microscope given to him by his wife, he provided himself with. Earlier, the anthrax bacillus had been discovered by Pollender, Rayer and Davaine, and Koch set himself to prove scientifically that that bacillus was, in fact, the cause of the disease. In 1880, he was provided with a better laboratory, in which he worked with Loeffler, Gaffky and others, as his assistants. Here, Koch continued to refine the bacteriological methods. He invented new methods of cultivating pure cultures of bacteria on solid media, such as potato and on agar kept in the special kind of the flat dish invented by his colleague, Petri. He also developed new methods of staining bacteria. The methods made the bacteria more easily visible and identifiable.

Some two years after his arrival in Berlin, Koch discovered the tubercle bacillus and also a method of growing it in pure culture. In 1882, he published his classical work on this bacillus. He was still busy with work on tuberculosis, when he was sent, in 1883, to Egypt as Leader of the German Cholera Commission to investigate an outbreak of cholera in that country. There, he discovered the vibrio that caused cholera and brought back pure cultures of it to Germany.

On the basis of his knowledge of the biology and mode of distribution of the cholera vibrio, Koch formulated rules for the control of epidemics of cholera. The rules were approved by the Great Powers in Dresden in 1893 and formed the basis of the methods of control.

In 1896, Koch went to South Africa to study the origin of rinderpest and although he did not identify the cause of this disease, he succeeded in limiting the outbreak of it by injection into healthy farm-stock of bile taken from the gall-bladders of infected animals. Then followed work in India and Africa on malaria, blackwater fever, surra of cattle and horses, and on plague, and the publication of his observations on these diseases in 1898. Soon after his return to Germany, he was sent to Italy, and the tropics, where he confirmed the work of Sir Ronald Ross on malaria and did useful work on the aetiology of the different forms of malaria and their control with quinine.

Imperial Bacteriological Laboratories, Poona and Mukteswar, 1895

The systematic investigation of the diseases of animals in India began in 1890, when Dr Lingard was appointed Imperial Bacteriologist at the College of Science at Poona for the investigation of surra in horses and camels. But the climate of Poona was not favourable for bacteriological research or for the manufacture of vaccines and sera, and Mukteswar, 13 miles (21 km) south-east of Almora, was selected for the location of the Imperial Bacteriological Laboratory, where work in a modest way was commenced in 1895. This institution has been the pioneer in the field of veterinary research in this country.

Manufacture of Anti-Rinderpest Serum

Rinderpest has always been the scourge of India and the necessity of finding a remedy early engaged attention. In 1896, Professor Koch, along with his associates, Gaffky and Pfeiffer, visited Mukteswar and demonstrated his bile method of inoculation. In a group photograph taken at Mukteswar we see them with the British veterinarians. Koch had been in South Africa on the same mission. On arrival in India, he at once declared that the diseases known as rinderpest in South Africa and the cattle plague in India were one and the same. A meeting was called at Mukteswar of provincial veterinary officers, to whom Koch demonstrated his method of protecting cattle by the injection of bile taken from an animal suffering from rinderpest. During the next few years, rinderpest and the preparation of a potent serum were the principal interests of the laboratory. With the discovery of this serum, the scale of operations rapidly extended. A temporary stoppage was caused by the destruction of the laboratory by fire in 1899. A new one was soon built and a branch laboratory was also opened at Bareilly, so that research might be carried on during the winter months. The Bareilly Laboratory was enlarged considerably so that the manufacture of anti-rinderpest and other sera could go on all the year round. Between 1901 and 1904, the preparation of sera for anthrax and haemorrhagic septicaemia, of black-quarter vaccine and of mallein (the test for glanders) was taken up.

As rinderpest or cattle-plague is the most prevalent disease in India, the main work of the Mukteswar Laboratory was the manufacture of anti-rinderpest serum. So popular was the Mukteswar serum that large indents were received from the Straits Settlements, Egypt and Rhodesia. Vaccines and sera were also manufactured for haemorrhagic septicaemia, anthrax and black-quarter.

The Civil Veterinary Department

In May 1892, the Civil Veterinary Department came into existence, with Hallan as its first Director-General. His staff included the six officers from his former Horse Breeding Department, and provision was made for seventeen—four for higher education, two for scientific investigation, nine for general duties in connection with secondary education, horse and cattle breeding and cattle disease, and two as leave reserves. H.T. Pease was posted from the Lahore College staff to become Superintendent, Bacteriological Survey.

Izatnagar as Branch Laboratory of Mukteswar

Lingard retired from the Mukteswar laboratory towards the end of 1907 and he was followed by J.D.E. Holmess, who had served at Mukteswar as Assistant Bacteriologist. During Holme's tenure at Mukteswar, an event of far-reaching importance occurred. It was the puchase of a site of nearly 800 acres (324 ha) at Izatnagar, on the outskirts of Bareilly, to which it was proposed to transfer the work being done at Kargaina and expand Izatnagar as a branch laboratory of Mukteswar.

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CHAPTER 24

CONSTRUCTION OF CANALS FOR PROTECTION AGAINST FAMINE

SIRHIND CANAL (PUNJAB), 1873-1882

LOWER GANGA CANAL AND THE BETWA CANAL (N.W. PROVINCES), 1881-1893

THE MUTHA CANALS AND KHADAKWASLA DAM (BOMBAY PRESIDENCY), 1869-1879

THE NIRA RIVER CANALS (BOMBAY PRESIDENCY), 1877-1894

In November 1875, Prime Minister Benjamin Disraeli appointed Robert Bulwer Lytton (1831 to 1891) Governor-General of India. At the time of his appointment, the Russian influence was growing in Afghanistan, and Lytton had orders to counteract it and to secure a strong frontier by force. When negotiations failed to persuade the Afghans to expel the Russians, Lytton resorted to force, precipitating the Second Afghan War of 1878-80.

A poet, diplomat and statesman, Lytton also improved the administration in many ways. He abolished internal customs barriers, decentralized the financial system, and reserved one-sixth of the civil service posts for Indians. After the great famine of 1876-1878, he decided to set apart, every year, 15 million rupees as Famine Relief and Insurance Fund for famine relief. This money was to be spent on the construction of canals in areas prone to famine. It was from this Fund that the Sirhind Canal in the Punjab, the Lower Ganga and the Betwa Canals in North-Western Provinces (now Uttar Pradesh), and the Mutha and Nira Canals in the Bombay Presidency were constructed.

The Sirhind Canal (Punjab), 1873-1882

The impetus for the construction of this canal was provided by a famine, which ravaged the Punjab, Central Provinces and Upper Provinces. A million people died.

The Sirhind Canal Project was undertaken in 1873 and the canal was opened for irrigation in 1882. The project was financed from the public-loan funds and it was constructed solely by the Government agency to irrigate areas lying in British Punjab as well as in the princely States of Patiala, Nabha, Jind, Faridkot, Malerkotla and Kalsia. The cost of common works and their annual maintenance, as well as the supplies available, were shared by the British and the princely States in the ratio of 64 : 36.

The Sirhind Canal takes off from the Sutlej River at Ropar. The original headworks of the canal consisted of a weir 2,370 feet (722.4 m) long, with 12 undersluices, each of 20-foot (6.1-m) span on the left of the weir and a head regulator of the canal with 13 bays, each 21 feet (6.4 m) wide. The design of the headworks was defective in as much as heavy silt was induced into the canal, which, in due course, became badly silted up.

Subsequently, the weir crest was fitted with 6-foot (1.8-m)-high falling shutters and the waterway of the head regulator was increased to permit its silt level to be raised, thus increasing the depth of the undersluice pocket and passing only the top water into the canal. A divide groyne, 1,000 feet (304.8 m) long, was also constructed upstream of the undersluices, so as to form a silt trap in front of the canal head regulator.

To carry out the scheme, as finally approved in 1879, Thorburn observes, '1,800 convicts and multitudes of free labourers, including, during three famine years, 15,000 relief workers from Sirsa and Bikaner, were located in movable camps at different points along the line.' This was the first experiment of employing convict labour on public works on a large scale. Three jails were built, capable of holding, in all, 2,500 men. The prisoners rarely reached this number, but there were usually from 1,400 to 1,800 on the works. Their services were of great value, as their presence ensured the placing of a large body of men on any urgent work, and it also tended to steady the rates of free labour. The jails proved a most valuable asset and contributed materially to the completion of the canal.

Materials

The works on the main line were constructed of sandstone, obtained from a quarry near Nalagarh, and the mortar was manufactured of bricks from the ruins of Sirhind, and lime from *kankar* quarries at Patharheri, a village, a few miles from Ropar. A railway line, 54 miles (86.9 km) long, was constructed from Doraha to the Nalagarh quarries to carry material, and was dismantled shortly after the completion of the canal in 1884-85.

Cross-drainage by Super- and Under-passages

A remarkable feature of this canal is the provision of super- and under-passages for the *chos* (monsoon torrents). In some places, we see the canal above and the *cho* below, and in others the *cho* is above the canal.

The problem of the disposal of the cross-drainages was solved by means of masonry conduits. The Dohar torrent siphon, which passes 5,000 cusecs (141.6 cumecs), is a good example of an under-passage and the Budki super-passage carries the combined streams of the Sugh and Budki torrents across the canal by a super-passage. The aggregate catchment area of these two torrents is 86 square miles (222.7 km^2), and their combined maximum discharge, when in flood, 65,000 cubic feet (1,840,546 litres) a second. The super-passage is 395 feet (120.4 m) wide between the parapets, which are 14 feet (4.3 m) high. The water in flood is about 12.1 feet (3.96 m) deep on the floor of the aqueduct, the cost of which was nearly Rs 700,000, excluding the cost of the torrent-training works. A long diversion cut leads the Sugh into the Budki above the super-passage, and there are training works for about three miles (4.83 km), both above and below the super-passage.

In the 7th mile (11.26 km), a super-passage carries the Siswan torrent over the canal. Its cost along with the training-work was (Rs 900,000). It is designed to pass 20,000 cubic feet (566,322 litres) per second, and is 250 feet (76.2m) wide between parapets, which are 10 feet (3 m) high. Unusual difficulties were encountered in laying the foundations of this work, and its construction was laborious and expensive.

'The aqueducts which transported over and under the main, the tens of thousands of tons of water, sand, mud, and gravel suddenly hurled upon it after every heavy downpour in the hills, are necessarily of a size and solidity compared with which the largest bridges in Europe are inconsiderable', observed Thorburn. 'That since 1882, when Lord Ripon formally opened the canal, the cross-drainage conduits have withstood the attacks of many floods, proves the high quality of the minds which designed, and the careful work of the hands which executed, those massive aqueducts. The successful carrying of the main over three miles (4.83 km) of low-lying marsh-land was rather a triumph for dogged persistence and engineering skill. As the bed of the canal had to be excavated to a depth of 14 feet (4.3 m) below spring level and raised as many above it, the chief difficulty lay in counteracting the constant inflow of water into the excavations. This was effected by incessant pumping and the casemating of the sides and bed as work progressed. In addition, as the marsh had no bottom other than soft mud, a precarious stability for the masonry superstructures required at various points had to be obtained by sinking wells to considerable depths and surrounding them with stones and blocks of concrete.'[1]

Workshop and Foundry

For the repairs of the engines and machinery in use on the canal, a workshop and foundry were erected near the regulator at Ropar. The whole of the original lock and regulator gates, with their fittings and gear, were built in these shops, and work was also done for other canals in the Punjab.

The construction of almost every canal has invariably brought out valuable lessons. Thus the reaction noticed from the excessive slopes on the Bari Doab Canal led to the provision of bed gradients so gentle that the canal silted up heavily. The remedial measures taken initiated the first study of river control at headworks and of silt exclusion.

The cost of the canal up to its opening in November 1882 was about 40.7 million rupees. The canal was opened with great ceremony by the

[1]Thorburn, S.S. *The Punjab in Peace and War*, pp. 267, 268

Viceroy, Lord Ripon, in the presence of the Chiefs who had largely contributed to the cost of the undertaking.

The canal has proved highly profitable. It irrigated 2,642,000 acres (1,069,217 ha) in 1960-61 and yielded 26.7 per cent revenue on the capital outlay. Besides, after the partition of the Punjab, in August 1947, when most of the canal-irrigated area was included in Pakistan, and the Bhakra canals had yet to come, the Sirhind Canal sustained the economy o. the Indian Punjab.

NORTH-WESTERN PROVINCES

The United Provinces of Agra and Oudh were known as North-Western Provinces in the early British rule. This area and the adjoining areas, now included in Rajasthan, Haryana, and Madhya Pradesh, were subject to famines and scarcities in the latter half of the nineteenth century. 'There were seven years of famine—viz. 1860-61, 1876-78, 1896-97, and 1899-1901; in addition, scarcities from short droughts in rain-dependent tracts were frequent.'[2] These famines and scarcities provided impetus for the construction of the Lower Ganga Canal and the Betwa Canal.

The Lower Ganga Canal

Following the damage caused by the failure of rains in 1866, the Lower Ganga Canal Project was conceived for extending irrigation in the Jamuna-Ganga Doab. The weir was executed on fine sand. Its subsequent partial failure, which necessitated reconstruction, led for the first time to a critical examination of the problem of checking the insidious flow of water underneath the foundations of the weirs in sand.

The most remarkable work on the canal is the magnificent Nadrai aqueduct of 15 arches, each of 60-foot (18.3-m) span, which carries the water over the Kali Nadi, a river subject to extraordinary variations in the flow of the floods. The canal irrigates over one million acres (404,686 ha).

The Betwa Canal (District Jhansi, U.P.), 1881-1893

The Betwa Canal in North-Western Provinces was sanctioned as a famine-relief measure in 1881. It is the first example of a non-productive work deliberately undertaken for its protective value, regardless of the heavy financial implications. Betwa is a tributary of the Jamuna, with a maximum discharge of over 800,000 cusecs (22,535 cumecs), which becomes almost negligible in winter. The storage reservoir was constructed at Parichha, 17 miles (27.36 km) from Jhansi. It impounds 2,500 million cubic feet (70,890.25 million litres) of water and feeds a canal of 700 cusecs (19.7cumecs).

The weir is 4,261 feet (1,298.7 m) long and its greatest height is 60

[2]Thorburn, S.S. *The Punjab in Peace and War*, p. 242

feet (18.3 m). Its crest is fitted with automatic shutters, 6 feet (1.8 m) high and the capacity of the reservoir formed upstream of the weir is 2,470 million (69.9 million m^3).

The river carries very little water during the dry season and, to augment the storage capacity, another weir, the Dukhwan Weir, was built in 1910, about 25 miles (40.2 km) upstream of Parichha.

The undersluices and the canal head regulator are situated on the left flank of the weir. The designed head discharge of the canal is 1,300 cusecs (36.8 cumecs). The length of the main canal and branches is 168 miles (270.3 km). The canal has served its purpose of protection against famine admirably. It irrigated 246,000 acres (99,553 ha) in 1960-61.

THE BOMBAY PRESIDENCY

The Mutha Canals and Khadakwasla Dam (Bombay Presidency), 1869-1879

The construction of the Mutha Canals, which irrigate the land around the Poona City and supply drinking-water to the City, was another landmark in the history of irrigation in India. Fife, of the Royal Engineers, was the author of the scheme.

With the construction of the Mutha Canals (1869-1879), India entered upon a new field, the building of large masonry dams.

Khadakwasla Dam—the First Dam in British India

In 1869, the first great storage work was undertaken on the Mutha River at Khadakwasla, about 10 miles (16.1 km) from Poona in the Bombay Presidency. The dam and the waste weir, which are nearly one mile (1.6 km) in length, took nearly 10 years to complete. The dam is 30.2 m high at its highest point. The profile adopted for the dam was decided after an intensive study of high dams in France, Italy and Spain. It was a bold experiment to employ uncoursed rubble masonry in a dam nearly 100 feet (30.48 km) high, but it proved highly successful and became a precedent for employing a similar technique in other high dams in India. The reservoir served the dual purpose of providing the Poona City and the adjoining cantonments with drinking-water and of irrigating the very precarious tract east of Poona.

The lake formed behind the dam had a water-spread of about 6 sq. miles (15.4^2 km) with a live storage capacity of nearly 4,000 million cu. ft (11.3 million m^3) of water.

Of the two canals, which drew their supplies from the reservoir, the left-bank canal was only 18 miles (28.9 km) in length and carried 38 cusecs (1.1 cumecs), whereas the right-bank canal was 70 miles (112.6 km) long and carried a discharge of 400 cusecs (11.3 cumecs). It also supplied drinking-water to Poona and terminated in a large tank, called the Matoba Tank, which received and distributed the surplus water of the canal. Numerous cross-drainage works had to be constructed on the right-bank canal to negotiate almost a hundred torrents and drainage lines, large and small. The waste weir was fitted with automatic gates in 1903-04. Eighty-eight sluice gates, 10 ft (3.0 m) wide and 8 ft (2.4 m) high, were provided and the gates were arranged in sets of eight and worked in pairs. The design provided a chamber in each eighth pier, containing a hollow water-tight cylinder which operated a set of eight gates and into this chamber an inlet channel from the reservoir, placed at the full-supply level, discharged. When that level was reached in the reservoir, water entered the chamber, raising the hollow cylinder owing to floatation, and the gates opened. When the water level in the reservoir fell, the chamber gradually emptied itself through a waste pipe, and the hollow cylinder went down, thus closing the gates.

The Nira River Canals, 1881-1894

Among the protective works constructed by the Government in the Bombay Presidency were the Nira River Canals. The Nira Canals comprise two distinct canal systems, viz. the Nira Left-Bank Canal and the Nira Right-Bank Canal. The former was built in 1877-1894, and the latter was undertaken about thirty years later. Both the canals take off from the River Nira at Vir, where a pick-up weir, 2,300 ft (701 m) long and 40 ft (12 m) high, has been constructed.

The head discharge of the Left-Bank Canal is 450 cusecs (12.7 cumecs) and that of the Right-Bank Canal is 1,500 cusecs (42.5 cumecs). The canals depend for their supplies on the Bhatgarh Storage Dam on the Yelwandi River, a tributary of the Nira River, built for the Left-Bank Canal in 1877-1894 and the Lloyd Dam built simultaneously with the Right-Bank Canal, close to the former dam.

The heights of the Bhatgarh and Lloyd Dams are 127 and 183.7 ft (38.6 and 56 m), and their lengths are 4,067 ft (1,240 m) and 5,333 ft (1, 626 m) respectively.

Shetpal Tank

At the tail of the Nira Left-Bank Canal is the Shetpal Tank, the principal object of which is to store the surplus monsoon flow of the canal, which would otherwise go waste, and utilize it during the winter season. Its construction was started in 1897 as a famine-relief work. The earthen embankment forming the tank is 12,432 ft (3,789 m) in length, with a maximum height of 66 ft (20.1 m). Its live storage capacity is 572 million cu. ft (16.62 million m^3) and it relies for its supply almost entirely upon the canal.

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CHAPTER 25

THE NINETEENTH-CENTURY VILLAGE

VILLAGE COMMUNITIES, CASTES AND PROFESSIONS
LIFE IN THE VILLAGE

THE nineteenth-century village differred from the present-day village in having fewer pucca houses. The use of cement and glass was then not known. The nine-inch brick (23-cm) came into use only in the last quarter of the nineteenth century, with the development of railways and coal-mines. Such of the houses which were pucca belonged to the village headman or the money-lender and were constructed with small bricks, which can be seen in the buildings of the Mughals. The small bricks were baked in native kilns (*pajawās*), fired with logs of wood or dung-cakes. For joining the bricks, lime was used, which was prepared from limestone brought from the quarries at the foot of the Siwaliks. There was no electricity to cheer the drab homes nor pucca roads to provide easy access to the market. The transport of goods and agricultural produce was by bullock or camel carts. People travelled on foot, and for the few who could afford to pay, there was the horse-drawn *ekka* (Fig. 24). The *ekka* still plies in eastern Uttar Pradesh, though it has vanished from the Punjab and Haryana.

THE VILLAGE ORGANIZATION, CASTES AND PROFESSIONS

The village was a self-sufficient economic and social unit. The village community consisted of land-owners, their tenants and village servants. The land-owners were usually the descendants of a common ancestor, and hence were connected with each other by ties of blood. The cultivators of land-owners belonged to distinct castes, e.g. Jats, Kambohs, Ahirs (Yadavas), Rajputs, Gujars and Sainis in the Punjab and Haryana. Among the Brahmin cultivating castes in western U.P. were the Tyagis or Tagas. Among the Moslems, the most intelligent and methodical cultivators were the Arains, the counterparts of Hindu Malis. In southern India, the best farmers were Kammas, Reddys, Vellalas, Thevars, Naickers, Kapus, Rajus, Vokkaligas, Lingayats, and Nairs.

Communication with the outside world was poor and unsafe, and the village community therefore included a nearly complete establishment of occupations and trades, which enabled it to continue its collective life without assistance from any external person or body. There was always a *bania* who maintained a shop for the sale of odds and ends and also supplemented his income by money-lending. There was a night watchman for police work and a messenger for communication with the outside world. Among the artisans was a potter who furnished a variety of pots to the villagers (Fig. 25). The shoe-maker made the shoes and the plough harness or gear. The carpenter fashioned agricultural implements and helped in housebuilding (Fig. 26). There was a blacksmith who kept the ploughshares and digging-implements in working order. Attached to the village was a colony of weavers and leather-workers (Harijans) who worked as daily labourers at harvest time, or as permanent labourers in agricultural partnership. There were dyers who dyed cotton cloth with indigo, the popular dye of the nineteenth century. In every village there was an oilman who pressed oilseeds like *sarson*, linseed, poppy-seed, and sesamum. In a painting dated 1865 an oilman is depicted extracting oil in his bullock-driven oil-mill, and on one side is a pile of oilseeds (Fig. 27). Spinning wheels were in every home, and women spun cotton-yarn, which they gave to the weaver for preparing coarse cloth. In more affluent villages, there was a goldsmith who made gold and silver ornaments for the village women (Fig. 28). There was a barber who also acted as a marriage broker and surgeon. Sometimes, there was an astrologer and even a "witch finder". Such village servants were not paid by the job, but by a regular income paid in foodgrains at harvest, on receipt of which they were bound to work for every village resident without further payment. Some of the others were Brahman priests, who performed birth, marriage and death ceremonies. In Moslem villages there were *mullas*, who looked after the mosque and religious needs of the Moslems. There were jugglers, acrobats, faqirs, sadhus and mountebanks of various types. Sometimes, a dancing girl was attached to the village, and she performed on the occasion of marriages and relieved the drunken *baratis* of their hard-earned rupees. There were *mirasis* and mimics *(naqals)* who entertained the villagers. The women-folk of *mirasis* directed *siapas* when some one died. The *mirasin* would lead the female mourners, mentioning the good qualities of the deceased, whom she called 'Dilli Nawab'. The mourners would beat their thighs, breasts and faces, thus relieving the anguish of their minds. This is what is called catharsis in modern psychology and is recommended as a cure for depression. The village organization inspired a spirit of mutual good-will and friendliness.

In South Indian villages, particularly in Karnataka, the functions of various castes became clear at the time of a wedding. For instance, the Brahmin acted as the priest, the carpenter put up the *pandal*, the goldsmith made the ornaments, the potter provided the pots, the washerman presented clean clothes for the bridal pair to circumambulate the sacred fire during the ceremony, the barber shaved the bridegroom, the oilman supplied oil for lighting and cooking, the shepherd supplied wool for the sacred thread which was tied round the wrists of the bride and the groom, the *banajigas* (traders) sent the provisions, the *medas* (basket-makers) supplied baskets, and the Harijan performed menial tasks and made a pair of shoes for the

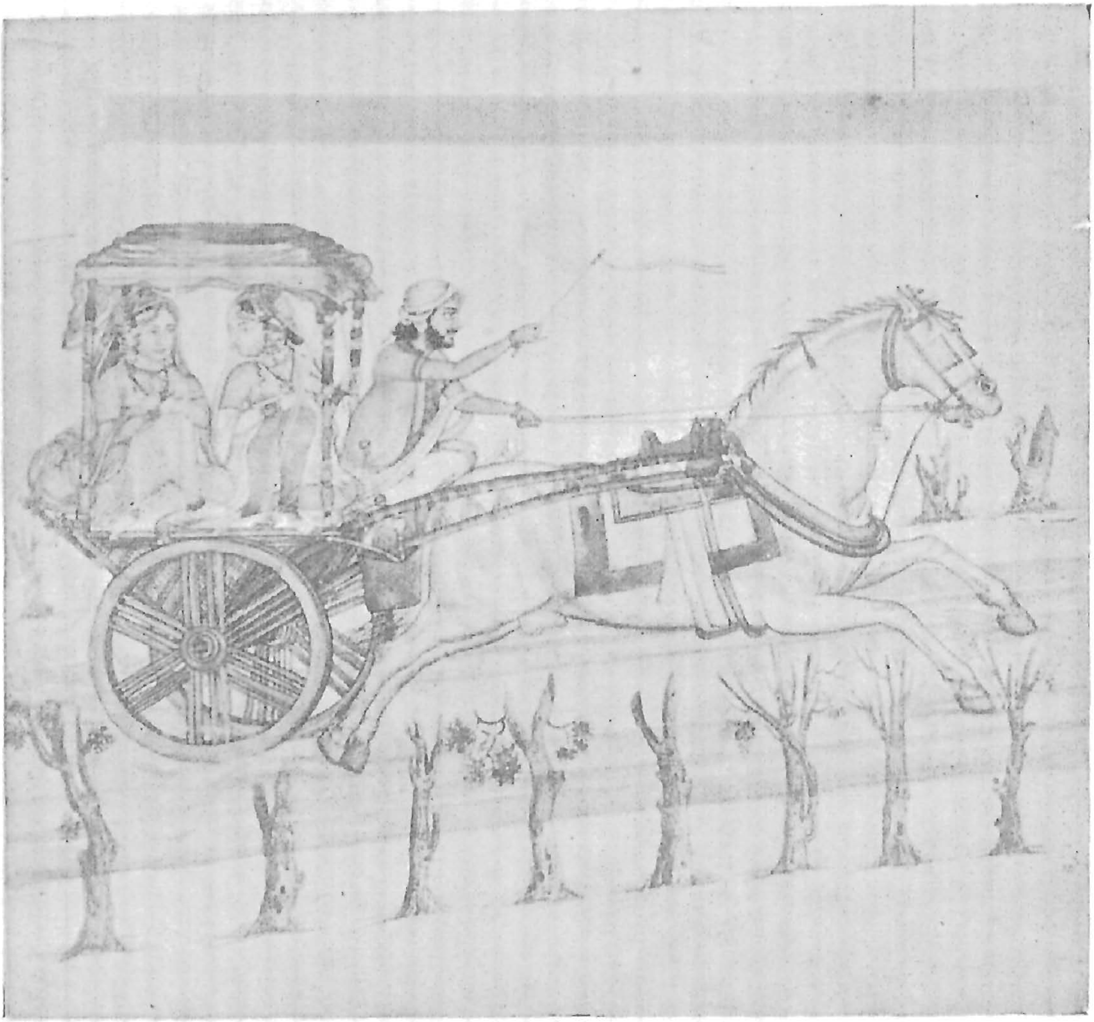

Fig. 24. Horse-drawn *ekka* was a common mode of transport in the 19th century Punjab. *Ekka* is still popular in Uttar Pradesh and Bihar. Artist Kehar Singh, *c.* 1870 (Courtesy: Chandigarh Museum)

Fig. 25. A potter. The inscription on the top reads, 'Nanaka potter Sabdalpura. His age is 130 years'. In front is Qutba, his son, turning the potter's wheel. Artist Kehar Singh, *c.* 1817
(Courtesy: Chandigarh Museum)

FIG. 26. A carpenter chiselling *pawa* of a charpoy. In the foreground are *pawas*. To his left are saws, chisels, files, etc. A sketch by Kehar Singh, *c*. 1865 (Courtesy: Chandigarh Museum)

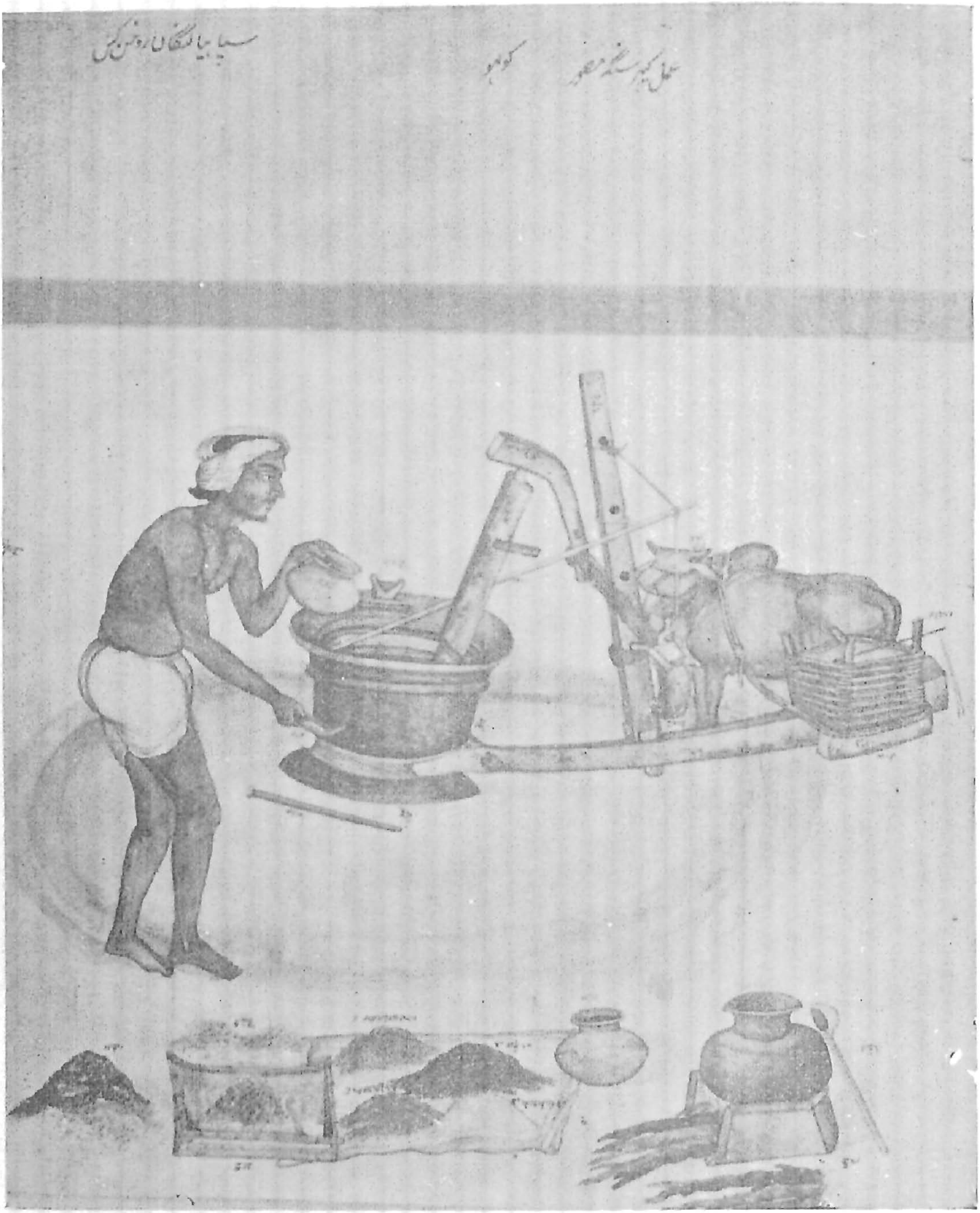

FIG. 27. An oilman (*teli*) crushing oilseeds. In the foreground are piles of *sarson*, linseed, poppy-seed, sesamum etc. A sketch by Kehar Singh, *c.* 1865 (Courtesy: Chandigarh Museum)

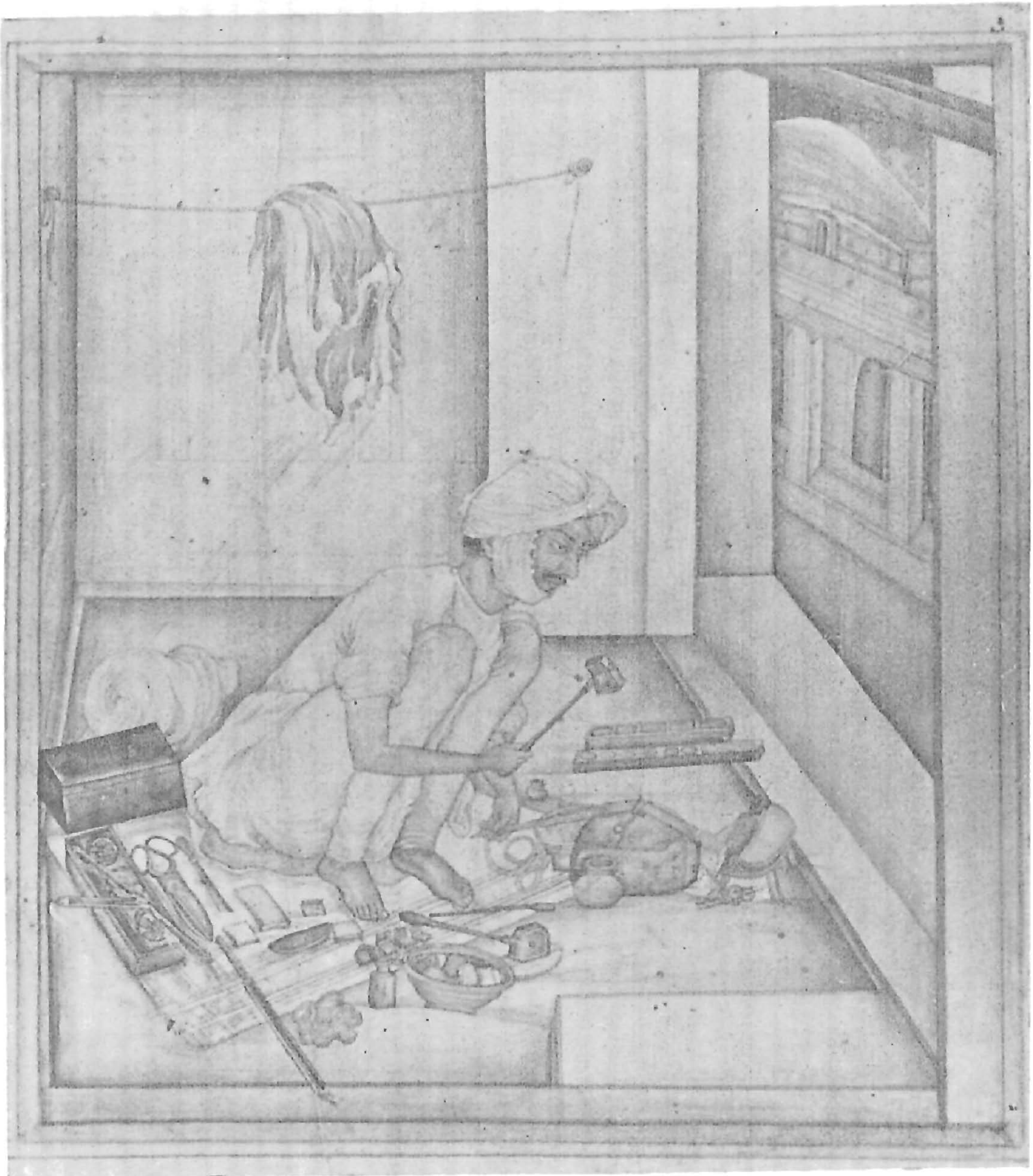

FIG. 28. A goldsmith in his workshop. A sketch by Kehar Singh, *c.* 1865 (Courtesy: Chandigarh Museum)

FIG. 29. Women baking *chapaties* in an oven (*tandoor*), in a Punjab village. Artist Kehar Singh, 1870
(Courtesy: Chandigarh Museum)

FIG. 30. A cobbler. Inscription reads 'Mambakhsh cobbler, Katra Ramgarhian, Amritsar, *Samvat* 1920 (1863 A.D.)'
(Courtesy: Chandigarh Museum)

FIG. 31. A weaver working on a hand-loom. In the background is his wife plying a spinning wheel, and in the foreground are his tools. –A sketch by Kehar Singh, *c.* 1865
(Courtesy: Chandigarh Museum)

groom. The carpenter, the blacksmith, the washerman, and other artisans performed their duties all the year round in return for a fixed quantity of paddy which each family gave them annually.

Life in the Village

While the social life of the villages centred largely on the *gurdwara*, the temple and the *dharamsala*, the well, the *bhatti* for parching grains and the village shop had their own importance. When the housewives were free from their domestic chores in the morning, they went to the well carrying earthen pitchers and brass vessels for fetching water. The idlers and young gallants usually took their position on the logs of wood which lay scattered around these wells and amused themselves by staring at them. On return from the well, the women baked *chapaties* in an earthen oven, the *tandoor* (Fig. 29). The *tandoor* dates back to Harappan times (about 2200 B.C.). The favourite vegetables for cooking were the leaves of *sarson*, and from among the pulses, *urd* was most popular. In some States women also participated in agricultural operations, e.g. the sowing of seed, weeding and harvesting. In addition they made cowdung cakes for use as fuel.

In the evening, boys and girls went with maize or gram to the *bhattis* or parching kilns which were maintained by the *jhiwars*. Parched grains were a favourite food of the villagers. The *bhatti* was a busy and lively place in the evening, the sound of the parching grains mixing pleasantly with the voices of the children chirping like sparrows. After sunset the people gathered for gossip on the platform below the village shop.

In the morning, apart from the crowing of cocks, one of the familiar sounds heard was that of the hand-mill. The ploughmen left for their fields with the bells of their bullocks tinkling merrily in the early morning. Before the sun was too strong, i.e., till about 10 AM, most of the ploughing was completed, and the womenfolk brought the morning meal consisting of wheat *chapatis*, mango pickles and buttermilk or *lassi* with which generous quantities of salt were taken. At about noon time, the farmers gave water to their cattle from the well, and after that there was quiet and silence for many hours.

People had their meals usually by sunset, and most of them were fast asleep by about 9 PM. Old men who were unfit for hard manual labour, spent their time during the winter months, removing fibre from sunn-hemp and warming their limbs by burning the pith.

The harvest season started with the celebration of Baisakhi when the wheat crop was golden yellow. The months of April, May and June were a busy season for the farmers as the harvest of wheat and its threshing and winnowing kept them fully occupied. In the month of June, when the wheat crop was gathered, a good deal of feasting went on. The families invited each other in rotation for meals. The host collected milk and *lassi* from other families, and from these milk-rice pudding and curd preparations were made.

The Collector's Camp

In the cold season, the peace of the village was disturbed by an intrusion, which upset the routine for a number of days. John Beames, who served as a Collector in the Champaran District in Bihar in 1860, thus describes how the District Officers toured the villages. 'One morning there arrived a number of bullock-carts loaded with tents, with a dozen chaprassees, tent-pitchers and policemen. They sent for the Tahsildar and while waiting for him cooked and ate their dinner. After a time that lordly official ambled up on his horse followed by a string of peons. He and the chaprassees then had a long conversation, after which they walked about the tope (grove) to select a proper site for the camp. It was amusing to hear the chaprassees explaining that their Sahib liked this or disliked that in the way of sites. At last they found a place which suited them, and after having it carefully swept they proceeded with much noise and shouting to erect a 'Swiss cottage' tent as a sitting-room, two large, square sleeping tents, a smaller cutcherry tent, and several *pals* for the servants. Then there was much wrangling as to the amount of food supplies required, the Tahsildar having been ordered by his own Collector to give the necessary supplies. The Tahsildar, after paying this short visit, ambled off again and the chaprassees and others curled themselves up and went to sleep. At dusk arrived coolies carrying hay, straw, cooking-pots, fire-wood, rice and other eatables for the camp.

'Very early the next morning arrived more carts carrying the Sahib's kitchen, also tables and chairs, boxes and other things. With these came two milch cows, two or three goats, coops full of fowls and a fat sheep. The tents were then furnished and arranged, the kitchen set in order under a tree and the business of cooking the breakfast begun. His highness the Khansamah on a pony, with several subordinate servants, now arrived and took charge of the proceedings. An hour later there was a stir in the camp, the servants all put on their clothes and began to look very active and attentive. Two syces leading horses and two more leading ponies now straggled in and announced that the sahib was close behind. Presently there was a sound of hoofs in the distance, everyone stood up and the Collector and his wife, mounted on two handsome Arabs, cantered into the tope and dismounted. Tea was brought to them at once and shortly afterwards a *champony* drawn by two bullocks trotted up, out of which emerged three little boys, an ayah, a bearer and a mass of rugs, clothes, toys and other things.'[1]

There was little doubt that it took the village quite some time before

[1]Beams, John. *Memoirs of a Bengal Civilian*, p. 177

it could recover from the ravages of the Collector's camp. The villagers were deprived of their milk and chickens for which a conscientious Collector might have paid his servants, but it was doubtful that the money reached the sellers. On the plus side of the Camp it must be said that the bad characters of the village got a fright and left the scene of their operations for some months.

THE VILLAGE COMMUNITIES

The village had a *chaupal* or meeting-place where the Panchayat consisting of five elders discussed village affairs, and settled disputes. Respect for its authority held together the Hindu rural society.

Describing the village communities of northern India, which had to face numerous invaders in the eighteenth and nineteenth centuries, Metcalfe observed, 'The village communities are little Republics having nearly every thing they want within themselves, and almost independent of any foreign relations. They seem to last where nothing else lasts. Dynasty after dynasty tumbles down; revolution succeeds to revolution; Hindu, Pathan, Mughal, Mahratta, Sikh, English, are masters in turn; but the village communities remain the same. In times of trouble they arm and fortify themselves; a hostile army passes through the country; the village community collect their cattle within their walls, and let the army pass unprovoked; if plunder and devastation be directed against themselves and the force employed be irresistible, they flee to friendly villages at a distance, but when the storm has passed over they return and resume their occupations. If a country remains for a series of years the scene of continual pillage and massacre, so that the villages cannot be inhabited, the villagers nevertheless return whenever the power of peaceable possession revives. A generation may pass away, but the succeeding generations will return. The sons will take the place of their fathers, the same site for the village, the same position for the houses, the same lands will be re-occupied by the descendants of those who were driven out when the village was depopulated; and it is not a trifling matter that will drive them out, for they will often maintain their post through times of disturbance and convulsion, and acquire strength sufficient to resist pillage and oppression with success.'

CHAPTER 26

TYPE OF VILLAGES AND VILLAGE HOMES

THE types of villages which still exist in rural India provide us with a view of the villages of the nineteenth century. These can be broadly categorized into four groups.

1. Northern India, from the hill areas to the plains of the Punjab, Haryana, Rajasthan, Uttar Pradesh and Bihar;
2. Eastern India, comprising Assam, Bengal and Orissa;
3. Southern India, comprising Tamil Nadu, Andhra Pradesh, Karnataka and Kerala, and
4. Central and western India, comprising Madhya Pradesh, Maharashtra and Gujarat.

1. NORTHERN INDIA

I. HILL AREAS

HOME-STEADS IN THE KANGRA VALLEY (HIMACHAL PRADESH)

The hamlets differ greatly in size. They are largest and most compact in the Hamirpur Tahsil and parts of the Dera and Nurpur tahsils. There they are called *graon* or *gaon*. In other parts, the name given to them is *larh*. The oldest and largest hamlets are generally held by families of good caste, who, on various grounds, used to hold land free of rent, in whole or part, under the hill Rajas, and who, therefore, had a special motive for sticking together. Generally speaking, in that part of the country which is nearest to the plains the land-holders had stronger feeling of property in the soil, and it is there that the largest hamlets are found.

The fiscal 'village' of Kangra has very little resemblance to the villages of the plains. The houses are scattered promiscuously, each family living upon its own holding in a state of isolation from the other families which are grouped with it into the fiscal circuit. Everyman resides upon his own farm and builds his cottage in some selected spot, open as a rule to the sun, and yet sheltered from the wind (Fig. 32). The house is of sun-dried bricks and generally has two storeys. The inmates occupy the lower floor, the upper being used during the greater part of the year as a lumber-room or store-room for grain. During the rains, the upper room is used for cooking and in many cases as a sleeping-room, the whole family occupying it at night to escape the unhealthy air of the ground floor. The upper roof is generally made of thatch and is thick, substantial, and neatly trimmed; slates are also used. The outside walls are plastered with red or light-coloured earth. The front space is kept clean and fresh, and the whole is encircled by a hedge of trees and brambles for maintaining privacy and

FIG. 32. Small clusters of huts in Himachal Pradesh
(Courtesy: Anthropological Survey of India.)

providing material for repairs. On one side of the cottage is the shed for the cows and bullocks, and is called *kurhal,* and another building or *ori* is for housing sheep and goats. If the owner of the farm is a man of substance, he usually possesses one or two buffaloes; they are penned in separate tenements called *menhara.* The thatch of the cottage is renewed every third year, and in areas where grass is plentiful, a fresh covering is added to the cottage annually.

II. PLAINS

Villages in the Indo-Gangetic Plain

The villages in the Indo-Gangetic plain, which includes the Punjab, Haryana, Uttar Pradesh, Bihar and Rajasthan, the Malwa plateau and portions of Maharashtra, are characterized by shapeless clusters (Fig. 33).

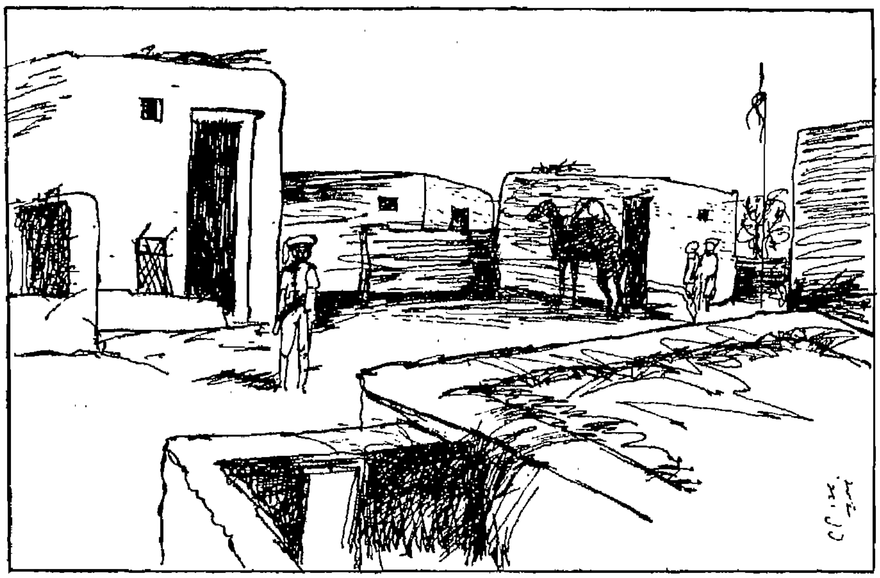

Fig. 33. A shapeless cluster of huts with horizontal roofs, western Uttar Pradesh (Courtesy: Anthropological Survey of India)

On account of insecurity which prevailed in earlier times, the population tended to congregate to form large clusters.

The houses were built of sun-dried mud bricks with flat roofs. Grouped together on the highest place in the low-lying fertile land near a river, these dwellings formed a dry refuge for their inhabitants during the monsoon floods. As the flimsy houses collapsed, others were built over them. The village site rose higher and higher till it formed the most conspicuous landmark in the boundless plain. The antiquity of a site may be roughly gauged by its height above the level plain surrounding it. The earth for building the houses and for the walls of the village was obtained by digging one or more ponds, which became filled with rain-water and afforded a drinking-place for cattle, and a wallowing-place for buffaloes in the hot weather. The village was generally enclosed by a wall or stockade provided with gates, outside which lay the arable land, guarded by fences, snares and field-watchmen from intrusive birds and beasts. Outside the village lay its pasture and its woodland or uncleared jungle.

A Punjab Village

On entering a Majha village in the Punjab, one finds the front doors of the houses opening on the main streets or the side lanes runnig off them. Ordinarily, the entrance leads straight into an open courtyard which has a trough along one or more of its sides for the cattle. The living-rooms are generally built along one of the sides of the courtyard. These are long and narrow, with or without a small verandah in front, and are generally provided with a flight of steps or with a wooden ladder giving access to the roof. A house has only a few windows; light and air enter it through the door, and the smoke also finds its way out in the same way, or through a hole in the roof. But cooking is carried on for the most part in a corner in the yard in a partly roofed shelter which is usually made of clay and is ornamented with folk designs. The people live as much as they can in the open air, and are only driven indoors by cold or rain. A noticeable object in every house is the *bharoli,* a large jar-shaped receptacle, for the grain of the household. It is made of plastered mud with a stoppered hole through which the grain runs out, when required. Each family living within the enclosure has a separate dwelling-house and a cooking-place, whereas in the yard, outside the doors, much of the available space is taken up by the bedsteads and waterpots of the households and by the spinning-wheels. The roof is used for storing heaps of sorghum and bundles of cotton sticks and also for drying chillies, maize cobs and seed grain in the sun. Some houses have a small upper chamber on the roof, called *chaubara.* Sometimes, the front door, instead of leading directly into the yard, takes one into the *deohri,* which again has a smaller door, so placed that the interior of the yard cannot be seen from the street. The *deohri* will only be found in the houses of well-to-do *zamindars,* or in the houses which have been built outside the village. It is used for stalling cattle, storing fodder, ploughs, yokes and other implements, or as a guest-house.

As regards the cost of construction and building material, in the last quarter of the nineteenth century, Atkinson (1878), describing the villages in the Tarai of the Nainital District, U.P., states, 'Bricks made in the district cost, for the nine-inch (23-cm) brick Rs 900 per lakh (100,000), and for the small native brick, Rs 125. The limestone from quarries at the foot of the hills is almost invariably used for lime; it yields a very strong and white lime which is peculiarly suited for fine plaster work and costs about 14 annas per 82 lb (Rs 1.20 per 50 kg). For large works, or where there is exposure, *sal* timber is used; its cost, at the forest depots, is from Rs 2 to Rs 2-12-0 per cubic foot (Rs 57 to 78 per cubic decimetre), so that when worked up, including carriage, the rate comes to Rs 2-8-0 to Rs 3-4-0 per cubic foot (Rs 71 to 92 per cubic decimetre).

MUD-HUTS

The ordinary mud-hut, generally common throughout Rohilkhand, is found in the greater portion of the district. It is built at a cost of about seven rupees, for the walls three rupees, and for the grass roof four rupees.'[1]

BIHAR, EASTERN UTTAR PRADESH AND MADHYA PRADESH

In this area, houses are usually *kutcha*, with a thatched roof. The

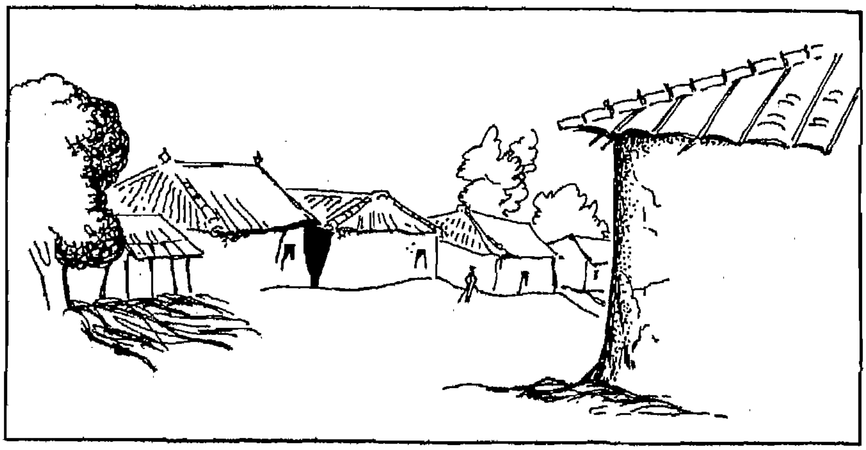

FIG. 34. A shapeless cluster of huts with tiled roofs, Patna District, Bihar (Courtesy: Anthropological Survey of India)

houses of the well-to-do are roofed (Fig. 34) with semi-cylindrical wheel-made tiles (*khaprail*).

2. EASTERN INDIA

ASSAM VILLAGES

Villages in the sense of beehive compact settlements, surrounded by fields, are hardly to be seen in Assam. All over the State, there is a marked

[1]Atkinson, E.T. *The Himalayan District of the North-West Province of India*, p. 704

preference for small hamlets, and the term 'village' generally refers only to a cadastral tract of land. The houses are usually concealed in dense groves of bamboo, plantain and jackfruit. It is difficult to tell where one village ends and another begins, or to which of the larger clumps of trees should be assigned the smaller clumps which are freely dotted about among the rice field. There is no dearth of building sites; there are no communal lands, and there is nothing to keep the population together.

The dwelling of an ordinary villager consists of three or four small and ill-ventilated rooms, built round three sides of a courtyard. The walls are usually made of reeds, plastered with mud; the roof of the thatch is supported on bamboos, and the floor is of mud. The dwellings of the middle class are in the same style, but are larger and of better quality than the cottages of the peasants. In the Surma Valley, the cottages are raised on high plinths, are well thatched, and have an arched roof-tree to resist the storms. In Kamrup, the house is often entered through a little room intended for the reception of guests—a refinement which is seldom seen in the homestead of the ordinary villager farther up the valley. Log huts are to be seen in areas liable to floods, and also in the forest clearings in the hills, where safety from wild animals is essential.

The furniture of the cultivating classes is simple, and consists of a few boxes and wickerwork stools, brass and bell-metal cooking-utensils, earthen pots and pans, baskets, and some bottles. Handloom-weaving is practised by all women, and in front of every house there is a handloom on which women weave silk cloth, whenever they find time. In no other part of India handloom-weaving is so prominent. The villager sometimes sleeps on a mat on the floor, but the middle classes have beds, tables and chairs in their houses.

The animistic tribes usually build their house on piles, the floor being raised a few feet above the ground. Such a structure is useful, if the ground is uneven, or there is likelihood of flooding. *San*-grass is used for thatching the roofs. The house consists of one long building, divided into cubicles by a few partitions.

Namghar, the village congregational prayer-hall, is a conspicuous feature of the Assamese village where people assemble on ceremonial occasions.

Bengal Villages

The village generally consists of small groups of houses scattered in rice and jute fields. Large compact villages, where periodical markets are held, are usually found only on the banks of rivers. The villagers live, more or less secluded, in detached homesteads, surrounded by a belt of fruit-trees or bamboo thickets; the screen of the trees and the jungle secures that privacy which the Bengali likes for his domestic life (Figs. 34, 35). The oldest villages are almost invariably found on the banks of rivers.

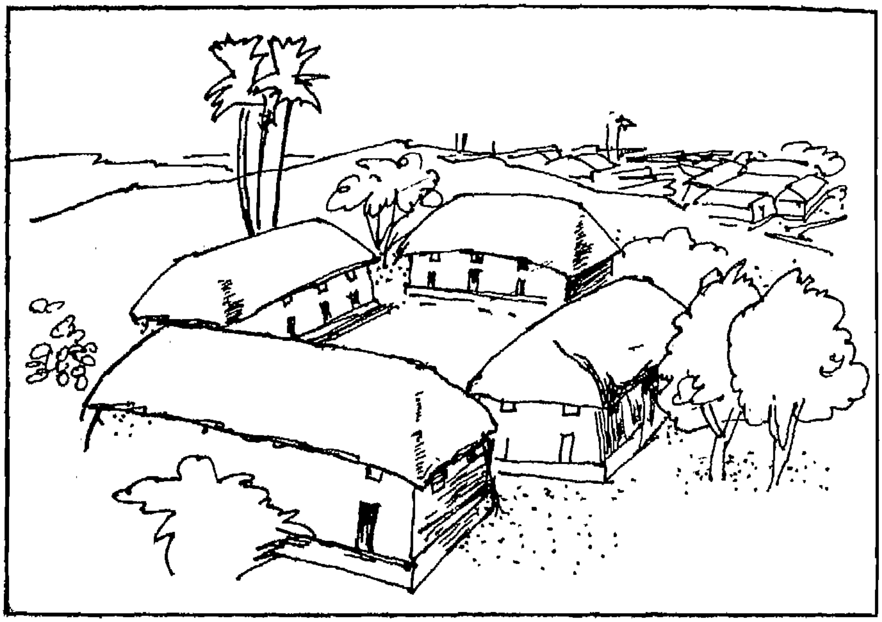

FIG. 35. An isolated homestead with central courtyard in a village in Birbhum District, West Bengal
(Courtesy: Anthropological Survey of India)

The following account of their external appearance is reproduced from the volume of Hunter's Statistical Account of Bengal:

"The dense mass of vegetation in which all Bengalis delight to shroud themselves, and which encircles the rich land-holder's palace as well as the peasant's hut, is everywhere more or less productive. It is composed of the materials for food or for building—the coconut, the bamboo, the jack tree, and the mango. There may be seen the slender stalks of the betel tree, and the towering stems of the coconut above them, their long arms waving in the breeze; on the other side, probably a thick garden of plantains, that curious link between the vegetables and the timber; in the background, an underwood of wild cane, twining itself round everything of firmer bulk; and a little farther on, on indistinguishable mass of thorn, creepers and underwood of every shape, length and denomination. The husbandman must have his fruit tree and his bamboo, which yield him a return for no expenditure of labour but that required for gathering and cutting, his protection for the womankind, and his shade against the fierce sun of April and May. If he attains these primary objects, he is content no matter how much miasma may be exhaled from the decaying vegetation, how much disease may lurk in that fair but deceitful mass of green foliage, how many reptiles and venomous snakes may be concealed in the unwholesome shades which surround his paternal inheritance. The sun, and gaze of the passing neighbour, must alike be excluded. Grant him this, and he will endure, with stoical fortitude, the periodical fever, the steamy heat of the rains, and the foetid water which stagnates in the pools whence he has dug the materials for his homestead site (*bhita*), and which never feels the influence of the breeze and the light."

The huts have a curved roof, which gives it strange beauty (Fig. 36). It inspired the architects of the Mughals in designing *chhatris* in Diwan-i-Khas of the Red Fort of Delhi.

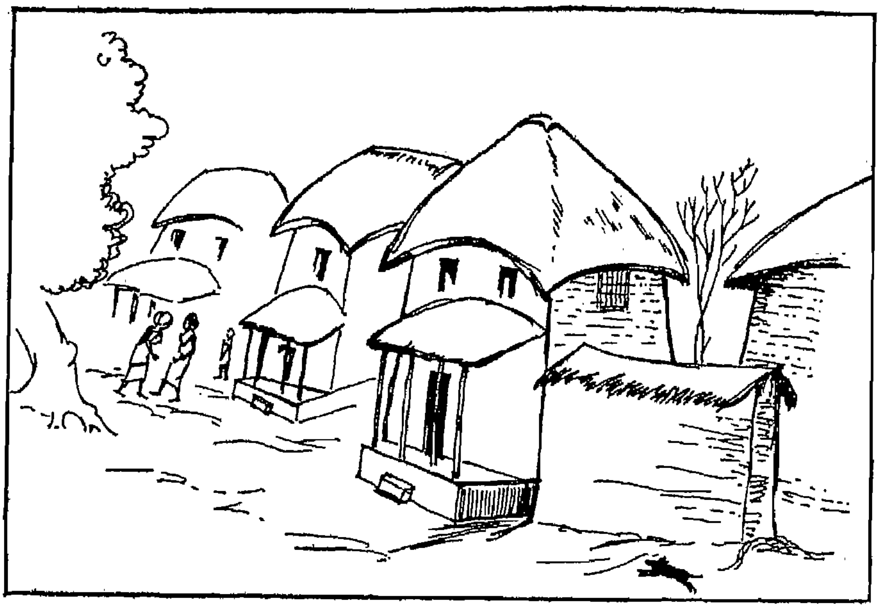

FIG. 36. Convex roofs of huts in a village in Birbhum District, West Bengal (Courtesy: Anthropological Survey of India)

THE LINEAR TYPE OF VILLAGES

The linear type of villages are in the coastal districts of Orissa, in the Coastal and Telengana areas of Andhra Pradesh, Gujarat, Kutch and Saurashtra. The houses tend to be contiguous, laid in an unbroken line, and quite often sharing a common well.

ORISSA

The villages in the coastal districts are situated on high ground, surrounded by paddy fields, which are fenced with hedges of *Pandanus* (*keora*). The roofs of houses are made of paddy straw and appear like inverted boats as in the villages of West Bengal (Fig. 37). The huts are buried in clumps of mangoes, bananas, jackfruit, bamboos and plantains.

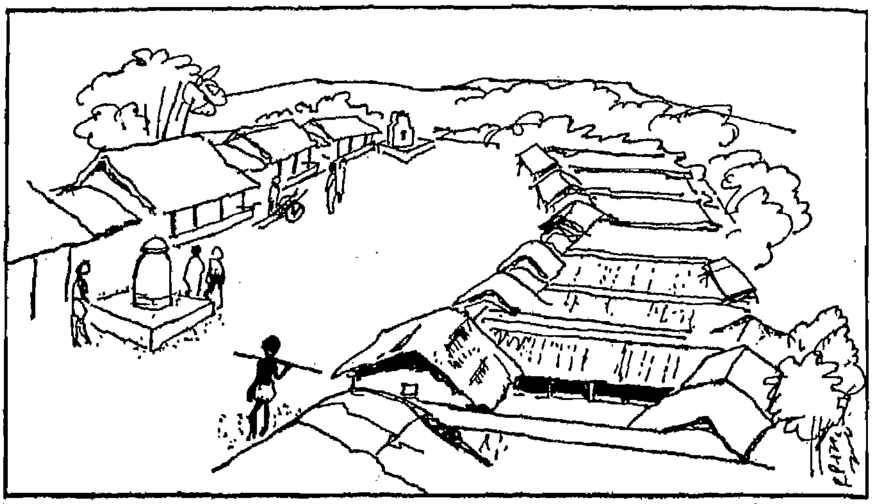

FIG. 37. A linear cluster of huts with central courtyard in a village in Puri District, Orissa (Courtesy: Anthropological Survey of India)

The houses of the villagers cluster around a central pond which is used for bathing, washing clothes and for watering cattle. With ducks floating on their surface, these ponds, studded with blue flowers of water-hyacinth, appear beautiful.

Earthen platforms, called *tulsi chauras*, with columns supporting the sacred *tulsi* plant, are very characteristic of the villages. They are usually lime-washed and are visible from a long distance. These *chauras*, regarded as the abode of goddess Brindavati, are worshipped by women. The walls of the houses facing the street are usually decorated with patterns of various types.

The house is called *ghar*. It is built of mud. The roofs are made of bamboo and straw thatch, and the doors are of solid wood. The farmer has at least five of these little apartments, called *kothis*—one for his cows in the front part of the house, another for his kitchen, a third for storing his paddy, and two rooms for sleeping in and for general use. Of these two rooms, the inner one is called *deosthan* where there will be a number of scriptures or *Puranas* written in palm leaves known as *pothis*. Anybody may enter the first room and sit there, but it is improper for an outsider to go into the inner room. Most of the household goods are hung from the roof.

There is an *alguni*, a bamboo or wooden pole over which is hung most of the clothing of the household. Standing in a corner of the inner room may be a *chatai*, *masina*, or *hensa*-reed mat for sleeping. A well-to-do farmer may have a plank made of wood for sitting.

3. SOUTH INDIA

TAMIL NADU

The villages of Tamil Nadu are planned as a square or rectangular cluster, with straight streets running parallel or at right angles to one another. The blocks of houses are inhabited by different castes or communities. Wherever possible, the houses are built in a cluster near a tank, a river or a channel, with every facility at hand for bathing, drinking and for washing clothes. In areas where the villagers depend only on wells, there are usually separate wells for different castes.

The villages possess some of the relics of the old corporate existence, a common temple, a choultry where the villagers meet for gossip, a *chavadi* which serves as a court for hearing disputes about caste questions, a company of artisans, for whose support everyone makes a rateable contribution, common pasture-grounds, threshing-floors, tanks and channels, in the maintenance of which all have an interest.

ANDHRA PRADESH

An average peasant home consists of mud walls, with a thatched roof. It has no windows, and looks decent only on festive occasions when it is whitewashed or smeared with red mud and is painted over with dots and straight lines, and sometimes with the pictures of deities. In parts of the State where stone abounds, such as the Rayalaseema districts, the walls are made of stone and the roof of cotton sticks spread over by *banderi* leaves and then plastered with mud to make them waterproof. For ventilation, there is a hole in the roof called the *gavakshi*. In the rainy season, water is kept out by placing an earthen pot over it. The grain stores are called *gariselu* which are of earth. Cattle have separate pens, but in poor homes the human beings and the cattle live together. In the better-class homes the kitchen is always separate from the living-quarters, and next to the kitchen is another room containing the family shrine.

The home of a substantial farmer is built in the shape of a square around an open courtyard (Fig. 38). The homes of higher castes have a separate section for women. On festive occasions, these buildings are plastered and painted, and festoons of marigold and mango leaves, called *toranam*, are tied across their windows and doorways. The main door and the principal pillars in the house are carved with figures of elephants, horses and bullocks.

FIG. 38. Linear cluster of huts with horizontal roofs in a village in Kurnool District, Andhra Pradesh
(Courtesy: Anthropological Survey of India)

KARNATAKA

Generally, the villages are surrounded by stone walls or thick hedges of thorn, which in the earlier days served as protection against raiders. Many had even turrets for defence. For the same reason, the entrance is often a flat arched stone gateway, so constructed as to prevent a horseman from riding straight into the village. In the districts lying north-east of the Bababudans, it is common to find the remains of towers to which women and children retreated in an emergency. The more important villages have fortresses of mud or stone. The *pete* or market adjoining the fortress is the residential area.

In some parts of the State, particularly in the *maidan* region, the houses conglomerate in the central portion of the village, surrounded by fields and waste lands. Narrow, uneven streets run winding between the rows of thatched and tiled houses. In the Malnad district, the villages consist of scattered homesteads.

Every large village has ordinarily a temple, a school, an irrigation tank and a *chavadi* or resting-place. The temples and shrines are generally dedicated to Hanuman, Virabhadra, and Basava, or to the village deity, Ammanavaru. They have a vestibule or portico, inside which the village elders meet to discuss public business, and travellers are allowed to stay.

The houses are generally of mud or of stone, one-storeyed and low, with not many openings other than the doors. Every dwelling has a courtyard within, surrounded by verandas and open to the sky. The houses are usually flat-roofed, and in many cases even the portion which would correspond to a yard is covered over. The front door, a window sometimes, and an opening in the roof of the kitchen, allow the smoke to escape.

Another feature of the rural house is the bin for storing grains. In addition to earthenware or wicker bins, there are also large rectangular masonry or wooden bins of the size of an ordinary room for storing paddy. Mostly, these bins are located above-ground and have a draw-hole at the base through which grain is taken out. Grain and pulses meant for seed are preserved in special receptacles, called *moodes*. These are cylindrical and are made of paddy straw, or are flat and pot-shaped, made of twisted straw.

Kerala—Isolated Homesteads

The villages in Kerala are different from those of most other States in India. They are not the usual compact clusters of houses surrounded by arable land, but comprise neat little scattered homesteads enclosed by boundary walls or fences of trees or shrubs. In the Travancore area, particularly this pattern of homesteading is very ancient, its earliest form having been the *kara* organization, in which each homestead was an integral part of the self-sufficient life of the unit. The *kara* covered an area of about 2 sq. miles (5.18 km^2) on the average, and all the families belonging to it had a loose-knit social life. Three to twenty *karas* formed the revenue unit (village) or the *pakuthy*. The *kara* organization has now practically ceased to function in its old self-sufficient form, but the physical character of the villages remains unchanged.

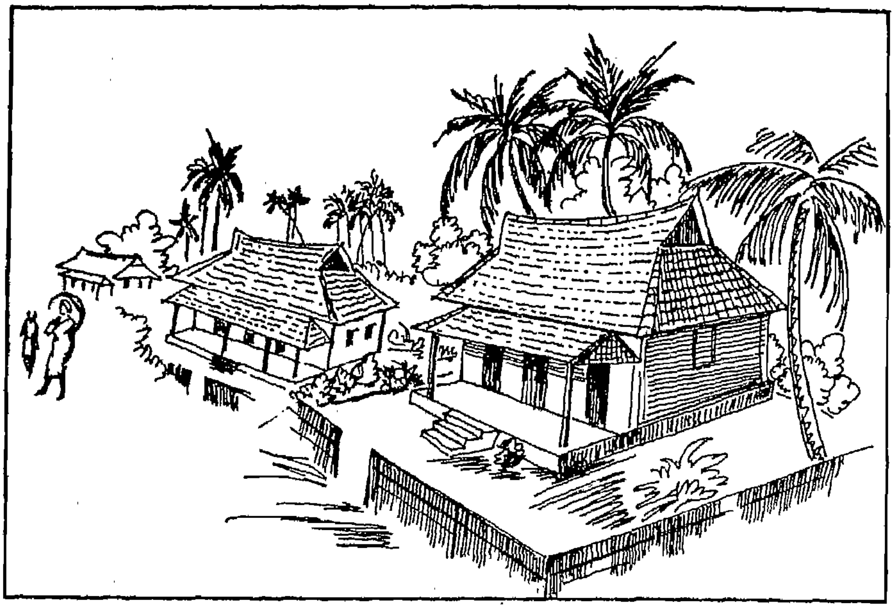

FIG. 39. Huts with upturned ridge poles in Kottayam District, Kerala (Courtesy: Anthropological Survey of India)

In every homestead, one finds a couple of jack-trees, papayas, a few drumstick-trees, a clump of bananas and several coconut-palms. The coconut-palm is particularly a great favourite (Fig. 39).

The best examples of the architectural style of village house in Kerala, combining simplicity with elegance, are the houses of upper-class Numbudiris and Nairs. Almost everyone of these may be called a walled family villa, with all domestic amenities provided within its boundaries. The entrance or the *padippura* consists of a tiled or thatched roof, supported on wooden pillars. Immediately beyond it is an extensive compound with a garden, yard, bathing-tank, the *kavoo* or the grove of trees dedicated to snakes, other traditional structures, and the residential buildings. The main family quarters display a simple architecture with beautifully carved dormers. The roofs used to be made of thatch in the past and now they are mostly of flat tiles. The natural elegance of this simple setting is enhanced by the beauty of the interior decorations which consist of wooden pillars and rich wood carvings on the walls and the ceiling. The entrance to the family *puja* room (place of worship) is very beautifully carved in most of the upper-class homes.

The Pulayas or the poorer sections of the agricultural labourers live in the fields where they work. Their huts are clustered in places generally away from other habitations.

The village temple is an important institution in the life of the people. The temples are mostly dedicated to Shiva, Bhagavati (Shakti) and Vishnu and whatever the faith of any individual, all do their homage to the deities with equal fervour. All religious festivals centre on these temples and are celebrated with enthusiasm. The women visit the temples every morning, and after the offerings made to the deities are distributed by the priest, they return home to recite the *Ramayana* or the *Mahabharata.*

4. CENTRAL AND WESTERN INDIA

MAHARASHTRA

A glance at any village in Maharashtra indicates that it is situated at a higher elevation than the surrounding land and has a water source nearby. The area chosen for a settlement is known as *gaothan* and the land as *pandhari*, literally meaning 'white' in contrast with 'kali', that is black soil, which is of better quality and, therefore, more useful for agriculture. The land where a village is located is of poor quality and is of light colour, i.e. 'white'. Therefore when farmers say *pandhari*, they mean the area occupied by the village, and by 'kali' they denote the land under agriculture.

Sometimes, a village is split into two groups: for example, as *mouje-sukene* and *kasabe-sukene*. Originally, *mouje* meant a statement of agriculturists and the *kasabe* indicated that part of the village which contained houses of artisans and agricultural labourers.

Many of the villages in the up-*ghat* regions, including Vidarbha and Marathwada, have protecting walls around them. These are (or were) 5 to 6 metres high and 1 to 2 metres thick, built of stone or unbaked bricks. The walls had watch-towers. At each of the entrances, strong doors and guardrooms were provided. Most of these protecting walls have crumbled away, as they are no longer necessary. The villages in Konkan are smaller than those in the up-*ghat* region and usually have no walls around them.

The main population of the village within the *gaothan* consists of 'clean' castes, grouped in distinct units, according to hierarchal order. The so-called untouchables, especially the castes such as the Mahar and the Mang, have each a separate settlement outside the village proper, the farthest being that of the Mangs. These settlements are known as *Maharwada* and *Mang-wada*. These *wadas* are usually located to the east of the village and sometimes to the south.

THE HOUSES

The types of houses vary according to the status of the villager and his community. The climatic conditions, especially rainfall and temperature, and the nature and the availability of local building-material also have their influence on the construction and the design of the houses.

In Konkan, the Kunbi farmer has a small house with walls constructed from mud and gravel and thatched with rice-straw or grass on bamboo rafters. In Thana and Kolaba, the usual mode is to have thatched roofs of grass or rice straw, but in the Ratnagiri District, the farmers' houses are built of mud walls, with roofs of either country tiles or shingles. The house of a Maratha farmer is generally better constructed and usually has a stone plinth and a veranda, thatched with palm leaves. The floors are of beaten earth made smooth and plastered with cowdung.

In the eastern side of Sahyadri, houses with stone walls and tiles or shingles predominate, whereas in the areas within the basins of the Krishna, the Manjra and the Godavari, the houses with stone walls and flat roofs predominate. In the north mid-western districts, the houses have mud walls and flat roofs of corrugated sheets. In the eastern districts, with heavy rainfall, the general trend is to have houses with mud walls and sloping roofs with tiles, slates or shingles. Only well-to-do agriculturists or the money-lenders have *pucca* houses built with stone, cement or lime.

GUJARAT

The farmers' houses may be broadly divided into two categories: *kutcha* houses made of unbaked bricks, plastered with cowdung, and with thatched roofs; and *pucca* houses, made of baked bricks and plastered with lime, or lime and cement, and with tiled roofs. The vast majority, of course, have *kutcha* houses, and only the more well-to-do can afford *pucca* houses. The style of the houses, whether *pucca* or *kutcha*, is, on the whole, similar. There is a front room, known as *deli*, which may be described as a drawing-room or a guest-room. The furniture usually consists of cots. Beyond the *deli* is an open quadrangle, in which different shade-giving trees, such as *neem* and *peepal*, and *tulsi* plants are grown. Then comes the cattleshed, followed by the living-rooms. The front portion of these rooms is decorated with idols of Ganesh.

Ceilings, doors and windows are carved. The walls also are decorated with patterns in loud colours. The usual furnishings in a farmer's home are wooden cots, huge wooden trunks, known as *pataras*, a flat bench used to keep mattresses and other materials, brass vessels and other vessels. Hand-fans of different shapes and decorated in a variety of ways are found in most peasant homes.

Generally speaking, the houses of the *patidars* have two storeys (Fig. 40). The ground floor has three rooms; the front room is used as a spare guest-room, the next one, which is slightly bigger, is used as a living-room, and the last is used as the kitchen. Some houses have their kitchen separate from the main building. There are bathrooms and latrines in most houses. However, the houses which are built nowadays invariably provide these facilities. Ceilings, doors and windows are of wood, whereas the walls are of mud and bricks. The flooring is usually of mud mixed with cowdung.

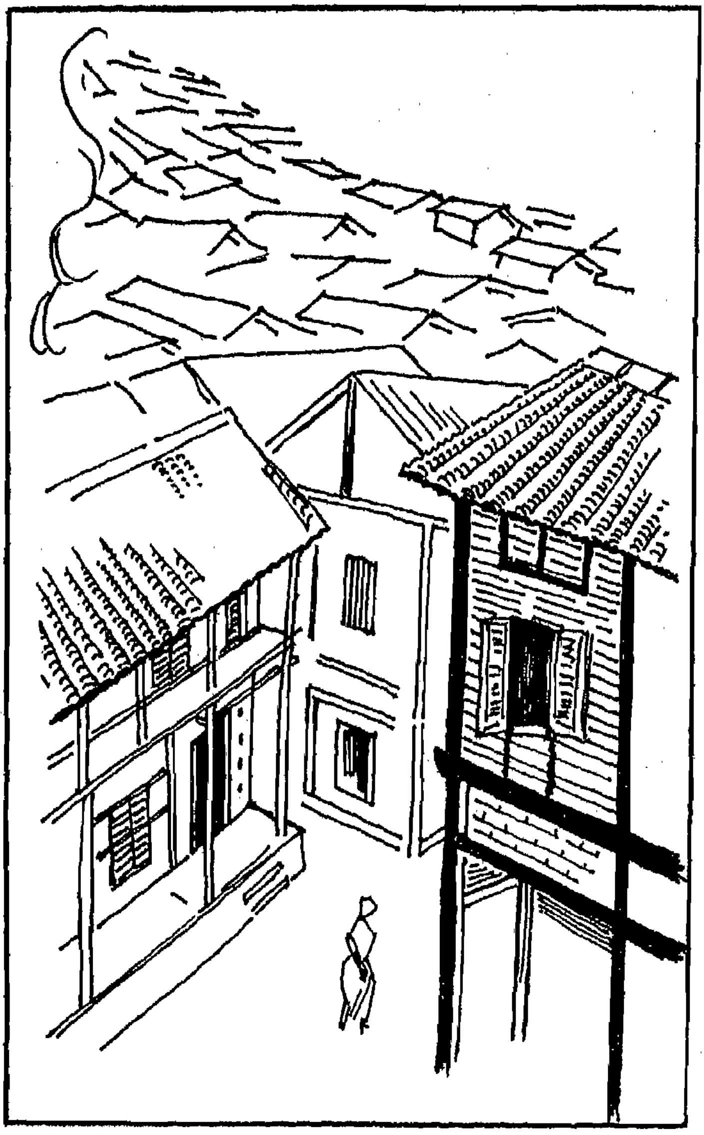

FIG. 40. Two-storeyed houses with wooden framework in a village in Kaira District, Gujarat
(Courtesy: Anthropological Survey of India)

The roofs are usually covered with Mangalore or country tiles or with corrugated iron sheets.

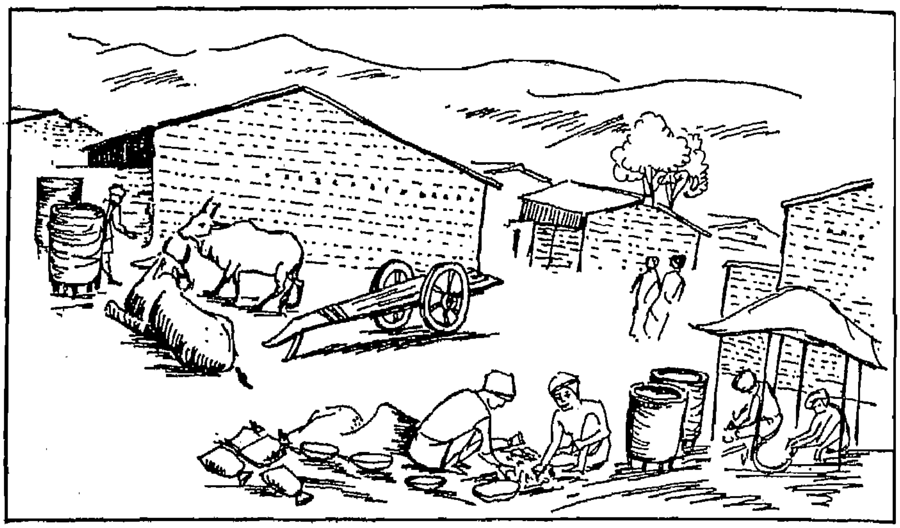

FIG. 41. A linear cluster of houses in a village in Sabarkantha District, Gujarat (Courtesy: Anthropological Survey of India)

The houses of the Rajputs and Harijans usually are of one floor only and are more correctly described as huts built of *kutcha* clay. Ceilings are usually low. These communities invariably tie their cattle in front of their houses. The houses of the tribal people are rarely to be found in clusters or in rows along a street.

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CHAPTER 27

DR VOELCKER'S REPORT ON IMPROVEMENT OF INDIAN AGRICULTURE

1891

HIS OBSERVATIONS ON THE STATE OF AGRICULTURE IN INDIA AT THE CLOSE OF THE NINETEENTH CENTURY

NEED OF AGRICULTURAL ENQUIRY AND NECESSITY OF AN EXPERT AGENCY

In the famine of 1876-78 about 60 million people were affected, and mortality exceeded 5,250,000. This famine led to the institution of the Famine Commission of 1880. The Famine Commission Report, 1880, revived interest in improvement of agriculture. It recommended that improved agriculture should be the main step for obtaining security against disastrous failures in food supply. The Famine Commissioner's scheme contemplated a central department controlled by the Imperial Secretariat, but they insisted on the absolute necessity of the simultaneous formation, in each province, of a Department of Agriculture, with a large subordinate establishment under an executive officer. This part of their proposals was the corner-stone of the main administrative reforms which they projected. Sir Edward Buck was appointed Secretary and under his guidance the development of provincial agencies was taken in hand. Agricultural enquiry, agricultural improvement and famine relief were laid down as the duties of the new departments, and Directors of Agriculture were appointed in most provinces.

Between 1881 and 1889 various questions were considered. The appointment of an agricultural chemist to the Government of India was discussed and a proposal to attach an agricultural branch to the Dehra Dun Forest School and to utilize it as a National School of Agriculture for Northern India was considered, but aborted.

Dr J. A. Voelcker's Report on Improvement of Indian Agriculture (1891)

In 1889, when Marquess of Lansdowne was the Governor-General, the Secretary of State expressed his willingness to send out a competent agricultural chemist who should make enquiries in India itself and advise upon the best course to be adopted in order to (1) apply the teachings of agricultural chemistry to Indian agriculture, and (2) effect improvements in Indian agriculture. The need of an agricultural chemist was felt as there were large tracts of unculturable land in the North-West Provinces (present Uttar Pradesh) which were infested with noxious salts, and it was thought that science might aid in reclaiming these lands. The selection of an expert was entrusted to Sir James Caird, who had been one of the Famine Commissioners. Sir James Caird selected Dr John Augustus Voelcker, Consulting Chemist of the Royal Agricultural Society of England, who arrived in India on 10 December 1889 and left early in 1891.

Dr Voelcker toured over India, meeting representatives of all provinces, and the record of his journeyings and impressions is contained in his report, *Improvement of Indian Agriculture.*

State of Agriculture

Considering the vastness of the country and conditions prevailing in different provinces, Voelcker realized that India is a country about which one cannot make a 'general' remark, and certainly not with regard to agriculture. 'If I am asked whether the agriculture of India is capable of improvement, I must answer both "Yes" and "No". If, for instance, I am taken to see the cultivation of parts of Gujarat (Bombay), of Mahim in the Thana District of Bombay, the garden culture of Coimbatore in Madras, or that of Meerut in the North-West Provinces, and of Gujarat and Hoshiarpur in the Punjab, I may be inclined to say, "No; there is nothing, or, at all events, very little, that can be bettered here".

'At his best the Indian *raiyat* or cultivator is quite as good as, and, in some respects, the superior of, the average British farmer, whilst at his worst it can only be said that this state is brought about largely by an absence of facilities for improvement which is probably unequalled in any other country, and that the *raiyat* will struggle on patiently and uncomplainingly in the face of difficulties in a way that no one else would.

'Certain it is that I, at least, have never seen a more perfect picture of careful cultivation, combined with hard labour, perseverance, and fertility of resource, than I have seen at many of the halting places in my tour. Such are the gardens of Mahim, the fields of Nadiad (the centre of the "garden" of Gujarat, in Bombay), and many others.'

Influence of Castes and Races on Agriculture

Voelcker noted that there were great differences between the various castes and races of India in respect of their cultivating abilities—differences which were inherent to the people themselves, and which were consequently difficult to level. 'Yet the very existence of these differences gives a decided encouragement to the belief in the possibility of improvement', he remarked. 'It would proceed on the right lines when dealing with Indian agriculture, viz. to improve it from within, and by means of its own examples, rather than by bringing foreign influences and methods to bear upon it. The fact that a cultivator in one place, or, better still, in the same village, can act as an example to another elsewhere or co-resident.'

'Some castes are hereditarily inferior as cultivators to others, but the agricultural practice of any one caste is not uniformly alike everywhere, nor equally good. The Jats, for example, are spoken of in the Meerut district as being unsurpassed as cultivators. The Rajputs and Brahmans do not themselves, as a rule, cultivate, but they employ hired labour: in some parts, however, they are described as being moderate cultivators. Again, there are castes and races, distinguished for the special branches of agriculture which they practise, or for the particular methods they employ; such are the Koeris, who are mostly growers of vegetables; the Kurmis, Lodhas, and Malis, who are largely market-gardeners; the Kachhis, who, in their cultivation, use the night-soil of villages and towns; the Vellola caste, again, are cattle breeders; the Gavlis are suppliers of milk, and also breed their own cattle; the Gujars, Vanjaras, and others are graziers.

Voelcker felt that the breaking down of caste prejudice would be followed by considerable improvement in agriculture. 'If the Rajput or Brahman be brought to see that there was nothing derogatory in manual labour, or in taking an interest in the cultivation of the soil, so could other cultivators be led to follow the practice of the Kachhis, and abandon the prejudices against the use of night-soil as a manure; they could then raise crops such as the Kachhi does, and the country would be greatly benefited thereby.

'In the course of my first tour, Sir Edward Buck pointed out to me, a village named Singhouli, in the Doab, where the former tenants, who happened to belong to a low caste (Kurmi), had worked so industriously and profitably that they had actually been able to buy out the original proprietors, who were of higher caste (Rajput), and had become possessors of the village themselves.

'The town of Farukhabad, again, is surrounded by a perfect garden, the result entirely of Kachhi cultivation. When, about twenty years ago, Sir Edward Buck transferred some of these cultivators from Farukhabad to Cawnpore, they showed at the latter city how a profitable use could be made of what would otherwise have been a public nuisance, and also how the State revenue derived from the area they cultivated could be very largely increased.'

'Some eight or ten years ago a batch of Kachhis from the North-West was transferred to Nagpur, in the Central Provinces. Not only did they continue to employ their particular practice with profit, but other cultivators around followed their example, amongst these being even Brahmans. The latter began to grow sugarcane and vegetables of all kinds, just as the Kachhis had done. I might instance, too, the sugarcane cultivation around Poona. This was commenced by a Brahman who first showed the Municipality how to make "poudrette" out of the night-soil of the town, and then taught the Hindu cultivators how to use it. The "poudrette" is now used to an enormous extent. At Nagpur, again, I saw Brahman lads engaged in cultivating; they work with the plough just like others.'

'Improvement by force of example is not confined to native methods only, for, as Mr R. H. Elliot pointed out to me, coffee-planting by the natives has improved very considerably in Mysore since European planters settled in the country and introduced better systems. The same remark applies to the cultivation and manufacture of indigo since English planters came to the districts where the plant is grown.' Voelcker concluded that the spread of education will be a potent factor in creating interest in agriculture, and through education Government can aid in lessening those differences which are at present inherent to the cultivating classes as such, and which stand in the way of agricultural improvement.[1]

AGRICULTURAL ENQUIRY

Voelcker recommended the systematic prosecution of agricultural enquiry, and the spread of general and agricultural education, and laid down, in considerable detail, the lines on which agricultural improvement was possible. Stressing the necessity of an agricultural enquiry he observed: 'As regards India, comparatively little is known of its agricultural methods, and that they have only been, so far, the subject of casual and isolated enquiry by individuals. An organized system of enquiry, on the other hand, might result in the collection of definite knowledge of the agricultural resources and needs of the country. 'Practical enquiry, or the obtaining of knowledge respecting agricultural practice, precedes both scientific enquiry and experiment. The scientist, without some knowledge of the practical issues involved, is unable to push his enquiries in the right direction, and, however able his researches, he may fail from being unpractical. Similarly, the experimenter without a knowledge of what is done elsewhere, or of what is within the reach of the cultivator, may waste both time and money in trying what has no chance of ever becoming of any practical value.

'The practical man must first become thoroughly conversant with what is being done in native agriculture, and with the conditions under which it is carried on; then the scientist may come in and explain the rationale of the practice, and may apply these principles to the extension of the better systems, and to the discovery of further resources; finally, by the happy combination of science and practice, the work of experiment may proceed in a definite and useful direction. In this way some advance in agriculture may be made.

'I believe that it will be possible here and there to graft on to native practice the results of Western experience, but the main advance will come from an enquiry into native agriculture, and from the extension of the

[1]Voelcker, John Augustus. *Report on the Improvement of Indian Agriculture*, pp. 20-23

better indigenous methods to parts where they are not known or employed.

'Real progress came only when it was realised that in India agricultural practice had been built up on the traditional custom, of years, and in which reside, though unexpressed and unexplained, deep scientific principles, the reasons for which can only gradually be elucidated.'

THE FIELD OF ENQUIRY

Defining the special problems which deserved investigation, Voelcker observed:

'Firstly, it is important to ascertain the requirements of each district in regard to the provision of water, of manure, of wood, and of grazing, and to decide in what way the needs can best be met; whether, for instance, irrigation by canal or by wells is best suited; whether embanking of land should be done; whether "Fuel and Fodder Reserves" can be usefully formed; where grazing can be provided; whether the *taccavi* system of advances for agricultural improvement is properly brought before the people, and utilized by them; and so on.

'Secondly, it is desirable to ascertain where a transference of the practice of one part may be beneficially made to another part. Of this nature are the embanking of land; green-manuring; hedging and enclosure of fields; sheep-folding; the use of leaves; the growing of fodder-crops; the ploughing of rice fields after harvest; the use of castor and other oilseed refuse as manure; the utilisation of night-soil and town-sweepings; the planting of sugar-cane in furrows; the use of the iron sugar-mill and shallow evaporating-pan in sugar manufacture; the extended growing of sugarcane, potatoes, and other crops.

'Thirdly, there are a number of questions, of a practical nature which await solution, and which, though mainly of the nature of experiment, cannot proceed without first employing practical enquiry. Such questions are: What is the out-turn of different crops? What is the right amount of seed to use in sowing rice? What quantity of water should be employed in rice cultivation? Does manuring of rice fields pay? Would draining of rice fields be advantageous? What is the relative out-turn of sugar from different varieties of cane? Does continuous growing of sugarcane pay? Will it pay in the long run to grow a long-stapled variety of cotton rather than the short-stapled varieties generally grown? Is interculture of other crops with cotton profitable? Is the use of bones advantageous?

'Lastly, there are points more connected with the introduction of foreign agricultural practice; for example, the possibility of introducing new crops; the growing of new varieties; the acclimatisation of seed, the selection of seed; the making of silage; the use of new implements; the use of litter and preservation of urine; the better conservation of cattle-manure; the reclamation of salty land (*usar*), of ravine and other waste land.

The Need of an Expert Agency

To carry out the enquiry, he stressed the need of an expert agency. He observed, 'The enumeration of the subjects set out in the last paragraph clearly points to the necessity of having an agency of an expert nature to deal with them. They are not matters which administrative genius, a high intellect, or even ordinary common sense can decide, but which need the application of special technical knowledge of agricultural conditions and practice.'[2]

A conference of provincial delegates was held to discuss these proposals. The possibilities of improvements, it was agreed, were sufficiently great to justify the gradual establishment of a sound system of scientific investigation and of agricultural education. With regard to the general character of this system, it was agreed that an expert was required for the purposes of scientific investigation apart from the requirements of agricultural education, and great stress was laid on the importance of having a man able to deal with the practical side of agricultural questions and competent to direct general enquiries. The conference concluded by advising the appointment of a really first-class man as agricultural chemist for the conduct of general investigation and an assistant for purposes of instruction. An agricultural chemist and an assistant chemist were accordingly selected. They arrived in November 1892. The duties of the senior officer were research, and of the junior, teaching, at Poona, Dehra Dun and Saidapet and the disposal of chemical questions connected with forests and agriculture. Thus, in a modest way, was laid the foundation of a scientific staff for the Agricultural Department.

The next decade saw marked development in the scientific side of the work. The need for something more than chemistry was being felt and interest in agricultural development was increasing in the provinces. Agricultural science, moreover, was becoming better organized in Europe.

Inspector-General of Agriculture, 1897

In 1897, in view of the considerable development in the provinces, it was thought that the time was ripe for the appointment of an Inspector-General of Agriculture, but great difficulty was experienced in finding a suitable man and it was not till 1901 that the vacancy was filled by the appointment of J. Mollison, who had done excellent work as a Deputy Director of Agriculture in Bombay. His duties were to act as an adviser in agricultural matters both to the Imperial and Provincial Governments. Attention was directed to the expansion of the Imperial department, which at this stage consisted only of an agricultural chemist in addition to the Inspector-General of Agriculture. A cryptogamic botanist, later known as the Imperial Mycologist, had joined in 1901, and an entomologist in 1903.

[2]Voelcker, John Augustus. *Report on the Improvement of Indian Agriculture*, pp. 296-299

CHAPTER 28

ANIMAL HUSBANDRY AND DAIRY FARMING IN INDIA IN THE NINETEENTH CENTURY

TWO PIONEERS—HOWMAN AND KEVENTER BULL-BREEDING AND HISSAR CATTLE FARM

VOELCKER made sound observations on the relative merits of cows and buffaloes as dairy animals and also described the pioneer attempts which were made to start dairy farms in India. As in the case of horse-breeding and horse-keeping, the military played *an important role in creating the dairy* industry.

Voelcker's observations are as follows: 'As a dairy animal the she-buffalo is more esteemed than the cow; it yields a larger and richer supply of milk, and is generally better cared for. In parts of the Punjab the purchase of a buffalo is the first indication of prosperity. The two most striking features in Indian dairying are the small yield of milk given by the cows, and the richness of the milk of the buffalo.

'In Bengal the ordinary country cow will not give more than 2 lb. (0.9 litre) of milk a day. In Madras it may yield from 2 to 4 lb. (0.9 to 1.81 litres) a day. As a rule, the cows will only milk for six months, and often have only one calf in the course of two years.

'The milk of the buffalo, on the other hand, is very much richer than average cow's milk in England, for, whereas the latter may be said to contain 3 to 4 per cent of butter-fat, and 12 to 13 per cent of total solids, buffalo's milk has no less than 7¾ per cent of butter-fat and 18 per cent of total solids.

'The yield of milk will of course, depend upon the breed of the cattle, the food given them, and the care bestowed upon them. The Gujarat, Sind, and Nellore cows are specially noted for their milking properties, qualities in which the Mysore breed, for instance, are deficient. The cattle of these special breeds are, however, very different from the ordinary country cattle.

'Throughout Chota Nagpur the village cows are very poor, owing to insufficiency of food and want of fodder-crops; no oilcake or other additional food is given to them. From 1 lb. to 1½ lb. (0.45 to 0.73 litre) of milk a day is all that they yield, and their value is from Rs 7 to Rs 10 each. Buffaloes, however, cost there Rs 25 each, and will yield about 5 lb. (2.27 litres) of milk per diem. Oilcake is fed to them in the dry season. At Seraj-gunj, in Eastern Bengal, 2 lb. (0.9 litre) of milk is the average daily supply of a cow. In Dacca, cows are rather better cared for, and oilcake is given to them as well as to buffaloes. They will yield, in consequence, about 4 lb. (1.8 litres) of milk a day.

'In Gujarat (Bombay) milking-cattle are much more valued. Thus, a cow will milk for seven months, giving 5 to 10 lb. (2.27 to 4.53 litres) of milk a day, and will cost from Rs 20 to Rs 50. The buffalo is still more prized, and, being fed with oilcake, cotton-seed and *juar* fodder, will keep in milk for eight months, giving for the first three months 20 lb. (9.07 litres), the next three 12 lb. (5.4 litres) and the last two 6 lb. (2.7 litres) of milk daily. Its value is from Rs 30 to Rs 100.

'Nellore cows are good milkers. Some that I saw at the Saidapet (Madras) Farm gave about 20 lb. (9.07 litres) of milk a day. They were being fed on 5 lb. (2.27 litres) per head daily on groundnut cake and bran, with *cholum* fodder.

Improvement of Milking-cattle

'When such differences exist as are instanced above, it is very clear that in many parts improvement in the milking-cattle is possible. As regards buffaloes, the people seem to appreciate their value, and there is little, I think, that need be done further. But there is a good deal that may be done towards improving cows, more particularly where the sale of milk or the manufacture of the native butter, called *ghi*, is carried on. This will be found to be chiefly the case where pasture and grazing areas abound, and where the professional graziers resort with the cattle of the villagers, generally taking payment themselves in a share of the milk. Beyond where such pasturage exists, little is done to maintain the cow specially as a milking-animal; but the buffalo takes its place, and the cow is looked on rather as the breeder of future plough cattle. Thus, while the distribution of stud bulls for breeding working-cattle is capable of wide extension, it will, I think, only be in special parts, and where pasturage exists in abundance, that improvement of the milking strains of the country cattle will be effected to any great extent.

'This matter has, however, not been altogether neglected at Government Farms, for, at Hissar, Mysore cattle are crossed with Sind, Gujarat, Ongole, and Nagore breeds, partly with the object of improving their milking properties, the Mysore breed being specially deficient in these. At the Bhadgaon Farm, Malvi cows are kept as nurse cows for the young Mysore stock; and at Poona, investigations have for some time been carried on as to the milk-producing qualities of Gujarat and Aden cows, and on the influence of different feeds upon the yield of milk.

Dairy Farming in India—Two Pioneers: Howman and Keventer

'Of late, efforts have been made to extend the practice of dairy farming in India. Mr Ozanne, who, at the time of my visit, was Director of the Department of Land Records and Agriculture in the Bombay Presidency, was foremost in the endeavours to foster this industry. A considerable impetus was given to the movement by the visit to India, in 1889, of Mr H.A. Howman, a well-known dairy farmer, from Warwickshire, England, and who came out on behalf of the Dairy Supply Company Limited, of London, for the purpose of introducing the mechanical "cream-separators", for which that company were agents. These separators were of Swedish make, the invention of Dr de Laval, and were of a size which could be worked by hand-power. Mr Howman also took over with him a number of other appliances for making butter. The native way of making butter is to boil the milk as soon as drawn from the cow, then to cool it, and, after adding a little sour milk, to let it stand from 12 to 20 hours in a brass vessel narrowed towards the top. After standing, the milk is churned by the rapid twisting round in it of a stick which is kept spinning round by the hand, first warm and then cold water being added now and again, but quite empirically. The butter "comes" in about a quarter of an hour, and is drained off on to a cloth, the sour butter-milk, called *lassi*, being much relished by the people. The butter is collected, put into another brass vessel, and melted over a fire. This operation requires careful watching, and good *ghi*-makers are adepts at it. In the heating, the water is evaporated, and a portion of the mass, which is probably the enclosed curd, deposits at the bottom of the vessel, the remainder being poured into jars and stores. This is the *ghi*, or native butter, so largely used in cooking, &c., and it has the property, which ordinary butter has not, of keeping good for a long time.

'Howman, when he first came to India, was met with what proved to be a difficulty—the exceptional richness of buffalo milk. But this was soon overcome, and wherever the mechanical separators were shown at work, the opinion was universal that capital butter was produced, and that the system which Howman demonstrated, that of making butter without it being at any stage touched by the hand, was an immense improvement on, and a far more cleanly method than, the native one. The butter which Mr Howman made would also keep quite well for a week. He further showed that he could not only make *ghi* from the butter produced, but that from the separated milk sweetmeats and curds could be made perfectly well. The separation also gave, in the form of freshly separated milk, a perfectly sweet and wholesome article of drink. In England, the main difficulty with the cream-separator has been the utilization of the skim-milk, and this is likely to prove the same in India. If the natives show a readiness to take it, either for drinking or for manufacture into sweetmeats, this obstacle may be overcome, but not otherwise. It was, however, when Mr Howman put himself into competition with the skilled *ghi*-makers that he failed in showing that he could produce more *ghi* than the native manipulator. He could always get more butter, but in making it into *ghi* the native excelled. I cannot, however, regard the trials as by any means satisfactory or complete. In one butter-making trial which I witnessed, the native operator showed himself very clever in making up his butter with a great deal of water, so that it might weigh heavy, whereas Mr Howman's butter contained no superfluous amount. Then, when Mr Howman's butter was made into *ghi* this was done by the *ghi*-makers, and it is very certain that in some cases, at least, it was spoilt by them. But the chief consideration is the following. In the absence of any chemical investigation into the nature and composition of *ghi*, it is impossible to say what *ghi* exactly is, and whether, as made by the native, it is purely butter-fat, or whether it does not contain some amount of curd. The latter, indeed, is probably the case. The butter as made by Mr Howman was merely butter-fat, without curd; this may account for the fact that Mr Howman obtained more butter but less *ghi*. What is really wanted is the investigation of such points as these by an agricultural chemist resident in India itself.'

Howman's visit undoubtedly showed that great improvement was possible in dairy matters in India, but whether the benefit will extend beyond the European community was questionable.

Steps Taken to Follow up Howman's Teaching

Mr Ozanne was not slow to follow up the stimulus given to the plans he had had for some time in contemplation.

'Keventer, a Swiss, who had assisted Howman, was retained in India by the Bombay Government, and the Agricultural Department started a working dairy in the city of Bombay. This was fitted with cream-separators, churners, refrigerators, &c., and so successful was the sale of butter that, after a time, the concern was taken over by a private capitalist and worked by him. Then another capitalist started a second similar business, and, at the time I left, both were succeeding well. At Poona, also, butter is similarly made by the Agricultural Department, and is sold in the town. Keventer's services were lent for a time to the North-West Government, and at Cawnpore and elsewhere he showed the process of butter-making. He was also engaged in demonstrating that cheese might be manufactured in India. The berries of *Puneria* can be used in India for the purpose of curdling milk; they are obtained from Sind. At the Saidapet Farm (Madras) a cream-separator was used. There was a ready sale for cream and more was sold as such than as made into butter.'

Is There Likelihood that Improved Dairying Methods will Spread in India?

Voelcker next considered whether butter-making by improved methods was likely to make much advance in India. 'I must say I hardly think that it will. So far as the native population is concerned', he observed, 'butter will not replace *ghi*, for the reason that it will not keep anything like the time that *ghi* does. The native, again, makes *ghi* with the simple utensils he has at hand; he could not make butter in this way. But, wherever there is a considerable European population, then, I think, English dairying may be pursued with much benefit and comfort to the community. I could not help wondering how, in such towns as Calcutta, Bombay, Madras, Poona, Allahabad, and others, the English residents put up with the so-called "butter" with which they are supplied.

Unsatisfactory Condition of Milk Supply in India

'But of greater importance than butter-making is the question of the milk supply; of the conditions under which it is generally carried on, the less said the better. The surroundings in almost all cases are most insanitary; the manure heaps are too often close beside the wells and drain into them; the vessels are washed in this water, and the cattle drink it or other equally bad water. Seeing, as we know only too well in England, how readily disease is propagated through the medium of milk, the wonder is that, in India, epidemics have not been more closely traced to impure water, or to insanitary surroundings affecting the milk supply. The supply of milk to military cantonments is one affecting vitally the health of our troops in India, and that this should go on, as at present, without any control, is highly prejudicial to their welfare. There is little or no check upon either the state of the places where the milk is produced, or upon the adulteration (often with impure water) which constantly goes on. Bombay and Poona are exceptions to this statement, as careful supervision is exercised there.

'Wherever troops are stationed, the supply of milk should be carrried out by regular contract, and the sheds where the cattle are kept and the milk is produced should be under constant inspection and control by sanitary officers.

Military Dairy Farms

'Schemes for the establishment of regular dairy farms in connection with the supply of milk to troops have been suggested by Colonel Marriott, of Allahabad, and others, and I regard the proposals very favourably. Where troops are regularly quartered such farms might with advantage be established, and should have a herd of good milking cows, with two or three stud bulls. In addition to the milk supplied, the cows would produce calves, which, if females, would be the future milking animals, and, if males, would do for entering into Government service as transport and artillery bullocks.

'The attention of the Commissariat Department should be strongly directed to this important matter of a pure milk supply to troops.

'In addition to military cantonments, jails are institutions which would benefit from a regular and supervised system of milk supply.

MADURA FARM

'At Madura, what was formerly the Experimental Farm of the Agricultural Society is now kept up as a dairy farm. There are about 15 cows here, most of them good country cows, and a few Aden cattle. They are reckoned to give about 12 lb. (5.4 litres) of milk each daily, when in full milk, and are fed with groundnut cake and gingelly cake. Milk is sold to the town, but not cream, butter, or *ghi*. This part of the farm pays very well, and would seem to show that a good milk supply would be appreciated in native towns as well as where Europeans are in considerable numbers. Mr Ozanne has in prospect the establishment of a large dairy farm for supplying Poona with milk, butter, &c.'[1]

ANIMAL HUSBANDRY

In 1902 the Indian Civil Veterinary Department was firmly established by the permanent transfer of seventeen officers from the Army Veterinary Department to the Civil Department, and the appointment by the Secretary of State for India of four civil officers recruited in England. This method of recruitment by the Secretary of State, or by local appointment, remained in force till the end of British rule in India. In spite of these additions to the staff, complaints were still being made that, owing to a shortage of officers insufficient attention was paid to cattle breeding. The Inspector-General in his report for the year 1902 pointed out that the demand for bulls could not possibly be met from the only two farms under his control, namely that at Hissar in the Punjab and that at Chharodi, in the Gujarat district of Bombay, established to save the famous Kankrej breed of cattle in danger of extinction owing to famine.

Cattle breeding gradually came to be looked upon as a responsibility of the provincial agricultural department, and in most provinces the veterinary establishment concentrated upon control of contagious disease.

The exception was the Punjab, where the Provincial Government always encouraged projects for livestock improvement.

Proposals were submitted for the establishment of bull-rearing farms throughout India, but no action seems to have been taken, and both horse- and cattle-breeding projects were gradually removed from the control of the Veterinary Department. In 1904, as a result of the findings of the Horse and Mule Breeding Commission, imperial horse breeding was made an Army Remount Department responsibility, provincial horse breeding being left in the charge of local bodies.

HISSAR CATTLE FARM

'One of the largest state farms in the world, Hissar Cattle Farm was

[1]Voelcker, John Augustus. *Report on the Improvement of Indian Agriculture*, London, 1893, pp. 206-211

opened originally as a horse breeding depot early in the nineteenth century, and converted into a cattle farm in 1839. At that time it was required to breed siege-train bullocks, for the transport of heavy artillery, so that size was the main consideration. The work was based on the local Hariana breed; but bulls of many of the larger breeds, such as the Kankrej, Gir and Nellore, were introduced and the resulting product, after many years of development, was known as the Hissar.

'The Inspector-General, Civil Veterinary Department, took over control of the farm from the military department in 1898; and in 1907 it was decided to reduce the mixed stock on the farm and concentrate on the Hariana breed, but the Hissar type of animal was still being produced many years later. Later on, more attention was paid to the breeding of dual-purpose (milk and draught) Hariana animal, and the Hissar has been removed from the list of recognized breeds in India.

'In 1905 the breeding of zebra hybrids was being attempted at Hissar, and, more important, a flock of country (Bikaner) ewes was being run with two Merino rams. It was thus that the Hissardale sheep with a high quality fleece developed.'[2]

[2]West, G.P. (Ed.), *A History of the Overseas Veterinary Services*, pp. 35, 36

CHAPTER 29

AGRICULTURAL IMPLEMENTS IN THE NINETEENTH CENTURY

PLOUGHS, IRON SUGAR-MILLS AND CHAFF-CUTTERS
OBSERVATIONS OF DR J. A. VOELCKER, 1888, AND
PROFESSORS ROBERT WALLACE AND N. G. MUKERJI
RISE OF STEEL INDUSTRY IN INDIA AT JAMSHEDPUR

In the middle of the nineteenth century, with the growth of steel industry, a variety of agricultural implements were manufactured in England. These included mowers, reapers, threshing machines, iron ploughs, seed drills, etc. Agricultural improvers without examining the conditions prevalent in India and ignoring the fact that the Indian farmers got a low price for their produce, and hence were poor, imported agricultural implements from England for the experimental farms in India. Most of the farm managers who were in charge of these experimental farms had no agricultural training, practical or scientific. Some of them were unsuccessful planters who had no knowledge of English agriculture or of Indian agricultural practices. Besides it was not realized that novelty is not necessarily an improvement. The result was that large dumps of agricultural implements and machinery got accumulated at these farms. As a result experimental farms in India became museums of imported farm implements and machinery.

The Cawnpore Experimental Farm was, however, exceptional. Voelcker noted that several kinds of implements were manufactured and sold yearly. In 1888-89, 84 ploughs ("Watts" and "Kaisar"), 22 pumps, 24 corn-grinders (costing Rs 25 each), and 8 chaff-cutters, were sold at the Cawnpore Farm. Sometimes implements were given out on trial, but most were sold outright.

The pump sold here was known as the "Cawnpore pump". It was a kind of chain pump, admirably suited for raising water the depth of which below the surface did not exceed 20 feet (6.1 m). The pump had considerable success in the neighbourhood, though it hardly came within the *raiyat's* means; the prices were, for depths from 3 to 10 feet (0.9 to 3 m), Rs 40; for a depth of 15 feet (4.6 m), Rs 45; and for a depth of 20 feet (6.1 m), Rs 50. This pump was an adaptation from the one brought by Sir Edward Buck from Australia.

Water-lifting Devices

The indigenous methods of lifting water from wells are of three types. If the lift is small, the water is raised by palmyra leaf or bamboo baskets attached to ropes which are swung by two persons (Fig. 42, iii). For greater depths the Picotah or 'Yetham' worked by men is employed. The Picotah consists of a vertical post which supports a long inclined beam from which a bamboo carrying a bucket is suspended at one end. This end is raised or lowered by men or boys walking on the beam on either side of the vertical support. When the bucket is thus lifted with the water, it is emptied by another operator into the irrigation channel (Fig. 43). For still greater depths the Kapila lift consisting of a large hemispherical leather or iron bucket with a long leather tail open at the end is used. A rope supports the top of the bucket and another is attached to the tail. The former passes over a wheel working between two posts fixed at an angle and the latter runs over a roller on a level with the channel. As soon as the bucket is filled, it is hoisted by a pair of bullocks as they walk down a steep slope. In the process of lifting, the tail of the bucket is drawn up level with the mouth and the water cannot escape, but as soon as the level of the channel is reached the tail is drawn over the roller while its mouth rises to the upper wheel and the water is automatically discharged into the channel. The bullocks are then backed up the slope and the operation is repeated (Fig. 42, i). The Kapila with a pair of bullocks lifts about three times as much water as the Picotah, and for ordinary lifts the average discharge is about 1,800-2,000 gallons (8.2 to 9.1 kilolitres) an hour from a depth of about 20 feet (6.1 m). The level of water in the wells may range from 10 to 40 feet (3 to 12 m) from the ground level.

Another simple device for lifting water from ponds and canals is a canoe-lever. It is tied to a bamboo supported by a tripod of logs of wood. The bamboo carries a weight on one end. It is worked by one man who stands in front on a log of wood (Fig. 44). This device is in common use in West Bengal and is used for irrigating paddy fields. It is also mentioned in the Buddhist tests.

Ploughs

There is a variety of Desi wooden ploughs, fitted with iron ploughshares, still in use in India. Some of these are shown in Fig. 45. 'Ploughs have often been made the subject of attempted improvement, and yet the native wooden plough holds its own, and will continue to do so, I expect, whereas not one of the new kinds of iron ploughs have had more than a local fame', observed Voelcker. 'Almost every Government Experimental Farm had its "pet" plough; the "Kaisar", the "Duplex" (Colonel Pitcher's), and the "Watts" plough, at Cawnpore; the "Saidapet" plough and the "Massey" plough, at Madras; the "Stormont" plough, at Khandesh; the "Seebpore" plough, at Calcutta. Then there were the "S.S." (Seeley's) and the "Hindoostan" (Avery's) ploughs, both in use among the Bihar indigo-planters. A certain number of the ploughs were sold annually in the

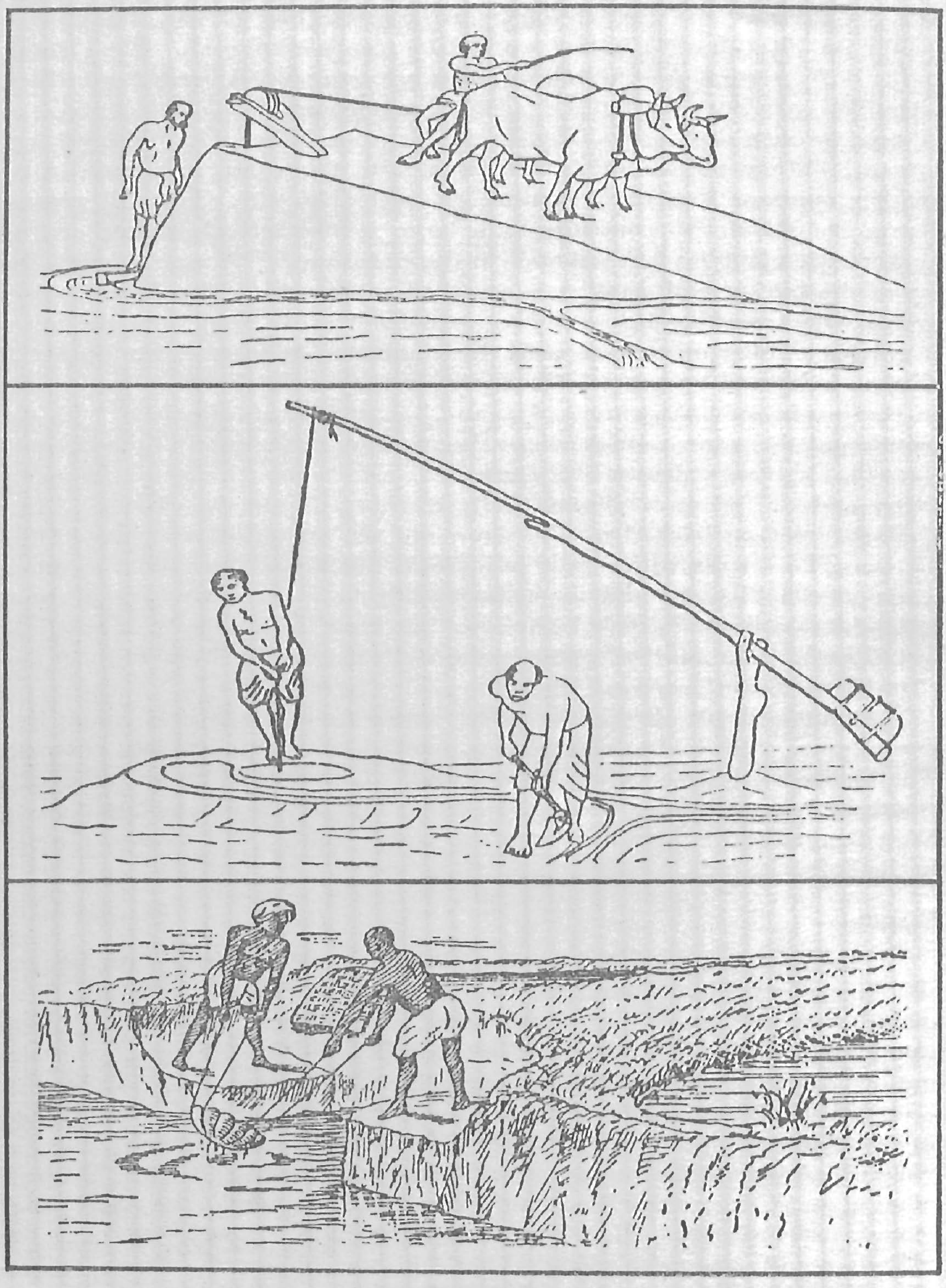

FIG. 42. Three types of water lifts which are still in use in India. (i) The *charsa*, which the bullocks pull on an inclined plain; (ii) The *dhenkli*, a water lift constructed on the principle of a lever; (iii) Farmers lifting water with the aid of a basket from a stream at a lower level to a field at a higher level

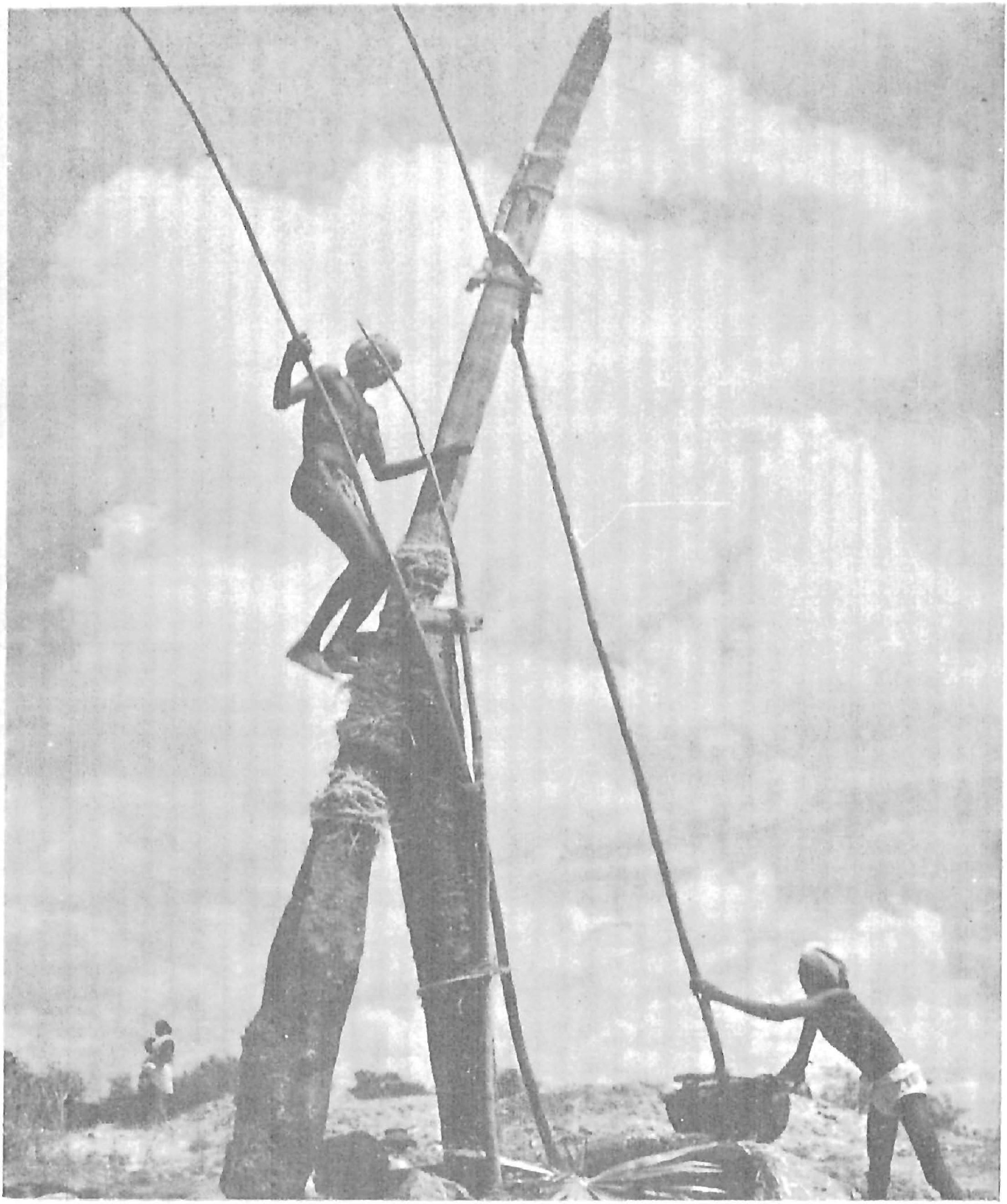

FIG. 43. The picotah is a water-lifting lever still in use in Tamil Nadu. It consists of a vertical post which supports a long inclined beam, from which a bamboo, carrying a bucket, is suspended at one end. This end is lowered or raised by a man walking on this beam

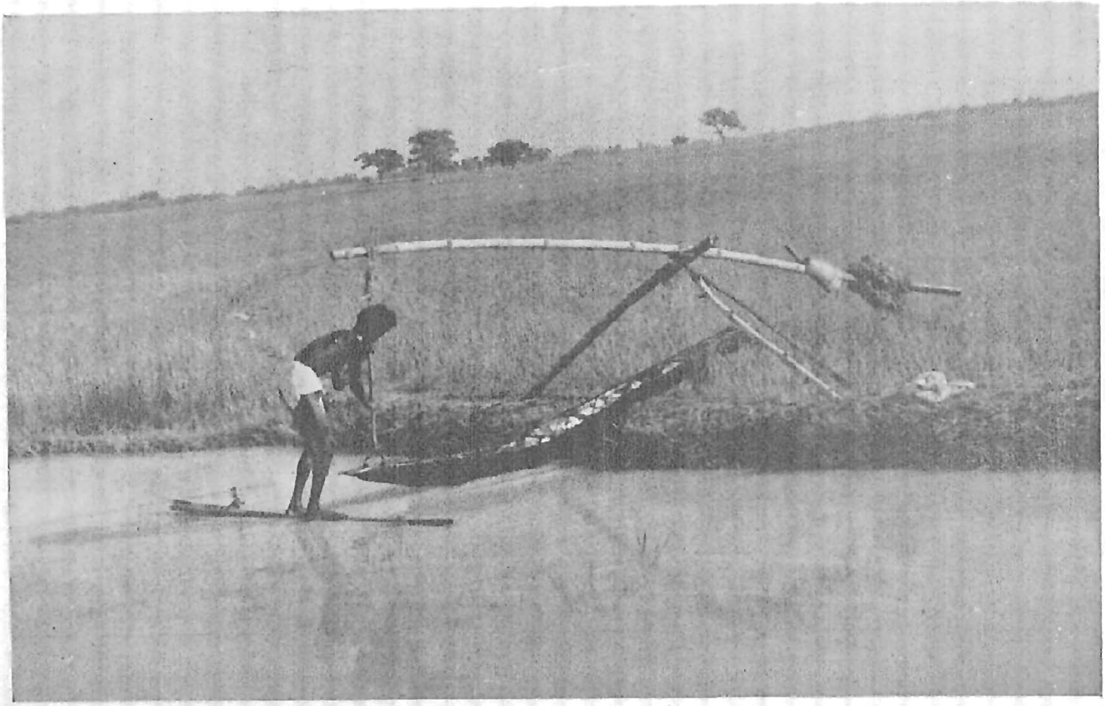

FIG. 44. A canoe-like lever device for lifting water from a fresh-water stream into paddy fields. It is in common use in the West Bengal and is also mentioned in the Buddhist texts

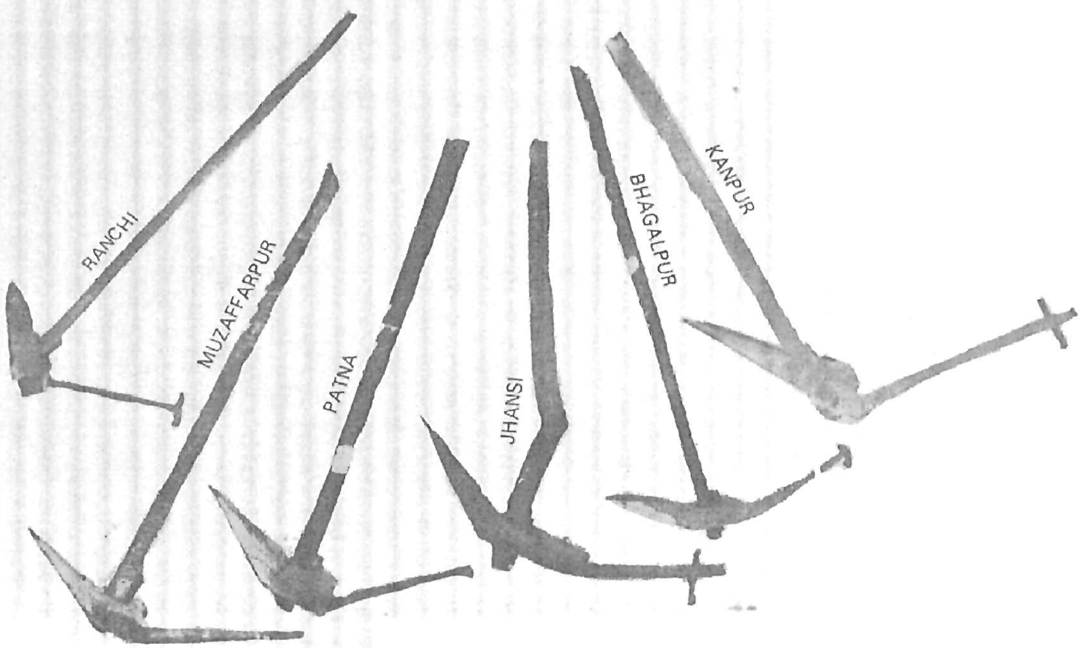

FIG. 45. Indian ploughs: Kanpur, U.P.; Bhagalpur, Bihar; Jhansi, U.P.; Patna, Bihar; Muzaffarpur, Bihar; Ranchi, Bihar

particular districts named; but, except among the larger land-owners and planters, they did not find their way. The reasons are several, the first being that of cost. The *raiyat*'s practice was to buy an iron share in the *bazar*, for 4 annas; this he took along with some *babul* wood to the village carpenter, who then made the plough. In eastern Bengal a wooden plough costs 8 annas only, but Rs 2 to Rs 4 may be considered the general range of prices throughout India. The cheapest improved plough costs Rs 5 to Rs 6. The prices were as follows: the "Duplex", Rs 5; the "Kaisar", Rs 6; the "Seebpore", Rs 6; the "Watts", Rs 7; the "Saidapet", Rs 8; and the "Hindoostan", Rs 12 As 8. A second objection which the *raiyat* had was the *weight* of an iron plough; it was heavy to work; his cattle were not strong enough, and he could not carry it himself on his shoulder from field to field. The native plough, generally speaking, weighs about 25 lb. (11.3 kg) some were even lighter; the Konkan plough, for example, weighed only 20 lb. (9.1 kg). An "improved" plough will weigh from 30 lb. to 80 lb. (13.6 to 36.3 kg).

'A third and more potent objection was the *difficulty of repairing* iron ploughs. When, occasionally, iron ploughs are used in a district, it was where a proprietor owned a small foundry, and was able to execute the repairs there. This was the case at Bellary', reports Voelckor. 'Mr A. Sabapathi Mudaliar sells a number of Swedish ploughs here. Those used on the black soil go 1 foot (0.3 m) deep, and require six to eight pairs of oxen; they cost Rs 50 each, but a smaller size, used on red soil, costs Rs 25 only. One thousand ploughs, in all, have been sold; the repairs, however, are all done at Mr Sabapathi's factory. Mr Sabanayagam Mudaliar, at Shiyali, also had his own workshop, where repairs could be executed.

'Even if properly used, a plough that goes deep may do harm in some soils where a native one would not, viz., by turning up inferior soil, and by bringing lumps of limestone (*kankar*) to the surface.

'Again, it is quite possible', observed Voelcker, 'that where deeper ploughing is in vogue, the moisture (which in the case of some soils is so necessary to retain) might be lost. The turning over of a furrow is not always an advantage in India; if the soil be at all stiff, the sun will rapidly bake the slice turned over; it will remain more like a brick than like soil, and will not readily pulverize again. This would not occur with the native plough, the action of which is more like that of a pointed stick running through the ground, just below the surface, say 2½ to 3 inches (6.3 to 7.6 cm) deep, simply stirring and loosening it. For hard and sun-baked ground, such as is often met with, no action could be better adapted, and, in a trial at Meerut, I saw an English plough completely fail on such land.'

'In black soil, too, a plough that goes deep is bad, if no rain falls after ploughing.

'The fine tilth produced by the frequent ploughing with a native plough produces a surface which will absorb water better, if rain follows, than would that left by a furrow-turning plough.

'Against deeper ploughing it may also be said that there is so little manure to go on the land that more would be lost if the soil were turned up to a greater depth.

'Even when deep ploughing is employed, as by Mr Sabapathi Mudaliar at Bellary, this is only done once in four years with the Swedish plough. The native plough is used for the rest of the time.

'Further, land is frequently infested with weeds, such as *kunda* (*Saccharum ciliare*), which, if buried, will readily spring up, and whereas the native plough, with its digging action, tears the weed out and brings it to the surface, a furrow-turning plough would cover it over, and give to it the very bed it required for propagating itself. So, too, would it be with a field covered with *dub* grass (*Cynodon dactylon*), every joint of which will grow again. For rice cultivation, nothing but a digging and stirring plough, like the native one, would do any good, working, as it does, among mud with several inches of water over it. For breaking up new land the native plough has also advantages, and somewhat resembles the tearing action of the "steam-digger".'

THE STEAM PLOUGH

In Bihar Voelcker was informed that even the steam-plough did good service, and Mr W.B. Hudson told him that he considered it a good plan to plough with it about half an inch deep each time, so as to bring a fresh layer of soil into use. Again, at Captain Champan's estate at Bati, Oudh, he saw a steam-plough at work. The "cultivator" was employed for the purpose of breaking up land and bringing it under cultivation. 'The land had previously formed the bottom of a lake, and such a matting of weeds and roots I have seldom seen. The steam-plough had as hard a task set as was possible to imagine, but it did its work splendidly; side by side was other land which had before been in the same state, but now, mainly as the result of steam-ploughing, was bearing magnificent crops.'

In preparing land for sugarcane, the land was ploughed 8, 12, or even 20 times in order to get deep enough and to render the soil fine enough. In such cases, Voelcker felt that deep ploughing was useful. Sugarcane has a deep root-system, and in the case of all deep-rooted crops, deep ploughing is useful.

TRANSFERENCE OF IMPLEMENTS FROM ONE PROVINCE TO ANOTHER

Dandrala for breaking crust and seed-drills: Voelcker also noticed that there were implements in some provinces in India which were not known in other provinces. *Dandrala* or the bullock-drawn rake was one such implement. While on tour in the Punjab, he observed, 'At a little distance from

Ferozepore, on the way to Ludhiana, Mr E.B. Francis showed me some light sandy land on which, when a shower of rain falls soon after sowing, a crust is very apt to form, so that the young shoots cannot force their way through it. This is especially the case with barley, and rather less with wheat; when it forms, the people habitually resow the crop, for they have no implement corresponding to a harrow. I have instanced how careful the Bihar indigo-planter is to break up this crust the instant it forms, using a bullock-rake or harrow having spikes some 8 inches (20 cm) long, and penetrating about 2 inches (5 cm) into the soil. An implement of this kind, if introduced at Ferozepore, would entirely dispense with the necessity of resowing. The improvement here would consist in a transference of native methods, not an importation of foreign ones. A similar instance is that of a seed-drill for "dry" (unirrigated) cultivation. In the northern or Telugu portion of Madras such a drill is used, but not in the southern or Tamil portion, where the grain is sown broadcast on "dry" land.'

Iron Sugar-mills

In the nineteenth century, while the price of wheat was a rupee a *maund* of forty seers, sugar was selling at a higher price. As such, the growing of sugarcane was more remunerative, and the farmers could invest money in purchasing a comparatively costly iron sugar-mill. Before the iron sugar-mills came into use, sugarcane was pressed by *kolhu* or *belna* type of mills. Of these, in *kohlu* there was a mortar-and-pestle arrangement. Cane was cut into short lengths and fed into the mill. The *belna* type had two horizontal wooden rollers. The wooden mills cost Rs 20 to Rs 30, and lasted about 10 years. They were hard to work, and the pressing of canes was inefficient, the canes having to be passed through the rollers several times, always three or four, and sometimes as many as eight times. It extracted juice to an extent of 40 percent of cane weight. The only points in favour of the wooden roller-mills were that they could be made locally, and that the canes were not to be chopped up or cut into short lengths, as is the case with the *kolhu* and with the iron mills; thus, the fibre, after pressing, was available for rope-making, and especially for ropes for wells. For the latter purpose, sugarcane fibre was much prized, as it could stand constant immersion in water, necessitated by the employment of the Persian wheel, the method of raising water most common throughout the Punjab.

In 1873-74, an improved iron sugar-mill was manufactured by Messrs Thomson & Mylne. When first manufactured, it had two rollers, and cost from Rs 80 to Rs 100. In 1880, a three-roller mill was introduced and it cost Rs 170 (Fig. 46). Robert Wallace, Professor of Agriculture in the University of Edinburgh, who came to India about 1880, noted that about 70,000 iron sugar-mills were in use in India. The machine was simple and

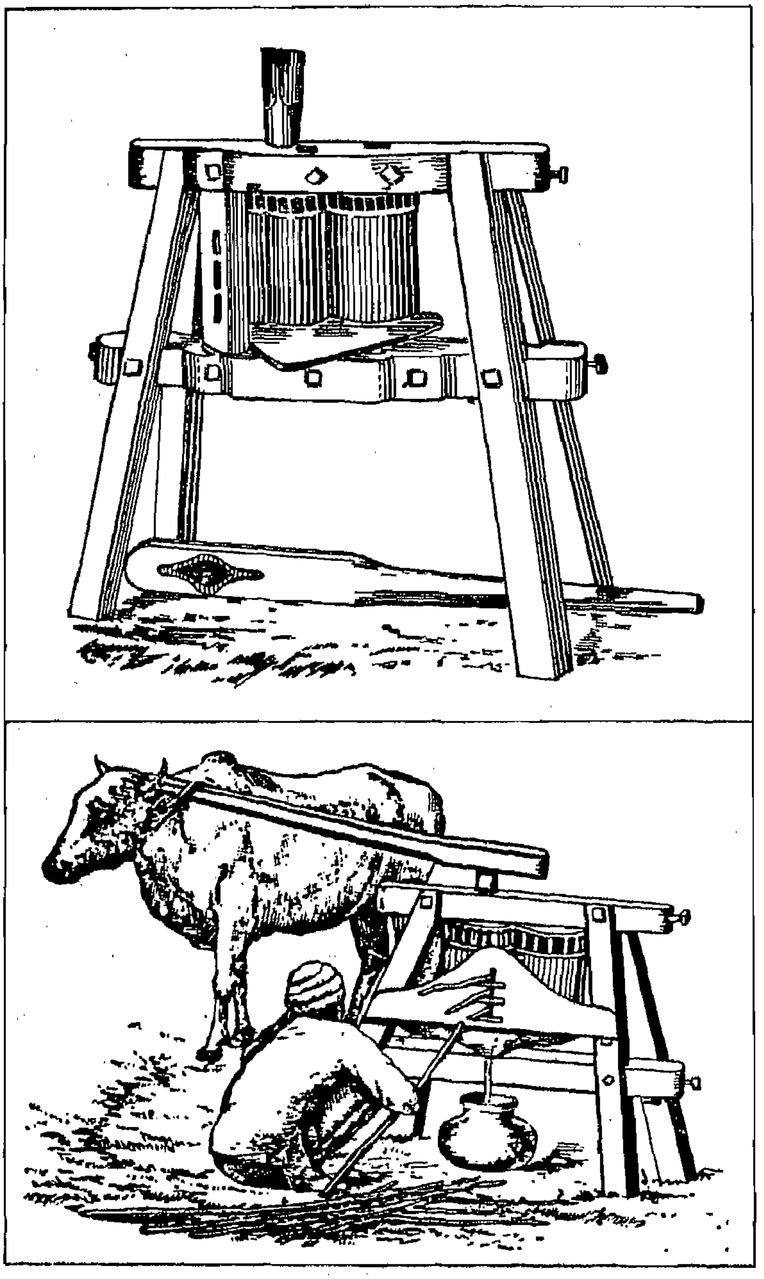

FIG. 46. The Beheea sugar-mill introduced into Bihar in 1873. Initially it had two rollers (as on top). In 1880, a three-roller-mill was introduced (as below). Its manufacturers, Messrs Thomson and Mylne, established depots in the sugarcane-growing districts, where worn-out mills were replaced by new ones

the manufacturing company established depots in the districts, where worn-out mills would be replaced by new ones. It extracted juice up to 50-60 per cent of the cane weight.

Wallace noted that where the *ryot* saw a distinct advantage in terms of economics, he adopted an innovation. 'The way the sewing-machine has been taken up by the village tailor throughout India is another proof of what I say as regards the possibility of introducing changes when there are improvements.

'My experience throughout, without even a single exception to the rule, showed that the *ryot* would not reject any proposal that he could see would turn out for his benefit, but at the same time he would treat with silent indifference, without troubling to give his reason, any attempt to establish a practice which would not suit surrounding circumstances, however feasible the proposal might look on paper to those who were unaware of the practical facts.

'The great secret of the success of the Beheea mill is that it was originated under the light of a knowledge of the requirements of the case, and at the same time a knowledge of the defects of the mills that had been in use. It is, further, an improvement of a native mill of a somewhat similar pattern, not an entirely new invention, or something copied from the European world. Taken as a whole, the Beheea mill, with its simplicity and its success, shows unquestionably the lines upon which all efforts must be made to bring about the social revolution which is being sought after in India.

'Small cane-growers club together in the Bihiya District to help one another with their work and also to purchase bullocks and a mill as company property. The mill passes from place to place for a few days at a time in each case.

'Should one man's cane begin to get too ripe near the end of the season before his turn comes round again, he irrigates it and sets it growing. Cane-squeezing begins in October and goes on till the end of March.

'Over 70 per cent of the sugar-cane can be extracted as juice under favourable circumstances.'[1]

The Beheea sugar-mill spread rapidly in the Punjab, Bengal, Madras, Bombay and North-West Province. Voelcker noted in his report in 1897, 'The Punjab Administration Report (1889) speaks of the Beheea sugar-mill and its modifications as being "the only implement successfully introduced into the Punjab in late years". In Rohtak it is "driving the old '*kolhu*' (native mill) out of use"; in Kapurthala the substitution of it for wooden mills is actively encouraged. At first the cultivators would not take it; but when, in 1886, as the result of competition, the price came down, first 30 mills were purchased, and later on 200 more. In Hoshiarpur the iron mill

[1]Wallace, R. *Indian Agriculture*, p. 228

is coming into use; the native mill (*belna*) is worked by three pairs of bullocks, and the cane has to be passed through the rollers several times.

'From Bengal there are many reports of the extension of the use of the iron mill, e.g. in Lohardaga, Palamau, Rungpore. In Palamau the native *kolhu* has been driven out of use, and in Rungpore, on one Estate (Balashan) alone there are 300 iron mills in use.

'At Hospet, in Madras, I found that 75 Beheea mills had been sent there between January and August 1884 alone. Mr Goud, of Hospet, has since pushed the sale of iron mills largely, and they are highly appreciated; there are now 600 Beheea mills in the district, and the wooden mills are all gone. The iron mills are hired out for one rupee per day. Mr Goud told me that there is a large field for iron mills in Hyderabad, as the people had not yet given up their wooden mills.

'From Bombay it is reported that in one village alone, viz. Velur, in Valva *taluk*, Satara, there are 120 iron mills in use. The mill is pushing its way in the Deccan, but in Gujarat, with few exceptions, the wooden mill still holds sway.

'It is in the North-West Provinces that most advance has been made, and iron mills are almost general. The Beheea firm have depots at Saharanpur and elsewhere.'[2]

Nahan Sugar-mills

At the close of the nineteenth century, primacy in the manufacture of sugar-mills passed on to the Sirmur State, which was ruled by a progressive ruler, Raja Shamsher Prakash (1856 to 1898). The Raja modernized the State administration, and in 1887 started a foundry at Nahan for the manufacture of weights. As it turned out to be a losing venture, he decided to make wrought iron in the foundry as there were large deposits of iron ore in the State. For this work, he obtained an engineer from England (Mr F. R. Jones, M. I. M. E., the present Superintending Engineer and patentee of the several types of sugarcane-crushing mills now manufactured), who on arrival found this to be an exceptionally good magnetic iron ore. Machinery was got out from England, and a blast furnace was erected. Charcoal was to be used as fuel, and this, of course, made the iron very expensive, but as the ore contained practically no phosphorus or sulphur, the iron produced equalled the best Swedish brands, for which there was a large market in India at high rates. Unfortunately for the prospects of the Nahan iron works, just at this time Swedish iron was replaced by English mild steel at a greatly reduced price. The idea of making wrought iron at Nahan was abandoned, and the manufacture of sugar-mills was instituted.'[3]

[2]Voelcker, J.A. *Report on Improvement of Indian Agriculture*, p. 227
[3]*Gazetteer, Sirmur State*, p. 78

Of the bullock-driven mills tried so far, the Nahan Sultan manufactured at Nahan was found to be the most efficient and the best constructed. It consisted of three rollers grooved vertically and gave an extraction of 56 to 65 per cent. Its output was about $3\frac{1}{2}$ maunds (130 kg) of cane per hour, and its price was Rs 135 in 1946 (Fig. 47, *above*).

Soon after, bullock-drawn sugar-mills were manufactured in many cities in India in the sugarcane-growing provinces.

Shallow Iron Evaporating-Pan

Another improvement which Voelcker recommended was the popularization of the shallow iron evaporating-pan for boiling the expressed cane-juice in. 'The more rapid evaporation effected by the broad shallow pan, as against that with the narrow and deeper pan generally used, would give much less opportunity for secondary fermentations setting up, and for impurities finding their way into the juice. Both of these circumstances will cause a loss in the amount of crystallizable sugar yielded. In Palamau (Bengal), the shallow pan is in use, but not in Lohardaga, nor yet in Dacca; in the latter earthen pans are employed. In Gujarat (Bombay) the use of the shallow pan is universal, but it is not known in Bassein, where deep narrow copper pans are in vogue.'

Chaff-cutters

As already mentioned, chaff-cutters were sold in small numbers at the Cawnpore Experimental Farm as early as 1888. They were imported from England. It seems that the manufacture of chaff-cutters started early in the current century. Mukerji[4] mentions that Burn & Co. of Calcutta sold chaff-cutters in 1915 at a price of Rs 53. However, these chaff-cutters were confined only to large farms. Right up to 1924, fodder was cut in the Punjab and in most provinces in India by *gandasa* or hand-*toka*. Farmers used to cut fodder with this implement early in the morning and accidents were common. A large number of farmers could be seen with cut fingers.

In 1927, Prem Nath Mayor, a pioneer in agricultural implement industry, established a concern known as Watkins Mayor & Co. at Jullundur.[5] He started the manufacture of chaff-cutters, centrifugal pumps, etc. He came to be known as the King of Chaff-cutters. By 1946, the Punjab had more than 100,000 fodder-cutters. The manufacture of chaff-cutters spread to Phillaur, Goraya, Batala, Okara and Lyallpur in the Punjab. In U.P., the manufacture of chaff-cutters started at Cawnpore, Allahabad, and a number of other towns. The local manufacture in large numbers resulted in lowering the price from Rs 64 per piece for the imported machine to about

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[4]Mukerji, N.G. *Handbook of Agriculture*, p. 136

[5]Mayor, R. Farm Engineering Industries, *The Tribune*, 7 February 1978

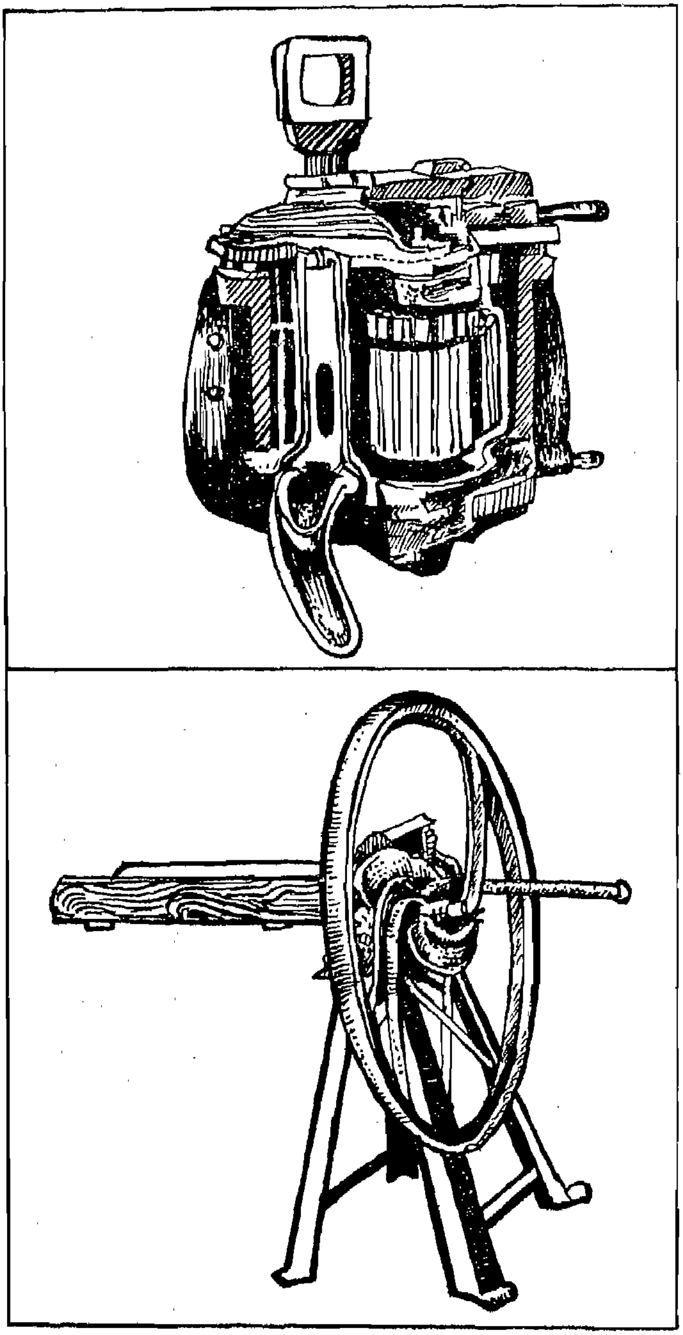
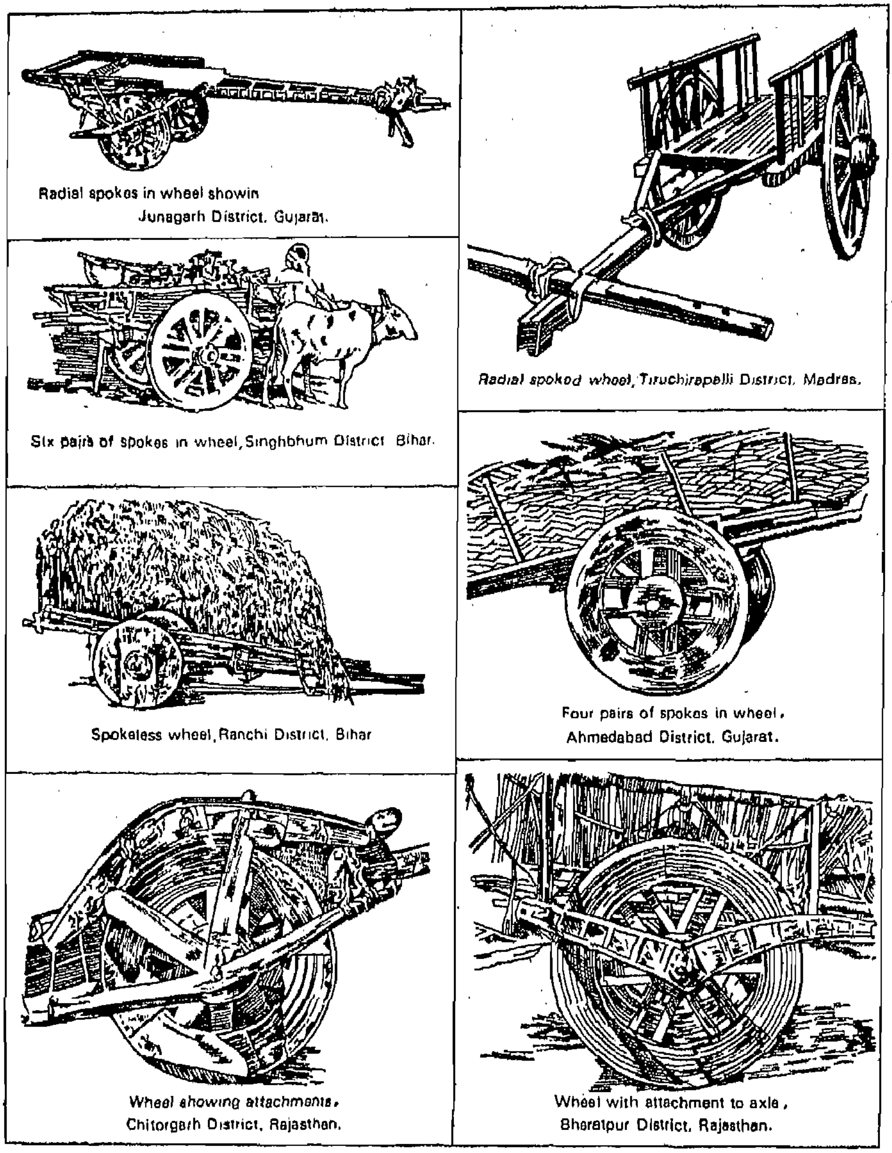


FIG. 47. Improved agricultural implements in India in the first half of the present century. Nahan Sultan sugarcane mill (above) and the chaff-cutter (below) became popular from 1924 onwards



Radial spokes in wheel showin Junagarh District, Gujarat.

Radial spoked wheel, Tiruchirapalli District, Madras.

Six pairs of spokes in wheel, Singhbhum District Bihar.

Four pairs of spokes in wheel, Ahmedabad District, Gujarat.

Spokeless wheel, Ranchi District, Bihar

Wheel showing attachments, Chitorgarh District, Rajasthan.

Wheel with attachment to axle, Bharatpur District, Rajasthan.

FIG. 48. Types of bullock carts used in different States in India (Courtesy: Anthropological Survey of India)

Rs 40 and hence they were within the purchasing capacity of most farmers.

The use of chaff-cutter saves labour and economizes fodder, as there is less wastage. The work that can be done by a good hand-driven chaff-cutter is equal to three times that of a hand-*toka*. Chaff-cutters worked by bullocks can chaff from 20 to 40 *maunds* (740 to 1,480 kg) of green fodder per hour. Those driven by mechanical power (oil engine or electricity) cut from 30 to 150 *maunds* (1.11 to 5.55 tonnes) per hour.

The rural electrification and improvement of the economy of the farms due to cultivation of cash-crops, such as sugarcane, cotton and jute, led to the diffusion of chaff-cutters all over the countryside.

Mukerji observed in 1915 that 'By ordinary farming, i.e. by cultivating rice and pulses, with hired labour, a capitalist cannot expect to make farming pay in this country. Fifteen maunds of paddy and ten maunds of pulses per acre (1,371 kg and 914 kg/ha, respectively) are obtained and when these are sold at Rs 2 a maund (Rs 7.40 a quintal), the income is only Rs 50 per acre (Rs 123 per hectare). By judicious cropping, two crops can be taken every year out of the land, or one crop of double value, such as sugarcane, tobacco and jute, or a crop which costs much less in cultivating, as maize, pulses, etc. But the average outturn per acre from mixed farming may safely be put down at Rs 50 and the cost also at Rs 50. Ordinary farming therefore just keeps the cultivators who are their own field labourers, and it pays them no better than service as a coolie.

'It is only by growing special crops, such as sugarcane, jute, etc., that a capitalist or a gentleman-farmer may hope to make farming pay. An acre of sugarcane will cost in Bengal about Rs 150 for growing, but the *gur* from it may be worth Rs 200 or more.[6] Thus the role of cash-crops in improving the economy of the farmers is well established. It also drives home the lesson that agricultural progress cannot take place when the farmer can hardly make both ends meet and has no surplus for making improvements.

Rise of Steel Industry in India, 1911-1913

An important factor in the manufacture of agricultural implements is the availability of cast iron and steel. Various attempts were made to start an iron industry in India in the early nineteenth century but failed for want of fuel and experience. Some progress was made from 1875, but it was chequered and halting. It was Jamshed Tata who saw the possibility of the iron industry. His sons founded in 1907 the Tata Iron & Steel Company at a site in Bihar, which they named after their father as Jamshedpur. Production of iron began in 1911 and of steel in 1913. One of the largest steel mills in the world, it produced about a million tons annually. This explains the

[6]Mukerji, N.G. *Handbook of Agriculture*, p. 142

spurt in the manufacture of chaff-cutters, iron Persian wheels and other implements after the conclusion of World War I in 1919.

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CHAPTER 30

LORD CURZON

1898-1905

I. FAMINE, 1899-1900
THE INDIAN IRRIGATION COMMISSION, 1901-1903
IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, PUSA, 1905
SETTING UP OF PROVINCIAL DEPARTMENTS OF AGRICULTURE AND COLLEGES OF AGRICULTURE

GEORGE Nathaniel Curzon (1859 to 1925) was, at thirty-nine, the youngest Viceroy of India. After Mayo, he was the next Viceroy with a background of agriculture. His father had an estate in Derbyshire. In 1895 he married Mary Victoria Leiter, daughter of Levi Leiter, a Chicago millionaire. This link with America not only provided him with a wife, but also brought him in touch with American agriculture and an American millionaire, Henry Phipps.

Curzon had many of the qualities of a good ruler. He had energy, industry, and intelligence of a high order, and had already made his mark in public life in England. He had worked as Under-Secretary of State for India in 1891-92, and as Under-Secretary for Foreign Affairs from 1895 to 1898. He had travelled extensively in Asia, and had written on Central Asia, Persia, and the Far East. He had the gift of eloquence and an elegant style. More than this, he had a real appreciation of Oriental life; he felt an admiration for Oriental art and literature. Above all, he was an innovator and believed in creative administration. His worst fault was complete inability to delegate authority. He was so conscious of the inferiority of others that he had to do everything himself.

One of his great works was the organization of the Archaeological Survey of India and protection and preservation of India's ancient monuments. 'I regard the stately or beautiful or historic fabrics of a bygone age as a priceless heirloom, to be tenderly and almost religiously guarded by succeeding generations,' he wrote; 'and during my administration of the Government of India no one shall find me niggardly or grudging in the practical realization of this aim.'

On a tour to Agra, Curzon saw, for the first time, the famous Taj Mahal and embarked upon one of the most energetic hobbies of his viceroyalty: the restoration and recognition of India's famous monuments. It was his wife, Mary, who first drew him to it and excited his enthusiasm. 'No word of mine can give any idea of the Taj,' she wrote to Curzon. 'It is the most divine creation of a building in the whole world. You will never be able to satisfy your eyes by seeing it enough.' What Curzon saw when he went

FIG. 49. Lord Curzon at work in the Government House, Calcutta, by G.P. Jascomb Hood, 14 February 1903. It was on Curzon's initiative that the Imperial Agricultural Research Institute was set up in 1905 at Pusa, and colleges of agriculture and departments of agriculture set up in the provinces

FIG. 50a. Statue of Lord Curzon installed on the grounds of the Victoria Memorial Hall, Calcutta

FIG. 50b. Victoria Memorial Monument, Calcutta. It contains portraits of important Viceroys and Governors-General who served India during the British period as well as of important personalities

over it for the second time were signs of decay and neglect, and he issued immediate decrees for its restoration, for which he pledged the Government of India's financial backing. He was determined to restore the Taj Mahal to its original beauty, and he carried on a correspondence for six months with Lord Cromer, the then Governor-General of Egypt, to find him 'a silver hanging lamp of Saracenic design' to put in the mausoleum. Eventually he went to Egypt and found it himself, and it hangs in the Taj today. Curzon paid for it out of his own pocket.'[1]

While he was interested in preserving the beautiful buildings of the past, he was equally interested in creating new buildings with elegant architecture. To commemmorate the reign and death of Queen Victoria, he initiated the project of Victoria Memorial at Calcutta. This building is the repository of paintings and manuscripts relating to the British period of Indian history.

FAMINE, 1899-1900

A year after he became Viceroy, Curzon had to deal with the famine of 1899-1900, the most severe on record. All the western parts of India, the Deccan, including the Nizam's dominions, the Central Provinces, the Central India Agency, the Bombay Presidency, including Gujarat (comprising Kathiawar, Cutch, and Baroda), Sind, and Rajputana and the Punjab, especially the southern part, were hit by this awful famine. Sir John Elliot, the Government Meteorologist, in his careful forecast of the monsoon of 1900, before the famine was at its worst, stated that the drought of 1897 extended over a larger area and was more severe than any that had occurred during the previous 200 years. So far as can be judged from the data collected by the Famine Commission, the drought of 1897 and the subsequent famine of 1899-1900, were unique in their extent of area, and probably also in their intensity. No such complete failure of the rains after the first month of the monsoon was on record.

The area affected was over 475,000 square miles (1,230,240 km^2), with a population of 25,000,000 in the British territory, and 30,000,000 in the native States. The rich province of Gujarat, which had known no famine for a century, was left desolate. Sir Thomas Holderness calculated that the loss in crops alone amounted to £50,000,000 in British India, and £30,000,000 in the native States. To the failure of the crops was added a failure of the water-supply in many areas, while the Bombay Presidency and a number of native States suffered from a fodder famine. Cattle died in millions, and the famous breeds of Gujarat were almost wiped out.

J. E. Scott, an American missionary commented, 'The misery is terrible. But still worse is the fearful emaciation; living skeletons are on every side. The barren lands of the Deccan, none too rich at best of times, are fast

[1]Mosley, L. *Curzon, the End of an Epoch*, p. 87

being turned into tracts of dismal, sun-cracked, desert-chirred earth, whose friable edges are caught by the wind and seen flying in clouds of pungent dust. No water in the wells; no water in the rivers. This is the report that comes in from the districts, and you can easily test it for yourself. The central horror of this famine lies in the fact that the misery and torment of a water famine have to be endured, together with a famine of food for people and fodder for beasts. Coming farther north, the whole of the Central Provinces was overwhelmed by it. When the famine was at its worst, in August, nearly two and a half million people were on relief works, or about a fourth of the population. All that part of the Central Provinces in the northern part of the Deccan between the Narbada and the Godavari was dried up.'[2]

In October 1900, Lord Curzon thus summed up some of the special characteristics of the famine. "It was not merely a crop failure, but a fodder famine on an enormous scale, followed in many parts by a positive devastation of cattle—both plough cattle, buffaloes, and milch kine. In other words, it affected, and may almost be said to have annihilated, the working capital of the agricultural classes. It struck some of them when they were still down from the effects of the recent shock. It struck others who had never before known what calamity was, and who were crushed and shattered by the suddenness and directness of the blow. It attacked native states, to whose Durbars had never previously been brought home the obligation of famine relief on an extended scale, and whose dearth of administrative staff was enhanced by the poverty of their financial resources. It laid its hand upon primitive hillmen, unused to discipline or restraint, impulsive, improvident, lazy, living in an almost barbarous state in wild and inaccessible jungles. It sharpened the lurking nomadic instinct of wandering tribes, and sent them aimlessly drifting about the country, a terror to the famine officer, and an incubus to the camp. For a year it never left hold of its victims; and one-half of the year had not elapsed before famine had brought its familiar attendant furies in its train, and cholera, dysentery, and fever had fallen upon an already exhausted, enfeebled population. This is the picture of suffering that India has presented during the past year."[3]

Indians and English friends of India in England formed the Indian Famine Union in London in 1902. Among the members were Marquis of Ripon, Lord Hobhouse, Sir Raymond West, Mr S. S. Thorburn, Mr Wedderburn and Mr Vaughan Nash. The Union urged the Government to hold an enquiry into the conditions of the people of India, to introduce elasticity into the land revenue system of the country, to solve the problem

[2]Scott, J.E. *In Famine Land, Observations and Experiences in India During the Great Drought of* 1899-1904, pp. 31, 32

[3]Fraser, L. *India under Curzon and After*, pp. 283-285

of rural indebtedness by promoting the establishment of agricultural banks and to encourage the construction of canals. There is no doubt that Curzon took note of these suggestions.

THE INDIAN IRRIGATION COMMISSION, 1901-1903
PROTECTION TO FAMINE-PRONE AREAS

Next, Curzon paid attention to irrigation problems. He saw in land not only a source of revenue but also a means of production. Among the techniques of production, irrigation was one which could substantially increase the production of food and fibre. Hence he paid close attention to the problems of augmenting irrigation. In 1901, he appointed a Commission, under the presidency of Sir Colin Scott-Moncrieff, to investigate the whole question of irrigation in India and its possibilities. One of the functions of the Commission was to report on the desirability of the extension of irrigation as a means of protection against famine. This function was enunciated in following extract in the Government Resolution convening the Commission:

"In considering proposals for new irrigation works the Commission will understand that greater importance may often be attached to the extent and reliability of the protection that will be afforded than to the merits of the schemes regarded as financial investments. The irrigation works hitherto constructed by the State in India have on the whole proved directly remunerative; but it is recognized that the programme of works of this kind may be approaching completion, and that the great storage works required for any considerable extension of irrigation in the tracts which are most exposed to famine must necessarily be more costly per acre protected, and therefore less remunerative, than the completed works which draw unfailing and perennial supplies from the great rivers in northern and southern India. As regards new works, therefore, the main question is not whether they will be likely to prove directly remunerative, but whether the net financial burden which they may impose on the State in the form of charges for interest and maintenance will be too high a price to pay for the protection against famine.... It is from this point of view that the Commission should consider proposals for the extension of irrigation in districts in which cultivation is very insecure and precarious."

The Commission toured throughout the country and, in 1903, presented a report which, in addition to recommending lines of policy regarding the selection, financing and maintenance of irrigation works, dealt in detail with practically every scheme under consideration at the time. As a result of the Commission's recommendations, a large number of new works were undertaken.

The Commission increased the rough estimate announced by Curzon in 1900 by recommending projects which would irrigate 6,500,000 acres

(2,630,460 ha) of land in the country.

In his Budget speech in 1905, Curzon, thus reviewed the irrigation problems:

"Now let me say what our outlay upon all these works up till the present hour has been, and what the property thus created represents. The Government of India have spent in all 46½ crores or 31 millions sterling upon State irrigation works in all the above classes. With it they have dug nearly 50,000 miles (80,467 km) of canals and distributaries, they have irrigated an area of 21½ million acres (8,700,743 ha), out of a total irrigated area in British India of about 47 million acres (19,020,200 ha), and they derive from it a net revenue of £2,700,000 per annum, or a net revenue on capital outlay of approximately 7 per cent. If we capitalize the net revenue at 25 years' purchase, we obtain a total of 67½ million sterling, or considerably more than double the capital outlay. These figures are an indication of what has already been done.

"Next, what are we going to do or what are we capable of doing? In my first year in India I went to see the Chenab Canal in the Punjab, which had been finished a few years earlier. At that time it irrigated 1,000,000 acres (404,686 ha); it now irrigated 2,000,000 (809,372 ha); at that time it had cost 1½ millions sterling, there have now been spent upon it two millions; at that time it supported a population of 200,000 persons; the population is now over 1,000,000; and this huge aggregate is diffused over an expanse, now waving with corn and grain, that but a few years ago was a forsaken waste. Since then we have completed the Jhelum Canal, which already irrigates 300,000 acres (121,406 ha), and will irrigate three-quarters of a million. Everywhere these lands, once waste and desolate, are being given out to colonization; and the Punjab Province, if it lost the doubtful prestige of the frontier with its disturbing problems and its warring tribes, has gained instead the solid asset of a contented and peaceful peasantry that will yearly swell its resources and enhance its importance. Then you have heard of the fresh obligations which we have since undertaken in the same quarter; 5½ millions sterling have just been sanctioned for the group of canals known as the Upper Chenab, the Upper Jhelum, and the Lower Bari Doab. Before another decade has elapsed 2,000,000 acres (809,372 ha) more will have been added to the irrigated area, with a proportionate increase in the population, and with an estimated return of 10 per cent on the capital outlay.

"So much for the near future. Now let me look a little further ahead, and come to the recommendations of the Irrigation Commission. They have advised an additional expenditure of 44 crores or nearly 30 millions sterling, spread out over 20 years, or an annual average expenditure of 1½ millions sterling. We accept that estimate; we regard it as reasonable; and we hope to be able to provide the funds. This will increase the area under irrigation in British India to 6½ million acres (2,630,457ha) as compared with the 4 million (1,618,744 ha) which I mentioned five years ago, the difference being explained by the fact that as we draw towards the close of this gigantic programme we shall no longer be able to talk glibly of remunerative programmes or of lucrative interest on capital outlay, but shall find ourselves dealing with protective works, pure and simple, where no return or but little return is to be expected, and where we shall have to measure the financial burden imposed on the State against the degree of protection from scarcity and famine obtained for the people. I do not think that we need shrink from that more exacting test; for we shall have approached, if the metaphor may be permitted, the rocky passes in which our forces will then be engaged, across smiling plains and verdant pastures, in which they will have derived strength and sustenance for the harder and less remunerative toil that will lie before them."

According to Fraser, the special merit of Curzon's labours lay in the fact that he systematized the whole enterprise, prepared a clear and final programme which represented the utmost possible extension of the Indian irrigation system, arranged for its finance and for its steady prosecution.[4]

Decline of Agri-Horticultural Societies and Need of Department of Agriculture

By the last quarter of the nineteenth century, Agri-Horticultural Societies which had done useful work in introducing new crops, were almost at the end of their tether. This was well-illustrated by the fate of the Punjab Agri-Horticultural Society, which was started on 16 May 1851 with Henry Lawrence as President, and Lord Dalhousie as patron. Out of its 105 members, only six were Indians. In 1864 it had only two subscribing Indian members—the Raja of Patiala and the Raja of Chamba. The Society's activities were concentrated in the Lahore urban area. At its annual flower and vegetable shows *malis* were given prizes, and 'the beauty and fashion of Lahore promenaded the Lawrence Garden to the music of two excellent bands.'

The Society went into decline during 1856-1861. In the *Proceedings* of the Society for 1864 commercial crops are mentioned which had no relevance to Punjab agriculture. The Famine Commission Report in 1881 mentions the various crops the Society or Government had tried to introduce into the Punjab; imphi, oats, new varieties of maize, Carolina rice, flax, better varieties of cotton, cinchona, China grass and silk. The Famine Commission's assessment of these efforts is invariably the same; limited or no success. The Commission applied the same assessment to the efforts to introduce light-weight iron ploughs, a better Persian wheel

[4]Fraser, L. *India under Curzon and After*, pp. 300-302

and improved manuring techniques.'

As regards the improvement of the modes of cultivation, irrigation, system of manuring and agricultural implements, the Society's contribution was of little value.

A Punjabi journalist in the Urdu *Koh-i-Noor* of 17 May 1873 wrote as follows regarding the work of the Society:

'All it does is to present now and then a few packets or *dālees* of flowers and vegetables to the native gentlemen who are called its members for form's sake and pay subscriptions, or to please Europeans by a show of good flowers, fruits, and vegetables in their gardens.'[5]

This experience clearly indicated that a more ambitious effort was required to improve the state of agriculture. This could only be done by a well-organized department of agriculture with responsibility for research, extension and education in agricultural sciences.

Inspector-General of Agriculture, 1901

The famine convinced Lord Curzon that the Government of India must pay urgent attention to agriculture. His first step was to appoint, in 1901, an Inspector-General of Agriculture to control and direct the new policy. He chose Mr J. Mollison, an able Canadian who had shown by his work for agriculture in Bombay that he possessed exceptional qualifications for the task.

Imperial Agricultural Research Institute, Pusa, 1905

Among the works of Curzon for the betterment of the people on the land, one achievement stands out. He first introduced the application of scientific inquiry to the needs of Indian agriculture, on a comprehensive and systematic basis. From his administration dates the beginning of a great movement towards agricultural education and research. The days were past when the association of scientific research with agricultural pursuits stood in need of defence. The United States taught the world how much a well-organized Department of Agriculture could do for the people on the soil.

Curzon summed up in a speech to the Bombay Chamber of Commerce an answer to his own question: "What have we been doing for agriculture?" "Our real reform has been to endeavour for the first time to apply science on a large scale to the study and practice of Indian agriculture," he said. He was fortunate in his chief helper Sir Denzil Ibbetson, who was the head of the Department of Land Revenue and Agriculture during the later stages of his Viceroyalty. A loyal lieutenant, he shared his devotion to questions

[5]Kerr, I.J. The Agri-Horticultural Society of the Punjab, 1851-1871, in *Punjab Past and Present, Essays in Honour of Dr Ganda Singh,* by Harbans Singh and N. Gerald Barrier, Patiala.

in which the welfare of the bulk of the population was concerned. Curzon had the further advantage of association for five years with a Finance Minister, Sir Edward Law, who was sympathetic to problems of agriculture.

How did the Imperial Agricultural Research Institute come into being? In 1905 a proposal emanated from the Government of Bengal to utilize a large Government estate at village Pusa in the Darbhanga District of Bihar as a provincial research station and college. At that time, Bengal included Bihar and Orissa. The Government of India considered that this site might suit their needs and, with the full concurrence of the Government of Bengal, the estate was taken over for the purposes of an agricultural research institute, an experimental farm and an agricultural college. At this juncture a generous donation of £20,000, to which £10,000 was subsequently added, was made to the Viceroy by his American friend Henry Phipps of Chicago. This gift was tendered when the extensive development of agricultural departments was under consideration and Lord Curzon decided to devote the greater portion of it to the equipment of the new research institute. The institute was designed to assist in the solution of the fundamental problems of tropical agriculture.

The Setting up of Provincial Departments of Agriculture

The Resolution of the Government of India of December 1881 defined the functions of the Provincial Agriculture Department as agricultural enquiry, improvement and famine relief. In practice, statistical enquiries and management of famine relief became the primary concerns of the Department. The subject of agriculture was combined with land records and settlement work.

Lord Curzon's Viceroyalty marks the beginning of a new era of growth for agricultural departments both at the Centre and in the Provinces and the Despatch of the Government of India of 4 June 1903 provided its key-note. In 1905, the Government of India decided to set apart annually Rs 2 million to assist the development of agricultural research, demonstration and education in the provinces. Full-time Directors of Agriculture were appointed in all the major provinces. The provinces were divided into a suitable number of "circles" and each was to have an experimental farm on the basis of regional differences of soil and climate under a Deputy Director of Agriculture. These farms were to function also as depots for seeds, manures and implements.

The Establishment of Agricultural Colleges, 1905

With the annual grant of Rs 2 million it was contemplated to establish, in each important province, an agricultural college and research station adequately equipped with laboratories and classrooms, to which would be attached a farm of suitable size. The superior staff proposed at each of these provincial institutions was an expert agriculturist, an economic botanist, an agricultural chemist, an entomologist and a mycologist, one of the members of this staff discharging the duties of the principal of the college. The staff was to combine teaching with research. It was held that research would ordinarily be more active and better sustained if associated with lecturing as this would check any tendency to the investigation of problems unlikely to lead to practical results. To enable the experts to carry on research and to tour, an adequate number of assistants and demonstrators were to be provided. They would also assist in the teaching so that the time of the experts might not be wasted in elementary tuition.

To direct the work, civilian directors were appointed in all the larger provinces. But the expansion of staff was not as rapid as anticipated. The view was taken that the backbone of the scheme was the educational aspect, and the establishment sanctioned for each of the provinces was limited to an all-round agriculturist as principal of the college, an agricultural botanist and an agricultural chemist. In the words of Lord Morley, the creation of provincial colleges having the above-mentioned staff would remain a primary feature of the scheme. Colleges were accordingly reorganized or started at Poona, Cawnpore, Sabour, Nagpur, Lyallpur and Coimbatore.

Agricultural Research

However desirable the establishment of colleges may be, it is clear that apart from teaching there is an enormous amount of experiment and research to be done if agriculture is to be improved. Officers are necessary for the superintendence of farms for experimentation and for the supervision of demonstration and seed distribution. The duties of such officers cannot be carried out satisfactorily by experts who are tied down to their headquarters by teaching duties. To meet this desideratum, Deputy Directors were appointed. The importance of a staff of entomologists and mycologists for the larger provinces was again emphasized. The addition of entomologists and mycologists was, however, considered by the Secretary of State to be premature as it was thought that the Imperial Entomologist and the Mycologist could undertake important investigations for the provinces and could train Indian assistants.

The Indian Civil Veterinary Department, 1902

In 1902 the Indian Civil Veterinary Department was established. Seventeen officers from the Army Veterinary Department were transferred to man the new civil department, and four civil officers were provided from England by the Secretary of State for India. This method of recruitment by the Secretary of State or through local appointment remained in force till the end of the British rule in India.

Cattle Farm, Chharodi (Gujarat), 1902

In 1902 a cattle farm was established at Chharodi in Gujarat District to save the famous Kankrej breed of cattle, which was in danger of extinction owing to famine.

Horse Breeding, 1904

As a result of the findings of the Horse and Mule Breeding Commission, horse breeding for the purposes of the military was made the responsibility of the Army Remount Depot. Horse breeding for civil puposes was left in the charge of local bodies.

CHAPTER 31

LORD CURZON

1898-1905

II. WELFARE OF THE FARMERS
LAND-REVENUE SUSPENSION AND REMISSION RESOLUTION
RELIEF TO FARMERS IN DEBT
THE PUNJAB LAND ALIENATION ACT, 1901
THE CO-OPERATIVE CREDIT SOCIETIES ACT, 1904

CURZON was keenly interested in the welfare of the farmers. In one of his speeches he declared that 'the Indian peasant should be the first and final object of every Viceroy's regard'. The bulk of the population of India was rural and agricultural. The census of 1901 showed a population of 196,000,000 directly dependent upon agriculture and cattle-rearing. It was estimated that nine-tenths of the rural population of India live directly or indirectly by agriculture.

RELAXATION OF THE RIGOURS OF LAND REVENUE SUSPENSION AND REMISSION RESOLUTION

Sir Denzil Ibbetson, in his settlement report of the Karnal District, declared that in that tract the first British assessments were "incredibly oppressive", that it would have taken the whole gross produce of the land and cattle to satisfy the demand, and that Government guards were sent to watch the growing crops, and horse and foot were quartered in the villages to compel payment. This oppression had the worst impact on the farmers when the crops failed. Curzon introduced new principles of suspension and remission of land-revenue collection in times of scarcity, which transformed, to some extent, the spirit in which the dues of the Government were collected. This reform was widely appreciated, for it relieved the peasants from the terror of inexorable demands when their crops had failed. Moreover, as a measure of decentralization, district officers were given powers to suspend the collection of land revenue, and circuitous references to headquarters were obviated.

INDEBTEDNESS OF THE CULTIVATORS IN THE BOMBAY PRESIDENCY

The problem of the indebtedness of the cultivators was first noticed in the Bombay Presidency during the Viceroyalty of Lytton I (1876-80). In this Presidency the money-lenders were Marwaris from Rajputana and their victims were the Maratha farmers. Coming from the arid Rajputana with nothing but a brass *lota* as their sole possession, Marwaris thus started their business operations in the Bombay Presidency.

'Generally when a Marwari first comes to the district, he enters into the service of one of his relations of countrymen, and when he has saved a little money, he sets up a small shop in some village, where he thinks he can improve his circumstances. At first he is very meek and forbearing in his transactions with the *ryots*, and sometimes induces the patels or other influential parties to lend him money to enable him to enlarge his business and provide for the wants of the villagers. By degrees he extends his operations, until he has got the *ryots* completely into his hands, and by dint of usury and of any oppressive dealings in which he may be able to obtain aid from the civil court, he collects, say, from Rs 3,000 to Rs 4,000, and returns to his country to marry. On his return, he plays the same game, other members of his family join him, and with his assistance set up separate shops.'

The money-lenders acquired this power under the newly enacted British laws. Under the rule of Marathas, a creditor had no legal means for enforcing payment from his debtors.

Maratha Land League

Seeing no remedy in sight, the Maratha farmers banded themselves together as a Maratha Land League and boycotted their creditors. The contagion spread rapidly. In the following May the cultivators in a large village near Poona rose and gutted the shops of their oppressors. Similar riots and disturbances took place in a score of other villages, the object in every case being the destruction of bonds and decrees in the hands of the money-lenders. The immediately exciting cause—for the risings were believed to be unconnected—was in each case the circulation of a story that usurious bonds had, with the approval of Government, been extorted from a debtor. That the most docile and law-abiding agriculturists in India should almost within sight of Poona—the summer capital of the Bombay Government—riotously rebel against the justice of that Government's laws—ungratefully forgetful that for upwards of thirty years their grievances had been subjected to 'anxious consideration'—took that Government by surprise. Urged on by apprehension of a general Maratha uprising, a Commission of Inquiry was immediately appointed, and the excited peasantry pacified by promises of the redress of grievances.'

The Deccan Agriculturists Relief Act, 1879

The Commission did its work leisurely but thoroughly. Finally, after great opposition, the Deccan Agriculturists Relief Act, 1879, was passed. So sweeping were the changes made by that measure that it may be called revolutionary. Besides cheapening and simplifying litigation between the peasant and the creditor, and compelling the registration of all instruments between them, it required a civil court in debt cases, after separating the true principal from the interest, to decree only reasonable interest and fix instalments for the payment; the period of limitation for debts secured by registration was extended from six to twelve years, and debts on account and on unregistered bond, from three to six years; debts under Rs 50 could be extinguished at once, the court exacting payment of as much as the debtor was able to pay; agriculturists were exempted from liability to arrest or imprisonment in execution of a decree for money; and the attachment and sale of their land, unless specifically mortgaged, was forbidden in the cases of usufructuary mortgage on registered deeds; agriculturists were empowered to redeem on payment by instalments of the ascertained principal with moderate interest super-added; creditors were required, under penalty of fine, to grant written receipts for payments, to render annual statements of account, and even to provide agriculturists with pass-books.

'This drastic measure has been in force five years over an area 21,523 square miles (55,744 km^2) with a population of 3,296,686', observed Thorburn. 'It has worked well, restored the cultivator to life and hope, and up to the end of 1884 had enabled more than ten thousand mortgagors to redeem their lost fields.'

As for the money-lenders, some had gone back to their own country, some had been absorbed into the general population, and taken to honourable trading, and even to agriculture as the sole occupation, and many of the best class still engaged in banking in a legitimate way, only lending to solvent cultivators on good security and on reasonable terms, and had given up land-grabbing as a bad speculation.[1]

RURAL INDEBTEDNESS IN WEST PUNJAB

It was in 1886 that S. S. Thorburn of the Indian Civil Service highlighted the problem of indebtedness of the farmers of West Punjab much to the dislike of the provincial government. 'Thorburn refused to prophecy smooth things to a Government, which in return fed him with the bread of affliction and the water of affliction all his days. There had been many brave warm-hearted and selfless officials before Thorburn, but none who combined with these essential qualities of soul, the same mastery of detail, persistency of purpose, and audacity of spirit', states Travaskis.

The toreador of Punjab politics, he baffled and confounded the bull-like charges of an infuriated Government by the rapidity of his thrusts and the dexterity of his aim. To silence him, he was in 1884 ordered to conduct an investigation into the indebtedness of Muhammadan agriculturists in the western Punjab. But while his masterly exposition of the situation was being slowly smothered under a mass of official comment and criticism, public opinion in England and India was suddenly aroused by the

[1]Thorburn, S.S. *Musalamans and Moneylenders in the Punjab*, pp. 58, 59, 80

publication in 1886 of his *Musalmans and Moneylenders in the Punjab,* which presented the same material in a more popular form.[2]

'The Punjab is an agricultural province, a land of peasant proprietors, a large and annually increasing portion of whom are sinking into the position of serfs to the money-lenders', observed Thorburn. 'The gradual transfer of ownership of the soil from its natural lords—the cultivators—to astute but uninfluential Hindu traders and bankers is directly due to a system of law and administration created by ourselves, which, unless remedied in time, must eventually imperil the stability of our hold on the country.'

The cultivators in West Punjab were mostly Muhammadans and the money-lenders were Hindus of Khatri and Arora castes. 'That the Musalman peasant is a short-sighted and long-suffering animal is demonstrated from his history during the last twenty years. So long as the paternal acres remain in his possession, and the pinch of actual poverty is not felt, he is content to rub along from day to day, deliberately oblivious of accumulating debts until Fate's decree removes him to paradise', stated Thorburn. The problem of indebtedness of the Muhammadan farmers became acute between 1860 and 1870. In 1866 the number of suits instituted in the Province rose to the hitherto unprecedented figure of 165,520, or one suit to every ninety souls or eighteen heads of families. This was the result of the inauguration of a reign of technical law and slow but costly litigation, which favoured the affluent money-lender.

Thorburn observed, 'With the advent of British rule, British institutions, Civil Courts, Civil Procedure Codes, Contract, Limitation, Legal Practitioners and other Acts were introduced, and a bond or a debt secured on the mortgage or conditional sale of land became a sacred instrument, to be construed according to its terms. A debtor became liable to his creditor to his last farthing. In the eyes of the law the two were equal. In sober truth, the peasant was in money-matters a crass and hardly intelligible simpleton; the money-lender, a sharp, unscrupulous businessman, whose sole study was self-interest. With their opposing interests and their widely different intelligences, it soon became abundantly evident to those civil officers whose duties caused them to have much direct intercourse with any of "the people of India," that under the aegis of British "justice", that "people" was being reduced into a state of praedial slavery by a small but ever-increasing class of shopkeepers and money-lenders.

"To the Bunniah class the change to fixed cash assessments, the creation of individual rights in lands, and the introduction of civil courts administering laws and procedure code framed on European models, were as welcome as would be the succession to a great estate of an impecunious Anglo-

[2]Trevaskis, H.K. *The Land of Five Rivers*, p. 332

Indian, or the discovery of a gold mine on his land to an Australian settler. With their inherited business habits, their want of sympathy for Musalmans, their unscrupulous greed for gain, their established position as accountants and factors for the agricultural population, their monopoly of education, of general intelligence, and of trade—most particularly of money-lending (the taking of interest being unlawful for Musalman)—prospects of wealth and position, never before attained in their history, were opened for the Bunniah class.[3]

THE PUNJAB LAND ALIENATION ACT, 1901

Ultimately a drastic solution was proposed to save the peasantry of the Punjab from expropriation by the money-lenders. This was the Punjab Land Alienation Act of 1901, to which Curzon gave his ready assent. Its broad effect was that moneylenders, shopkeepers, and professional men could not buy land from hereditary cultivators, or hold such land on mortgage for more than twenty years, without the consent of the State. Hereditary cultivators could, however, dispose of their land to tribesmen of their own class without restriction. An important provision was that the land of a hereditary cultivator could not be sold in execution of a decree. This act saved the peasantry of the Punjab. The money-lending castes in the long run also benefited and instead of indulging in usury, they invested their money in business and industry.

CO-OPERATIVE CREDIT

The problem of indebtedness of the farmers could not be solved simply by curbing the money-lender. The need of credit was there for the purchase of bullocks and buffaloes, sinking of wells and other agricultural improvements. It was slowly realized that co-operative credit could meet the situation.

THE CO-OPERATIVE CREDIT SOCIETIES ACT, 1904

Sir William Wedderburn had tried, when he was attached to the Bombay Government, to start an agricultural bank at Poona. He was stopped, oddly enough, by Lord Kimberley, then Secretary of State, who disapproved of the degree of State aid implied in the scheme. In 1892, Sir Frederick Nicholson was entrusted by the Madras Government with the task of drawing up a scheme of land and agricultural banks. His report included a study of the co-operative institutions existing in Europe. It was duly published, and much discussed, but appeared likely to grow dusty on the secretariat bookshelves. In 1900, H. Dupernex, a U.P. civil servant who had visited France and Italy to examine the co-operative popular banks in those countries,

[3]Thorburn, S.S. *Musalmans and Moneylenders in the Punjab*, pp. 50, 51

published a book entitled *People's Banks for Northern India.* The views of both these officers came to the notice of Lord Curzon, who was at that time casting about for further expedients for relieving the peasantry from their load of perpetual indebtedness. He saw in their proposals the solution he sought. They were called to Calcutta, and in the course of talks, a scheme of co-operative credit societies was started and it seemed destined to revolutionize rural finance in India. The Co-operative Credit Societies Act was passed in March 1904.

Some features of the Act of 1904 were as follows: unlimited liability was insisted upon in the case of rural societies; it was laid down that profits were not to be directly divided among the members, and that any surplus that might accrue should either be carried to a reserve fund or be applied to reducing the rate of interest upon loans; the society was forbidden to borrow money without sanction; and pawn-broking was prohibited, but the society was allowed to receive agricultural produce as security, or in payment of a loan.

In 1913-14 the number of agricultural societies in the Punjab was 2,780, the number of members over 100,000, and the amount of working capital about Rs 10 million.

After the Act was passed, progress was very slow at first. Experienced and sympathetic officers were converted into missionaries, and perambulated the villages, explaining them in simple terms the meaning of the new project.

One or two societies were experimentally started in each province in order to show how they should be organized. Then success came with a rush. In 1911, at the end of seven years' working, there were 3,456 societies, with a membership of 226,958 persons, and a working capital of £686,000. Out of that sum, the State had been called upon to provide only £46,000. The rest had been found by the people themselves.

A feature of the Act was the flexibility it permitted in the formation of societies. Sir Frederick Nicholson recommended societies of the Raiffeisen type, but there are also organizations on the basis propounded by Schulze-Delitzsch. Sir Theodore Morison says that "every province appears to be developing a special type of society adapted to its special social structure". The whole movement is permissive, and the initiative must come, under guidance, from the people themselves. Curzon said in his speech on the passing of the Bill into law that its object was "to foster a spirit of responsibility and self-reliance", and that Government aid would only be forthcoming when necessary. The societies are of two kinds—urban and rural. Urban societies are particularly required to assist such industries as weaving and leather-working. The urban societies are usually on a share basis, with limited liability, while in the rural societies unlimited liability is the rule.

LOANS

The most important objects for which loans were given by the Co-operative Societies in the Punjab in the order of their importance were: re-payment of old debt, purchase of cattle, trade, payment of land revenue, ceremonies, and purchase of land.[4] Details are given in the statement below:

ANALYSIS OF THE LOAN GIVEN BY OVER, 2000 CO-OPERATIVE SOCIETIES IN THE PUNJAB

	Loans No.	Amount Rs	Proportion per cent of total number of loans	Proportion per cent of total amount of loans
1. Cattle	11,015	914,829	22.1	18.2
2. Revenue	6,643	474,897	13.3	9.5
3. Debt	11,394	1,356,897	22.8	27.0
4. Land cultivation	426	39,035	0.8	0.8
5. Building	1,464	193,581	3.0	3.8
6. Trade	3,205	567,481	6.4	11.3

RISE OF THE MIDDLE CLASS

With the advance of education in Western science and literature, the opening of the countryside by railways, and the construction of the Suez Canal, a middle class developed in India. The port cities of Calcutta, Madras and Bombay flourished and spawned a merchant class. Some from among them turned to industry. In nearly all the towns of India, a lawyer class emerged. They were professionals who were not dependent on the government for their livelihood. It is from this class that political leadership arose. There was an increasing demand from the Indians for participation in the apparatus of government. It was precisely this class, which the imperious and know-all Curzon spurned and ignored. In 1900, he wrote that the Congress was tottering to its fall, and one of his great ambitions was to assist it to a peaceful demise![5] When in 1904 he proposed the partition of Bengal, which meant the separation of the predominantly Moslem eastern Bengal and Assam with Dacca as its capital, it provoked an agitation on an unprecedented scale. A *swadeshi* movement started and the boycott of foreign cloth was urged. Ultimately, the partition decision was revoked.

In 1905, Curzon had a quarrel with his Commander-in-Chief, Kitchener, whom he had himself invited to India for his army assignment. Curzon resigned and returned to England. He served as Chancellor of Oxford

[4]Brij Narain. *Indian Economic Life, Past and Present*, p. 411
[5]Fraser, L. *India under Curzon and After*, pp. 165, 166

University, and devoted his leisure to collecting art treasures. On 20 March 1925, he died in his sleep.

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CHAPTER 32

THE CANAL COLONIES OF WEST PUNJAB

THE LAND, THE PEOPLE AND THE CROPS
DECREASE IN WELL IRRIGATION, AGRICULTURAL DEVELOPMENT
ECONOMICS OF FARMING IN THE COLONIES
1886-1917

THE Canal Colonies of West Punjab, also known as the Bars, were the bread-basket of India before Independence. Embracing an area of 5½ million acres (225,773 ha), they were developed in the districts of Lyallpur, Sargodha (Shahpur), Montgomery and Multan. The Lyallpur Colony, named after Sir James Lyall, Lieutenant-Governor of the Punjab, was started in 1892, and is the oldest. It is irrigated by the Lower Chenab Canal. The Sargodha Colony was started in 1897, when irrigation was extended to it by the Lower Jhelum Canal. It was followed by the development of Montgomery Colony also called Nilli Bar. Its irrigation was rendered possible by the famous Triple Project (1905-1917), which was conceived by Sir Thomas Benton, the great canal engineer. Three canals were made. The first, the Upper Jhelum, took the spare water of the Jhelum and poured it into the Chenab, irrigating 350,000 acres (161,640 ha) on its way. Chenab and the Ravi were then linked together by a second canal, the Upper Chenab, which irrigated another 650,000 acres (263,046 ha) in Gujranwala and Sheikhupura. Finally, the water that remained was carried across the Ravi by a level-crossing—barrage, 550 yards (503 m) long, which was flung across the river, and the third canal, the Lower Bari Doab, took it another 134 miles (216 km) through Montgomery into the heart of Multan. The Lower Bari Doab Canal Colony, the Montgomery Bar, the third of the great colonies, was the result.

THE LAND BEFORE COLONIZATION

What was the condition of land in the Bars before colonization? Its wide open spaces lay desolate and sparsely inhabited by nomads. It was undoubtedly the ugliest and dreariest part of India. Geoffrey, F. de Montmorency, who was Deputy Commissioner of Lyallpur, and had seen it before colonization, provides a graphic account.

"*The Sandal Bar*, from which the colony was framed, consisted of a vast rolling plain or upland lying between the Chenab and Ravi riverains. It was situated in the districts of Gujranwala, Lahore, Jhang, Montgomery and Multan. Its characteristic was its extreme flatness, with a gentle slope from the north-east to the south-west. At its highest point it is 670 feet (204 m) above sea-level and at its lowest 489 feet (149 m). The surface of the plain was almost entirely unbroken. At Sangla there is a group of rock hills, an outlying isolated spur of the Aravalli range, and there are two old river beds of unknown antiquity which run through the Bar for many miles. On the borders of these, some old mounds with broken potsherds and bricks testified to some past period of inhabitation and civilization. These were, however, the only accidents which relieved the intense monotony of the flatness of the plain. The tract was one of intense heat. In the interior of the Bar the rainfall in pre-colony days was seldom more than 4 inches (10 cm) and often much less. In the centre of the Bar the water level beneath the surface was 104 feet (31.7 m). The Botany of the Bar was not of a quality or variety which much relieved the intensity of the desert. The Bar was covered chiefly with three kinds of trees, growing mostly in clumps—the *Prosopis cineraria*, the *Salvadora oleoides* and the *Capparis decidua*, locally called the *jhand*, the *van* and the *karil*. An occasional *ber (Ziziphus mauritiana)* or *ukan (Tamarix aphylla)* relieved the sameness of the scene. Some variety was given by an occasional low bush of *malha (Ziziphus nummularia)* or *phog (Calligonum polygonoides)*. The jungle scrub varied in density towards the Ravi, and was in places too thick to force a horse through. In the southern part of the Bar the desolation and monotony increased; the sandy loamy soil with its occasional patches of clay and ample, if monotonous, scrub gave way to pure sand and sand-hills devoid of bushes and trees, and ornamented only with a few grey salsolaceous plants such as *Haloxylon recurvum* and *suoeda indiflora*. Trees here were so rare as to be known by distinctive local names and to be landmarks for miles in the desert. The Bar was the playground of the severest dust storms, rivalling those of the Rajputana desert. A dense dust haze often hung over the Bar for days together. Every tree and bush in the Bar with its stunted growth and gnarled, knotted limbs showed the fight which any living thing had to wage in that desert with a merciless sky. Small wonder that to the inhabitants of the rest of the Punjab, the Bar with its pathless, waterless expanse was a *terra incognita*, of which everyone stood in dread. The Bar had, however, its kindlier moods and its own folk. The loam had here and there depressions with pockets of clay into which the water of the surrounding expanse would flow after scanty rains. These depressions held water for many months together. The soil of the Bar was of such excellent quality and the accumulations of decayed leaves of the jungle scrub so vivifying that it needed but a slight shower of rain to restore to verdure the parched roots of the grasses with which the tract abounded. One shower and the Bar was transformed into a rolling plain of grasses—a thick mat of *Eleusine aegyptiaca*, *Sporobolus maderaspatanus*, *Cenchrus ciliaris*. *Dichanthium annulatum*, locally called *chimbar*, *keo* and *dhaman* grass, spread itself out. Gathered round these ponds, the Bar nomad tribes used to pasture their cattle on these grasses, and in years of any rainfall the Bar was a paradise for those who had flocks and herds. Living almost entirely on milk and wild berries, they reared fine cattle and lived on the profits and sale of young stock, clarified butter, hides and horns. Years of great scarcity would drive them to the riverains; but the true nomad grazier lived in the Bar all the year round. After a bad season he replenished his flock by liberal thefts from surrounding districts. Against this expert tracker and thief, living in a patriarchally governed tribe in the middle of the desert, those who lost cattle had no remedy and no hope. No young *jungli*, as the Bar nomads were called, could wear a puggaree till he had stolen some cattle successfully. The boy was brought up with cattle theft as his only career. If he delayed his first effort, his mother was ready to rebuke him with the jungli proverb; *machhi sande pungre jamde tarand* (fishes learn to swim as soon as they are hatched). Such was the Bar, a scene of extreme desolation and monotony. Those, however, who knew it in its pristine condition and know it now as the most successful agricultural paradise in the Punjab, must experience a pang of regret at the passing of a desert of peculiar natural fascination and the sudden transition from the life of the book of Genesis to the vulgar modernity of successful agricultural exploitation.

"It was, however, the very monotony of the Bar plain which made for its future success as a Canal colony. The level plain enabled the Irrigation Department to convey branches and major and minor distributaries without obstacle over an area which on the completion of the scheme will measure 6,073 square miles (15,729 km^2). The greater portion of the Bar was *maira* soil or a sandy loam, especially easy of tillage and adapted to canal irrigation. The only poor soils which existed in the Bar were the *kalarathi* or salt-impregnated and the *retli* or sandy soil, both of which in the hands of good colonists improved greatly under irrigation. The flatness of the surface enabled the surveyist to lay out the whole of the Bar in squares of 1,100 feet square (102 m^2) (about 28 acres or 11.3 ha), each of which was sub-divided into 25 sub-squares, each 220 feet by 220 feet (67 m$\times$67 m; just over one acre or 0.404 ha). A country laid out like a chess board, one of the dreams of "Alice through the looking glass", became a fact instead of a freak of the imagination. These squares formed the basis of the system on which the allotment of land was made. The sub-squares each became a separate field for cultivation and irrigational purposes. Every cultivator who received a full square would map out his agricultural programme for the year and divide up his land to tenants in details of sub-squares and would be entitled to water to mature a fixed number of sub-squares per square.

THE COLONISTS

"The Bar nomads scattered about the Bar were the only inhabitants. At a rough computation they numbered 50,000 at the start of irrigation in

1892. At the special census of the Chenab colony held in 1906, the population of the tract which had been the Sandal Bar numbered 857,829 souls. A few villages in the Bar were sold by public auction, but practically the whole of the land was given out to picked colonists. These colonists were of four kinds:

(a) Capitalists with more than five squares of land each
(b) Yeomen with three to five squares of land each
(c) Peasant colonists with $\frac{1}{2}$, 1 or 2 squares of land each
(d) Service grantees who held grants for the upkeep of camels or for breeding mules for transport purposes.

The capitalists were wealthy men or men who had rendered distinguished services to Government. The yeomen were usually men belonging to families of the more substantial squire or country gentleman class in the old districts. The peasants were men picked from the ranks of the cultivators themselves in the more congested parts of the Punjab. They included in their ranks the nomad graziers of the Bar who had been dispossessed of their grazing grounds. The peasant colonists form the great bulk of the settlers and some account of their selection may be interesting. This can hardly be better described than in the words in which Mr Grant, Settlement Officer of Amritsar, gave a description of his selections: "I used to find it convenient to halt a day at the village and the evening before to call up the headmen of the village to explain to them the terms on which land would be given. They were at the same time warned that any deceit or personation would be punished by my refusing to give any land to that village, and moving on to some other. They were told that they would be required to expose any deceit that might be attempted, and to name the men who were embarrassed by debt, and the bad characters. If, afterwards, it was found they failed to expose such, the whole list was liable to be cancelled. Then, they were sent to talk it over, until the next day, when all would-be settlers came up in a body. These I would first separate into *pattis*, and make the men of each patti sit in a long row, the fathers next their sons, and brothers next one another. Walking down the row, I could then easily see the men who were physically unsuitable. Many old dotards and mere boys would be brought up in the hope of thus securing an extra square for the family, though they had no intention of going and would do no good if they did. His colour would often betray the habitual opium-eater, and his general appearance (more specially his hands) the *shaukin* and the *jawan* who had been in the army or in Burma, and who, cutting his name after a few years spent with a regiment, had come home to the village, but had never done a hand's turn of honest work behind the plough. Such men would never do any good in the Bar. A show of hands is a simple method for discovering the real workers among the community. Next, if any one family was represented by too many members, one or two of these would be weeded out amid loud protests. Sometimes, three generations would come forward headed by a hoary old grandfather, and try to secure six or seven squares between them. It was plain that they would not all go, and, even if they did, that their going would deprive some other family of relief; so they had to be thinned out. Then, with the patwari and the munshi at my elbow, and attended by the lambardar of the *patti*, I would go down the line and take down the names and the area of each man's share, his age, parentage, and *got*. This process would expose those who already had sufficient holdings or who had mortgaged a considerable share of their land, and these, too, were weeded out. The residue would be put down for a square each, with perhaps an extra square for the man who, by common consent, was named as the leading man of the *patti*—the bell-wether, whose lead all would follow. Thus, the original crowd of applicants would be reduced to a band of men all connected by common descent, all physically fit to take up a life in a new country under considerable difficulties, all hard up for land, but with sufficient resources to start them."[1]

"The result of the selection was a great company of people with everything which makes for agricultural success. The capitalists and yeomen were drawn from all quarters. They had most of them seen the world, were above the average in intelligence, and had the leisure, money and acres to try agricultural experiments, new methods and new crops. The peasant colonists who received the bulk of the land had every kind of agricultural tradition and experience. There were the market gardeners of Amritsar and Jullundur. There were the sturdy Jat Sikhs of the Ferozepore and Ludhiana uplands who had grown rain crops all their lives. There were the enervated and careless cultivators of the riverains used to raising crops by hasty ploughings and sowings on rich alluvial deposits. There were the submontane cultivators of Hoshiarpur and Gurdaspur used to heavy rainfall and intensive agriculture in a congested country. There were Amritsar and Lahore Jats with 13 or 14 years of experience of canal irrigation and cultivation on the Bari Doab Canal behind them. Lastly, there were the Bar nomads who had never held a plough in their hands or reaped an acre in their lives. There was plenty of variety in the elements. The *jungli* nomads had the whole lesson to learn, while the cultivators of various Punjab districts, who for years had known nothing but their own kinds of crops, their own agricultural implements and their own systems of tillage, could step into the next *chak* or colony village and see how their fellow farmers living at a distance of half the province away pursued the cult of Ceres."[2]

[1]*Colony Manual*, p. 94

[2]Montmorency, G.F.D. The Chenab Canal Colony, *Agric. J. of India*, III, iii, pp. 196-201

COLONISTS

The best of the colonists were the Sikh Jats from Ludhiana, Jullundur, and Amritsar. 'They represent the flower of Indian agriculture', observed Malcolm Darling. 'It would be difficult to say which of the three has produced the best type; for industry and thrift, the Ludhiana Sikh is hard to beat, and the Sikh from Amritsar, though he may be spendthrift and violent, is unsurpassed as a cultivator. Grit, skill in farming, and a fine physique are characteristics common to all, and in his new environment the Jat Sikh has reached a point of development probably beyond anything else of the kind in India. In less than a generation he has made the wilderness blossom like the rose. It is as if the energy of the virgin soil of the Bar had passed into his veins and made him almost a part of the forces of nature which he has conquered.'[3]

HOW THE COLONISTS CAME TO LYALLPUR

Here is an account of colonization of Lyallpur Colony by a farmer who belonged to village Gill in Ludhiana District.

'The land which is included in Lyallpur, Montgomery and Sheikhupura Districts was a dreary waste. It was known as *Dulle-di-bar* after Dulla Bhatti, a Moslem Rajput, who flourished during the reign of Akbar. In Robinhood style he used to loot Government treasure and rob the rich, and distribute the booty among the poor.

'When we migrated from my village Gill to Lyallpore Colony, in 1891, there was no railway link with Lyallpore. A caravan of bullock-cart started from my village. We had laden pulses, wheat flour, and our household goods in the bullock-cart. When we reached the *Chak* in which land had been allotted to us, we continued to live in our bullock-carts, for there were no houses. After some time we built mud-huts with thatched roofs. There was no lack of timber and we cut forest trees for making rafters for roofs of our houses. Our *Chak* was numbered 208 on Rakh branch of the canal. The Government gave us no particular help in our land reclamation work. We cut the jungle trees, levelled the land and made it fit for cultivation. There was no lack of water, and cotton and wheat, which we raised in our fields without applying manure, gave us bumper yield. This was on account of the stored fertility of the virgin soil.

'To start with, there were only four families from village Gill in *Chak* 208. When some of our family members returned to the ancestral village, dressed in clean clothes, more families were tempted to migrate. Slowly the colonists improved their houses. Along with jat families, barbers, carpenters, blacksmiths, water-carriers and Brahman priests also came to our *Chak*.

[3]Darling, M.L. *The Punjab Peasant in Prosperity and Debt*, p. 123

Entertainment

'In due course parties of singers and dancers also came to entertain us. They were called *jālse-wālās*, and were given board and lodging by the village beaus. As women were not allowed on the stage, boys used to dress in female attire. One of the boys dressed in female clothes would appear on the stage with his face covered with a veil. The person among the audience who was selected to lift the veil had to present a rupee coin to him. This fee was called *ghund-chukai*. The *jalsa* party would not accept donations in excess of a rupee coin. If a jat under the influence of alcohol gave six or seven rupees, they would keep only one rupee and return the rest. They would announce the name of the generous donor and would exclaim, 'Your single rupee is equal to a lac, keep the rest in your pocket'. Occasionally, an affluent jat would throw a bag of coins on the stage under the influence of a heavy dose of spirits. The dance party would take out a rupee coin from the bag and return the rest. They would also announce, 'Budh Singh gave a silver coin, which was sent by the *mem* from London'. The rupee coins of that age had an effigy of Queen Victoria embossed on one side. For the villagers, she was the *mem* from London. Apart from these song and dance parties, acrobats *(bazigars)* and wrestlers also used to come to the village to entertain us. There was also a poet in our village, Dyal Singh by name, who used to recite a ballad, narrating how the Bar was colonized. In this ballad he used to praise a British Officer, Mr Young, who had given him a square of land (25 acres or 10 ha).'[4]

These colonists in August 1947 on the partition of India, returned to their ancestral village, Gill in the same bullock carts in which they had migrated to the *Bar* about fifty years ago.

Crops

What crops were grown by the colonists in Lyallpur Canal Colony? Montmorency provides the following information.

'Wheat is the favourite colony crop. There are five European exporting firms in Lyallpur who spend their whole time in buying and exporting colony wheat. A vast agglomeration of grain at a colony station or colony market in the wheat season after the harvest is a sight to see. There are a number of Lyallpur wheats which have been introduced by various colonists. The most popular of all is the 'Lal Kasarwali Chitti', a bearded wheat with a red ear and white grain. This has all the virtues; it commands a good market price; succeeds in most seasons, does not require too much water, has a strong straw and does not shell too quickly on maturity. It keeps well and is comparatively safe from weevils. Originally unknown to many

[4]This account was given to S. Mangal Singh Gill, who was then Member of the Central Legislative Assembly, and published in *Ajeet*, Punjabi daily, Jullundur, 20 September 1980

colonists and in general use only by the colonists from the Central Punjab, it has now become the chief wheat for general growth and sale. Australian wheat No. 27, introduced by the Agricultural Department, is also growing in popularity. For personal use the colonists each grow a little 'Goni' or a little 'Vadhanak' wheat. The former is a beardless wheat with weak straw. It is much preyed on by birds and falls down if the winds are strong at the time of changing colour. It also shells rapidly on maturity. 'Vadhanak' is a heavy, tall wheat. It requires more water than any class of wheat in the colony and is much damaged by its weight if there are rains or winds at harvest time.

"Cotton was an extraordinary crop on the virgin soil of the Bar when it first came under irrigation. On quite new land, with hardly any preparation, cotton in the colony used to produce 10 to 15 maunds to the acre (922 to 1,383 kg/ha) commonly. Colonists brought with them several kinds of short-stapled cotton, and owing to the fine profits which they made from the crop, they were not slow in experimenting with new kinds. The best of the local kinds have proved to be the Hissar cotton and the red-flowered Multan cotton. Grantees select seed of these two cottons, and after a few harvests return to the parent districts for their seed to avoid the deterioration. Khaki-coloured cotton, Spence's cotton, American cotton, hybrid American and Egyptian and Assam cottons have been tried. The Assam cotton (the Garo hill variety) is doing well and seems similar in nature and requirements to the Hissar cotton on which it is an improvement. Egyptian cottons have been a failure. The bolls form too late and their complete expansion is checked by early frosts. American cotton has paid some of its devotees, but is undoubtedly more delicate than native varieties. Some colonists are persevering with Spence's tree cotton, but it has brought no lint to their mill as yet, and is alleged to act through the winter months as a hot case for the preservation of all the pests to which cotton is heir.

"*Toria (Brassica rapa* var. *napus)* is a curiously popular crop. The vast majority of grantees in their old homes sowed *sarson (Brassica rapa* var. *glauca)* and *taramira (Eruca sativa)* only and had never heard of this kind of oilseed.

Maize and millets grown in the *kharif* season are the chief food-grain crops of the people. They freely enter into rotation with wheat, oilseeds and cotton. The extending cultivation of sugarcane on many holdings of small individual areas is a marked sign of material agricultural progress. Iron-roller sugar mills are in common use and a good deal of capital per acre is invested in this crop.

"The miscellaneous crops are interesting. The Amritsar *Kambohs*, who are the best cultivators amongst the colonists, habitually grow one or two sub-squares of potatoes and roses. They have had many imitators in growing potatoes, but no one else has as yet followed in their wake in growing roses for *attar* of rose manufacture. One grantee has been most successful in the cultivation of turmeric on a large scale; this has been previously popularly supposed to be only successful as a submontane crop in the Punjab. *Sardas* (or the Kabuli melon) have been grown by a number of colonists with success when the Peshawar colonists had once shown the way. The Amritsar and Jullundur colonists introduced lucerne as a common fodder crop, and now, even in the squares of the Bar nomads, patches of this useful fodder and of *senji* (sweet-clover) may be seen. Turnips are extensively and successfully grown as cattle food. Many orchards have been started in the colony and orange-growing promises very well."[5]

Crops Without Manuring

A notable fact about the canal colonies of the Punjab was that wheat was grown year after year without manure, apparently without producing any diminution in the fertility of the soil. Judging from the dark green colour of the leaves and the general vegetative vigour of the crop, no nitrogenous manures seemed to be necessary. The question arose whence do the large wheat crops derive their nitrogenous manure? According to Sir Albert Howard the answer was to be found in the leguminous weeds which thrive so luxuriantly as a bottom growth in the wheat fields of the Punjab.

'There are three common leguminous weeds among others in the Punjab wheat fields: (1) yellow-flowered *senji* (*Melilotus indica*), (2) white-flowered *senji* (*Melilotus alba*), and (3) a creeping clover-like plant with curious curved pods (*Medicago denticulata*). These three plants also grow and seed freely on the banks of the water channels, and are very probably distributed by the irrigation water. In the wheat fields they ripen their seeds and dry up by the early part of April before the wheat is cut and thus give no trouble at harvest time. At flowering time in March their roots are covered with nodules. Their general vigour shows that they are admirably adapted for bottom growth with wheat.

'It would appear, therefore, that these weeds confer on the soil of some of the irrigated wheat lands of the Punjab all the benefits of a leguminous rotation and supply the nitrogenous manure required by the wheat crop. In this respect the wheat growers of the Punjab seem to be especially favoured by circumstances as they are able to obtain all the benefits of leguminous crops without the diminution of wheat output entailed in the usual rotations practised on wheat lands in other part of India.'[6]

Decrease in Well Irrigation

The area irrigated from wells in the Punjab decreased steadily on

[5]Montmorency, G.F. De. *The Chenab Canal Colony*, pp. 202-205
[6]Howard, L.E. *Sir Albert Howard in India*, p. 59

account of the extension of canal irrigation to tracts formerly dependent on wells. It amounted to 4.6 million acres (1.86 million ha) in 1868-69, 3.8 million acres (1.54 million ha) in 1918-19 and about 3½ million acres (1.42 million ha) in 1926-27. The explanation lies in the fact that the cost of irrigation from canals is less as compared with that from wells. The figures given by the Agricultural Commission were Rs 3-8 per acre (Rs 7 to 20 per ha) for canal irrigation and Rs 22 per acre (Rs 54/ha) for irrigation from a well. In view of such a large difference in cost, it was not surprising that wells were superseded by canals as the source of water supply in the areas served by the canals.

Water-logging

Irrigation is not an unmixed blessing. Water-logging and salinity closely follow. The area thrown out of cultivation in the Punjab by the rise of sub-soil water to the ground surface was about 125,000 acres (50,586 ha) in 1926. The *Punjab Administration Report* for 1926-27 stated that there was danger of expansion of water-logging to the extent of 700,000 acres (283,685 ha) more. Roughly, the area water-logged and which was seriously threatened by water-logging in the near future, was about 8 per cent of the area receiving state irrigation in the Punjab. The districts affected were Sheikhupura, Gujranwala, Karnal, Ambala, Amritsar, Lahore, Sialkot, Shahpur and Jhung (Chiniot *tehsil*). Water-logging was spreading in Lahore, and it was severe in Sheikhupura and Gujranwala.[7]

Agricultural Development

One of the objects before officials who were interested in rural development was 'to create villages of a type superior in comfort and civilization to anything which had previously existed in the Punjab'. Upon this basis arose the Lyallpur colony, which now embraces 2½ million acres (1.01 million ha). Subsequently, another object appeared. The South African War brought the needs of the army vividly to the fore. It was feared that if ever India became involved in a great war, the supply of horse, mule, and camel might fail. Accordingly, it was proposed that land should be given to those who would undertake to maintain mares or camels for breeding purposes. This object has been dominant in Shahpur and Montgomery, and in the former over 200,000 acres (80,937 ha) have been given out on horse-breeding conditions. Laterly, the conditional grant has been further developed, and it is now applied to the most heterogeneous schemes, 'each devoted to one object dear to the heart of some particular department of Government.' Lands have

[7]Brij Narain, *Indian Economic Life—Past and Present*, pp. 383, 384

been given for the growth of selected seed, for the breeding of special strains of cattle, for the supply of cantonments with milk or butter, for plantations and experiments in fruit farming, and even for the introduction of steam ploughs. The modern colony, therefore, is made not only to serve the primary needs of life, but also to supply the requirements of the army, and to develop a higher standard of agriculture.[8]

Economics of Farming in the Canal Colonies

The Punjab Board of Economic Enquiry made an investigation in the economics of farming in the canal colonies of West Punjab. In Nili Bar Colony (District Montgomery), the *murabba* (square) was of 25 acres (10 ha). The gross income was Rs 950/14/11, expenditure Rs 414/3/8 and net income Rs 536/11/3. The per acre gross income was Rs 38/0/7, expenditure Rs 16/9/1 and net income Rs 21/7/6 (approximately Rs 53.12/ha). Expenditure included family labour of two workers. Details are given in Appendix I.

The Lower Chenab Canal Colony, the *murabba* (square) was of 28 acres (11.3 ha). This was the average holding. The economics of a *murabba* with two family workers and one hired worker was slightly better. Price per *maund* of forty seers was Rs 2/9/0, American cotton, *kapas* Rs 9/5, *gur* Rs 5/3 and maize Rs 2/8. Gross income came to Rs 1250/8/7, expenditure Rs 726/3/11, and net income Rs 324/4/8. Per acre net income was Rs 18/11/7 (approximately Rs 46.33/ha).

As regards wages, a permanent worker was paid Rs 60 per annum in cash plus food or 12 *maunds* of wheat. Including this his emoluments came to Rs 90/12/0 per annum.

Details of Farm Accounts are provided in Appendix I.

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[8]Darling, M.L. *The Punjab Peasant in Prosperity and Debt*, pp. 121, 122

APPENDIX I

Income and Expenditure of a one rectangle farm in the Nili Bar Canal Colony

AREA HELD	..	25 ACRES
INTENSITY OF CROPPING	..	72 PER CENT
PERMANENT FAMILY WORKERS	..	2
PERMANENT HIRED WORKERS	..	NIL

GROSS INCOME

Crop		Area	Product	Yield per acre	Total yield	Price per *maund*			Value		
		Acres		Mds	Mds	Rs	a.	p.	Rs	a.	p.
Wheat	..	8.0	Grain	12.9	100.8	2	9	0	258	4	10
			Bhusa	19.0	152.0	0	7	0	66	8	0
Cotton American		5.5	*Kapas*	8.7	47.9	9	5	0	446	1	1
			Sticks	..	..	1	0	0	5	8	0
Cotton *desi*		0.5	*Kapas*	7.3	3.7	8	2	0	30	1	0
			Sticks	..	..	1	0	0	0	8	0
Kharif Fodders	..	2.0	..	..	..	32	0	0	64	0	0
Rabi Fodders		2.0	..	..	..	40	0	0	80	0	0
		18.0							950	14	11

EXPENDITURE

1 *Manual labour hired*		Rs	a.	p.	Rs	a.	p.
(a) Permanent—nil							
(b) Casual							
Harvesting wheat 6 acres at 4 bundles per acre= 24 bundles, each bundle at Rs 1/4/7 each	..	30	14	0			
Winnowing 92 *maunds* wheat at 2 *seers* per *maund*= 4.6 *maunds* at Rs 2/9/0 per *maund*	..	11	12	7			
		42	10	7			
Cotton picking 1/10th share American *kapas* 4.8 *maunds* at Rs 9/5/0 per *maund* ..	..	41	14	6			
Desi kapas 0.4 *maund* at Rs 8/2/0 per *maund*		3	4	0			
Miscellaneous ..	..	2	0	0			
					89	13	1
2 *Bullock labour*							
Roughages consumed by all stock							
Wheat *bhusa* 130 *maunds* at As. 7 per *maund*		56	14	0			
Green fodders		144	0	0			
	Total	200	14	0			

	Rs	a.	p.	Rs	a.	p.
Total stock on the farm=6						
Bullocks =2			..			
Bullocks' share of roughages 1/3	66	15	4			
Concentrates 10 *maunds* at Rs 3 per *maund* ..	30	0	0			
Salt 10 *seers* at Rs 2/8/0 per *maund*	0	10	0			
Miscellaneous feeds	2	0	0			
Interest at 4 per cent and depreciation at 12 per cent on Rs 150	24	0	0			
Miscellaneous expenses	5	0	0			
				128	9	4
Seeds						
Wheat	13	3	2			
Cotton American	1	10	5			
Cotton *desi* ..	0	1	7			
Kharif fodders	3	0	0			
Rabi fodders	6	0	0			
.. ..				23	15	2
Implements						
Depreciation at 10 per cent on cart =Rs 100 ..	10	0	0			
At 20 per cent on fodder cutter =Rs 40	8	0	0			
Interest at 4 per cent on Rs 140	5	9	7			
Miscellaneous repairs and replacements ..	6	0	0			
				29	9	7
Artisans (Carpenter and Blacksmith)						
Wheat bundles 6 at Rs 1/4/7 each	7	11	6			
Wheat 2 *maunds* at Rs 2/9/0 per *maund*	5	2	0			
Cotton 4 *seers* at Rs 8/2/0 per *maund*	0	13	0			
Fodder 6 bundles at As. 3 each	1	2	0			
				14	12	6
Water Rates				55	8	0
Land Revenue				72	0	0
Total ..				414	3	8

SUMMARY

	Total Rs	a.	p.	Per Acre Rs	a.	p.
Gross Income	850	14	11	38	0	7
Expenditure	414	3	8	16	9	1
Net Income	536	11	3	21	7	6

Note : 1 acre = 0.404686 ha
1 maund (= 40 seers) = 37.324 kg
12 pies (p.) = 1 anna (a.)
16 annas (a.) = 1 rupee

**Farm Accounts in the Punjab*, Punjab Board of Economic Enquiry, 1944

CHAPTER 33

IRRIGATION SCHEMES IN PRINCELY STATES

MYSORE, HYDERABAD AND BIKANER, AND THE SARDA CANAL PROJECT IN U. P. 1911-1931

WHEN the benefits of canal irrigation in British India became apparent, interest arose for such projects in some princely States. The pioneer in this field was the Mysore State, which had a progressive administration and enjoyed enlightened leadership of an engineer and administrator, Sir M. Visvesvaraya (1861-1962). Born at the Village of Muddenahalli in the Mysore State, Visvesvaraya had a rural background. While working as an executive engineer in Poona, he devised automatic sluice-gates for the Khadakvasla Dam in 1903. He also designed the Block System of irrigation in Poona in 1903. The object of the system was to distribute the benefits of an irrigation work over a larger number of villages and to concentrate the irrigation in each village within blocks of specified units and in selected soils and situations. The total area of the blocks in each village had to be large enough to enable everyone who was able to grow an irrigated crop to have a share, but not too large a share to constitute a surfeit or lead cultivators to neglect the advantages of water-supply in good seasons as was being done.

THE KRISHNARAJA SAGAR DAM PROJECT, 1911-1931

As the Chief Engineer of the Mysore State and later on as Diwan, Visvesvaraya made a plan in November 1909 for the Kannambadi Dam, later named the Krishnaraja Sagar Dam (after the ruler of Mysore, Krishnaraja Wadeyer IV). It was constructed at the Village of Kannambadi to harness the waters of the Cauvery for irrigation and electric power. This masonry dam is 124 feet (38 metres) high and stores 48,000 million cubic feet (about 1,360 million cubic metres) of water which irrigates 150,000 acres (about 60,700 hectares) and generates power to the extent of 80,000 hp (60,000 kW).

This dam was constructed below the confluence of three rivers, viz. the Cauvery, the Hemavathi and the Lakshmanatirtha. The dam is 8,600 ft (2,621 m) long, with a maximum height of 140 ft (42.7 m) above the foundations. The live storage capacity of the dam is 44,827 million cu. ft (1,273 million m^3). The profile of the dam is non-overflow gravity type and it is built in random rubble stone masonry in *surkhi* mortar, the facing being built of roughly dressed granite.

The construction of the dam was delayed a great deal on account of a dispute which arose between the Mysore and Madras governments regarding the sharing of the Cauvery waters. The dispute dragged on for several years. The final agreement between the two governments was reached in 1924 and the works were completed by 1931.

Two canals take off from the reservoir. The North-Bank High-level Canal is known as the Visvesvaraya Canal. It was originally known as the Irwin Canal. It draws supplies from the reservoir through three vents, 6 ft × 12 ft (1.8 m × 3.6 m) with their sill level 60 ft (18.3 m) above the bed of the reservoir. Its full supply discharge is 2,200 cusecs (62.2 cumecs) and it is designed to irrigate 120,000 acres (48,564 hectares). The Right-Bank Low-Level Canal is a small channel, designed to irrigate only 3,500 acres (1,416 hectares). It is fed by a vent, 6 ft × 8 ft (1.8 m × 2.4 m), located 60 ft (18.3 m) above the bed of the reservoir.

Immediately below the dam is the Brindavan Garden laid out in terraces with fountains and pools illuminated by multicoloured lights. This garden is a major tourist resort in Karnataka.

The Krishnaraja Sagar was the largest reservoir built in India till that date. To take the left bank of the Cauvery Canal through, a 2.8-km-long tunnel was bored through the hills—the largest irrigation canal tunnel, again in India.

It was a multipurpose project and a large number of industries came up as a result of the power-supply and the irrigation provided by the dam. The Mysore Sugar Mills were made possible only because of this project.

It was estimated that the cost of the scheme worked out at about 105 million rupees and the benefit to the population was Rs 150 million a year. The project brought an annual revenue of about Rs 15 million to the Government, i.e. a yield of nearly 15 per cent on the capital. It transformed the economy of the Mandya District. Visvesvaraya was pleased with the fact that every agriculturist near about Mandya owned an iron safe.[1]

The Nizamsagar Project, 1924-1931

The Nizamsagar Project is another large irrigation project executed by the Government of the former princely State of Hyderabad. The construction of the project was commenced in 1924 and was finished in 1931. The project comprises a dam across the River Manjira, a tributary of the River Godavari, in the Nizamabad District, and a canal carrying a full supply discharge of 3,400 cusecs (96.3 cumecs) at the head, for irrigating 275,000 acres (111,293 hectares) gross.

The total length of the dam is 12,800 ft (3,901 m), of which 7,500 ft (2,286 m) is built in stone masonry and the rest consists of earthen embank-

[1]Sitaramiah, V. *M. Visvesvaraya—Builders of Modern India*, New Delhi, 1971

ments faced with masonry. The maximum height of the masonry dam is 158 ft (48.1 m) above the deepest foundations and the live storage capacity of the reservoir is 25,600 million cu. ft (724.91 million m^3) of water. The water-spread of the Nizamsagar Reservoir is 48.50 sq. miles (125.6 km^2). Arrangements for creating a surplus storage of water at the dam are noteworthy, as they have been made to cope with a high flood of over 470,000 cusecs (13,309 cumecs). A major portion of the flood waters is disposed of through 28 automatic gates of 40 ft (12.2 m) span each and 15½ ft (4.6 m) high, 16 gates on the left flank and 12 on the right flank of the main dam. Besides these, there are 9 scouring sluices, each 8 ft × 15 ft (2.4 m × 4.5 m) and two free overall weirs 1,200 ft and 800 ft (365.7 m and 243.8 m) long.

The head regulator of the Canal is located in a detached saddle on the right flank. It consists of 11 gates, 8 ft (2.4 m) wide and 10½ ft (3.1 m) high.

The length of the main Canal and its branches is 756.5 miles (1,218 km).

The project was completed at a cost of Rs 39.178 million.[2]

THE GANG OR BIKANER CANAL, 1922-1927

The Gang Canal takes off from the River Sutlej at the Ferozepore Barrage on its left bank, just upstream of the head regulator of the Eastern Canal. This Canal was constructed to exclusively irrigate land in the princely State of Bikaner, now in the State of Rajasthan, on the initiatives of Maharaja Ganga Singh (1880-1943). As a young man of nineteen Ganga Singh had seen the suffering of his subjects in the famine of 1899, and hence felt the urgency of bringing water to Bikaner through a canal. The construction of the canal was started in December 1922 and it was opened on 26 October 1927. The main canal is 84 miles (135.1 km) in length and is lined throughout its length with hydraulic lime concrete at a cost of about 10 million of rupees. This expenditure was in addition to Rs two crores, the cost of digging and construction. The *kankar* (hydraulic limestone) for lining consists of a nodular limestone found in shallow deposits near the Bikaner Town. It was brought by a metre-gauge railway over a distance of nearly 243 miles (391 km) to the dump site. Here it was unloaded and passed through mechanically operated screeners, which separated out the dust and large *kankar* from the bulk of the material used for aggregate, which consisted of well-graded material up to 1½ inches (3.8 cm) in size. The oversize *kankar* was ground in ball-mills to provide the filler material called, for convenience, grit. Thus, all the ingredients of the concrete were obtained from one source, greatly simplifying the problems of supply. Concrete was mixed mechanically in one-cubic-yard (0.764 m^3) mixers and the mix found to be most suitable was: one part of lime, one part of grit and six parts of graded *kankar*. The thickness adopted for the lining in the bed and

[2]*Irrigation Development in India*

on the sides was 6 inches (15.2 cm). The lining of the canal was supposed to prevent absorption losses to the extent of 400 cusecs (11.3 cumecs).

It was the first large canal to be lined in India. It was constructed by the Punjab Government, whereas the distribution system was constructed by the Bikaner State Government. The concrete lining was meant to cut down absorption losses in the first 73 miles (117.4 km) of the main canal, which runs through the territory of the Punjab State. No irrigation in the Punjab is done from it in this long reach.

The head regulator of the canal consists of four bays of 20-ft (6.1-m) span each and the designed full-supply discharge at the head is 2,144 cusecs (60.7 cumecs). The bed width of the canal is 52 ft (15.8 m), and at the full-supply depth of 8 ft (2.4 m) its calculated capacity being 2,164 cusecs (61.3 cumecs).

The culturable commanded area of the canal is 0.70 million acres (283,290 hectares) and the gross area to be irrigated is 558,152 acres (225,885 hectares).[3]

Colonization of the Ganganagar Canal Colony

Though the land in the Ganganagar Canal Colony was sold at Rs 2,500 for a square of sixteen acres (6.5 ha), to be paid in instalments, the colonists, who were mostly farmers from the districts of Jullundur, Hoshiarpur and Amritsar in the Punjab, faced great difficulty in paying the instalments as the Great Depression of 1930 had ruined them. Wheat was selling at Rs 1½ per *maund* (Re 1 for-5 kg), and everywhere farmers were in distress and they could not even pay land revenue to the Government. At that time, I was in Chak 2 F.F.B. near Gaj Singh Nagar, looking after the development of the land which my father had purchased, and was also preparing for the ICS competitive examination. Maharaja Ganga Singh, accompanied by Lala Jai Gopal, Colonization Officer, came to Gaj Singh Nagar in his special saloon. A large number of Sikh colonists came to see him and told him to take back his land and to refund the purchase money. On getting a negative reply, they irreverently threw dust on the royal saloon.

At that time, there were no trees in that area. Along the irrigation channels the colonists planted castor, which, in a short period of six months, grew into small trees. On all sides, there were shifting sand-dunes, which could ruin cultivated land in a few days. Potable water-supply was from ponds, which were fed by the canal, and it was a potent source of infestation with guinea-worms (*narwa*). The worm usually came out from the muscles of the forearm of the victim, who would take a dose of ghee and worked on a hand-mill. As the ribbon-like worm emerged, it was coiled round a reel.

When there was a closure of the canal, a large number of fish were

[3] *Irrigation Development in India*, pp. 94, 97

stranded in the dried-up water-courses, providing a feast to the crows and kites.

The colonists, who also had land in the Canal Colonies of western Punjab, brought their tenants from their *chaks* in Lyallpur and Montgomery to cultivate the land. As there were no crops in the fields, the *zamindars* had to buy provisions for them from the *banias* who unscrupulously made false entries in their accounts. These dishonest dealings added to the woes of the colonists.

The first crop of wheat attracted herds of deer, which roamed about in the canal colony, and caused great damage. These animals were regarded as sacred by the *Bagaris*, the original inhabitants of Bikaner, and they protected them. The colonists were meat-eaters and had no compunction in shooting them and this sacrilege often resulted in fracas.

The colonists were unwelcome intruders into the homeland of the *Bagaris*. When they saw their distress, the *Bagaris* used to say, 'They will all go back'. The colonists, however, persevered, and when the prices of cotton and wheat recovered, they prospered and modernized their agriculture in 1966-67. Now the Ganganagar Canal Colony is a Green Revolution area and has become the bread-basket of Rajasthan. It contributes 35 per cent of the foodgrains of Rajasthan and 50 per cent of cotton.

THE SARDA CANAL, U.P., 1915-1926

The Sarda Canal Project in the United Provinces of Agra and Oudh was taken in hand in 1915 during the Viceroyalty of Lord Hardinge of Penshurst. It was completed in 1926. The project consists of two parts, the Sarda Canal proper, with a discharge of 8,000 cusecs (226.5 cumecs), and the Sarda Kichha Feeder, having a discharge of 1,500 cusecs (42.5 cumecs), and takes off from the main canal near its seventh mile (11th kilometre).

The Sarda Canal irrigates the north-western districts of Uttar Pradesh, whereas the feeder supplies are used to irrigate areas under the command of the old Rohilkhand Canals.

The headworks are situated upon the Sarda River, a few miles below the point where it debouches from the hills. At this place, the river forms the boundary between India and Nepal. At the time of the construction of the headworks, the Nepal Government exchanged with the Government of India a small bit of territory, so as to permit the left abutment of the weir and the left-bank works to be located within the Indian territory.

The weir is 2,000 ft (609.6 m) long and the undersluices have a length of 240 ft (73.2 m). The undersluices are designed to negotiate a maximum discharge of 400,000 cusecs (11,327 cumecs).

The alignment of the Sarda Kichha Feeder was radically modified after the project was sanctioned. The feeder channel has been carried only up to the first river crossed, viz. the Lohia, and from there it follows the river course until it meets the main drainage line of the tract, viz. the Deoha River, from which water is again picked up and carried westwards. This alignment obviates a large number of cross-drainage works which would otherwise have been necessary.

The designed head discharge of the main canal is 9,500 cusecs (269 cumecs) and the gross area to be irrigated is 1.1 million acres (0.44 million hectares). The total length of the main canal and branches is 1,164 miles (1,873 km). The project yields about 7.5 per cent on the capital outlay.[4]

[4]*Irrigation Development in India*, p 85

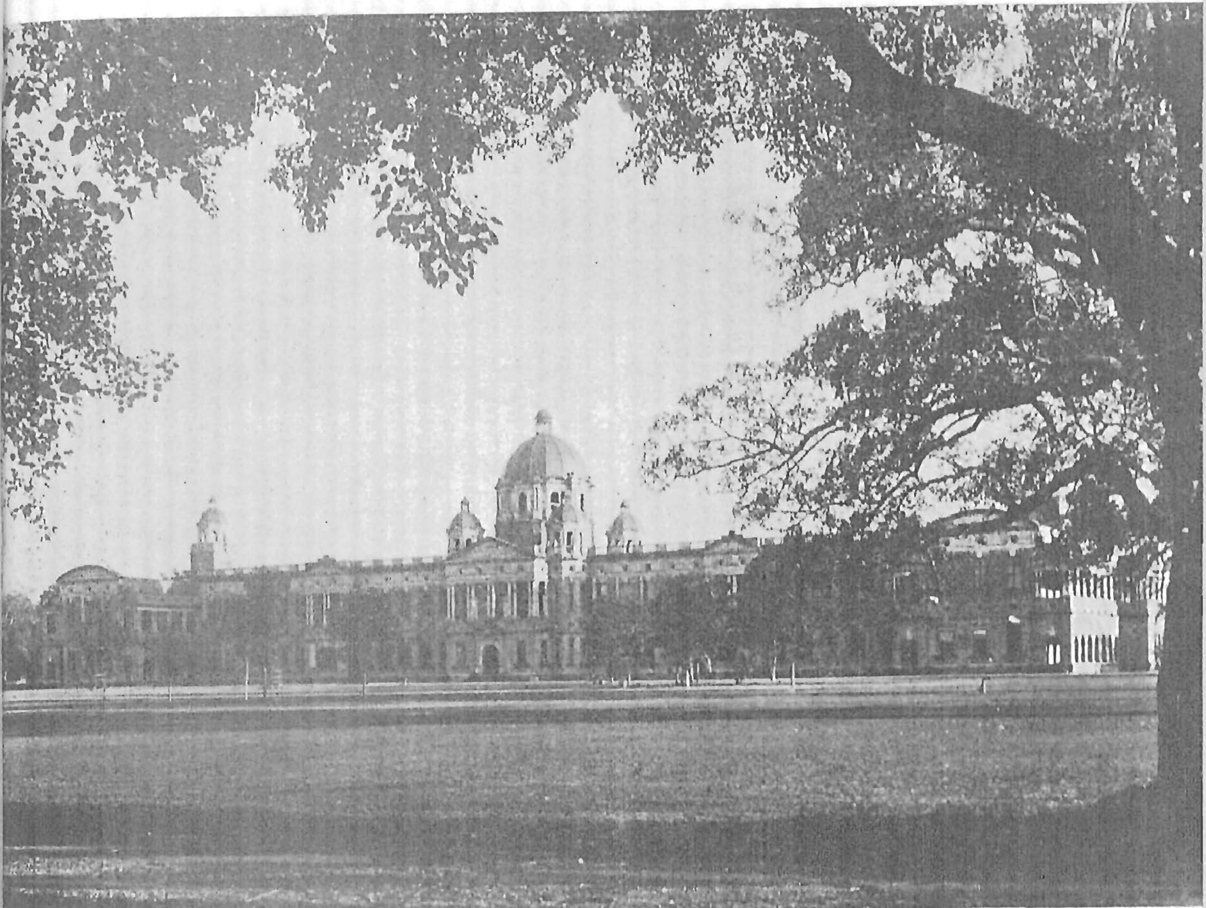


FIG. 51. The building of the Imperial Agricultural Research Institute at Pusa, named after the American philanthropist Henry Phipps. It was destroyed by an earthquake in 1934

FIG. 52. Sir Albert Howard (1873 to 1947). He promoted organic farming, particularly the composting of farmyard refuse and animal wastes. He discovered the role of mycorrhiza in the root-system of fruit-trees. He also selected and bred new varieties of wheat

CHAPTER 34

PIONEERS IN AGRICULTURAL RESEARCH

SIR ALBERT HOWARD, 1905-1924

IMPORTANCE OF SOIL AERATION AND ORGANIC MANURES

STUDY OF ROOTS AND ROOT-SYSTEMS OF FRUIT-PLANTS

GREEN-MANURING AND COMPOSTING OF PLANT AND ANIMAL WASTES

THE Imperial Agricultural Research Institute was founded in 1905 at the Village of Pusa in Bihar on a government estate. A magnificent building was constructed, and was named Phipps' Laboratory, after the American donor (Fig. 51). It was a location uncommonly isolated and to which access was most inconvenient and awkward, but it provided isolation which is no doubt conducive to serious thought and research. With the establishment of the Institute, five sections were started, viz. Chemistry, Agriculture, Cattle Breeding, Economic Botany, Entomology and Mycology. The Institute attracted five brilliant young British scientists, viz. Albert Howard, Edwin John Butler, Harold Maxwell Lefroy, Thomas Bainbrigge Fletcher and John Walter Leather.

Albert Howard (1873 to 1947) came from an English farming family of high reputation. He had a brilliant academic career at the Royal College of Science, London, and St John's College at Cambridge. From 1899 to 1902, he was Mycologist and Agricultural Lecturer, Imperial Department of Agriculture for the West Indies. In 1905, he was appointed Imperial Economic Botanist at the IARI, Pusa. He made outstanding contribution to the selection of wheat strains, known as Pusa wheats, to soil studies in relation to the root-systems of crop plants, and he pointed out the importance of organic manures, composts and green-manuring. His work proved that the quality of leadership in agricultural research was as important as in other fields of human endeavour, and all notable advances were initiated by individuals and not by the systems of organization. In fact, this statement applies to creative work of every kind. In 1914, Howard took a leading part in founding the Indian Science Congress, of which he was elected President in 1926.

THE STUDY OF ROOTS AND ROOT-SYSTEMS

It is through the roots that a plant draws nutrients from the soil. Some crop plants have deep roots and some have shallow roots. From what level of soil does the plant draw its nutrients? In agricultural research in India so far, no attention had been paid to study the root-systems of plants. Howard was the pioneer in this work. He made it a habit to carefully examine the roots of all crops on which he was working. In the case of deep-rooted fruit-trees, e.g. the mango, the roots were exposed from 10 to 40 feet (3 to 12 m) below ground by careful washing.

Howard pointed out that the most important aspect of the physical condition of the soil was that connected with the air in the soil. It was on the vital question of introducing air into the soil for the use of the plant that his interest was focussed. In other words, the physical aspects of soil texture were only a bridge to the biological aspect, i.e. to the needs of the growing plant in its call on the gaseous contents of the soil as material for its life processes. The plant rootlets are in a permanent need of the oxygen dissolved in the film of water coating the loose soil particles, and this is lost if there is not plenty of crumb structure creating the pore space; without such a supply, the rootlets cannot breathe and the plant perishes.

All living plant cells respire just as animals do, and, in the process, use up oxygen and produce carbon dioxide as a waste product. Air is therefore necessary for that part of the plant, the root-system, which is below ground. This fact is well known, but the importance of continuous gaseous interchange between the soil and the atmosphere during the growth of the crop is not always sufficiently recognized. This is particularly the case in India, where water is so often all important and a frequent limiting factor in crop production. The necessity for irrigation, the attention paid to dry-farming methods and to water conservation, all tend to concentrate the attention of the investigator on questions relating to water and, at the same time, to obscure the importance of the air-supply of the roots.

Howard further observed that all trees had a double root-system; this was later confirmed in the case of 15 species of forest-trees also. Thus the effect of grass on these trees was to kill them by cutting off the air-supply. Only those trees which could successfully force their surface roots upwards to penetrate the grass cover and reach the air survived; these trees flourished. Such trees included, among the fruit-trees, none but the guava (Fig. 53). This observation explains why the pastures of Grenda and St Vincent in the West Indies are so rapidly invaded and destroyed by the wild guava, a fact observed by Howard at the outset of his research career.

To demonstrate the asphyxiating effect of grass on fruit-trees, Howard started an interesting experiment at Pusa. Six trees were chosen, viz. plum, custard-apple, mango, guava, litchi, and loquat. A beginning was made by noting the inevitable competition in wild nature between trees and grass, in which the trees so often win and spread over the pastures to become the ultimate succession.

Nevertheless, there were occasions when grass was able to oust certain kinds of trees. In order to master the facts of the competition, the trees chosen were treated in three ways: (a) clean-cultivated, (b) completely grassed over, and (c) grassed over, but subsequently given aeration trenches.

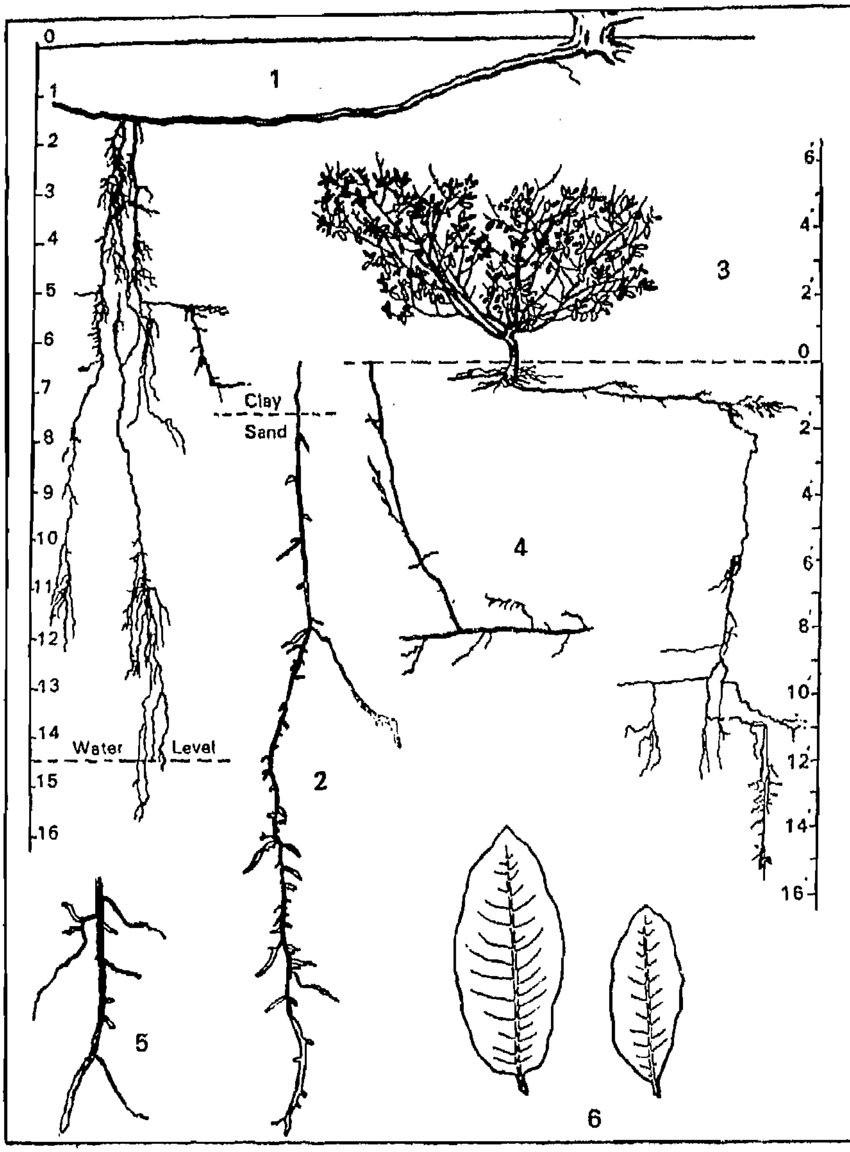


FIG. 53. The root-system of guava and effect of grass on the size of leaves. (1) Guava has superficial and deep roots. When the ground-water rises during the monsoon the superficial roots function actively. In dry months the deep roots provide water and nutrients to the plant. Superficial and deep roots (23 November 1921). (2) The influence of soil texture on the formation of the rootlets (29 March 1921). (3) The root-system under grass (21 April 1921). (4) Superficial rootlets growing to the surface (28 August 1921). (5) Formation of new rootlets in fine sand following the fall of the ground water (20 November 1921). (6) Reduction in the size of leaves (right) after 20 months under grass
(Courtesy: After Sir Albert Howard)

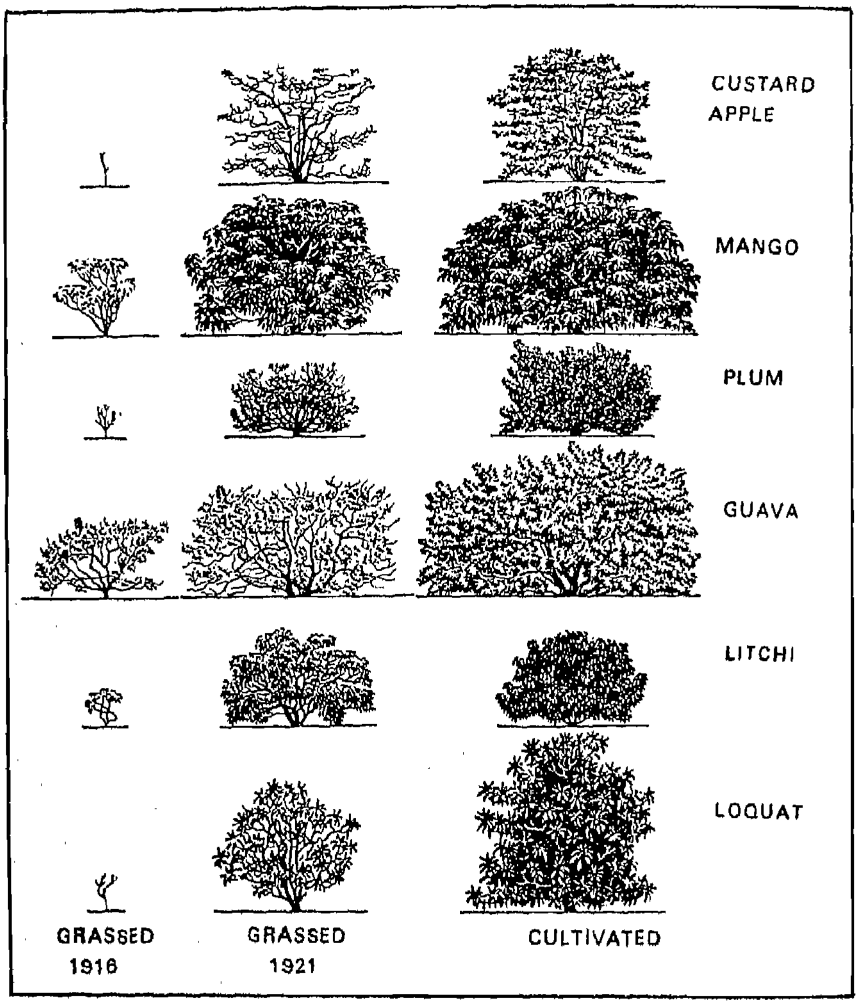


FIG. 54. The harmful effect of grass on fruit trees. Custard-apple, plum, loquat and litchi suffered most. But under clean cultivation all the trees flourished
(Courtesy; After Sir Albert Howard)

Those trees that were completely grassed over, if young, died—the custard apple within two years of sowing the grass (1916), then the loquats before the end of 1919, and the plums by the end of 1921. Those better established were just able to maintain themselves, the guava being by far the most resistant, though even this species was greatly checked in growth by the grass. But under clean cultivation, all the trees flourished (Fig. 54).

Cultivation of Fruit Gardens

This experiment conclusively demonstrated the need of cultivating fruit gardens. 'In India little attention was paid either to the tillage of fruit lands or to the best condition in which the surface should be maintained', observed Howard. 'Some of the fruit plantations in the country are under grass, others are to a large extent uncultivated, the surface being covered with weeds and grass. In some cases the trees are so closely planted that they form a dense overhead canopy like that of a forest, under which no surface growth is possible. Vegetables or bananas are generally grown between the young trees, the object of the cultivator being to take off the largest crop possible. It is not surprising that under these circumstances the fruit trees have a neglected, stunted, and half-starved appearance. In the older plantations, the thickly planted trees are drawn and spindly and often bear but few fruits. Cultivation is often restricted to one digging in the cold weather, while there is generally little or no cultivation or weeding during the monsoon. The tillage of fruit plantations such as is understood and practised in Europe and North America is still undreamt of in India. It is not surprising therefore that the produce of the average Indian fruit garden in the plains is so exceedingly poor.'[1]

For the irrigation of orchards, Howard suggested the replacement of the basins by shallow rings corresponding to the outer spread of the branches.

Deep-rooting Plants as Soil-aerators

Howard also noted that the Indian cultivators planted deep-rooting plants, which served as natural soil-aerators. He observed that some plants could act in this way by the thrusting nature of their root-systems, pigeonpea (*Cajanus cajan*) being one of the best examples. It was a well-known practice to grow before tobacco a crop requiring especially good aeration, and also usual to break up soured airless packed soil under rough grassland (*perti*) by means of a first crop of the sweet-potato, which managed to thrive in conditions which would choke other crops and whose swelling roots, acting 'like a mild explosive', shattered the soil for the next crop.

Termites as Soil-aerators

Termites are usually regarded as harmful. They are always attracted by old weed, which they rapidly devour. In addition to assisting the transformation of vegetable matter into humus, these insects were observed by Howard to be most useful as aerating agents and their systematic destruction, as is sometimes advocated, would, if successful, only lead to great loss to India.

[1]Howard, L.E. *Sir Albert Howard in India*, pp. 125, 126

Cracking of Black Soil as a Mechanism for Soil Aeration

The black soils expand during the monsoon into a jelly-like mass and begin to crack after drying. This goes on all through the cold season. Further contraction takes place during the hot months and deep, wide cracks are formed in all directions. *Rabi* crops obtain an abundance of air by this process and so great is the cracking that moisture is lost and roots are broken. Howard observed that the cracking of these soils in the hot weather, combined with the hot winds, is a perfect aerating method.

Breaking Crusts (*papri*) in Alluvial Soils for Soil Aeration

In alluvial soils of the Indo-Gangetic plain, a crust forms on the top of the soil after rain. The formation of such a crust interferes with the aeration of the roots and as soon as the air-supply in the soil is used up, growth stops. The presence of an excess of carbon dioxide round the roots seems to hasten the first steps of asphyxiation, which can be seen by a slow yellowing of the leaves. This is followed by a gradual wilting of the crop and the plants often die without setting seed. The moment the *papri* is broken and the gaseous interchange is renewed, there is an almost instantaneous effect. The leaves turn dark green and the arrested growth recommences. Howard noted that it was a common practice among the farmers in the northern region to break the crust by hoeing or ploughing.

Recent research has shown that operations which favour the stirring of the soil and consequent aeration result in a higher production of nitrates. The proper preparation of seedbed and regular interculture of the growing crops, thus, help to produce a better nitrate regime in the soil through the process of better soil aeration.[2]

Benefits of Mixed Cropping

Howard had respect for the Indian peasants, whom he named his professors. They had acquired an empiric knowledge of cultivation methods in the course of centuries of tradition and experience. He noticed that leguminous crops, such as chickpea and pulses, were often grown mixed with wheat. The wheat crop benefited from the nitrogen fixed by the bacteria in the nodules by the leguminous crops. He arranged an experiment in 1915 to test this observation. A field of wheat was sown, three lines of wheat separated by one line of chickpea, a pulse; the superior growth of the two outside lines of wheat which were next to the lines of gram was so marked that weighings of grain were made when harvest came round; the result showed that the outer lines of wheat gave a harvest 34 per cent higher than the inner lines.

[2]Agarwal, R.R. *Soil Fertility in India*, Bombay (1965), p. 31

Organic Matter

Scientists consider organic matter more a process rather than a substance in the soil. It becomes valuable as a fertility component only when it is in the process of decay. Organic matter in the soil, or humus, on decomposition, releases the plant nutrients, which are inorganic, e.g. nitrogen, phosphorus, sulphur and micronutrients, for the use of the growing crops. It is a potential source of nitrogen, phosphorus and sulphur, since it contains about 95 per cent of the total nitrogen and 5 to 10 per cent of the total phosphorus and sulphur present in the soil. In tropical soils, which primarily lack in nitrogen, it plays a valuable role in maintaining soil fertility, although phosphorus and sulphur are usually supplied as only a minor fraction of the total needs of the plants. In fact, we have a nitrogen cycle, a phosphorus cycle and a sulphur cycle in soils where the soil organic matter is one of the important focal points. Organic matter cannot, however, be directly used by plants, and it is wrong to maintain that it has any direct attribute in soil fertility. But, besides its contribution to the supply of some major plant nutrients, organic matter confers other useful benefits upon the soil and they help to maintain and augment soil fertility. It improves the physical properties of the soil, maintains its structure and promotes tilth.

Among the well-known organic manures are the farmyard manure and compost. Although there are experimental evidences to show that farmyard manure and compost owe their value to the amounts of plant nutrients they supply, these organic forms of manures also create a favourable physical regime in the soil and help the plants to obtain their moisture and air-supplies through the roots. Green-manuring can supplement these sources under many situations.

Baron Justus von Liebig, the famous German chemist, in his essay, 'Chemistry in Application to Agriculture and Physiology', stated a great truth that 'everything required by living plants was to be found in the mineral salts present in their ashes'. Liebig, however, did not realize that the plants required something more than mineral salts, viz. aeration, which they get if the soil is dug and compost applied. Every good Indian farmer realizes that hoeing and cultivation are as important for plants as the application of manure.

Role of Mycorrhizae in Plant Growth

The master idea that freedom from disease is secured by the living organism's natural capacity, if in good health, to repel attack, and its inevitable decline and defeat in the face of the bacterium, virus, fungus, or parasite, if any way weakened or out of condition, began to formulate itself in Howard's mind in the course of his first years of work in Barbados and at Wye College. 'A fertile soil, that is a soil teeming with healthy life in the shape of abundant microflora and microfauna, will bear healthy plants, and these when consumed by animals and man will confer health on animals and man. But an infertile soil, that is one lacking sufficient microbial, fungal, and other life, will pass on some form of deficiency to the plant, and such plant, in turn, will pass on some form of deficiency to animal and man.'

Howard further noted the role of mycorrhiza in plant growth. Mycorrhiza which literally means 'fungus-roots' have been known to exist for a long time. This term was first used by A. B. Frank, a German botanist, in 1885, to describe the association between non-pathogenic fungi and higher plants. A unique, highly specialized microbial root association is established with plant roots becoming infected with mycorrhizae. This relationship is intimate and balanced where the micro-organism obtains nourishment from the host without destroying or adversely affecting the functioning of the root-system and in several other circumstances the mycorrhizal infection is beneficial to the host.

In the majority of cases, the plant roots are greatly aided by mycorrhizae in obtaining water and nutrients from the soil. It is now conclusively known that the mycorrhizae affect the plant growth both in agricultural and horticultural crops. Experimental evidence shows that such a beneficial effect is more pronounced when the fruit-crops are grown under conditions of low soil fertility. Under such situations, the mycorrhizae help to mobilize the available nutrients in the marginal soils and produce a significant effect as compared with the fruit-plants grown in naturally fertile soils.

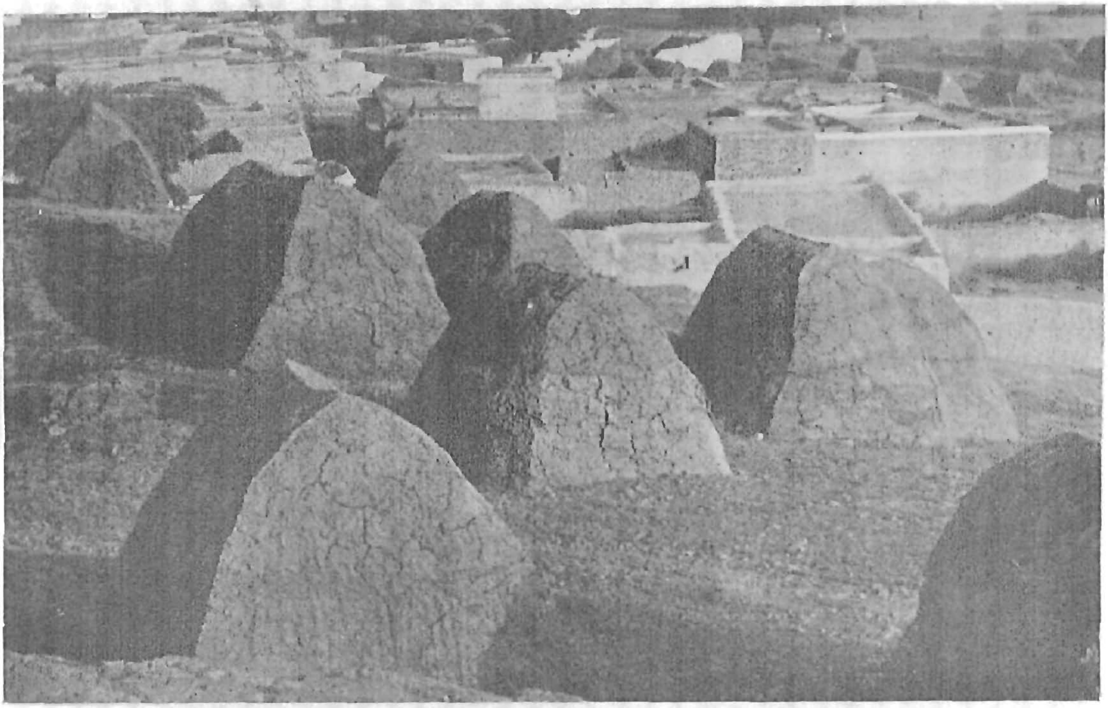
The mycorrhizae produce growth substances and vitamins for the use of the host plants. They also increase the resistance of the host plants to water stress. The most important practical role of mycorrhizae, however, is in plant nutrition, especially with respect to the uptake of phosphorus.

In addition to phosphorus, the mycorrhizae promote the uptake of many other essential elements such as zinc, copper, manangese, calcium and nitrogen. The role of mycorrhizae in plant nutrition is, therefore, to enable plants to better utilize less available forms of these nutrients.

Mycorrhizae have been demonstrated to be beneficial to several fruit-plants such as apples, peaches, citrus, strawberries and litchi. Generally, the fruit-plants do not make proper growth when replanted in soils cleared of old orchards even when they are chemically disinfected against pathogens. The introduction of mycorrhizae under such situations helps to establish healthy orchards.

Green-Manuring

As animal manure is insufficient in quantity, green-manuring is



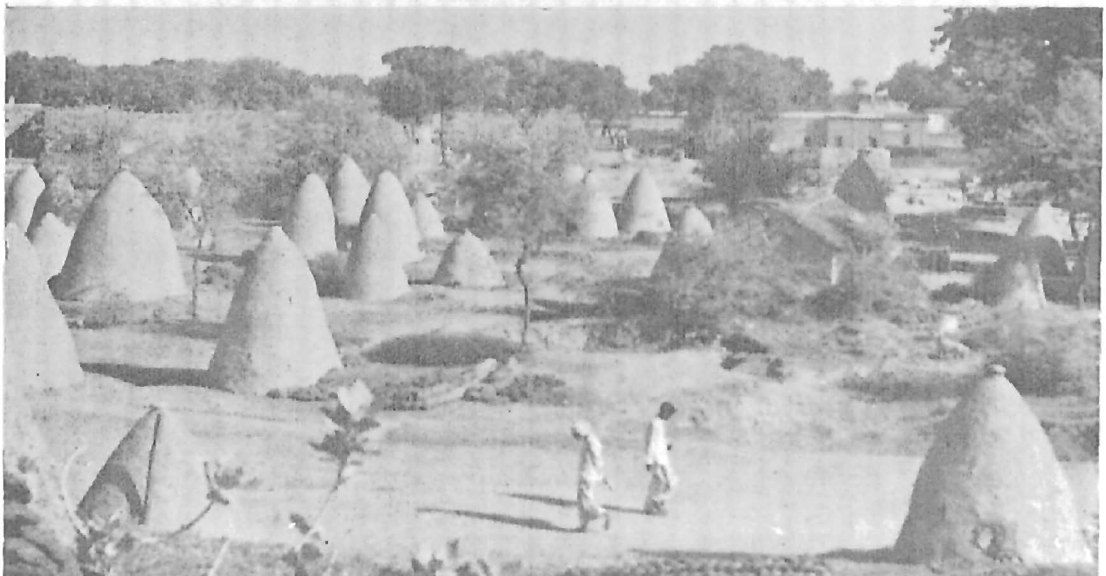


FIG. 55. Farmers know the value of cattle dung as a manure, but are compelled to burn it, because of the scarcity of fuel. In the cotton-growing and pigeonpea-growing areas stalks of cotton and pigeonpea supply the fuel. In other areas, quick-growing trees such as eucalyptus and sesbanea should be planted

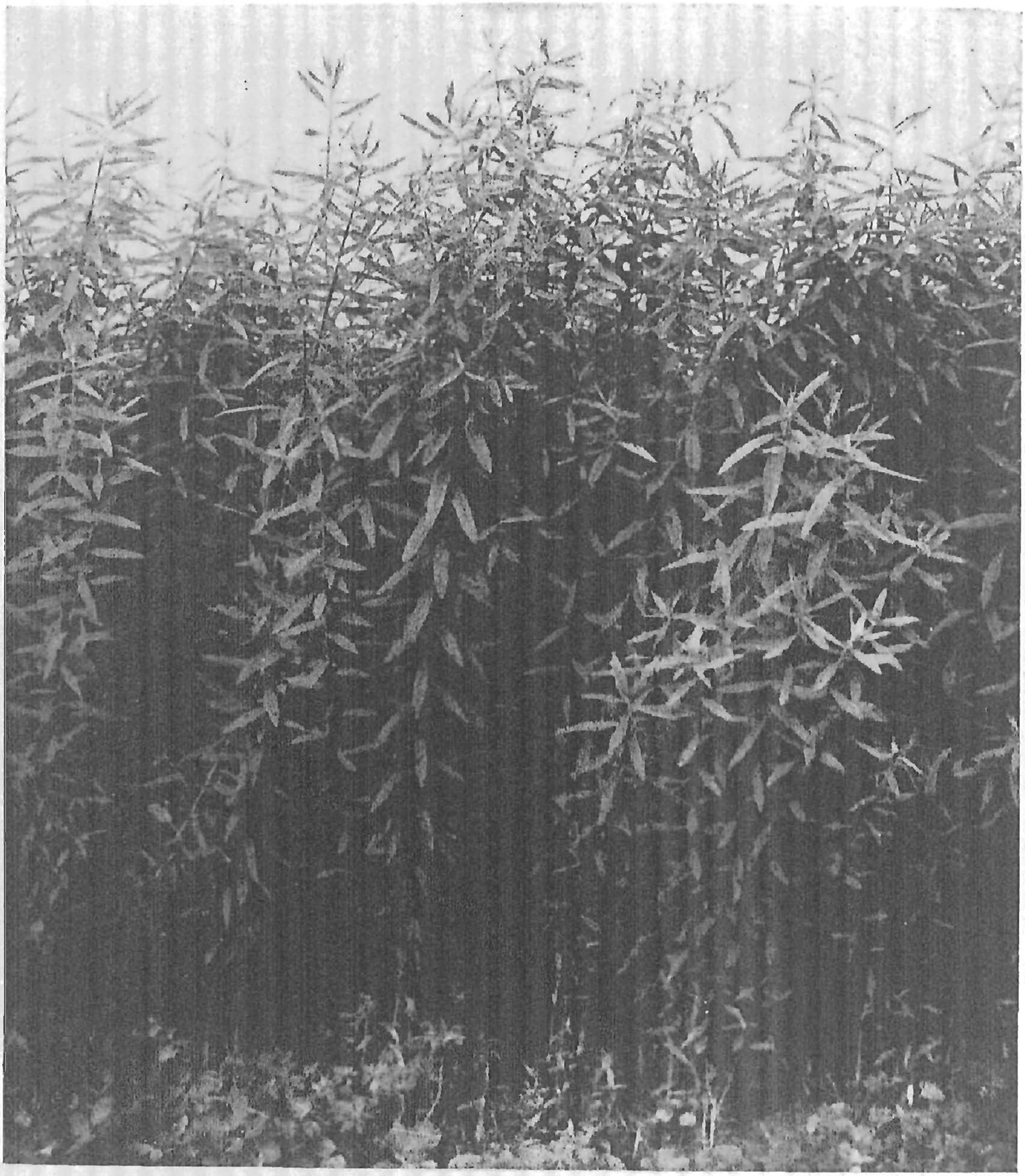


FIG. 56. Sunnhemp (*Crotalaria juncea*) is a popular green-manure crop all over India. Its roots bear nodules which contain the nitrogen-fixing bacteria

important in India. In 1889, Voelcker noted that the practice of green-manuring was widely practised in some areas. He states, '*San (Crotalaria juncea)* is the crop most generally ploughed in (Fig. 56), indigo is another; mustard is occasionally used; and frequently on rice fields the weeds are allowed to grow, and then turned in to act as manure. In Lohardaga the favourite green crop is *sawan*, a wild form of *Panicum miliaceum*; it is often grown with rice, and after the rice has been harvested, the green crop is turned in the soil and buried. Green-manuring is well understood in some parts; for example, in Gujarat (Bombay Presidency). It is also practised in Hoshiarpur (Punjab), Burdwan, Hooghly, Chota Nagpur, Poona, and parts of Khandesh. *San* ploughed in as a green crop, in preparation for sugarcane, is the usual form of green-manuring.

'Over a large part of Madras, the spreading of wild shrubs, such as wild indigo *(Wrightia tinctoria)*, *madar (Calotropis gigantea)*, *avarai (Cassia auriculata)*, *kolinji (Tephrosia purpurea)*, convolvulus, and the shoots and leaves of *Pongamia pinnata* and other trees is much used on "wet" lands, principally on rice fields. The shrubs and leaves are spread green on the fields, and then trodden in by feet. At Hospet, which is served by a canal, led by a weir or *anicut* from the River Tungabhadra, and where the cultivation is exceptionally good, I saw this plan of green-manuring being carried out. Trees are grown round every field and along the banks of the water-channels, and are defoliated once in three years; the twigs and leaves are spread on the land where rice is to be sown; canal water is let in, and the twigs are trodden into the soil with feet. About eight days later, rice is sown broadcast on the top.

'The practice of putting twigs and leaves on rice fields is largely adopted in Tinnevelly. Branches and leaves are used as manure near Bangalore in April, and at the end of the monsoon. When touring in the Suni Valley (Punjab), Dr Watt pointed out to me a shrub *(Adhatoda vasica)* which acts as weed-exterminator; the natives spread it, when green, on their rice fields, and it is said to kill the weeds in 24 hours. At Mahim, the leaves of sugarcane are spread on the ginger-beds to act as manure; leaves are also put round the plantations.'[3]

Compost-making

Howard realized that the solution of the manurial problem of India lies in the combination of animal and vegetable wastes by composting into humus. Humus influences soil fertility in the following ways:

The physical properties of humus exert a favourable influence on the tilth, moisture-retaining capacity and temperature of the soil as well as on the nature of the soil solution.

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[3]Voelcker, J.A. *Report on the Improvement of Indian Agriculture*, p. 107

The chemical properties of humus enable it to combine with the soil bases, and to interact with various salts. It thereby influences the general soil reaction, either acting directly as a weak organic acid or by combining with bases, liberating the more highly dissociating organic acids.

The biological properties of humus offer not only a habitat but also a source of energy, nitrogen and minerals for various micro-organisms.

'These properties—physical, chemical and biological—confer upon humus a place apart in the general work of the soil including crop production. It is not too much to say that this material provides the very basis of successful soil management and of agricultural practice.'

After defining the three-fold aspect of the values of compost, Howard continues by laying down seven conditions for its making, as follows:

The labour required must be reduced to the minimum.

A suitable and also a regular carbon-nitrogen ratio must be produced by mixing well the vegetable residues before going into the compost pits.

The process must be rapid. To achieve this, it must be aerobic throughout, and must include arrangements for an adequate supply of water and for inoculation at the right moment with the proper fungi and bacteria. The general reaction of the mass must be maintained within the optimum range by means of earth and wood ashes.

There should be no losses of nitrogen at any stage; if possible, matters should be so arranged that fixation takes place in the compost factory itself and afterwards in the field.

There must be no serious competition between the last stages of the decay of the compost and the work of the soil in growing a crop.

The compost should not only add to the store of organic matter and provide combined nitrogen for the soil solution but should also stimulate the micro-organisms.

The manufacture must be a cleanly and sanitary process from the point of view both of man and also of his crops. There must be no smell at any stage; flies must not breed in the compost pits or in the earth under the work cattle.

Howard, apart from being a scientist, was also a crusader. He spread his gospel of organic manuring in the English-speaking countries through his books. There were some faddists among his followers who regarded chemical fertilizers as an anathema and strongly opposed the setting up of fertilizer factories in India. This shows how dangerous it is to entrust policy matters to people with single-track minds. The cultivated crops in India remove annually, on an average, 3 million tonnes of nitrogen, 1.5 million tonnes of phosphorus oxide and 3.5 million tonnes of potash. This comes to 8 million tonnes of plant food. Through organic sources the plant food returned to the soil is hardly 1.8 million tonnes of nitrogen, 0.60 million tonnes of phosphorus oxide and 1.8 million tonnes of potash. This

FIG. 57. *Dhaincha* (*Sesbanea aculeata*) is a very popular green-manure crop for the paddy lands all over India. The roots bear nodules containing nitrogen-fixing bacteria. It is sown in June and ploughed in by the close of July. Then the fields are prepared for transplanting paddy

FIG. 58. Clusterbean (*Cyamposis tetragonoloba*) is grown in dry area as fodder and green manure crop. Recently industrial use is being made of its gum in textile industry

amounts to 4.2 million tonnes of plant food. Even allowing for the biological and other natural processes for recuperation of fertility, the balance is tremendous.[4] This was the main reason for low crop yields in India.

Thus it is clear that both organic manures and chemical fertilizers are necessary for Indian agriculture, and it is a downright folly to condemn the use of chemical fertilizers. Progressive Indian farmers have realized the role of both organic manure and chemical fertilizers in their cropping.

[4]Agarwal, R.R. *Soil Fertility in India*, p. 13

CHAPTER 35

PIONEERS IN RESEARCH IN SOIL SCIENCE, ENTOMOLOGY AND PLANT PATHOLOGY

JOHN Walter Leather, pioneer in soil science in India, was born on 26 December 1860 in Lancashire, England, and was educated at Hayton College. After graduation, he worked at the Kekule University, Bonn, Germany, during 1883-86 and obtained his doctorate. On return to England, he was appointed Senior Assistant to Dr J. W. Voelcker, Consulting Chemist to the Royal Agricultural Society, England. In 1891, he joined as Professor of Chemistry at Harris University, Presten. In 1892, he was appointed Agricultural Chemist in the Imperial Revenue and Agriculture Department of the Government of India by the Secretary of State for India. In 1906, the post of Agricultural Chemist to the Government of India was renamed Imperial Agricultural Chemist in the Indian Agricultural Serivce on the establishment of the Imperial Agricultural Research Institute at Pusa in Bihar. Dr Leather retired as Imperial Agricultural Chemist on 12 August 1916, and died the same year.

Leather was pioneer in initiating a series of chemical investigations in soil and fertilizer research and he trained a batch of Indian workers. His contributions in the field of Agricultural Chemistry and Soil Science are outstanding. These include soil studies for classification purposes leading to the identification of four major groups of soil in India, namely (1) the Indo-Gangetic alluvium, (2) the black cotton soil or *regur*, (3) the red soil lying on metamorphic rocks, and (4) laterites.

His systematic investigation on the drain-guages was the first of its kind in India for the quantitative measurements of (a) the run-off of rain-water, (b) the amount passing into the soil and into drains and (c) that evaporating from the soil surface. His work relating to the water requirements of crops highlighted the effect of manure on the transpiration ratio and the economy in water use. His work on saline-alkali soils and soil temperature is also noteworthy. He initiated the first series of permanent manurial and rotational experiments in India at Kanpur, Pusa and Coimbatore.

TWO ENTOMOLOGISTS, HAROLD MAXWELL-LEFROY (1877-1925) AND THOMAS BAINBRIGGE FLETCHER (1878-1951)

Harold Maxwell-Lefroy was born on 20 June 1877 in England. He got his primary education at Marlborough and graduated from King's College, Cambridge, in Natural Science under the supervision of Dr David Sharp. In 1899, he got his first appointment as Entomologist to the Imperial

Department of Agriculture, West Indies. In 1903, he succeeded Lincel de Niceville as Entomologist to the Government of India. He started his work at Surat and in 1905 took over as the first Imperial Entomologist.

He worked in India for about a decade, during which he organized his department on a sound footing. He issued a series of publications on general entomology, studies of pests, control of insects, useful insects, medical entomology and on insects and plant diseases.

In 1906, he published the book entitled *Indian Insect Pests*. It deals with procedures on how to collect, pin and set insects; their morphology, classification and nomenclature; the origin of pests and how the balance of nature is disturbed by man. The formulations of several insecticides were given, along with methods of spraying. The pests injurious to crops were separately dealt with under crops, such as cotton, rice, wheat, maize, sorghum, legumes, vegetables and fruits. Insects were grouped in different categories, e.g. caterpillar., beetles, locusts, grasshoppers, burrowing insects and sucking insects. He tried to avoid scientific terminology so that the contents might be easily understood by laymen.

His monumental work, *Indian Insect Life*, was published in 1909. It includes the history of entomology in India, general classification of Indian insects, general information on insects, such as number of insect species, their distribution, food habits and habitat.

In 1923, he published a *Manual of Entomology* for students of Economic Entomology. In this manual, he revised the old classification and treated insects under 26 orders, and described morphological and anatomical characteristics of each family.

Maxwell-Lefroy did extensive work on insect pests. His studies included the pests of cotton in Bihar, with a detailed account of 14 species and later a general account of the world species. His other works included the Indian surface caterpillars of the genus *Agrotis* (1906), the mustard saw-fly, *Athelia proxima* (1908); notes on Indian scale insects (Coccidae) (1908) and *Locusts in India*. He published bulletins on insect pests of coffee in south India, household insects, insects injurious to books and paper, weevil in wheat, a list of injurious insects of India, and more important insects injurious to Indian agriculture (1907).

In 1911, he wrote an article on insecticide fixtures and recipes for use against insects in the field, the orchard, the garden and the house. It introduced the use of chemicals against pests in India. In 1915, he reviewed the work done on insecticides in different countries and described the action of insecticides on animals. He wrote several popular articles, containing formulae of easily made sprays and directions for their application. His other works include the control of white fly and soft scale, practical remedies for insect pests, destruction of fleas with insecticides, and experiments on fumigation with hydrocyanic acid in Barbados.

Maxwell-Lefroy maintained his interest in useful insects such as silkworm and lac insects. In 1915-16, as Imperial Silk Specialist, he wrote a detailed report, highlighting the scope of silk industries in India. He emphasized the need for the cultivation of lac. He described the method of inoculation by tying sticks of ripe lac to the branches of host trees.

He also wrote on insects important for human health. In the paper 'The tsetse-fly in India' (1907), he provided strong evidence that this fly did not exist in India. In a preliminary account of the biting flies of India, he included Anoplura lice, Pulscidae fleas, Diptera flies and Cimicidae bugs.

He also investigated the role of insects as vectors of plant diseases. He wrote an article on the psylla disease of indigo in Bihar, showing that 'X' disease was the chief cause of loss. He also worked on the fungal and bacterial diseases of insects.

In 1912, Lefroy joined the Imperial College of Science and Technology at South Kensington, London, to impart training to entomologists. From 1913 onwards, he acted as honorary curator of the insect-house at Zoological Gardens, London. He visited India during 1915-1916 as Imperial Silk Specialist. In 1916, he was given the temporary rank of Lieutenant-Colonel and sent to Mesopotamia with the specific duty of carrying out sanitary measures against flies to protect the armed forces against disease. He died on 14 October 1925 after an accidental exposure to gas. During his last days, apart from giving training to entomologists, he tackled several problems, e.g. devising methods for preventing losses to large quantities of wheat from beetle infestation, saving timbers of old buildings, and studying insecticides for public use.

THOMAS BAINBRIGGE FLETCHER (1878-1951)

Thomas Bainbrigge Fletcher began his official career as a paymaster in the Royal Navy, in which capacity he developed a keen aptitude for the study of the insect fauna of insular and coastal areas. In 1905, he joined the Percy Slader Expedition to the Indian Ocean, under the leadership of J. Stanley Gardiner, and studied the insects collected during the expedition. In 1909, he was appointed supernumerary Entomologist, Government of India, at the Imperial Agricultural Research Institute, Pusa (Bihar). In 1912, he was appointed to the post of Entomologist to the Government of Madras, where he made extensive studies of insect fauna. In 1913, he succeeded H. Maxwell-Lefroy as Imperial Entomologist to the Government of India, and held this post till his retirement in 1932.

Fletcher specialized in insect systematics. As Imperial Entomologist, he elevated the status of entomology in this country through his research contributions and by his organizational capabilities and leadership.

In 1914, he published his well-known book, *Some South Indian Insects,*

FIG. 59. Portrait of Mr T.B. Fletcher. He made a study of the insects of India

FIG. 60. Portrait of Dr E. J. Butler. His work on the fungi of India is classic

which gives the descriptions of several south Indian insects, their classification, nomenclature, systematic position, life-histories, and their distribution and control measures.

His other contributions deal with insect pests of crop plants. These include treatises on 'Cotton bollworms in India' (Fletcher and Mishra, 1920), 'Borers of sugarcane and rice' (1920), 'Stored grain pests' (1921), 'Food preservation against termites' (1920), 'Cabbage butterfly' (1912), 'Grasshoppers' (1912), 'Weevil and dry wheat' (1911), and 'Rice bug' (1914). He also published a list of insect pests of cultivated plants in south India in 1913. It contains information on the distribution, host plants and the relative importance of as many as 275 different species. His annotated list of Indian crop pests published in 1920 included some 1,047 species belonging to different orders.

Fletcher's contribution to the systematics of insects is monumental. He published papers on the collection and preservation of insects in 1920. During 1926, he published a bulletin which gives tentative keys to the orders and families of Indian insects. In 1929, he produced a list of generic names used for Microlepidoptera. He stressed the need for publishing general catalogues of Indian insects and produced eight volumes dealing with families Acrididae, Lasiocampidae, Amatidae, Syntomidae, Zygaenidae, Cosmopterygidae, Alucitidae, and Chlidanotidae, among others.

Fletcher worked extensively on the biology of Indian insects and published his work in nine parts under the title *Life-histories of Indian Microlepidoptera,* which included 2,422 species under 458 genera.

Fletcher in his paper, 'Note on plant imports into India' (1920), mentioned how exotic pests and diseases were carried along with different materials. It was due to his efforts that the "Destructive Insects and Pests Act, 1914" was passed as a measure against the introduction of noxious insects into India.

Fletcher also contributed to the field of industrial entomology. In 1915, his paper entitled "Bees and the fertilization of coffee" provided a hint to the coffee-growers to encourage bees in their estates for increased yield. In 1911, he developed a simple honey-extractor.

During 1926-1932, in collaboration with S.K. Sen, he wrote ten papers on medical and veterinary entomology. Fletcher died in England on 30 April 1951.

SIR EDWIN JOHN BUTLER

Sir Edwin John Butler (1874 to 1943), an Irishman, is considered to be the Father of Plant Pathology in India. He was born in County Clare, Ireland, on 13 August 1874 and had his early education in the Queen's College, Cork. He qualified himself for M.B. (Hon.) in 1898 from the Royal University, Ireland, with a creditable record. In 1899-1900, he had an opportunity to visit Paris and Kew in England, and during these tours he got interested in fungi. He came to India in 1901 and was appointed the first Cryptogamic Botanist in the Botanical Survey of India, at its headquarters at Calcutta. In 1902, the Cryptogamic Section was shifted to Dehra Dun. On the establishment of the Imperial Agricultural Research Institute at Pusa in 1905, he was transferred there as Imperial Mycologist. In the isolation and quiet of Pusa, Butler had ample opportunity to develop his interests. At Pusa, he laid a sound foundation of the sciences of mycology and plant pathology. Later, he also served as the Director of the Imperial Agricultural Research Institute.

Butler was a taxonomist as well as a plant pathologist. He identified a number of new genera and species, and worked on the fundamental aspect of the perpetuation of a number of well-known diseases of crop plants. Before Butler, hardly any work on taxonomy had been done. From the recorded evidence, it appears that Linnaeus was the first person to identify a mushroom sent to him from southern India. In the latter half of nineteenth century, some European taxonomists, particularly D.D. Cunningham, and A. Barclay made studies on the identification of Indian Fungi. Amongst Indians, Dr K. R. Kirtikar, of the Indian Medical Service, was the first person to publish a paper on *Agaricus ostreatus* in 1885, which was presented to the Bombay Natural History Society. All these attempts, however, were isolated, and systematic work began in this country only after the arrival of Butler in India in 1901. His monumental work began with extensive and regular surveys which made it possible for him to collect a large number of fungi. During this period, he closely collaborated with European taxonomists, particularly Theissen and P. Sydow. He identified and classified his collected material systematically. His studies on the genera *Allomyces* and *Pythium* are even today recognized as classical pieces of work. His studies on Chytridiales are an important landmark in the history of plant pathology in India. He published a series of papers in *Annales Mycologici*, along with H. and P. Sydow under the title *Fungi Indiae Orientalis*. Later, in 1931, he jointly published, with G.R. Bisby, the *Fungi of India*. The first book, *Fungi and Disease in Plants*, was published in 1918 by Butler, while at Pusa (Bihar), apparently on the request of James Mollison, the then Inspector-General of Agriculture in India. It is a classical work and it deals with more than 200 important diseases of field and plantation crops. It includes illustrations, diagrams, and life-cycles of important plant pathogens. Even today, this 60-year-old publication is consulted as a reference book by the students of Plant Pathology.

Butler studied not only the diseases caused by fungi, but also the diseases of plants, in general. He was the first man to describe the nematode disease of paddy in Bengal, caused by *Tylenchus* sp.

He worked on diseases of a wide range of crops, such as plantation crops, betelvine, sugarcane, paddy, wheat, potato, maize, groundnut, pigeonpea, cotton and sesamum.

A number of eminent workers in plant pathology in the early 1920s were trained by Butler. Some of his trainees who have left a mark in the plant pathological and taxonomical literature of India were Munshi Inayat Khan, Azmatullah Khan, R. R. Sen, Abdul Hafiz and L. S. Subramaniam.

Butler was the founder of "Herbarium Cryptogamae Indiae Orientalis", which today is one of the largest collections of specimens in the world.

Butler went back to England in 1920 to shoulder still higher responsibilities as the Director of the Imperial Bureau of Mycology at Kew. He had the honour and privilege to bring out the first issue of *The Review of Applied Mycology* in January 1922. He served at Kew till 1935. *The Review of Applied Mycology* perhaps is the one journal most widely referred to today by mycologists and plant pathologists. Butler continued his interest in plant pathology and, in collaboration with S. G. Jones, wrote a much bigger volume than *Fungi and Diseases in Plants*. He, however, did not live to see the publication of that volume, which was published posthumously in 1949.

Butler's contribution to plant pathology was recognized well during his life time, and he was honoured with the title of CIE in 1921. In 1924, he organized the First Imperial Mycological Conference in England and soon after, in 1926, he was elected the Fellow of Royal Society and chaired the Mycological Section of the International Congress of Plant Sciences at Ithaca, USA. In 1931, he was invited to Sudan to investigate a serious disease of the cotton crop which was assuming damaging proportions. Two years later, he was elected to the Council of Royal Society, and was asked to give the Lowell Lectures at Harvard University. The degree of LL.D. (honoris causa) was conferred upon him in 1938 by the University of Aberdeen, and finally he was knighted in 1939. He died on 4 April 1943. Butler laid a solid foundation of the disciplines of mycology and plant pathology in India and is rightly called the Father of Plant Pathology in this country.

DR B.B. MUNDKUR, 1896-1952

Balchandra Bhawanishankar Mundkur was born in the Village of Mundkur (Mysore State) on 26 June 1896. He graduated in Botany from the Presidency College, Madras, in 1922. He joined as Agricultural Officer in Bengal and was later appointed Assistant Mycologist in the Cotton Research Scheme at Dharwar (Mysore State). He got his Ph.D. from the Iowa State College of Agriculture, USA, in 1931. On return to India, he joined as Assistant Mycologist in the Division of Mycology and Plant Pathology, Imperial Agricultural Research Institute, Pusa (Bihar).

After the building of the Institute was destroyed by a violent earthquake, he shifted to the New Delhi Campus of the IARI and remained there up to 1947.

Mundkur was an eminent taxonomist and plant pathologist who studied a wide range of diseases of plants. In his career, when he joined at Dharwar, he studied the wilt disease of cotton. After joining the IARI, he continued to study soil fungi, including *Fusarium* and *Sclerotium*. He carried out basic investigations on the parasitism and culturing of *Sclerotium* spp. Later, he expanded his field of activity and studied a large number of fungi causing diseases of crops such as wheat, barley, potato, oats, sesamum, sugarcane, cucurbits, *Brassica* spp. and groundnut.

Mundkur was recognized as the topmost taxonomist of his time in India, a worthy successor of Butler. He brought out a supplement to Butler and Bisby's *Fungi of India*. He published *Revisions and Additions to Indian Fungi* (Nos I, II and III). His work on Ustilaginales, first with Dr M. J. Thirumalachar, and later with Dr M. S. Pavgi, is outstanding. Between 1949 and 1950, he published jointly with Thirumalachar a series of papers on the genera of rusts.

Mundkur applied his knowledge of plant pathology for breeding disease-resistant varieties of important crops. He collaborated with Dr B.P. Pal and Pushkar Nath in investigating the resistance of wild and cultivated varieties of potato. Later, along with Dr Pal, he published a series of papers on the screening of varieties to various cereal smuts. This covered crops such as wheat, oats and barley. This collaborative effort was the first organized attempt of plant breeders and plant pathologists to identify sources of resistance and to utilize them in breeding for disease resistance. This work is being followed even today in many field crops in India in evolving resistant varieties.

Mundkur published a textbook entitled *Fungi and Plant Diseases* in 1949. He was the founder of the Indian Phytopathological Society and started the quarterly journal, *Indian Phytopathology*. He was twice elected the President of the Society. He died in 1952.

CHAPTER 36

SUGARCANE IMPROVEMENT

DR C.A. BARBER AND SIR T.S. VENKATARAMAN EVOLVE HYBRID CANES AT COIMBATORE
INDIA BECOMES SELF-SUFFICIENT IN SUGAR
1912-1933

SUGARCANE belongs to the genus *Saccharum* of the family Gramineae. It is essentially a plant of the tropics, but is grown successfully over large areas in the world in the subtropics. The important sugarcane-growing countries are India, Brazil, Cuba, China (F), Pakistan, the USA (Louisiana, Florida and Hawaii), Australia, Indonesia, South Africa and Mauritius. In India, sugarcane is an important cash crop and is grown over about 2.6 million hectares, with a production of 156.9 million tonnes. India is the largest producer of sugar in the world, followed by Brazil and Cuba. There are two distinct sugarcane-growing areas in India; the tropical and the sub-tropical. In the tropical belt lie Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. In these States, the yield of sugar is highest and the growing period is almost a year. The subtropical belt comprises Uttar Pradesh, Bihar, the Punjab, Haryana and Rajasthan. About 70 per cent of the total cane area in the country lies in the subtropical northern India.

SPECIES

India is the home of the *katha* or the *Saccharum barberi* canes. Another cane in India is *S. sinense*, the China cane. According to Roxburgh, the China canes were introduced into the Botanical Gardens, Calcutta. He regarded them as a separate species and gave them the name *Saccharum sinense* Roxb. Watt (1908) has stated that if the original stock of China canes survives to this day at all, the plants have very largely merged into the indigenous forms and their origin is forgotten.

A wild cane found in India is *kans* or *kahi* (*S. spontaneum* Linn.), a trouble-some weed found all over India on waste-lands and on the banks of rivers. The forms of this species have thin stalks, high tillering, high fibre and an extremely low sugar content. Different forms of this species can withstand drought, disease and frost to a high degree.

The indigenous thin north Indian canes, belonging to *Saccharum barberi*, are believed to have originated in northern India through natural hybridization of *Saccharum officinarum* and *Saccharum spontaneum*. *Kans* proved to be of great use in the breeding programmes of sugarcane.

The thick canes, also called the noble canes, belong to the species

Saccharum officinarum Linn. This species includes tropical canes indigenous to the New Guinea region. The canes are thick, and soft-stemmed, and have high cane yield and sugar content. It was in 1827 that Captain Sleeman brought the noble Mauritius canes to India and gave them to the Botanical Gardens, Calcutta. The *Transactions* of the Agri-Horticultural Society of India contain details of the cultivation etc. of these and other foreign canes. Sleeman received the gold medal of the Society in recognition of his being the most energetic worker in the experimentation and introduction of foreign canes. Watt (1893) gives the details of these canes under Mauritius, Otaheite, Bourbon cane, and Batavian canes.

The introduced thick canes, which belong to *Saccharum officinarum*, are still being grown in certain parts of the country, but on a limited scale. They have, by now, acquired local names. Thus the 'Vellai' of the Coimbatore District, the *desi* or 'Peshawri Paunda' of the North-Western Frontier Province (now in Pakistan) and the 'Toungoo Yellow' of Burma are one and the same cane, viz. Otaheite. Then there are other thick canes (including Otaheite types) which are known as 'Paunda' canes and are grown for chewing. The 'Pundia' cane of Maharashtra falls in this class (*S. officinarum*), and the 'Poovan' cane of the Coimbatore District, 'Hottai Kabbu' of Bellary and 'Patta Patti' of Karnataka are the same canes as 'Pundia'. The 'Patta Patti' is a striped variant of the 'Poovan' cane and is said to have been introduced into Karnataka from Vellore (Iyer, 1944). The canes of the 'Paunda' type must have existed in India earlier, as Ibn-i-Batuta makes a mention of them in his travelogue.[1]

Propagation

Sugarcane is propagated vegetatively by planting stem cuttings, called seed-sets, each having two to three buds or eyes. It flowers profusely in tropical areas, but the flowering in the subtropical areas is sparse. The sugarcane inflorescence, called the 'arrow', consists of an open-branched panicle and contains as many as 100,000 flowers. The flowers are borne in paired spikelets—one sessile and the other pedicellate. The flowers open in the early morning, usually between 5 and 6 a.m., and it takes about 10 to 15 days for an arrow to complete flowering. The flowering starts at the top of the arrow and proceeds downwards. Cross-pollination normally occurs. The seeds are generally referred to as 'fluff' or 'fuzz' and are extremely small and bear silvery hairs.

The important factors controlling flowering in sugarcane are temperature, humidity, rainfall, the age of the plant, the length of the photoperiod and the genotype. Owing to profuse flowering under natural

[1] Dutt, N.L. 'Sugarcane in India—a Retrospect and Prospect', *Proc. 34th Indian Science Congress, Part II: Presidential Address*, 3 Jan., 1947

conditions in the tropical areas, the breeding of sugarcane has remained mainly confined to these areas.

Syed Muhammad Hadi's Work on Sugarcane and Manufacturing of Sugar

Syed Muhammad Hadi's work on the sugar industry of the United Provinces appeared in 1902. He described the different varieties comprehensively and, for the first time, an attempt was made for the serious study of the Indian sugarcanes with a view to classifying them. His descriptions are detailed, though not strictly in botanical terms, and his classification is based on the general appearance (mainly colour) and the agronomic characters of the different varieties. He describes six series of canes, of which the fifth and the sixth, namely the 'Ganna' and 'Paunda' canes, will now fall under *S. sinense* and *S. officinarum* respectively. His first four series, namely (1) the Dhaulu canes, (2) the Matna canes, (3) the Kuswar canes, and (4) the Chin group will come under *S. barberi*. Hadi was also interested in the manufacturing of sugar by the *khandsari* method and he developed a system of his own for open-pan boiling. He maintained his interest in sugarcane throughout his life. In his later days, when he was the Director of Agriculture, Bhopal, he published a voluminous book on the Indian Sugar Industry under the auspices of the Government of Bhopal.

The Sugarcane Revolution in Java

The last decade of the nineteenth century saw a revolution in the method of cane improvement. The discovery of fertile seed in sugarcane was made by Soltwedel in Java in 1888, and quite independently in Barbados by Bovell and Harrison in 1889. These two countries thenceforward made great advances in the production of seedling canes to serve their sugar industries. India had to wait for 31 years after the discovery of fertile cane seed and its utilization in Java and Barbados, and in this interval Java and the West Indies made great progress in sugar production, whereas India continued to rely on low-yielding indigenous canes, yielding not more than 15 tonnes/ha. The breakthrough came with the work of Barber and Venkataraman in 1912, with the founding of the Cane Breeding Station at Coimbatore.

THE SUGARCANE REVOLUTION IN INDIA

Dr Charles Alfred Barber, 1860-1932

Born on 10 November 1860, at Wynberg, South Africa, where his father, the Rev. William Barber, was a missionary, Charles Alfred Barber spent the first ten years of his life in Cape Colony. In 1871, he came to England and was educated at New Kingswood School, Bath. From the School, at the age of 18, he entered the Manchester and Liverpool District Bank in which he served for five years. But the love of nature, which he had acquired in his South African home, was not to be renounced, and he found time during those five years to study Chemistry, Botany and Geology, and to pass the first B.Sc. examination of London University. In 1883, he decided on a scientific career and proceeded to Germany, studying first at Heidelberg and subsequently at Bonn University. Here, he came under the influence of botanists Strassburger, Schmitz and Schimper and, largely through their influence, his attention was more particularly diverted to Botany. At the age of 24, on his return to England, he was admitted to Christ's College, Cambridge, of which College he became a scholar. He passed both parts of the Natural Science Tripos with first-class honours.

In 1891, he proceeded to the West Indies to take up the appointment of Superintendent of Agriculture in the Leeward Islands. Here, he obtained his first practical acquaintance with sugarcane, the plant to which he was, in future years, to devote so much study. In 1895, owing to the depression in sugar, his post was abolished and he returned to England. From 1895 to 1898, he held a post on the staff of the Royal Engineering College, Cooper's Hill, where he succeeded Professor H. Marshall Ward. In 1898, he proceeded to India to take up an appointment as Government Botanist, Madras. From this time onwards, he concentrated on tropical agriculture.

In India, he arrived at a time when the functions and even the field of work of a scientific officer were little understood. If India, under the influence of Kew, had been fortunate in throwing up a number of outstanding personalities in the field of systematic botany, their very success, which remains on record in the most complete tropical flora in existence, tended to confuse systematic botany with science in general. His initial instructions were to prepare *A Flora of the Madras Presidency* and, for this purpose, he was appointed Director of the Botanical Survey of Southern India. It was not long, however, before his duties were extended to include a study of the diseases of crops. During these first years, the scope of his work expanded to include economic botany, mycology and entomology.

In 1908, Barber joined the staff of the newly established Agricultural College at Coimbatore, with the charge of the Botanical, Entomological and Mycological Sections. The Government decided to create a special department for the study of sugarcane, and Barber was appointed the first Sugarcane Expert, and, in that capacity, opened the Sugarcane Research Station at Coimbatore.

Though 1912 marks the date of the commencement of Barber's more serious study of the cane plant, it does not mark the commencement of his earliest investigations of the problems involved. These commenced in the Leeward Islands and were early renewed in India where, in Madras, the spread of red rot was causing some alarm. He combated that specific problem by introducing new canes, from which he selected those showing resistance to the disease. Recognizing the need of a close personal study

FIG. 61. Dr Charles Alfred Barber (1860-1932). A South African by birth, he joined as Economic Botanist to the Madras Government in 1907. In 1908 he joined the Agricultural College at Coimbatore. He started the work of crossing indigenous canes with Noble canes in 1912. He introduced the wild *Saccharum spontaneum* into the combination by crossing it with 'Vellai', a Noble cane, acclimatized at Coimbatore. He gave improved canes 'Co 205', 'Co 210', 'Co 213' and 'Co 214' to India

FIG. 62. Dr T.S. Venkataraman (1884 to 1963). He joined the Madras Agriculture Department at Coimbatore in 1907 as Assistant to Dr C.A. Barber. On the retirement of Barber in 1919, he took over as Government Sugarcane Expert. His improved varieties of sugarcane 'Co 244', 'Co 331' and 'Co 363', among others, made India self-sufficient in sugar

FIG. 63. Nand Lal Dutt, Director of the Sugarcane Breeding Station, Coimbatore, from 1942 to 1958. He gave a number of improved varieties of cane to India, viz. 'Co 419', 'Co 475', 'Co 467' and 'Co 617'

FIG. 64. The sugarcane variety 'Co 6404' in a grower's field near Coimbatore gave a yield of 150 tonnes per hectare. This variety was released from the Sugarcane Breeding Institute, Coimbatore, for general cultivation in Tamil Nadu

of the plant in all its aspects, he took up land at Samalkota and grew the plant under his direct supervision.

From 1912 to the end of his service, his energies were devoted to the various aspects of cane production in India. The problem with which he was faced was, in many respects, unique. The centre of cane cultivation lay in northern India in Bihar, the United Provinces of Agra and Oudh and the Punjab in the subtropical zone, where the climatic conditions only allowed a period of active growth of some four months and the cultivation of noble (thick) canes was consequently precluded. At this time, the practice of raising seedling canes had been reduced to a high art in many countries outside India, but had not been tried in India itself. The future work depended on proving that such work was possible. In northern India, many of the canes commonly grown rarely flower, whereas those that did so failed to set seed. This failure was traced to the infertility of the pollen-grains or to the withering of the anthers without shedding. This was shown to be a climatic effect, for the fertile pollen was produced when these canes were grown in southern India. These reasons compelled the establishment of the research station outside the sugar tract, but, as an inevitable result, a further complication arose, viz. the preliminary tests of the seedlings had to be conducted under conditions materially different from those under which their commercial growth took place. A scheme for transferring and testing the seedlings in northern India had to be worked out. This led to the development of research stations in the provinces.

Among the most important characters demanded in a cane for northern India were hardiness and a capacity to thrive under the equally trying conditions of a cold winter and an intensely hot and dry summer. To secure these characters, Barber turned to crossing between the thin indigenous canes and the thick noble canes. The problem here arose: Which of the indigenous canes would best serve the purpose? This problem led him to conduct an intensive study of the canes growing in northern India. The results of that investigation he has placed on record in a number of monumental papers in the *Memoirs of the Department of Agriculture in India*. These memoirs illustrate one of the essential features of his method—an intense concentration on detail. It is one of his main achievements that, in this mass of detail, among which most men would have lost themselves, he did not lose touch with the practical issue. The success of the Coimbatore ('Co') series of canes and the extent to which they are now cultivated are a sufficient evidence of that fact. That detailed study of the Indian canes is summed up in his classification and in his views of their double origin. It must be remembered that, at this time, the complex chromosomal constitution of the cane plant had not been worked out and he was guided by morphological features only. It bears testimony to his judgement and insight that these later chromosomal investigations, particularly those of Bremer, have demanded so little an alteration of his conclusions. Brief reference, too, must be made to his early appreciation of the importance of the root, a much-neglected subject, which is only now receiving the attention it merits.

In his study of the local canes, particularly with reference to the Punjab, he was especially concerned with two, the *kāhu* and the *kāthā*. The *kāhu* was severely affected by frost and, on occasion, had to be reintroduced; the *kāthā* was hardier. The similarity between the *kathā*, the thinnest form, and the *kāns*, the wild *S. spontaneum*, attracted his attention, and he was led to introduce the wild plant into the combination by crossing it with 'Vellai', a noble cane, long acclimatized at Coimbatore. With the success of interspecific crosses between *Saccharum officinarum* and *Saccharum spontaneum*, the foundation was laid for the development of hybrid 'Co' canes. At present, all the hybrid canes in cultivation throughout the world have the blood of *Saccharum spontaneum*. The noble canes, belonging to the species *Saccharum officinarum*, although they possess a high yield potential and a high sugar content, were highly susceptible to a number of diseases and also could not withstand the adverse climatic conditions of northern India. 'Co 205' survives as the result of this original cross. Other notable canes which have resulted from crosses made by Barber are 'Co 210', 'Co 213' and 'Co 214'. The value of Barber's work lies in the sure foundations of breeding work on canes, for which Coimbatore has won international renown.[a]

SIR T.S. VENKATARAMAN

Born at Salem in the Madras State, Tiruvadi Sambasiva Venkataraman had his high-school education in Tiruchirapalli. He took his B.A. degree in Botany from the Presidency College, Madras, in 1905, standing first in the Presidency. He joined the Madras Agricultural Department at Coimbatore in 1907 as an assistant to Dr C.A. Barber, the then Economic Botanist. When in 1912 the Government of India started the Imperial Cane Breeding Station at Coimbatore, with Dr C.A. Barber at its head, Venkataraman was selected to fill the post of the second in command. On the retirement of Barber in 1919, Venkataraman was placed in charge of the Station.

While Barber was the first breeder in the world to employ *Saccharum spontaneum* to raise an interspecific hybrid, Venkataraman was the first to be able to bring about intergeneric hybridization, i.e. between sugarcane and sorghum (*jowar*) and also between sugarcane and bamboo. These crosses were made to meet the demand for early and late canes, the canes which would not lodge, and the canes that would resist diseases, pests and other adverse conditions. The sugarcane-sorghum cross, which was first made in 1930 and which has since been successfully repeated in Hawaii, Java and

[a]*The International Sugar Journal*, Vol. XXXV, London, 1933

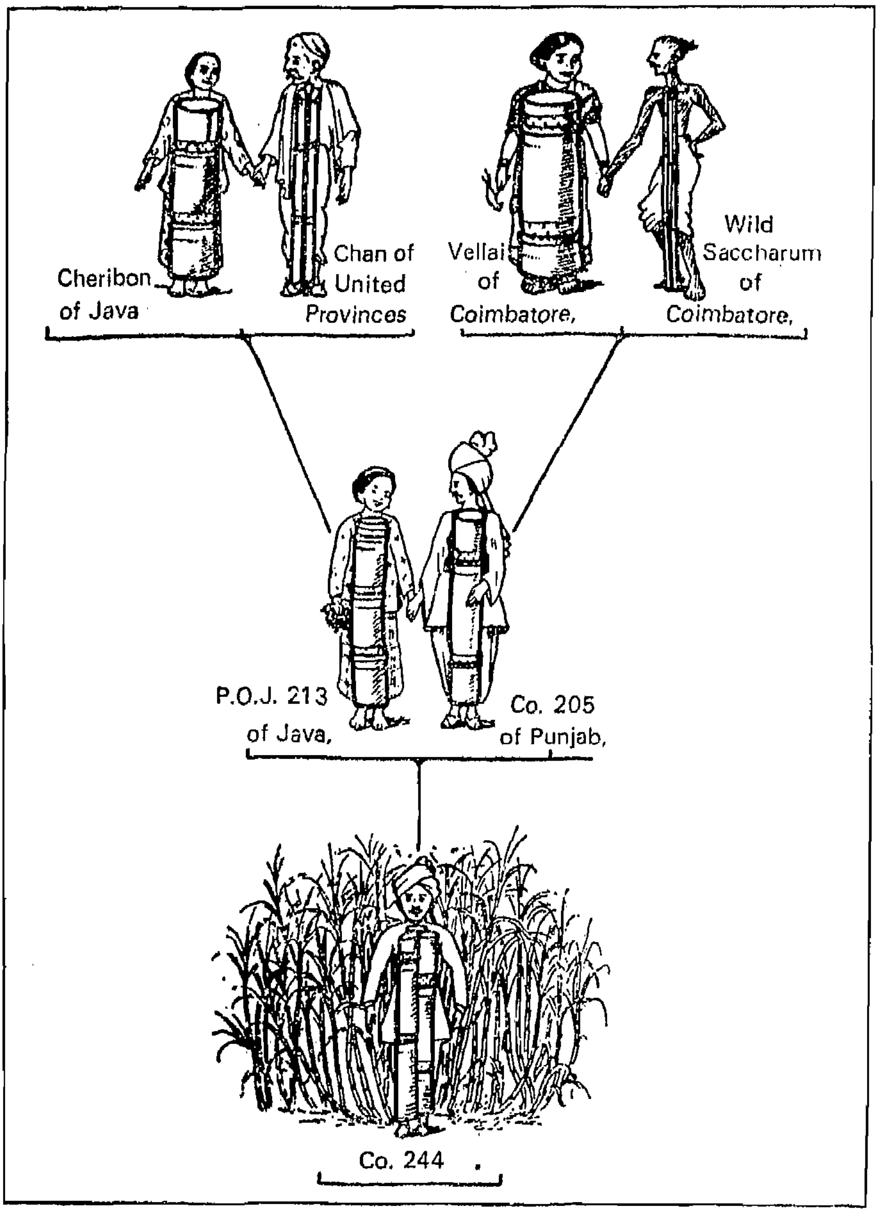

FIG. 65. A family tree of a Coimbatore hybrid sugarcane. It is by such diagrams that Sir T.S. Venkataraman popularized the knowledge about the creation of these varieties among laymen
(Reproduced from the *Agriculture and Livestock of India*, VI, pt. 6, 1936)

Florida, yielded two early types which are doing exceptionally well in Tamil Nadu, Uttar Pradesh and Bihar.

The improved sugarcanes bred by Venkataraman at Coimbatore are estimated to occupy over 75 per cent of the total acreage under the crop in India. These are 'Co 281', 'Co 290', 'Co 299', 'Co 312', 'Co 313', 'Co 331', 'Co 352', 'Co 356', 'Co 419' and 'Co 421'. Some of them won recognition even outside India. For example, 'Co 290' won the Grand Prize in Hawaii for possessing the biggest stool ever produced anywhere, with 360 canes to the stool, standing 30 feet (9·1 m) high, weighing two tonnes in raw material and yielding 400 lb (181.4 kg) of commercial sugar. In South Africa, 'Co 281', 'Co 290', and 'Co 301' are giving an increased yield of 40

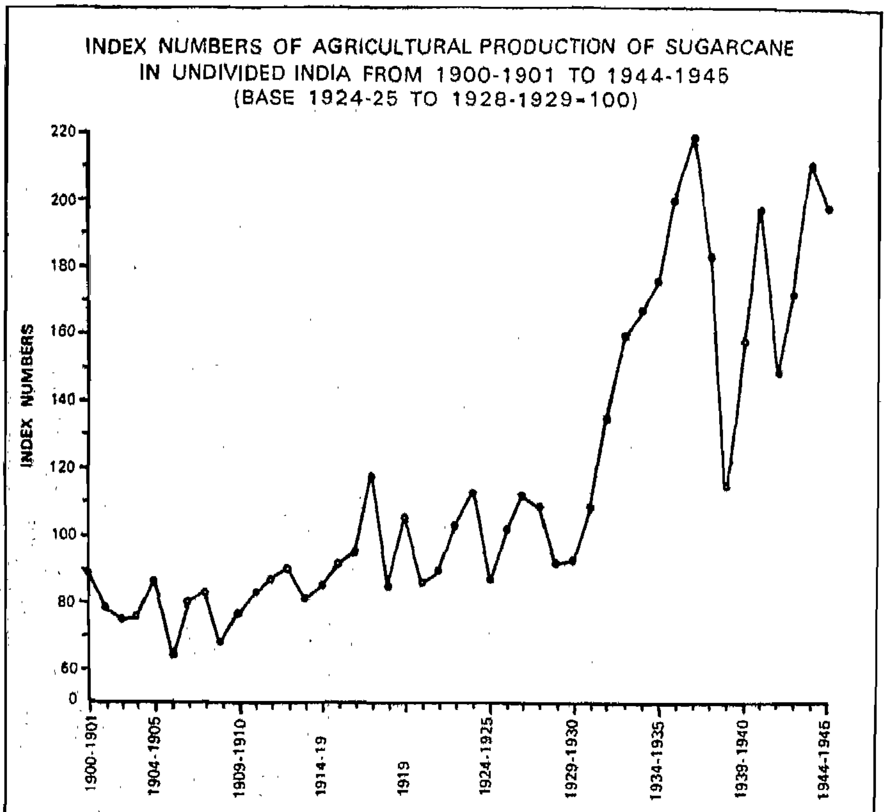

FIG. 66. Improved varieties of sugarcane evolved by Sir T.S. Venkataraman at the Sugarcane Research Station, Coimbatore, started showing their impact from 1930 onwards. India became self-sufficient in sugar in 1935. The fall in production in subsequent years was due to vagaries in price offered to the growers
(Graph based on the figures supplied by the Economic and Statistical Adviser, Ministry of Food and Agriculture, Government of India)

per cent over the rapidly disappearing 'Uba' and occupy 56 per cent of the total area under the crop. India would not have been independent of imports of sugar from foreign countries had it not been for the increased raw material available to the mills at competitive rates through the introduction of hybrid Coimbatore canes.

The contributions of Venkataraman to the science and practice of sugarcane breeding and to the transformation of India from a sugar-importing country into a sugar-exporting country attracted world-wide attention. He was elected to the Vice-Chairmanship and to the Sectional Presidentship of the International Society of Sugarcane Technologists. He represented India at the International Sugarcane Convention, held in Java and Brisbane in 1929 and 1935 respectively. His scientific colleagues in India conferred on him the highest honour by electing him the General President of the Indian Science Congress in January 1937. On the eve of his retirement from service in 1942, he was knighted by the Government of India.

THE RISE OF THE SUGAR INDUSTRY, 1932

The Imperial Council of Agricultural Research constituted a Sugar Committee, which, in October 1929, recommended that an inquiry be held by a Tariff Board into the necessity of protection for the Indian Sugar Industry. The Tariff Board was constituted in 1930 and studied all aspects of the industry and in their report of 1931 recommended protection for 15 years. In coming to this decision, the Tariff Board stated that much progress had been made at the Coimbatore Station and the 'Co' canes had increased the output by 50 per cent and that there had also been a remarkable increase in the efficiency of the Indian sugar factories since the Sugar Committee of 1920 last reported. The Government of India accepted the recommendations of the Tariff Board, and the Sugar Industry (Protection) Act, 1932, was passed by the Legislature.

The protective policy of the Government had an immediate impact. Indian capitalists, who were shy in investing money in the sugar factories, responded at once. The number of sugar factories in the pre-protection period was 32. In two years after the grant of protection, the number of factories rose to 112. By 1941, the number of sugar factories rose to 150. This is a record in the annals of the growth of any industry in the world. In four years (1936-39), the sugar produced in the Indian factories rose from the pre-protection figure of about 100,000 tons to over 1,100,000 tons. In fact, in 1936-37, the production of sugar in India by all processes was 1,254,000 tons, which was 53,000 tons in excess of the estimated consumption. The imports of foreign sugar into India began to decrease from 1932-33 and became negligible in a few years.

The work of Barber, Venkataraman and Dutt and the impact it had on the economy of the country vividly brought out the benefits of agricultural research. It is also noteworthy that economic gains were enormous as compared with the meagre investment in research.

The Cane-Development Work in the States, 1937-38

The work of improvement of sugarcane in the fields of cultivators had merely formed one of the so many items of work of the deputy directors of agriculture in the provinces. The beginnings of whole-time cane-development work date from 1935, when the Government of India placed sums from the Sugar Excise Fund at the disposal of provincial governments with the specific object of the improvement of this crop. In 1937-38, however, a separate Cane-Development Department was formed in the United Provinces under the charge of a cane commissioner. Mr Vishnu Sahay, ICS, was the first Cane Commissioner and it is largely due to the sound foundations laid by him that excellent results were obtained in the succeeding years. A Cane-Development Section has also existed in Bihar since 1939.

The Indian Central Sugarcane Committee, 1944

A new era opened up with the inauguration of the Indian Central Sugarcane Committee in 1944 on the initiative of Sir Jogendra Singh, Minister, Department of Education, Health and Lands, of the Government of India, and the Secretary, Sir Pheroze M. Kharegat. They generously placed Rs 12.5 million for sugarcane development at the disposal of the Committee.

Nand Lal Dutt, 1942-1958

In 1942, on the retirement of Sir T.S. Venkataraman, Nand Lal Dutt was appointed Government Sugarcane Expert. This post, later redesignated as Director, Sugarcane Breeding Station, he held till his retirement in 1958. As the Second Cane-Breeding Officer, Dutt was in charge of breeding sugarcanes for tropical India. 'Co 419' cane was evolved by him within the first few years of his joining the Institute and came into commercial cultivation as early as 1936. It has stood the test of time and of popular choice in the entire sugarcane area of the Indian Peninsula and even now it holds the field as the principal supporter of the *gur* and sugar industries. Side by side with it came his selection, 'Co 421', for subtropical India and this cane established itself successfully in many parts of northern India. Several other canes evolved by Dutt followed these two canes. The most prominent among them was 'Co 453', the phenomenal cane of the subtropics, which saved the sugar industry of northern India during the Second World War. Other remarkable selections made by Dutt were 'Co 413' (which even today is the principal cane variety in Egypt), 'Co 449', 'Co 467' and 'Co 617', which have become popular in certain areas in India.

Dutt was the first in India to initiate studies on the cytology of sugarcane. His researches in this field brought to light the phenomena of non-reduction of gametes in certain sugarcane crosses and of parthenogenesis and polyembryony in certain varieties. He made detailed investigations on inflorescence emergence, stigma receptivity, seed-setting and seed germination. Side by side with these studies, he carried out many studies on the preservation of pollen for cross-breeding. He was the first person in India to initiate experiments on photoperiodism with a view to acquiring control over flowering in sugarcane. He established a World Collection of Sugarcane Germplasm at Coimbatore. His book, *Coimbatore Canes in Cultivation,* is an authoritative work.

The State Sugarcane Research Stations

Very useful work has been done at the chain of sugarcane research stations which were established in different States of the country with the help of the funds from the Imperial Council of Agricultural Research. Work of great utility on the varietal, cultural, manurial, cane growth and sucrose development, entomological and mycological aspects of the cane crop has been done at the Shahjahanpur Sugarcane Station in Uttar Pradesh. There are two substations, one at Muzaffarnagar and the other at Gorakhpur. The Pusa Sugarcane Station in Bihar has also done equally important work on all the above aspects of cane. A feature of the Pusa Station is the live contact it has all along maintained with the sugar factories in Bihar. The Station has conducted soil surveys (with rapid chemical methods) and also disease and pest surveys. There is a substation at Patna for conditions obtaining in southern Bihar. In the Punjab, there is a sugarcane research station in Jullundur. Work on seed-rate, time of planting and the interaction of these two factors and also on the manurial, irrigational and entomological aspects has been done. Frost is a factor to reckon with in this tract and the resistance or susceptibility of the varieties to frost is studied before releasing them for cultivation by the farmers. In Maharashtra, there is a concentration of sugar factories in the Deccan Canal area. Some of the best work on sugarcane soils has been done at the Padegaon Sugarcane Station. Useful information has been obtained on varietal, manurial and cultural aspects at the Anakapalle Sugarcane Station in Andhra Pradesh.

Co-operation among the State Sugarcane Research Stations and the Sugarcane Breeding Institute, Coimbatore

The Sugarcane-Breeding Institute, Coimbatore, has the responsibility for making suitable crosses for the States in the north, viz. Uttar Pradesh, Bihar, Punjab and Haryana. Desirable crosses are made in consultation with the sugarcane breeders of the respective States. The fluff (seed) from crosses is supplied to the sugarcane research stations in northern India every year by the Sugarcane Breeding Institute, Coimbatore, for raising seedlings and making further selection.

CHAPTER 37

WHEAT IMPROVEMENT

SIR ALBERT HOWARD AND THE PUSA WHEATS
RAM DHAN SINGH AND THE PUNJAB WHEATS
DR B. P. PAL AND THE RUST-RESISTANT WHEATS

SOME attempts to improve the wheat crop by the introduction of better varieties were made in the last two decades of the nineteenth century. A number of introductions of exotic wheats from various countries, such as Canada, America, England and Australia, were attempted during the closing phase of the nineteenth century. The varieties received were tried at a number of stations. However, the introduced exotic wheat varieties had a long record of failures. This result of general failures is apparently due to the varieties introduced into India being either too late, or not forming ears at all or drying up prematurely owing to the blowing of hot winds. Some of them were also reported to be highly susceptible to rusts.

The wheat-improvement work in India can be roughly divided into three periods:

The first period (from 1905 to 1930-35): Improvement through selection of pure lines and through an early hybridization programme

The second period (from 1935 to 1965): Improvement with respect to resistance to diseases

The third period (from 1965 onwards): The era of dwarf and semi-dwarf high-yielding wheats

SIR ALBERT HOWARD AND THE PUSA WHEATS

Wheat has always been one of the major crops of the Indian subcontinent and the chief cereal of northern India. For a very long time, the improvement of wheat was no doubt carried on by the farmers themselves, without knowing the laws of heredity, which became known only in modern times. They selected from their fields the types which appeared to them to be superior to others and also developed a system of cultivation which, for the conditions prevailing at that time, was quite sound. At the beginning of this century, when research on wheat on modern lines was first taken up at the Imperial Agricultural Research Institute at Pusa, the outstanding personality in charge of the investigations was Sir Albert Howard, who laid the foundations of the genetical improvement not only of wheat but also of a range of other crops. He was assisted by his wife, G.L.C. Howard, and by Abdul Rahman Khan.

Practically nothing of a satisfactory kind had been done on the sorting out of the varieties of many tropical crops and the Howards undertook an enormous amount of work in classifying wheat, tobacco, linseed, chickpea, fibres and other crops.

The only way to master the situation was to examine, review, and classify all the wheats of India. In the course of the intensive examination undertaken, involving thousands of specimens, a mass of data on the inheritance of characters was arrived at, covering such points as beardedness, grain colour, felting, grain consistency, and the shattering of the ear.

Samples of seeds from the chief wheat-growing areas were sown and the results were observed in 1906 and the succeeding years. The wheats of the Punjab were studied separately at Lyallpur and a number of unit species were isolated between 1906 and 1909.

Nearly forty different botanical varieties were found in the Indian wheat crop. Ten of these belong to the macaroni wheats (*Triticum durum* Desf.), six to the group of dwarf wheats (*T. compactum* Host); there is one variety of Emmer (*T. dicoccum* Schrank) and nineteen varieties of bread wheat (*T. aestivum* Linn. emend. Thell.). No spelt wheats were found.

Subsequently, the wheats of Baluchistan were examined and classified. Interesting forms intermediate between *T. turgidum* Linn. and *T. aestivum* Linn. emend. Thell. were found, but nothing of economic importance emerged from the material studied. In 1922, the classification of the wheats of Bihar was carried out as far as the unit species. Very interesting and valuable types were found in this series.

'These preliminary studies led to the isolation of large numbers of varieties and of unit species which formed the basis for subsequent work. Some of the unit species found were distinctly superior in general vigour and yielding power to the mixtures ordinarily grown.

'The type itself, however, is formed of an assemblage of individuals which may differ from each other to a very slight extent. Such an assemblage of individuals is termed a population and forms the raw material of the selectionist. If individual plants of this population are selected and grown separately, their progenies are termed pure lines.... The mean values of any particular character, such as yield, may differ, however, in the various pure lines composing a population, and it is on these differences that the possibility of any improvement by selection depends.'

The new Indian wheats, known as the Pusa wheats, were perhaps the greatest practical achievement of the Howards. Some 50 named varieties were eventually produced through brilliant and sustained work.

At Pusa, four varieties were at first isolated, namely 'Pusa 20', 'Pusa 21', 'Pusa 22' and 'Pusa 23'. Of these, 'Pusa 22' proved to be the most useful and subsequently gave rise to superior hybrids, but all the four were later discarded for various reasons. At Lyallpur in the Punjab, 25 agricultural types were isolated. Although none of these were of a really high quality, one

'Punjab 11', a white bearded wheat, with red chaff, was adopted for distribution on account of its good qualities. By 1923, the area under it increased to 750,000 acres (303,514 ha).

'Pusa 12' proved to be the most successful of all the early Pusa selections on account of its great adaptability and high-yielding power. It had a large grain of an intermediate texture, whereas its bright red chaff made it easy to recognize in the field. Distribution on a large scale was carried out in the United Provinces, the Simla Hill States, the eastern Punjab, Sind, and some of the Rajputana States. Yields as high as 37.5 maunds to the acre (approximately 3,459 kg/ha) were obtained. This wheat is also doing well in the Argentine.

There follows the story of the famous 'Pusa 4', again best told in the words of the original account. This wheat rivalled and then surpassed even 'Pusa 12' in popularity.

"'Pusa 4', obtained by selection from a heterozygote shortly after 'Pusa 12', was perhaps the best of the Pusa wheats as far as grain characters are concerned. It had a strong straw and a large, translucent white grain of very fine appearance. It was a rapidly maturing variety, immune to yellow rust and was very suitable for tracts where an early wheat is required.... 'Pusa 4' proved very suitable for certain tracts in India, notably Bihar, Bundelkhund, the North-West Frontier Province and Gujarat. When well grown the grain has a very fine appearance and was awarded the first prize for hard wheats in Australia.

"The phenomenal success of the Pusa wheats left the computators behind. Track could not be kept of the way in which they were spreading; the demand for seed far exceeded the supply. They were in demand by scientists and growers in the most distant parts of the world and were despatched to Burma, Java, Uganda, Nigeria, South Africa, Sudan, Argentine, Canada, and France; in Australia, at the Sydney agricultural shows they won first prizes several years running. They were mentioned in Parliament as an argument justifying the expenditure of more money on agricultural research."[1] Sir Albert himself, when on leave, attended the Mark Lane and Liverpool corn exchanges and had the felicity of hearing his wheats described as 'equal to any in the world'; the formal reports from the British milling industry were conceived in the most flattering terms; the milling and baking tests were more than satisfactory.

The Howards deserve credit for their pioneering work assisted by only a small staff, which led to the collection and study of all the available indigenous material, and the breeding of improved varieties either by selection or by inter-varietal hybridization. A great deal of scientific information was collected and Howard's book, *Wheat in India*, remained

[1]Howard, L.E. *Sir Albert Howard in India*, pp. 29-30

a standard work of reference for many years.

CHOWDHARY RAM DHAN SINGH (1891-1978) AND THE PUNJAB WHEATS

While the Howards were busy with their work at Pusa, wheat breeders in the States were likewise active and they also developed a number of varieties which were specially suitable for growing under the soil and climatic conditions of their respective areas. Some of the outstanding work was done in the Punjab. The person who deserves credit for this work was Ram Dhan Singh.

Ram Dhan Singh was born on 1 May 1891 in a peasant Jat family of the Village of Kiloi in the Rohtak District. He received his school education at Rohtak and his college education up to the Intermediate at the D.A.V. College, Lahore. He joined the Punjab Agricultural College, Lyallpur, in 1909, among the first batch of students admitted to the Diploma class, and obtained the Licentiate in Agriculture (L. Ag.) in 1912. From 1914 to 1919, he worked with Sir Albert and Lady Howard, at the Imperial Agricultural Research Institute, Pusa. Simultaneously, he worked for his Bachelor of Science degree from the Patna University. He obtained the degree in 1919. Thereafter, he proceeded to Cambridge University, where he received his M.A. degree in Natural Science (Tripos) and also Diploma in Agriculture.

Ram Dhan Singh entered the Punjab Government service in 1925 as Fodder Specialist. In 1926, he became the Cerealist, Punjab, which position he held till 1946, when he became the Principal of the Punjab Agricultural College and Research Institute, Lyallpur, retiring from that position in 1947.

Ram Dhan Singh changed the entire face of wheat husbandry far and wide by the development of wheats 'C 518', and 'C 591', which were released for general cultivation in the 1930s. 'C 518' was characterized by stiff straw and resistance to lodging. 'C 591' had excellent quality for *chapati*-making. These wheats were cultivated not only in the pre-Independence Punjab, the North-Western Frontier Province, Sind, the then United Provinces (U.P.), the then Central Provinces (C.P.), Rajasthan and Gujarat but also crossed the national frontiers, even as far into Canada and Mexico. 'C 591', on account of the pearly appearance of its grain, fetched premium up to Rs 4 per maund (approximately Rs 10.80 per quintal) at that time. Subsequently, he developed further crossbred wheats, namely 'C 228', 'C 250' and 'C 217'.

Many new varieties were also released after the retirement of Ram Dhan Singh from the material that he had collected. He was a practical field-worker, who spent more time in the field watching plants than sitting in an office chair.

Wheat-Breeding in Central Provinces, and Bewar (now Madhya Pradesh) and Bombay Presidency (now Maharashtra)

In Central Provinces and Bewar (Madhya Pradesh), a wheat breeding station was set up at Powerkheda in 1941, and Ekbote and his colleagues bred many resistant strains, including 'Hyb 65', which has very attractive grains and is resistant to black rust.

In evolving high-yielding varieties, considerable success was achieved in the Bombay Presidency. Kadam and his colleagues released 'Niphad 4' in 1942. However, breeding for disease resistance began in 1943 and crosses between 'Niphad 4' and Kenya varieties yielded the 'Khenphad' series. The 'Khenphad' wheats released in 1951, though resistant to black rust, were highly susceptible to the *Alternaria* disease.

DR B.P. PAL (b. 1906) AND THE NEW PUSA (N.P.) RUST-RESISTANT WHEATS AT IARI

The next phase of wheat breeding was marked by sustained scientific attention to the problems of diseases which afflict the wheat crop. Though fortunately there is no serious major insect pest of wheat in India, the fungal diseases are very important, in particular the rusts and the smuts. As in other parts of the world, rust constitutes the greatest hazard to high and stable wheat production. This second phase coincided with the appointment of Dr B.P. Pal as Second Economic Botanist at the Imperial Agricultural Research Institute, Pusa, in October 1933.

Pal, a Punjabi by birth, was brought up in Burma where, after a brilliant school record, he joined the Rangoon University, whose Biology Department was under the distinguished British Zoologist, Professor F.J. Meggitt. Professor Meggitt, who was a strict taskmaster, inculcated in his students the qualities of accurate and concise writing. After taking a first class M.Sc. (Hons) degree in Botany having researched on the Charophyta of Burma (the work was published in the Journal of the Linnaean Society), Pal won a State scholarship and went to Cambridge University to specialize in plant breeding. At that time, Cambridge was perhaps the most important agricultural research centre in the Commonwealth and the staff included renowned scientists such as Sir Rowland Biffen, R.A. Punnett, R.N. Salaman, John Wishart, and many others.

Pal worked under the well-known expert, Professor Sir F.L. Engledow, and was greatly impressed by the Professor's very great thoroughness in all respects and by his knowledge of agricultural problems in various parts of the world. Since Pal had gone there as a student of pure botany, and plant breeding has its greatest application in agriculture, he took courses in all the major subjects relating to agriculture, though specializing in plant breeding and genetics. Professor Engledow allowed Pal the privilege of assisting him in his wheat breeding investigations which gave Pal a very good opportunity to participate in a high-level wheat improvement programme. His Ph.D. work was on the problem of heterosis in wheat. After completing his studies at Cambridge, he went back to Burma for a few months and worked there as a rice breeder at the Central Rice Research Farm at Hwawli. He was then selected for the post of Second Economic Botanist at the IARI, Pusa, and joined his new assignment on 30 October 1933.

Dr Pal entered the Indian wheat-improvement arena at a stage when Professor K.C. Mehta, of the Agra University, with the help of an ample financial grant from the ICAR, had completed a large part of his monumental work on the wheat rusts and had been able for the first time to identify the races of wheat rust found in India. The time was ripe for a fruitful partnership between plant breeders and plant pathologists. Pal put up a scheme to the ICAR for a financial grant to carry out wheat breeding for resistance to rust in collaboration with K.C. Mehta. This collaboration marked an important turning-point in the history of wheat breeding in India.

Rust epidemics have been known to occur in India since a very long time. For instance, an epidemic of wheat rust in the Narmada Valley was recorded in 1827 by Major Sleeman, who wrote that in the Jabalpur District the total amount of wheat gathered in the harvest of 1827 was not even equal to the total quantity of seed that had been sown. But it was only after the first quarter of this century that really comprehensive studies on the wheat rusts and the damage caused by them were undertaken. Great credit goes to K.C. Mehta, who not only carried out an imposing amount of research himself on the subject, but built up a school of research which has included distinguished workers such as R. Prasada, V.C. Lele and L.M. Joshi.

The three major rusts of wheat in India are: black rust, also known as stem rust, caused by *Puccinia graminis tritici;* brown rust, also known as leaf rust, caused by *Puccinia recondita;* and the yellow rust, also known as stripe rust, caused by *Puccinia striiformis.* The first two are of general distribution in India, whereas the third is mainly found in the north-western hills and plains, and also in the Nilgiris and the Pulney Hills. Any one of the rusts in a severe form can greatly damage, or, in extreme cases, even destroy the wheat crop. What greatly complicates the problem of breeding wheat varieties resistant to the three rusts is the fact that within each of them there exist a large number of forms of the fungi which, while morphologically indistinguishable, differ very much in their ability to infect the various varieties of wheat. In fact, these forms, or 'physiologic races' as they are called, are differentiated and identified on the basis of the reaction they produce, i.e. the types and the number of pustules on a standard set of wheat varieties, known as 'differentials'. There is a different set of differentials for each of the three rusts.

In nature, no cultivated variety of wheat is completely resistant to all

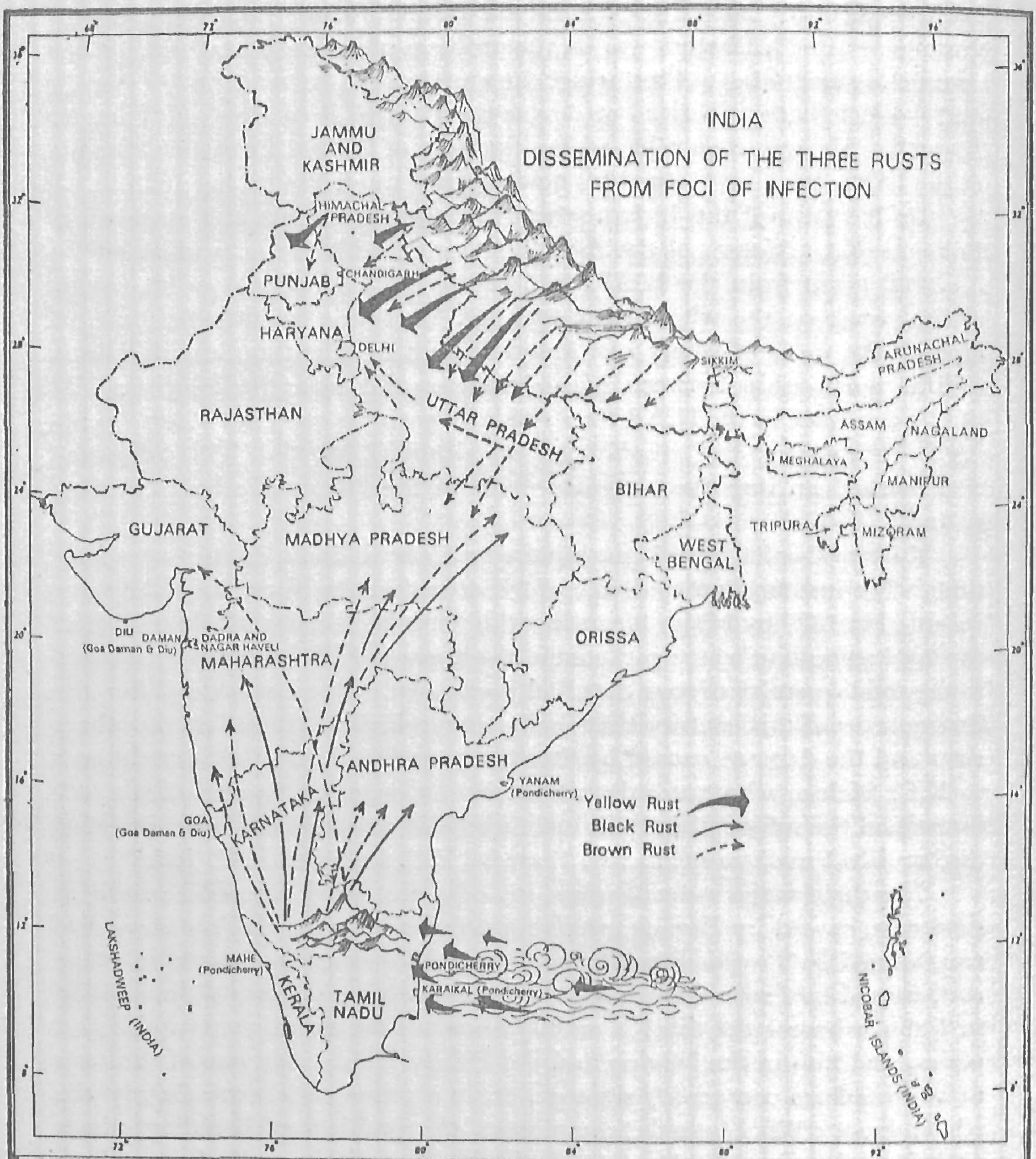

FIG. 67. Dissemination of wheat rusts in India from the foci of infection

the physiologic races of the three rusts. But, fortunately, all the races are not present in any one country. Their incidence varies from region to region, and from year to year. The task of breeding for rust resistance is further complicated by the fact that from time to time new races of the rust fungi arise in nature. Most of them arise through mutation, but in tempe-

FIG. 68. Ram Dhan Singh (1891 to 1978), Cerealist to the Punjab Government, renowned plant breeder, developed wheats 'C 518' and 'C 591', which were released in 1945 for general cultivation in northern and western India. These wheats crossed the national frontiers and reached Canada and Mexico

FIG. 69. Dr B.P. Pal (b.1906). An outstanding plant breeder who has done creditable work in breeding rust-resistant varieties of wheat. He was the first agricultural scientist to be appointed Director-General of the Indian Council of Agricultural Research. During his tenure Co-ordinated Research Projects on various crops came into existence

Fig. 70. Mian Sir Fazl-i-Husain (1877 to 1936), founder of the Rural Party (Unionist Party) in the Punjab. He allotted land to graduates in Agriculture in the Lyallpur District. He was also Member Education, Health, and Lands, Government of India, and was instrumental in bringing the Imperial Agricultural Research Institute from Pusa to New Delhi

FIG. 71. Chaudhary Sir Chhotu Ram (1881 to 1945), Co-founder of the Unionist Party, started the Rural Reconstruction Scheme as Minister of Agriculture, Punjab, reformed the *mandis* ('markets') and gave relief to indebted farmers by his agrarian legislations

rate countries, in the case of black rust, for example, hybridization occurs on the alternate host of the rust fungus, namely the barberry, leading to the development of new races. Besides the rust diseases, the wheat crop in India suffers from loose smut, flag smut, hill bunt, Karnal bunt, leaf blight, and a large number of other diseases. Although these diseases are not as important as the rusts, some of them, e.g. loose smut and flag smut, and the two bunts, can cause considerable damage in certain areas in some years.

It is against this scenario that wheat breeders had to work. Techniques had not yet been evolved for testing the resistance of varieties under controlled conditions. In the case of the wheat rusts, even the physiologic races occurring were not known until the studies of K.C. Mehta resulted in their identification for the first time in India.

Bringing a fresh outlook, and with his experience of wheat breeding at Cambridge, Pal set about the difficult task of breeding wheats which would combine high yield and high grain quality with disease resistance and other agronomically desirable characters. He built up a large collection of wheat germplasm and entered into close collaboration with K.C. Mehta in testing parental material and hybrids for rust resistance, and with B.B. Mundkur for resistance to the smut diseases. Owing to financial exigencies in the preceding period, the resources available at the Imperial Agricultural Research Institute were somewhat meagre and it was fortunate that Pal's scheme for breeding rust-resistant wheats in collaboration with K.C. Mehta was sanctioned in 1935 by the Imperial Council of Agricultural Research. From this small beginning, there was to be, in due course, a great development of wheat research, both at the Centre and in the States. This work at the present time is recognized as being one of the strongest national wheat-improvement programmes in the world.

Even though at the time the research project was initiated in 1935 the number of races of rust identified was small, adequately resistant donor parent varieties could not be found among the Indian wheat varieties, and the late-maturing foreign wheats had to be used in hybridization. As the stupendous task of combining, in a single variety, the resistance to all the races of the three rusts with suitable agronomic characters, appropriate for Indian conditions of cultivation, would have been virtually impossible of accomplishment in one step, Pal planned the breeding strategy in two stages. In the first stage, resistance to the races of each of the three rusts separately was built up, whereas in the second stage the resistance so obtained was brought together in agronomically suitable varieties by carrying out multiple crosses on a large scale.

This work yielded a number of useful resistant varieties, the climax being reached with the breeding of the wheat 'NP 809' after 18 years of work. The wheats bred at the IARI, New Delhi, were called New Pusa wheats, NP in brief. This was the first variety evolved under a planned programme which united, in a substantial degree, resistance to all the three rusts ravaging the wheat crop in India. In planning the crosses, a parent variety immune from loose smut was deliberately included as, after the rusts, it is the most widespread and destructive disease of wheat in India. This effort paid dividends, as some of the new varieties evolved by Pal were immune from loose smut, in addition to being resistant to rust. Apart from 'NP 809', another very useful variety for the hills, 'NP 770', was developed by Pal from a cross between 'Pusa 4' and the Japanese variety, 'Kononso'. This handsome, tall, late-maturing variety was resistant under field conditions to loose smut and yellow rust, these being important diseases of the higher hills. The grain quality of the variety was also of a nature which is liked by the inhabitants of these areas.

In addition to wheats for the hills, Dr Pal produced a series of wheats suitable for the plains of India, among them the outstanding ones being 'NP 710' and 'NP 718', which were found to have great adaptability and, at one time, covered a very large portion of the wheat-growing area of the country.

CHAPTER 38

THE GREAT ECONOMIC DEPRESSION, 1929-33

ITS ADVERSE EFFECT ON FARM ECONOMY
INDEBTEDNESS OF THE FARMERS
MIAN SIR FAZL-I-HUSAIN AND THE PUNJAB UNIONIST PARTY
F. L. BRAYNE'S GURGAON SCHEME FOR RURAL DEVELOPMENT
CHOWDHRI SIR CHHOTU RAM AND HIS ENACTMENTS TO GIVE RELIEF TO THE INDEBTED FARMERS

In 1929, India, like the rest of the world, was hit by the Great Economic Depression, which continued till 1933. Wheat, which was the key crop of India, faced disaster. It was selling at as low a price as one rupee and eight annas per maund (Rs 4.05 per quintal). The British Government followed a *laissez-faire* policy, while agriculture and agriculturists faced disaster. Vera Anstey, an economist, remarks, 'During the decade preceding the Depression, the Western economies had a spell of expansion of output, income and employment. In India even during 1925-29, despite some expansion in the protected manufacturing sector of the economy, there was stagnation. Producers of agricultural commodities were selling their stationary output at falling prices. Therefore, while in the Western economies, the fall in prices due to Depression was from a peak level, in India the prices fell from a level which was already very depressed. For instance, the general wholesale price index for Calcutta (July 1914=100) which stood at 202 in 1920 declined to 173 in 1924 and 141 by 1929 and touched the rock-bottom of 87 points in 1933. Indices of cereals, pulses and oilseeds in 1933 stood at 66, 84 and 74 points respectively.'[1]

The wages of agricultural labourers and the earnings of the members of a farmer's family were already low, as may be seen in the statement below.

Year		Per day					
		Wages of the hired labour			Earnings of a farmer's family member		
		Rs	a.	p.	Rs	a.	p.
1927-28	..	0	5	11	0	6	8
1930-31	..	0	3	6	0	0	9
1931-32	..	0	4	2	0	3	0
1934-35	..	0	3	11	0	5	2

Source: Kartar Singh and Roberts, *Textbook of Punjab Agriculture*, p. 70

[1]Vera Anstey, *The Economic Development of India*, London, Longmans Green & Co., 1952, p.493

While a labourer's wage was 5 annas 11 pies per day in 1927-28, the earnings of a member of a farmer's family were 6 annas and 8 pies. In the disastrous year of 1930-31, the wage of a farm labourer came down to 3 annas and 6 pies, and the earning of a member of a farmer's family was only 9 pies. Agriculture became a losing business and all incentive for production was killed.

Indebtedness of the Proprietors of Land

As a result of the depression, the farmers could pay their land revenue and irrigation rates with great difficulty, and in most cases by borrowing money from money-lenders, and their indebtedness increased. Sir Malcolm Lyall Darling, author of *Punjab Peasant in Prosperity and Debt* (1932) commented that the prosperity of the Punjab had come to an abrupt end, and wherever prosperity is mentioned in his book, the tense has had to be changed from the present to the past. The Punjab Banking Enquiry Committee estimated that by 1929 the total debt of the proprietors of land in the Punjab had risen to 1,170 million rupees. In 1930, their total debt was Rs 1,200 million, which was 22½ times the land revenue of the province.[2] The total agricultural debt with respect to British India was estimated at Rs 8,740 million. Between 1929 and 1936, the debt nearly doubled. The greatest indebtedness was in Bihar and Orissa (Rs 1,550 million), followed by Madras (1,500 million), Punjab (Rs 1,350 million), U.P. (Rs 1,240 million), Bengal (Rs 1,000 million), Bombay (Rs 810 million), C. P. and Berar (365 million), and Assam (Rs 220 million).

The average debt per indebted proprietor in the Punjab was Rs 463 in 1919, and in 1930 it rose to Rs 600. The larger proprietors were more heavily indebted than the smaller ones. Debt was as widespread among tenants as among proprietors. Only 17 per cent of the proprietors were free from debt, and the rest were all in debt. Due to this desperate situation, many agriculturists turned into landless labourers.[3]

The National Commission on Agriculture (1976) commented, 'There was a sharp contrast between the measures adopted by the Governments in the Western countries and those adopted by the Government of India to combat the effects of the Depression. In the Western economies, agricultural prices were raised by restricting production, the purchasing of surplus produce from the market and encouraging exports through bilateral agreements. There were other economic, fiscal and monetary measures, such as investment-planning for increasing output, income and employment and currency depreciation. In India, a few measures were taken and they

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[2]Darling, M.L. *The Punjab Peasant in Prosperity and Debt* (1932), p. 10

[3]Darling, M.L. *The Punjab Peasant in Prosperity and Debt*, pp. 18,21 and 22

were very inadequate and some of them came after a time-lag. No action was taken by the Government to support the prices of agricultural commodities, except the price of sugarcane. Nor did the Government take any measures to inject purchasing power into the economy, particularly the rural economy, through public works or give liberal credits to individuals for undertaking works of agricultural improvement, construction, etc. In fact, the Government pursued an exactly opposite policy. Gross public investments were reduced from Rs 814.4 million in 1929-30 to 334.0 million by 1933-34. Expenditure on agricultural research, etc., was drastically reduced; not even half a per cent of the total expenditure—Central and Provincial—was allocated to agriculture.

Assessing the Government of India's policies, Gadgil observed: "India was perhaps the one important country in the world in which the State did almost nothing to help the agriculturist through the crisis. On the question of price policy.....the Government of India was swayed by considerations very remote from those of the welfare of the agriculturist'.[4]

MIAN FAZL-I-HUSAIN AND THE PUNJAB UNIONIST PARTY

In this dark period, a leader of rural people emerged in the Punjab. He was Mian Fazl-i-Husain (1877 to 1936). He came of a family of Moslem Bhatti Rajputs of Batala in the Gurdaspur District. His ancestors Imam Bux and Makhe Khan served in the Sikh Army with distinction and had received a *jagir* for military services. Having failed to qualify for the ICS in the competitive examination, held in London, Fazl-i-Husain chose to elect legal profession as an alternative. He qualified as a Barrister-at-Law from Gray's Inn, London, and, on return to the Punjab, set up practice and entered into politics. He was elected to the Punjab Legislative Council and became the Revenue Member. The cardinal principle of his policy as the Revenue Member (1926-30) was the protection of the peasantry against money-lenders as well as against unjust Government demands. He founded the Punjab Unionist Party on economic basis.

Though the Rural Party led by Fazl-i-Husain primarily consisted of the Muslims, it soon attached to itself a few rural Sikhs and Hindus, who voted with the party when there arose questions which, broadly speaking, affected rural as opposed to urban interests. The party from its very inception recognized no caste, nor creed, and was open to all communities. The basic principle of the party was to assist and encourage backward areas, backward classes, and communities. This principle included the protection of the peasantry, particularly against the Hindu money-lender, and the extension of beneficent activities by the Government to the hitherto neglected rural areas; in other words, it meant the multiplication of rural dispensaries,

[4] *Report of the National Commission on Agriculture* (1976), Part I, p. 129

primary schools, high schools, intermediate colleges, co-operative societies, rural veterinary dispensaries, and agricultural farms. The beneficent activities of the Departments of Agriculture, Veterinary and Co-operative received a new impetus and support.

On the question of economic inequality, Fazl-i-Husain demonstrated by agrarian legislation what could be done to alleviate the sufferings of the peasantry, and although he was not a socialist in the light of the policy he pursued, he wrote the opening chapter in a volume in which many unexpected pages in the history of property is destined to be inscribed. He indicated how necessary it was for the State to take the initiative in raising the standard of living of the man behind the plough, and how this could be done by legislation and governmental machinery long before the masses were able to help themselves.

The Punjab Regulation of Accounts Bill, 1926

In 1926, with the concurrence of the Governor and the help of his party, Fazl-i-Husain succeeded in getting the Punjab Regulation of Accounts Bill passed. It provided for the preparation of six-monthly statements of accounts, and these statements were not to carry any presumption of correctness against the borrower, whereas the failure to keep accounts was subject to a penalty.

Liberalizing the 'Taccavi Loans' and Setting up Graduate 'Chaks' in the Canal Colonies

Azim Husain, his son and biographer, thus describes the measures promoted by his father to help the farmers. 'Government, as he saw it, should not only accord fair treatment to the peasant, but should actively assist him. He, therefore, revised the rates relating to the grants of *taccavi* loans and granted such loans on a liberal scale. Educated men were encouraged to take interest and pride in agricultural pursuits, and a scheme for the creation of model villages and 'Graduate *Chaks*' in the colony areas was introduced.

In 1928, Fazl-i-Husain secured the passage of the *Punjab Land Revenue (Amendment) Act*. The Act placed the reassessment of land revenue on a statutory basis. It restricted the share of the State to a maximum of 25 per cent of the net assets, and the measure of enhancement to a similar proportion in excess of the assessment at the expiring settlement. Before this amending Act, the State could claim 50 per cent of the net assets and enhance land revenue to an unlimited extent. The most important provision was, however, the one which fixed forty years as the period of settlement. This was a great boon to the peasantry, who could now cultivate the land on a long-term basis without fear of uncertain and repeated settlement operations and the perpetual anxiety of unlimited enhancement of the

Government demand. Although the amending Act caused Government a loss of 30 million rupees over the full term of settlement, Fazl-i-Husain regarded the relief afforded to the peasantry as vital and considered the sacrifice eminently worthwhile.[5]

CHOWDHRI SIR CHHOTU RAM, 1881-1945

Chhotu Ram was born in a poor Jat family on 24 November 1881 at Garhi Sampla, a village in the Rohtak District of the Punjab (now in Haryana). His original name was Ram Rachhpal. As he was the youngest member of the family, he was called Chhotu. When he sought admission in the village school, the teacher put down his name as Chhotu Ram.[6] His father, Chowdhri Sukhi Ram, was a small farmer. Chhotu Ram passed his matriculation from the Mission High School, Jhajjar in 1899, and graduated from St Stephen's College, Delhi, in 1905. After working as an Assistant Private Secretary to Raja Ram Pal Singh of the Kalakankar State (U.P.) for about six months in 1905, he shifted to Agra and worked as a teacher in St John's Mission High School. In 1911, he took his degree in Law from the Law College at Agra, and practised as a lawyer at Agra and later at Rohtak.

Chhotu Ram was the founder-President of the All-India Jat Maha Sabha established in 1906. He founded the All-India Jat Association in 1918, and presided at its annual functions many times. He appeared as the leader of the delegation of the Zamindar Association (Punjab) before the Montagu Commission.

Chhotu Ram was the co-founder of the Unionist Party, along with Fazl-i-Husain. When Fazl-i-Husain met Chhotu Ram for the first time, he recorded in his diary: "Saw Chhotu Ram. He is hard-working, intelligent and clear-headed, distinctly and considerably above the average. If my health permits my forming a ministry under the Reforms, it will not be without Chhotu Ram. We had a very satisfactory talk. I wish Firoz Khan Noon were possessed of even half the qualifications which distinguish Chhotu Ram from others". Again, speaking at the inauguration of the Unionist Party Headquarters he said: "Chowdhri Chhotu Ram did excellent work as minister; his work as leader of the Unionist Party is unsurpassed by any leader of a Party in any of the provincial legislatures. The ability, the industry, the sincerity, the enthusiasm, the perseverance, the persistence, the courage and the independence, all of which he possesses in pre-eminent degree, have won him the gratitude of the Party and of every member of the Party.[7]

[5]Azim Husain, *Fazl-i-Husain, a Political Biography*, Bombay, 1946, p. 149
[6]Verma, D.C. *Sir Chhotu Ram, Life and Times*, New Delhi, 1981, p. 34
[7]Azim Husain, *Fazl-i-Husain, a Political Biography*, Bombay, p. 279

Chhotu Ram worked as Minister for Agriculture and Industry in the Punjab Government from 1924 to 1926, and as Development and Revenue Minister from 1937 to 1945.

Work on Agriculture and Rural Development

During the period from 24 September 1924 to 26 December 1926, Chhotu Ram started schemes for the improvement of agriculture, irrigation and animal husbandry. He revived the Bhakra Project. Work was taken in hand with respect to the Jogindernagar Hydel Works, road construction and village industries. Rural co-operative societies and village *panchayats* were encouraged and strengthened.

Warehouses

The Punjab Government also set up a chain of warehouses where the peasants could store their produce till favourable prices could be obtained. The owner of the produce was entitled to draw two-thirds of the value of the stored goods in advance.

Support to F. L. Brayne's Rural Reconstruction Scheme

Frank Lugard Brayne (1882 to 1952), who was Deputy Commissioner of Gurgaon from 1920 to 1927, was a pioneer of the Rural Reconstruction Scheme. He drew a scheme for the rural development of Gurgaon, a backward district, now in Haryana. Describing the objectives of his scheme Brayne stated, "Our object in Gurgaon has been to jerk the villager out of his old groove, convince him that improvement is possible to kill his fatalism by demonstrating that both climate, disease and pests can be successfully fought. He must be laughed out of his uneconomic and unhealthy customs and taught better ways of living and farming. Further the secret of our success was to deal with the whole of village life, to take the whole district as the field of operations and to deluge the areas with every form of propaganda and publicity that could be devised or adopted or afforded. Uplift is a mass movement, a combined assault, and no area, no part of life, and no method of attack can be neglected."

Chhotu Ram, as Minister for Agriculture, gave full support to the Gurgaon Scheme. He closely followed its progress and was later instrumental in its evolution into the Rural Reconstruction Scheme. The Gurgaon Scheme proceeded on the basic premise that all sectors of rural economy had to be tackled at the same time. It embraced the setting up of institutions which could carry out research in rural development and train workers and bring out a journal. Work was started in the field of sanitation and education. Agricultural development received impetus through the popularization of improved implements, seeds and compost manures. Co-operation and social reforms were promoted. It was Chhotu Ram who was responsible for the first domestic training schools for female workers in India. Brayne later wrote that he liked working under the guidance of Chhotu Ram, 'for several years my official chief—the best I ever had. He was quick and decisive and knew his own mind, yet would listen and discuss, and could never disagree except on honest grounds.' After retirement, Brayne settled as a fruit-farmer at Ashill, Thetford, Norfolk, in England.

For a time impressive results were achieved in Gurgaon, which included notable improvements in cattle breeding and methods of cultivation, reafforestation, the destruction of pests, the encouragement of co-operation, the adoption of measures for the prevention of disease (including the digging of no less than 40,000 pits for village refuse, manure, etc.), educational progress (including the enrolling of over a thousand girls in boys' schools), and great reductions in the making of dung-cakes. The central idea is to imbue the villagers with the ideals of the dignity of labour, the dignity of woman, the dignity of cleanliness, and the dignity of service, by means of homely example and precept—"intensive propaganda, aided by laughter and often by song." The object is to train "village guides", teachers, voluntary workers and—above all—the women, in the elementary principles of sanitation, medical aid, co-operation and agricultural improvement, in order that they may act as "centres of infection" for the whole district. A "School of Rural Economy" and a "School of Domestic Economy" (for the women) have been established with this purpose, and Brayne has expressed the hope that "every official who comes in contact with village life will, before long, be compelled to go through a course" at the School of Rural Economy.[8]

After a year from the departure of Brayne from Gurgaon, the villages relapsed to their previous unsatisfactory condition. The main reason for setback in agricultural development was the poverty of the farmers, which had been accentuated by the Great Economic Depression. When the farmer does not receive adequate price for his produce, he has no incentive to make improvements. The importance of Brayne's work lies in the fact that he highlighted the need of improving the lot of rural people. In a sense, the Gurgaon Scheme was the predecessor of the Rural Reconstruction Scheme launched by the Congress Government in U.P., and also of the Community Development Scheme which was later on launched in Free India.

Relief in Taxation to the Farmers

Chhotu Ram set up two committees: (1) to devise measures to reduce the burden of taxation on the peasants, and (2) to devise means to increase the revenue of the Punjab Province with a view to increasing its financial

[8]Asiatic Review, January 1929, *Village Uplift in the Punjab*, pp. 116, 117, 121

resources. The taxes were to provide water, education and medical relief for the villagers in the Punjab. It was as a result of his efforts that very small holdings were exempted from the payment of land revenue. In some districts, e.g. Dera Ghazi Khan, the *jinsi batai* (the division of produce) was abolished. In many areas, irrigation charges were reduced.[9]

Agriculture

A new direction was given to agricultural development by Chhotu Ram. Improved seeds and implements were promoted. One-third of the 93,000,139 acres (37,635,856 ha) under wheat, for instance, used Ram Dhan Singh's new wheat seed, 'C 591', developed at the Punjab Agricultural College, Lyallpur (now in Pakistan and renamed Faisalabad) and Labh Singh's new strain of American cotton, 'LSS', was popularized. A new variety of groundnut was tried out for the first time and was successful in the Samrala Tahsil of the Ludhiana District. The man who introduced this crop into the agriculture of the sandy soil of the villages of Samrala was Charanjit Singh, a retired Inspector of the Co-operative Department. He belonged to the Village of Takhran. The introduction of groundnut changed the economy of the poverty-stricken villages of Samrala. A new variety of potato was popularized in the Kangra District. Irrigation schemes were implemented with speed. The Haveli Project, which irrigates one million acres (404,686 ha), was completed in two years and a half. Work was also started on the Beas Project. Irrigation wells were dug on a large scale. Electricity from Jogindernagar Hydro-electric Works was provided in some suburban villages. All these measures resulted in the increased production of foodgrains.

Reform of 'Mandis'

The measures sponsored by the Unionist Party led to an increase in the production of the primary agricultural commodities, but shopkeepers and traders, who had shops in the *mandis*, robbed the peasants. Malpractices prevailed. These included fraudulent weights—one set for purchasing the peasant's produce and another set for selling to him his requirements. Quoting a banking report, Chhotu Ram said that 43% of the 6,000 weights and 69% of the 8,000 scales checked were found to be fraudulent. A variety of impositions were revived by the *mahajans* on the peasants. Chhotu Ram, therefore, proposed controls on the operation of the *mandis*. The Punjab Agricultural Marketing Act, 1939, gave statutory protection to the agriculturists against these shady deals and malpractices of the traders and their commission agents in the markets, whereby the peasant used to be defrauded of his legitimate dues from the sale of his produce.

[9]Madan Gopal *Sir Chhotu Ram—A Political Biography*, New Delhi, 1977, pp. 65, 66

Incentive Price for the Wheat-growers of the Punjab

Lord Wavell, the Viceroy, called a meeting of the Provincial Food and Agriculture Ministers to devise measures to procure foodgrains at reasonable prices and asked all the Ministers to agree to the imposition of control on the prices of wheat at six rupees a maund (Rs 16 a quintal). Chhotu Ram was the only one to disagree. He was asked why he alone should disagree. Chhotu Ram replied, "They represent the deficit areas; most of them want wheat. I represent a province that is in a position to supply, and I have to think of the well-being of the peasants, and shall not agree to anything less than ten rupees. If this is not agreed to, I will hold back the stock." Eyebrows were raised. The Viceroy was angry. 'He had no time for arguments and left the conference room'. Chhotu Ram also left, saying that he too had little time to waste. The sequel to the altercation, however, was that the Government of India fixed the price of good-quality Punjab wheat at eleven rupees a maund (about Rs 29.70 a quintal).

Peasant-Relief Fund for Natural Calamities

The Peasant Relief Fund, the first of its kind in India, was established on the initiative of Chhotu Ram. To this fund, the Government contributed 5.5 million of rupees a year for the unco-ordinated, sporadic and *ad hoc* relief measures and to extend relief to the peasants who became victims of natural calamities, e.g. hailstorms or damage to their crops by locusts.

Curbing the Money-lenders and Providing Debt Relief

The greatest work of Chhotu Ram was in curbing the money-lenders, stopping malpractices by them and in giving relief to the indebted peasants. There are certain experiences in early life which have an abiding effect on a person. As a schoolboy, Chhotu Ram saw the indignities inflicted by the money-lenders on their rural clients. On one occasion, he accompanied his father, Sukhi Ram, to the shop of the village money-lender for settlement of accounts. It was a hot afternoon in summer, and the fat money-lender was profusely perspiring. On seeing the boy Chhotu, the money-lender threw the cord of the *punkha* towards his father and asked him to pull the fan. Chhotu Ram was incensed by his arrogant behaviour and asked him to call his own son to pull the *punkha*. Chhotu Ram neither forgot nor forgave that insult. When he became Revenue Minister of the Punjab, he felt that time had come to settle the scores with the tribe of the blood-sucking money-lenders.

Chhotu Ram often said that he was not really opposed to the *mahajans*. "I am not their enemy; I consider them to be my brothers. My enmity is against the merciless ways of the money-lenders who rob the peasants of the fruits of their labours, and usurp their lands through *benami* transactions.

"There were people in this country", he said, "who fell sick because of malnutrition, and others who took resort to medicines to digest their food. An effort would be made to remove this anomaly. The Unionist Government meant to enforce measures to lighten the burden of the peasantry, the operation of the *mandis* on co-operative principles, eliminating corruption, helping the organization of the village *panchayats* for administrative and judicial purposes, the writing-off of rural indebtedness, the restoration of mortgaged lands and so on.

"The exploitation of the weak by the strong, of the poor by the rich and of the ignorant by the intelligent has been a feature of human history in almost all ages and all countries. Usury is one of the most common forms of exploitation and indebtedness is the occasion for it."

The money-lenders resorted to many foul methods in collusion with bailiffs to coerce the indebted peasants. One of the tricks was for the decree holder to go to the house of a judgement-debtor for execution accompanied by a court official either on a festival day or at a time when there was a social function, such as a marriage, and friends and relations of the judgement-debtor were assembled. The decree-holder knew that the sight of a court official on such an occasion was likely to produce a great coercive effect on the judgement-debtor and, with that knowledge in his mind, he went to the village or *mohalla* of the judgement-debtor. In the first instance he sent word to the judgement-debtor that he should arrange for payment, failing which he would have either the property of the judgement-debtor attached or his person arrested in the presence of his friends and relations. This trick generally succeeded and the judgement-debtor, in order to save his honour, resorted to every possible means to satisfy the demand of the decree-holder.

Another trick employed was to conspire with the bailiff and secure a report of resistance. On the basis of this report, a criminal prosecution was threatened and the judgement-debtor was thus brought to his knees.

All the cotton, *gur*, oilseeds, wheat and other agricultural produce of a debtor found its way into the shop of the money-lender. The debtor has, in accordance with ancient custom, to make occasional and frequent presents of fodder, fuel, milk and personal service to his *sahukar*. No credit was given to the debtor for these presents.

The Punjab Registration of Money-lenders Act, 1938, provided for the elimination of malpractices by establishing control on the business of money-lending by compelling the money-lenders to obtain licences.

The list of possessions of the peasants that could not be attached in pursuance of a decree from the court was expanded to include bullock-carts, milch cattle and the area earmarked for the keeping of cattle, manure and fodder. The entire fodder crop, one-third production of foodgrains, and at least 20 maunds (740 kg), of food were also exempted. The vested interests tried to question the constitutional and legal validity of a State Legislature passing such a legislation. A threat was given that the matter would be taken to the Federal Court to declare the legislation of the Punjab Assembly *ultra vires*. Sir Sikander Hyat Khan, the then Chief Minister, was unnerved. Did Chhotu Ram really have mass support? To convince him, Chhotu Ram arranged a *zamindara* conference at Sonepat. It was attended by 100,000 farmers. This was the first farmers' rally in British India. Sir Sikander's eyes were opened and he realized that there was a mass following behind these demands. Other conferences followed at Lyallpur and Gujarat in the predominantly Muslim areas of the Punjab and were equally well attended. The real achievement of Chhotu Ram was not in the agrarian legislations which he fathered, but the class consciousness he created in the peasantry.[10]

The Restitution of Mortgaged Land Act, 1938, provided for the restitution of land mortgaged before 8 June 1901, free of any cost, to their alienors. This Act made 366,780 mortgagers redeem 835,000 acres (337,913 ha) of their land mortgaged for Rs 41,300,000, which under the ordinary law in force they could not have redeemed. The Punjab Alienation of Land Act (Second Amendment), 1938, declared invalid all *benami* transactions of lands made in contravention of the Land Alienation Act (1900). The total value of such *benami* mortgages in the province was estimated at Rs 150 to 160 million. All this land had been mortgaged to non-agriculturists as creditors through the good offices of such agriculturists as offered their names to be entered in the records of *patwaris*.

The Relief of Indebtedness Act XII, 1940, was a radical measure. The problem of indebtedness was solved to a great extent by this Act. Debt Conciliation Boards were established and the excessive load of compound interest was removed, and the debts were reduced to reasonable levels.

Chhotu Ram was a man of strong convictions, on which he never compromised. As Minister for Revenue and Development, Punjab, from 1924 till his death in 1945, he served the farmers. As a leader of farmers, he occupied an unrivalled position. The agrarian laws which he promoted were considered by progressive thinkers as pioneering measures. For his selfless work, he is still remembered and respected by the peasantry of the Punjab and Haryana.

[10]Verma, D.C. *Sir Chhotu Ram, Life and Times*, New Delhi, 1981

CHAPTER 39

EARLY EXPERIMENTS IN TRACTOR CULTIVATION IN THE UNITED PROVINCES, THE CENTRAL PROVINCES AND THE PUNJAB

1914-1932

SARDAR JOGENDRA SINGH, A PIONEER IN TRACTOR CULTIVATION

STEAM-TRACTORS were invented in 1890 in the USA, and by 1912 they attained their peak of size and performance. It seems that steam-tractors reached India before the close of the nineteenth century and were used for the eradication of *kans*, a tenacious weed. Bryce C. Burt, who later on succeeded Sir T. Vijaya Raghavacharya as Vice-President of the ICAR, was Deputy Director of Agriculture, U. P., from 1908 to 1921. He states, 'As regards the application of steam power to the eradication of deep-rooted weeds, it may be mentioned that steam-ploughing experiments were carried out in the Banda district by the Public Works Department some thirty years ago and that large areas were cleared and put under cultivation.' *Zamindars* and old residents told me that these areas were still practically free from *kans*, and were under cultivation, and there were many enquiries from farmers as to why Government did not repeat the experiment on other land. Several *zamindars* told me that they would be willing to pay a fixed sum per acre for steam-ploughing."[1]

RECLAMATION AND CULTIVATION OF WASTE-LAND IN KHERI DISTRICT OF U.P.

An expriment in reclamation and cultivation of waste-land was carried out in 1914 by Sardar Jogendra Singh (1877 to 1946). He was Minister of Agriculture, Punjab (1926-1937), and Member, Viceroy's Executive Council in charge of the Department of Education, Health and Lands (1941-1945). He thus describes this experiment: "I inherited an area of over 12,000 acres (4,856 ha) known as Aira Estate in Kheri District in U.P. in 1898. It was then yielding an annual rental of less than Rs 20,000. The land was good, a light loam which was periodically renewed by floods, and the yields of crops that matured were generally very high. Most of the land was taken up by tenants who, in spite of large holdings and comparatively light rents, were poor and did not know how to help themselves. I made up my mind to live with them and for them—a resolution which I have not been able to keep.

"My estate was situated in the backwater of the district. It did not

[1]Burt, B.C. Steam-Ploughing Experiments in the Aira Estate, Kheri, U.P. *Agric. J. of India*, Vol. IX (1914)

possess even a *kacha* road. There was no hospital within an area of ten miles (16 km). The nearest post office was nearly nine miles (14.5 km) away. It cost nearly Rs 16 to carry 100 mds. (37 quintals) to the district headquarters, a distance of 21 miles (34 km). The cultivation of economic crops was unknown. Large areas were lightly ploughed and sown, but the average yield of harvested crops was always poor. If the agriculturists, following a dry year, sowed maize, heavy floods swept the land and rich green battalions of maize withered away. It seemed to me my first duty as a landlord is to allow the land some rest, give fixity of tenure and easy rents so that the cultivator might get some confidence and take to more intensive methods of agriculture. The difference in cultivation in lands which are given on rent in kind and those which are given on fixed cash rent is visible at once. The former are cultivated without much attention, while the latter are manured, harrowed, and kept like a garden with no corner left uncared for.

"I began slowly by offering land at cheap cash rents, coupled with the condition that the tenant should grow either tobacco or sugarcane. I started at about Rs 5 per acre (Rs 12.35/ha), and now good land is in demand at about Rs 15 per acre (Rs 37/ha). After renting out worth-while land there remained 2,000 acres (809 ha) of flood-swept area for which no tenants could be found.

"On this area I wanted to farm on my own account to realize and understand directly the difficulties of the producer. I wanted to start steam-ploughing, but there was no road to my estate, and it seemed impossible to bring a heavy engine through ploughed fields and over deep *nalas* and rivers.

"With the advice of Mr Standley, who happened to be acting as an agricultural engineer, I procured a traction engine and then began the journey from Lakhimpur to Aira. The driver sent by Messrs Burn & Co. declared it was impossible to carry the engine along. I persisted and it took nearly a month and a half to do the 21 miles (34 km). We pushed, we hauled the panting engine through soft soil and deep *nalas*, and a large stream was crossed by anchoring the cable to a tree and allowing the engine to work its way up. The driver protested, but the plan succeeded and we marched forward again. The engine had to be taken to pieces and placed on a ferry boat to cross another deep stream and put together again on the other side.

"One evening the engine steamed in followed by crowds of villagers. Next morning we started the ploughing. The engine carried behind it a disc plough which cut up a large sod without breaking it. The operation did not prepare the field for the seed—it needed re-ploughing. But even this first operation was not smooth working—the soil was of unequal density, and often in a single turning the engine sank in two or three places and hours were lost in hauling it on to firm ground. Mr Burt, of the Agricultural Department, and Mr Jeffery, of Messrs Burn & Co., and a representative of Messrs Ransome Jeffery & Co., all helped me with the experiment. The plough supplied by Ransomes was twisted in the heavy soil after an hour's work.

"It became clear that on light grass-bound loams direct ploughing could only break the land at a cost which did not seem to me any the cheaper than the ordinary ploughing by bullocks. It meant the maintenance of ordinary ploughs and the required number of bullocks in addition to the steam plough.

"The experience of taking the tackle across country for 21 miles (34 km) was enough to preclude any further experiments with the heavier engines required in a double tackle. Experiments with an Ival motor tractor were no better. Mr Johnson, of Messrs Fowler & Co., recently told me that he has taken his engines almost everywhere and he could haul the engine through the river by an arrangement of cable and winding-drum."[2]

Bryce C. Burt, Deputy Director of Agriculture, United Provinces, provides the following details regarding the steam tractor used by Sardar Jogendra Singh, its performance and economics.

"The plant used was supplied on hire by Messrs Burn & Co., and consisted of a Garrett Single Cylinder Tractor of about 25 B.H.P., fitted with extra wide wheels and the usual accessories for direct ploughing. Coal being exceedingly expensive locally, and sufficient wood fuel unobtainable, the tractor was fitted with oil-burning apparatus for liquid fuel. The fuel was obtained from the Asiatic Petroleum Co., and cost 4 annas 6 pies per gallon (60 paise per litre) delivered at the site which was 26 miles (42 km) by *kachcha* road from the railway. For convenience in transport the oil was packed in ordinary four-gallon (18-litre) kerosene oil tins, the leakage in this way being less than in barrels, and the empty tin being readily saleable locally."

The ploughs used included three sets of three-discs Chittanoonga ploughs, constructed for use with a tractor ploughing furrows 10 in. (25.5 cm) wide, and capable of ploughing 12 in. (30.5 cm) deep. Deep cultivation not being essential, the actual work done rarely exceeded 8 in. (20.3 cm) in depth, and was frequently less. As a rule, two sets of these ploughs were used—nine furrows proving too much for the engine on this land.

A Ransomes' special tractor plough, with four breasts, was afterwards added for use in the heavier jungle where the roots were a serious hindrance to the disc plough.

Ploughing was carried out in the usual way, by opening a centre furrow and then gathering and ploughing round.

An area of about 100 acres (40.5 ha) was ploughed, and the following results were obtained on a four hours' trial run, on heavy grass land, after

[2]Jogendra Singh, Experiment in Steam Ploughing, *Agric. J. of India*, Vol. III, 1, 1918

FIG. 72. Sir Jogendra Singh (1877 to 1946), pioneer in tractor cultivation. In 1914 he experimented with steam tractors for the reclamation of wasteland in his Aira Estate in the Lakhimpur District in U.P. and at Iqbal Nagar in the Montgomery District in the Punjab

Fig. 73. Sir Ganga Ram (1851 to 1927), a distinguished engineer and agriculturist. He pioneered a lift irrigation scheme at Renala, Montgomery District, Punjab, in 1917 and reclaimed a large chunk of wasteland the staff had been trained and a number of minor adjustments made:

Time (including all stops for water)	4 hours
Area ploughed	9,800 square yards
Fuel consumption	18.05 gallons crude oil
Cost at As. 4-6 per gallon	Rs 5-1-3
Cost of oil per acre	Rs 2-9-0
Establishment	*Rupees*
Foreman	100 per mensem
Driver	30 ,, ,,
Three ploughmen @ Rs 10 each	30 ,, ,,
Bullocks and driver for a water-cart	30 ,, ,,
Coolies	24 ,, ,,
Total establishment	214

The area ploughed per month may be put at 100 acres (40.5 ha), allowing for an eight-hour ploughing day and for a six-day week, plus an allowance of two days for unforeseen stoppages or for shifting to new work.

		Rs	a.	p.
Cost of establishment per acre		2	2	3
Capital cost of the tractor landed		9,000	0	0
,, ,, ploughs		750	0	0
,, ,, a proper disc cultivator		350	0	0
,, ,, water-carts and accessories		400	0	0
Total:	Rs	10,500	0	0
Interest, depreciation and repairs at 25 per cent per annum		2,625	0	0

For work of this class, a ploughing season of eight months can be safely anticipated, so that, assuming the engine to be idle during the rains (which is not necessarily the case), the depreciation and interest charges amount to Rs 2,625 for 800 acres (324 ha) ploughed or Rs 3-4-6 per acre, making a total ploughing cost per acre of Rs 7-15-9 or in round figures Rs 8 per acre (Rs 19.75/ha) as compared with Rs 15 per acre (Rs 37/ha), the minimum cost of hand-digging to a less depth.

Sardar Jogendra Singh's Experiment of Tractor Cultivation at Iqbal Nagar, Montgomery District (Punjab), 1914

After some success in the Aira Estate in U. P., Sardar Jogendra Singh applied in 1914 for a grant of 2,000 acres (810 ha) in the Montgomery District on the Lower Bari Doab Canal for steam-ploughing. This request was sanctioned by the Punjab Government, and it was thus that Iqbal Nagar developed.

Sardar Jogendra Singh states, "I ordered the engines from Messrs Fowler & Co. It was lucky that they were despatched before the war broke out. The tackle arrived in due course and it was erected by an expert European ploughman who was employed for six months. It was not, however, all smooth sailing in the beginning. The land had to be cleared of brushwood, the roots to be taken out, and mounds standing in some cases several feet high had to be levelled. Then, when the ground was clean and absolutely level, the work was started. We did not do more than 5 acres (2 ha) on the first day, and for many days, on account of roots and other obstructions, the work was very slow, and people began to doubt the capacity of the tackle to run such a large farm. The Irrigation Department had built water-courses which intersected the land and were found a great obstruction. Then, when we watered the land, the water ran all over and it was found impossible to plough the seed in. One of the engines sank in the soft soil up to the fire-box, and Mr Haverty and I passed a couple of anxious days till we discovered a solution.

"The discovery was simple. It was simply to lay out water-courses and roads in such a way that the engines might have a dry road. The land is divided into rectangles of 25 acres (10 ha) each and it was decided to abolish the old water-courses and run one large water-course on one side of each rectangle, the road to be on the outside of the water-course so that the engines could always have a dry road. On the other side of the rectangle was put another ridge to protect the road on the corresponding side. This plan worked admirably. I am now able to cultivate 25 acres (10 ha) a day eight inches (20 cm) deep, and have broken the whole area. Steam-cultivation promises good returns for large farms, and I think the original idea of starting a sugar factory can now be worked.

"The cost of steam-cultivation may be worked as follows and will compare favourably with the highest rent that a landowner can obtain. The tackle, including a threshing machine and a seeder, cost me Rs 50,000; to this must be added the cost of cleaning, levelling, laying out roads, water-courses, buildings and wells, another Rs 57,000. The total capital expenditure may, therefore, be placed at Rs 107,000, excluding the price of the land. The establishment charges come to Rs 16,920 a year. The working expenses of the engines and the farm depreciation and renewals and interest are Rs 22,960. To this must be added about Rs 10,000 for farm-labour, which bring the total annual cost to Rs 59,880.

"The area that has been placed under crops has not exceeded 1,200 acres (485 ha), as the water-supply is not available for more. The crops grown and yields can be approximately placed as follows:

	Rs
500 acres of cotton at an average of 6 mds. an acre = 3,000 mds. at Rs 15 a maund	4,000

200 acres of oil-seeds, maize, etc., at Rs 50 an acre	10,000
500 acres of wheat at 13 mds. an acre=6,500 mds. at Rs 3-8 per maund	22,750
10,000 mds. of *bhusa* at 2 mds. a rupee	5,000
Total :	Rs 82,750

Deduct Rs 59,880, which leaves a net profit of Rs 22,870 a year on an investment of Rs 107,000. The profit would be almost doubled if the whole area could be brought under cultivation. Perhaps in a year or so I shall be able to tell the story of other advantages of steam-cultivation and crop experiments which are in progress."[3]

AN EXPERIMENT FOR THE ERADICATION OF 'KANS' WITH THE USE OF TRACTORS IN C.P., 1926

In 1926, we again hear about the use of tractors for the eradication of *kans* grass. In the northern part of the Central Provinces, a very large area had gone out of cultivation owing to this pernicious, deep-rooted weed. John H. Ritchie, Deputy Director of Agriculture, Northern Circle, Central Provinces, reports an experiment on the use of gasoline tractors for the eradication of *kans*, as below:

"In 1923, two International 15-30-hp tractors were purchased by the department for work on *kans* eradication. The ploughs used were 3-furrow self-lift International ploughs with digger bodies.

"Two years previously, at a demonstration of tractors given in Jubbulpore, it was found that it was not necessary to go to a great depth to kill the *kans*. It was at first thought that it would be necessary to plough to 12 inches (30 cm) deep and the first ploughings done were at this depth. It was found, however, that even at a depth of 7 or 8 inches (18 or 20.5 cm) the *kans* was killed, provided that the soil was inverted to expose the underground stems to the sun and to smother the roots still in the unploughed subsoil. In the fields ploughed it was found that only in the open furrows did the *kans* come up again during the following season, no matter at what depth the ploughing was done.

"Benefiting from the experience gained in the previous demonstrations, the department undertook to plough *kans*-infested fields to a minimum depth of 8 inches (20.5 cm) at a rate of Rs 25 per acre (Rs 62/ha).

"Work was started in December 1923 in land belonging to Diwan Bahadur Seth Jiwan Das in a village 6 miles (9.6 km) from Jubbulpore. An area of 100 acres (40.5 ha) was handed over for ploughing. The work done was very good, the soil being well turned up, and the *kans*, which at the start almost hid the tractors and ploughs, disappeared beneath the furrows.

[3]Jogendra Singh, S. Experiments in steam ploughing, *Agric. J. of India*, Vol. XIII, 1, 1918

Ploughing continued till April, when the soil became so hard that both the tractors broke down, but a total of 313 acres (127 ha) was completed before this happened.

"In December 1924 only one tractor was ready for work, as spares had to come from America and had not arrived. At the beginning of the ploughing season, a requisition for only 12 acres (4.9 ha) to be ploughed had been received by the department in one village five miles (8 km) from Jubbulpore, but before leaving that village, 99 acres (40 ha) were turned up. So successful was the work that requests came in from all over the district for the tractors, and when finally it was decided to stop operations in April owing to the hardness of the ground, only 202 acres (81.8 ha) out of nearly 1,000 acres (405 ha) for which orders were received had been ploughed with the one tractor.

"Breakdowns were frequent, but as we could fall back on the parts of the derelict machine, the time lost was not very great. At the close of the ploughing season, the spares were received from America just in time to send the machines to Nagpur, where they were required for the cultivation of the College Farm.

The total area ploughed in the two seasons was 515.26 acres (208.5) in 1,235 running hours. In addition, 74 hours were spent in belt work, driving a threshing machine on the Government farm at Adhartal."[4]

The cost of two tractors and other equipment was Rs 12,688 and expenditure, including fuel, repairs, pay of drivers and depreciation of machinery, was Rs 11,721. The experiment proved that it was a profitable venture.

Gasoline Tractors in the Punjab, 1929-1932

The gasoline tractors powered by internal-combustion engines running on gasoline, kerosene, or diesel fuel were marketed in India in 1928-1932. Power is transmitted in such tractors through a propeller shaft to a gearbox having 8 or 10 speeds and through the differential gear to the two large rear-drive wheels. Their engines were from about 12 to 120 horsepower. In 1932, oversize pneumatic rubber tyres with deep treads were introduced.

In 1929, there were 29 tractor-owners in the Punjab. Early experience with gasoline tractors was so unsatisfactory that most landowners were inclined to fight shy of them and their confidence in these machines was shaken.

However, most of the tractors which were in the market in 1930 were fairly reliable. Their main use was for the initial breaking of hard lands, for driving threshers, fodder-cutters, pumps, etc., and as stand-by on large

[4]Ritchie, J.H. Tractors in the Northern Circle of the Central Provinces, *Agric. J. of India*, Vol. 21, 1926

estates for augmenting the animal power in busy seasons.[5]

The period 1929-1932 was that of the Great Depression. The farmers' incomes rapidly declined and farmers were not financially capable of buying costly machines. As such, tractorization was rather tardy and was confined to only large farms, whose owners could afford experiments.

[5]Johnston, D.P. Tractor Trials in Lyallpur, Punjab, *Agric. J. of India*, Vol. 25, 1930

CHAPTER 40

THE ROYAL COMMISSION ON AGRICULTURE

SIR GANGA RAM AND LIFT IRRIGATION IN THE PUNJAB 1926-1935

In 1925, when Lord Reading was the Viceroy, the Government of India awoke to the necessity of giving a new impulse to the development of agriculture in India. Impetus was provided by the resolution of the Working Committee of the Indian National Congress, which in 1920 decided that the four-fold constructive programme of the party should be taken to the villages. This programme included production and use of *khadi* through handspinning, promotion of communal unity, prevention of the use of alcoholic drinks and removal of untouchability.

Fazl-i-Husain, who had joined as the Member in charge of the Department of Education, Health and Lands, and whose concern for the welfare of the rural people was well known, gave strong support to the Viceroy's proposal, and it ultimately resulted in the setting up of the Royal Commission on Agriculture. In his minute dated 8 October 1925, Fazl-i-Husain recorded that the rural people were not so well looked after as the urban people. He further commented that India was not necessarily located in the streets and lanes of big cities, and that it was unwise to neglect the rural people or let them believe that they are being neglected. He also expressed concern that the Congress leaders, headed by Mahatma Gandhi, who had been so far preoccupied by other problems, had started taking interest in the rural areas and the peasantry. All these factors combined brought the problem of agricultural development or rural reconstruction to the fore.

While suggesting solutions to the problem, Fazl-i-Husain recommended the strengthening of central research with men and money, and more investment of funds in education, agriculture, co-operation and local self-government in the provinces. Finally, he recommended the appointment of a Royal Commission to go into the question of how to increase the agricultural output of the country and to improve the economic condition of the people.[1]

The Royal Commission on Agriculture was appointed in 1926 under the chairmanship of Victor Alexander John Hope, 2nd marquess of Linlithgow (1887 to 1952), a Scotch landlord with deep interest in animal husbandry. He was born at Abercorn, in county Linlithgow, Scotland.

[1] *Government of India Department of Education, Health and Lands: Proceedings*, October 1926, No. 8-117, National Archives, New Delhi

During World War I, he served on the western front. In 1924 he was selected deputy chairman of the Conservative and Unionist Party organization. The members of the Commission were Sir Henry Staveley Lawrence, ICS; Sir Thomas Middleton; Sir Ganga Ram, engineer, agriculturist and philanthropist from the Punjab; Sir James MacKenna, ICS, Agricultural Adviser to the Government of India; Hubert Calvert, ICS, author of *The Wealth and Welfare of the Punjab* (1922); Raja Sri Krishna Chandra Gajapthi Nayaran Deo Garu; Nagendra Nath Gangulee, Professor of Agriculture and Rural Economy, Calcutta University; Lodhi Karim Hyder, Professor of Economics, Aligarh University; and Balkrishna Sitaram Kamat.

The Commission was directed "to examine and report on the present conditions of agricultural and rural economy in British India, and to make recommendations for the improvement of agriculture and to promote the welfare and prosperity of the rural population". The Commission recognized that "India is still pre-eminently the land of the small holders". The typical agriculturist is still the man who possesses a pair of bullocks and who cultivates a few acres with the assistance of his family and occasional hired labour and he requires all the help which science can afford, and which organization, education and training can bring within his reach. The Report emphasized the importance of providing for a minimum standard of life in villages and controlling the rate of growth of population in promoting agricultural development. The modernization of Indian agriculture was to be brought about through research, extension, greater co-ordination of various departments dealing with agriculture and the development of co-operative institutions.

The Commission made detailed recommendations in the fields of agricultural research, crop production, animal husbandry, forestry, fisheries, co-operation, village development, agricultural finance, communications, marketing, education and public health. Under crop husbandry, recommendations were made for anti-soil-erosion measures, the improvement of crop varieties, seed production, improved implements, the use of organic manures, plant-protection measures and ocular demonstrations. Under agricultural finance, the Commission recommended the encouragement of co-operative credit societies, the establishment of land-mortgage banks and the imposition of restrictive measures on money-lenders. For the improvement of livestock, a policy of selective breeding, a general reduction in unwanted stock, the improvement of draught and milch cattle, the expansion of veterinary departments, the upgrading of veterinary education and greater attention to fodder cultivation were recommended. The main recommendations with respect to forestry related to the provision of fodder for livestock and fuel and timber for the rural population and the protection of soils exposed to erosion hazards. Its other recommendations related to legislation to promote the consolidation of holdings, the encouragement to group marketing, the establishment of regulated markets, the appointment of marketing staff at the Centre and in the Provinces and the setting up of a Central Bureau of Information on Irrigation to deal with matters arising from hydro-electric development.

The Commission felt concerned that, as a result of constitutional changes of 1919, viz. the Montague-Chelmsford Reforms, the Government of India divested themselves, except to a very limited extent, of all powers of superintendence, direction and control over the administration of 'transferred' subjects to the provincial governments, and they included agriculture and veterinary. The administration of the Central agencies and institutions for research and for professional and technical training was retained as 'Central' subject, but no specific provision was made for co-ordinating the work of these with that of similar institutions in the provinces. Thus the provincial departments had, in the all-important matter of research, been left without the stimulus of a Central organization which could guide and co-ordinate their policy. Although no specific provision had been made in the Constitution of 1919 for co-ordinating research, either as between the Central and provincial spheres or as between province and province. The Commission felt that there was nothing inherent in that Constitution which prevented appropriate machinery being devised for that purpose.

SIR GANGA RAM (1851–1927)
ENGINEER, PHILANTHROPIST AND AGRICULTURIST

The most distinguished member of the Royal Commission on Agriculture was Sir Ganga Ram, a renowned engineer, philanthropist and agriculturist. He combined the creative imagination of an engineer with the realism of a farmer. A man of strong common sense and practical wisdom, he had the knowledge of techniques of agriculture and irrigation, as well as of the commercial aspect of farming.

Lala Daulat Ram, father of Ganga Ram, came to the Punjab from the United Provinces in search of a job and joined the Police Department. Ganga Ram was born at the Village of Mangatanwala. Being an honest man, Daulat Ram found that he could not reconcile himself to a corrupt environment. He resigned from the Police and came to Amritsar, where he earned his livelihood as a copyist of court documents. Ganga Ram passed his matriculation examination from the Government High School, Amritsar, in 1868. After two years at the Government College, Lahore, he joined the Thomson Engineering College, Roorkee. In 1873, he was appointed Assistant Engineer. In 1888, he was promoted Executive Engineer. He retired from the Punjab Government service in 1903. As an engineer, he left his imprint on Lahore. To him goes the credit of designing and constructing the magnificent buildings of the Lahore Museum, the Mayo School of Arts, the Aitchison College, the General Post Office, the Albert

Victor Wing of the Lahore Mayo Hospital and the Chemical Labortory of the Government College.

After his retirement from the Public Works Department of the Punjab Government in 1903, he was appointed Superintending Engineer, Patiala State, where he continued till 1911. As an engineer-architect, he was given an opportunity by Maharaja Bhupindra Singh (ruled 1900-1938) to reconstruct the Patiala City. 'The work of the reconstruction of Patiala was a gigantic one. Slowly the whole face of the city began to change. Construction was rapid, and the grace of his designs altered the whole atmosphere of the State capital. The magnificent Moti Bagh Palace, the Ijlas-i-Khas, the Secretariat building, the Victoria Girls School, the City High School, the Law Courts, the Police Station and the Dispensary, all bore the stamp of Sir Ganga Ram's handiwork', observed B.P.L.Bedi, his biographer.

Life as an Agriculturist

Ganga Ram retired from the Patiala State Service in 1911. A new life of creative activity lay before him, when he could make his own plans. He had his own land, his own farm. It beckoned him on.

"The problem of India is the problem of water", said Ganga Ram to himself, as he thought of the place of agriculture in India's national economy. "Engineering skill can move mountains, and the question of the water is an ant-hill compared with what we can really do," he observed.

When he examined the land position in the Punjab, he discovered that cultivable land (excluding State land) amounted to 46 million acres (18.6 million ha), out of which 17 million acres (6.9 million ha; 37 per cent) was lying waste because of deficient rainfall or lack of irrigation. Canal irrigation had its limitations. There had to be some other way. Then the idea came to him in a flash—'Lift-Irrigation'.

Gangapur (Lyallpur District)

From that moment the development of the idea of lift-irrigation to irrigate the Punjab waste-lands was his consuming passion. Many times he sat immersed in contemplation for hours, perfecting the details of his scheme with the care of an artist. His retirement brought him added responsibility and inspiration by the grant of 20 squares of land in the Rachna *Doab*. He further obtained two additional grants of 50 and 47 squares—2,500 acres (1,012 ha) in all—for cultivation through lift-irrigation. One of these plots, covering fifty acres (20.23 ha), was made over to him on the condition that he would arrange to irrigate it by lifting water, using steam power, and the second grant of forty-seven squares of high land for lift irrigation by using electricity. The land was situated six to nine feet (1.8 to 2.7 m) higher than the canal level at which water could be delivered by flow. The object of this grant was to conduct an experiment in irrigation by pumping—the first of its kind in northern India.

In defiance of hot weather, the work started in right earnest in June 1903. There was no *pucca* road in his barren stretch of land in Lyallpur. The nearest railway station was twenty-five miles (40 km) away, and the carriage of one boiler alone cost Rs 1,500. Nevertheless, the entire work was finished in three months, and the first *rabi* crop grew on the arid soil. It was in an atmosphere of feverish activity that the vast barren tracts of land were made fertile, and in the midst of it all grew up Gangapur, the village of Ganga Ram's dreams. In 1908, Gangapur got an award from the Punjab Government for a good harvest.

Tour of England in Search of Agricultural Machinery

In the hot weather of 1910, he made up his mind to make a tour of England with a view to studying at first hand the latest developments in mechanized farming. Farm machinery was changing the face of England. Men who saw farming in terms of the division of labour and modern techniques were rising and they saw no reason why the cultivation of land should continue to be an archaic occupation. Ganga Ram saw farms of every type, but the object of his tour was to enquire about and inspect agricultural machinery. He purchased over 26,000 rupees' worth of machinery and agricultural implements of the types not seen in India before.

Back home, the utilization of the power running to waste at many canal falls in the Punjab became his obsession. The plans for the new experiment were prepared with great precision, and he opened negotiations with the Punjab Government on the new project. He applied for a grant of 5,000 acres (2,023 ha) of waste-land in the Gujranwala District on payment of a fair market value. He proposed to generate electric energy from a fall on one of the new canals of the Triple Project, and he was willing to pay a reasonable rate for the hydro-power. He had protracted correspondence with the Punjab Government on the scheme. The Punjab Government imposed such difficult conditions that it was impossible for him to accept them.

The Lift-Irrigation Scheme, Renala (District Montgomery), 1917

It was only in 1917 that world events helped him in the achievement of his plans. The Government was in trouble, because land had been promised to the soldiers on their return from the battlefield. Ganga Ram saw his opportunity. His new proposals were that he should be given 23,000 acres (9,308 ha) of high-level land in Bari *Doab*. The Lower Bari *Doab* Canal irrigated the area, but the tract which he wanted could only be irrigated with water-lifting appliances. Hitherto, in the grants made to him, the land was his own, provided that he fulfilled the conditions, but in this case the stipulations were that at the end of three years he would return the land to the

Government fully equipped with the necessary irrigation channels and machinery, so that it might be available for colonization by the demobilized soldiers.

Then came the second lease—some 40,000 acres (16,187 ha) of unirrigated high land for a period of seven years, and the lessee was required to provide for the cultivation of the land by using hydro-electric machinery. The Government's terms of the contract this time were even more stringent. On the expiration of seven years, he had to restore the land to the Government for colonization, fully equipped with the necessary canals, distributing channels, and the hydro-electric plant in full working order, for lifting water for irrigating the tract.

During its conception, a hydro-electric scheme for lifting water to high land was very exceptional in India, showing the way towards a very wide field of expansion of lift irrigation in the country. A hydro-electric station was constructed on the canal at a point near the Renala Khurd Railway Station on the North-Western Railway. From it, transmission lines radiate both upstream and downstream, the total length of these lines being thirty miles (48 km). Steel poles were provided throughout and the telephone system connected all the main points.

At Renala, the site of the power-house, the Canal had a fall of only two feet (61 cm), but it was found possible to convert the fall into one of six feet (183 cm). Even six feet is a low fall for an economical turbine design, and special turbines of a horizontal type had to be designed. Looking at the figures of this huge undertaking, we can realize how enormous it was in its scope. Five turbines of 220 kW, commanded about 80,000 acres or 125 square miles (3,275 ha or 323 km^2). The cost of the installation was nearly half a crore, and Rs 1,200,000 was spent on 75 miles (121 km) of irrigation channels, 626 miles (1,007 km) of water-courses, 45 bridges, 565 miles (909 km) of village roads, 121 miles (194 km) of boundary roads and 640 culverts. About 1 million rupees was spent on the thermal machinery used for the lift before the completion of the hydro-electric plant. Up to the *rabi* of 1924, the Government were paid 1.2 million rupees in revenue. From the engineering point of view, the Renala Works stands unique in its distinction of harnessing energy from the smallest fall in the world. The story of the development of 80,000 acres (32,374 ha) of wasteland in the Montgomery District reads like a romance.

Prize for Innovations in Agriculture

When organizing his charitable donations, Sir Ganga Ram did not forget his first love, agriculture, and endowed a prize of Rs 3,000 to be given every three years for the inventor of any practical method of increasing the profits of agriculture in the Punjab.

THE MEMBERSHIP OF THE ROYAL COMMISSION ON AGRICULTURE

Sir Ganga Ram was nearing his 74th year when he received the highest recognition of his work as an agriculturist, with his appointment to the Royal Commission on Agriculture. Although full of years, his spirit was as young and vital as it had ever been.

In spite of his failing health due to age, he kept up his energy. Knowing that extra work at that advanced age would have a bad effect on his health, he still went on doing what he considered the most important work of all, giving advice to those who could act in the matter about India's great and urgent agricultural needs. Every action he took in the last few months of his life was directed to this one end—giving the information which he alone could give to the Commission and educating the public with respect to the value of the work of the Commission.

The work connected with the Royal Commission was exacting. The Commission visited all the provincial capitals and agricultural research stations. In May 1927, the Commission paid a visit to England and Mr Frank Noyce, ICS, was attached to the Commission as Assistant Commissioner. In London, the Commission examined the representatives of trading and manufacturing concerns, a number of experts in agricultural and veterinary matters, and retired officials from India who had experience of agricultural problems. Sir Ganga Ram also accompanied the members of the Commission to London in spite of ill-health. "Every rupee that India spent in carrying out the recommendations of the Royal Commission will bring thousands to the people in return," he said to a Press representative in London and the message was flashed across to India. It was his final message to his coutrymen and a fitting memorial to the love he bore the land and its cultivators. He died in London on 10 July 1927.

Here is a tribute from Mahatma Gandhi to Sir Ganga Ram, published in *Young India*. 'I had the privilege of coming into fair contact with him recently, and though we could not agree on several matters, I recognized in him a sincere reformer and a great worker. And although, with all respect to his age and experience, I expressed my dissent from many of his views with energy and insistence, his affection for me, whom he regarded comparatively to him as a young man of but yesterday, grew with my opposition to some of his extraordinary views on Indian poverty. He was so eager for long discussions with me, and so hopeful of weaning me from the error of my ways, that he offered to take me to England at his expense and drive all the nonsense out of my head. Though I could not accept the offer, which he had seriously meant, I wrote to him on the eve of his departure, promising to see him and convert him to the creed of the spinning-wheel, which he thought was fit only to be burned as firewood. The reader may well imagine my grief, therefore, over the news of his sudden death. But it is a death we could all wish to have. For he went to

England, not on a pleasure trip, but on what he considered to be his peremptory duty. He has, therefore, died in harness. India has every reason to be proud of having a man like Sir Ganga Ram as one of her distinguished sons. I tender both my congratulations and condolences to the family of the deceased reformer.'

CHAPTER 41

ESTABLISHMENT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

DESTRUCTION OF I.A.R.I. BUILDINGS AT PUSA

THE Royal Commission on Agriculture recognized the importance of research and stated that the basis of all agricultural progress was experiment. However efficient the organization which is built up for demonstration and propaganda be, unless that organization is based on the solid foundations provided by research, it is merely a house built on sand.

CONSTITUTION OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

The Commission proposed that an Imperial Council of Agricultural Research should be constituted, the primary function of which would be to promote, guide and co-ordinate agricultural research throughout India. It would not exercise any administrative control over the Imperial or provincial research institutions. It would be a body to which the Imperial and provincial departments of agriculture could look for guidance in all matters connected with research and to which such research programmes as they might choose would be submitted for criticism and approval. The Commission stated that their object in proposing that such a body should be constituted was to provide provincial governments with an organization embracing the whole research activities of the country, veterinary as well as agricultural, in which they could feel that they had a real and lively interest. That interest would undoubtedly be greatly accentuated if the Council were entrusted with the administration of funds with which it could supplement provincial activities in the matter of agricultural research. They, therefore, proposed that the Council should be entrusted with the administration of a non-lapsing fund of 5 million rupees, to which additions should be made from time to time as financial conditions permitted.

The Commission further observed that one of the most important functions of the Council would be in regard to the training of researchers and part of its funds should be used to provide for research scholarships for students who had given evidence that they were capable of taking full advantage of an opportunity for intensive training in scientific research in agriculture. The Commission envisaged that the Council would act as a clearing-house for information and would establish bureaux for crops as well as for animal husbandry, dairying and veterinary matters. It would also take over the publication work done by the Agricultural Adviser to the Government of India and would arrange for the sectional meetings of experts in particular branches of agricultural science.

The Commission proposed that the Council should consist of 39 members. Three of these would be whole-time members—the Chairman, who should be an experienced administrator with a knowledge of Indian conditions, and two eminent scientists qualified to represent, respectively, the interests of agriculture and animal husbandry. Of the remaining 36 members, eight would be nominated by the Government of India, 18 would represent the provincial agricultural and verterinary departments, three would represent the Indian universities, two would represent the Indian Central Cotton Committee and the planting community respectively and five would be non-official members, nominated by the Council by reason of their scientific knowledge or special qualifications. The Chairman and the two whole-time members might be appointed for five years and the other members for three years, as a general rule, and provision should be made for extending those periods.

The Commission realized the importance of associating the universities with the research effort and stated that it expected that the universities would take an increasing share in the prosecution of agricultural research and it was with the object of facilitating this work that they suggested that they should be represented on the Council of Agricultural Research.

Sir Frank Noyce was appointed an Officer on Special Duty to process the recommendations of the Commission on Agriculture. He submitted that the Government of India should issue a resolution constituting the Council of Agricultural Research as soon as the budget provision had been made and consent of the States to the scheme obtained. He further advised that the Vice-Chairman of the Governing Body of the Council and its Secretary should be appointed concurrently with the issue of the Government of India's resolution. Sir Muhammed Habibullah, Member of the Executive Council in charge of Education, Health and Lands, approved the recommendations made by Sir Frank Noyce on 2 February 1929. Lord Irwin, the Viceroy, agreed with Sir Muhammed Habibullah.

The Government of India, Department of Education, Health and Lands, after giving their careful consideration to the recommendation made by the Royal Commission on Agriculture decided to set up the Imperial Council of Agricultural Research by their resolution of Simla, dated 23 May 1929.

Sir Muhammed Habibullah—the First President of the ICAR

Sir Muhammed Habibullah (b. 1869) was the first President of the ICAR.[1] He came of an ancient Karnataka family, was educated at Zilla High School, Saidapet, and later on studied law. He practised at

[1]*Sources:* *EM*, 1926; *IO & BOL*, 1947; *Who's Who India*, 1927; 1912; *IYBA* 1947; *The History of the Indian National Congress*, Vol. I, *WWM*, 1940

Vellore and became a leading member of the bar. He joined the Congress Party in 1888, and made a mark by his eloquence. He was elected to the Madras Legislative Council in 1909. He was appointed member of the Madras Executive Council in 1919 and held the portfolio of Local Self-Government. In 1929, he was appointed leader of the Indian delegation to the League of Nations, Geneva. On return he was appointed a member of the Viceroy's Executive Council in charge of the Department of Education, Health and Lands from 1929 to 1930.

Appointment of the Principal Officers of the ICAR

Diwan Bahadur Sir T. Vijaya Raghavacharya, an officer of the Madras Provincial Service, who had served as Director of Fisheries, Madras, and was serving as a member of the Public Service Commission, was appointed Vice-Chairman, Imperial Council of Agricultural Research. A short-statured man with a handsome face and keen searching eyes, wearing a gold braided Mysore turban, he was a picturesque figure. He had a sense of humour and he enlivened the meetings, over which he presided, with anecdotes and witty remarks. Mr M.S.A. Hydari, ICS, was appointed Secretary, and Mr Bryce Burt as the Agricultural Expert.

First Members of the Governing Body

The Governing Body of the Imperial Council of Agricultural Research included 16 persons as its first members. This was a much smaller number than that recommended by the Commission, but ensured a more compact body. It included nine representatives of the Provinces of whom six were Ministers, viz. Mr Setu Ratnam Ayyar (Madras); Mr Bhaskar Rao V. Jadhav (Bombay); Sir A. Ghuznavi (Bengal); Maharaj Kumar Mahajit Singh (United Provinces); Sir Jogendra Singh (Punjab); Sir Lee Ah Yain (Burma); and Sir Sayid Mohammad Fakhruddin Khan Bahadur (Bihar and Orissa). Sir Arthur Edward Nelson, Member in Charge of Portfolio of Agriculture, Central Provinces and Berar and Sir Egbert Laurie Lucas Hammond, Member in Charge of Portfolio of Agriculture, Assam, were other two members. It further included three MLAs, viz. Mr V. Ramdas Pantulu, Member, Council of State, Madras; Mian Mohammad Shah Nawaz, Member, Legislative Assembly, Lahore, and Chaudhry Mukhtar Singh, Member Legislative Assembly, United Provinces. Besides, there were two members who represented commercial interests. They were Sir Joseph Kay, Representative of the Associated Chamber of Commerce of India and Ceylon, and Mr Walchand Hirachand, Representative of the Federation of Indian Chambers of Commerce and Industry, Bombay. The sixteenth member was Sir Frank Noyce, Officer on Special Duty, Department of Health, Education and Lands, who had processed the recommendations of the Commission.

Sir Mian Fazl-i-Husain, President, ICAR, 1930-1935

Leaving the Punjab, Fazl-i-Husain joined the Government of India in 1930 as member in charge, Department of Education, Health and Lands. In that capacity, he also became the President of the ICAR. In 1934, he added to the Council a marketing section in order to organize an efficient intelligence service in external markets regarding the Indian products and the requirements of consumers, both abroad and in India. A scheme was sanctioned by which trade agents were to be appointed to push Indian products in foreign markets.

Crop Planning

The economic depression of 1931 caused a heavy fall in prices of agricultural produce, which made it difficult for the *ryot* to pay land revenue and water rates. One way of helping the agriculturist was to plan the cropping pattern of the country. Fazl-i-Husain, therefore, held a Crop-Planning Conference in June 1934. The Conference decided to set up a comprehensive machinery for a scientific study of the cultivation of important crops and a periodic stock-taking in relation to the world market prospects to enable the raising of crops most in demand. It warned provinces against adding to the production of rice and wheat, as the increased production of those crops would reduce prices still further, and made the useful suggestion that two million acres (809,370 ha) could be brought under linseed, without reducing prices.

Destruction of the IARI Buildings at Pusa by an Earthquake in 1934

In 1934, the buildings of the Imperial Agricultural Research Institute at Pusa were destroyed by an earthquake. Here is given an account of the devastation of the IARI campus by an eye-witness. 'January 14, 1934, was the worst day in the history of the Pusa Institute. The Bihar earthquake on that day literally uprooted the campus. The calamity was so sudden and extensive that even today, when I recall it, the memory makes my hair stand.

'It was lunch-break when most of the employees of the Institute were having siesta in their homes after lunch. A rumbling sound started and the earth was shaking. I was playing in the garden with my elder sister, and all of a sudden I was horrified to see water spurting from our well and then sand started coming out. The compound wall collapsed suddenly and I saw my mother coming out of the house with my younger brother in her lap. Suddenly she fell on the ground and was injured. There were blowing of conch-shells and cries all over the place. My father rushed towards the college building on his bicycle, but could not reach it as there were fissures in the road. Some persons were trapped in the main building. The earthquake shook the foundation of the main building, the Phipps Laboratory, popularly known as Naulakha, so badly that it was declared unsafe. Two deep fissures appeared along the length of the building.

'In this calamity, spirit of sympathy, mutual help and brotherhood amongst the staff and students of the Institute was seen at its best. Forgetting status, caste and creed, all behaved as members of one family and courageously faced the common misfortune. Tents were pitched in the fields, and all the poeple in the campus took shelter in them for a month in shivering cold. The trembling of the earth continued for many days.

'Two days after the earthquake when everyone was panicky and road, rail, and telephone communications were not yet restored, the Director, William McRae, entrusted two letters containing his report on the damage done by the earthquake to R.B. Deshpande of the Botany Section and asked him to deliver them to the Commissioner of Tirhut Division at Muzaffarpur. Deshpande left for Muzaffarpur on a cold morning on a bicycle and covered 22 miles (35 km) of a badly fissured road with difficulty. He returned the same night with the reply from the Commissioner, which he handed over to Dr F.J.F. Shaw, the Imperial Economic Botanist.'[3]

SHIFTING OF THE IARI TO NEW DELHI

The question arose whether the building at Pusa should be repaired at a cost of Rs 700,000 or a new one be built at Delhi at a cost of Rs 3.6 million. Fazl-i-Husain saw great advantages in building it at Delhi and said that the selection of the site at Pusa was purely fortuitous. The Institute had failed to make an impact on agriculture and the farmers mainly because of its isolation. While Calcutta was the Imperial capital, Pusa was within easy reach to be frequently visited, but now it was difficult to do so. The soil and climate of Pusa was typical only of a portion of northern Bihar and could only raise crops without irrigation, while irrigation was an outstanding feature of Indian agriculture. The climate at Pusa was not conducive to experimental work in certain important branches and the production of some crops, such as cotton, was impossible. As against Pusa, Delhi had the great asset of accessibility to all interested in scientific agriculture. Here it was possible to carry out field experiments with both non-irrigated and irrigated crops, and at the same time the average alluvial soil was typical of a very large area in India. From the point of view of climate, there was a greater range of crops and there was no crop experimented upon at Pusa which could not be grown at Delhi. To those who objected to a capital expenditure of Rs 3.6 millon, Fazl-i-Husain pointed out that the expenditure on reconstruction at Pusa was no guarantee that fresh earthquakes would not again involve fresh expenditure. Further, that it was proposed to meet the expenditure by a loan, which, according to the prevailing easy rates of

[3]Personal communication from Mr P.C. Bose of the ICAR

interest, was not an excessive burden on the tax-payer. In order to help the country to face the depression, it was necessary to stimulate the purchasing power by undertaking expenditure on public works aimed at increasing the economic strength of the country.

After a great deal of discussion, the Legislature sanctioned the expenditure, but as everything appeared to be reaching a fruitful close, Sir James Grigg, the new Finance Member, wanted to quash the entire proposal. He did not wish to start his term of office with a large expenditure which would serve in future as a precedent for the starting of new development schemes. Fazl-i-Husain, on the other hand, regarded the question of the Institute as settled. Sir James could not tolerate opposition, and a dispute ensued. Fazl-i-Husain wrote to the Viceroy, Lord Willingdon, who was away in London, and while referring to the proposals of the Provincial Economic Conference said: "One of the proposals related to the transfer of Pusa and on our recommendation the Secretary of State sanctioned that proposal. When Grigg arrived, the Finance Department Secretariat seem to have given out that these proposals were the result of Schuster's own views and they had not their support. Grigg expressed a view that the sort of capital expenditure involved in the removal of Pusa was justifiable in the view of one set of financiers but that he belonged to the school of financiers who disapproved of it. On the other hand, Sir Frank Noyce and I held the view that the matter about Pusa was considered, discussed and decided, and the Secretary of State's sanction obtained. The fact that Schuster's successor holds views different from those of Schuster does not justify going back on a decision already arrived at and approved by the Secretary of State. A few days ago, His Excellency Sir George Stanley (officiating Viceroy during Lord Willingdon's absence) told me that last week he had written to you on the subject and asked me whether I had any objection to the matter being reopened. I told him frankly that I had the very strongest possible objection to the matter being reopened; that you were a party to the Pusa transfer decision; that you were definitely for it; and that he had no cause to assume that you had changed your mind; that on the other hand he should assume that you hold the view now that you held a few weeks ago when you and your Government arrived at that decision; and further that if anyone wanted that decision to be reconsidered, he should state in writing the grounds on which he wanted reconsideration, and that then I should be able to state whether those grounds were, in my opinion, grounds for reconsideration or not. I am quite clear that the Secretary in a department cannot have a matter reopened. It is open to him, when the matter was first under discussion, to approach the Governor-General with his views in case his views differed from the views of his Member; but if he did not avail himself of that opportunity and his Member retired he cannot afterwards ask that the matter be reconsidered. As to a new Member, he is responsible only with reference to the decisions arrived at after his appointment. I am glad His Excellency Sir George Stanley accepted the correctness of my contention and said that the matter must now go to the Standing Committee. I thought I might tell you this little controversy that had arisen about Pusa. A little later he wrote again: "You say, ask Grigg to open the strings of the purse. Well, I find him terribly stingy and miserly. I suppose, after a few skirmishes, we shall be able to understand each other better, but at present he absolutely refuses to incur any capital expenditure and is ostentatiously and violently opposed to the scheme of work which Schuster initiated last year. We are carrying on and looking forward to your return so as to arrive at a satisfactory understanding." When Lord Willingdon returned to India, the dispute became more acute, and the Viceroy was obliged to bring the matter again before the Executive Council. Votes in the Council were equally divided, and Fazl-i-Husain resolved to resign if the decision went against him. Lord Willingdon yielded, Fazl-i-Husain won the day, and the foundation-stone of the Institute was laid at Delhi in February 1935."[3]

[3]Azim Husain, *Sir Fazl-i-Husain, a Political Biography*, pp. 217-219

CHAPTER 42

RURAL DEVELOPMENT SCHEME OF THE FIRST CONGRESS MINISTRY IN THE UNITED PROVINCES OF AGRA AND OUDH

1937-1939

In 1936, the Indian National Congress decided to work within the framework of the Government of India Act of 1935. In the elections held in 1937, Congress Ministries were established in seven out of eleven provinces. In the United Provinces of Agra and Oudh, the Congress Ministry was headed by Pandit Govind Ballabh Pant, a seasoned patriot from Kumaon. The Development Minister was Dr Kailash Nath Katju, a prominent lawyer of Allahabad, who took keen interest in rural development.

Inspired by the thoughts of Mahatma Gandhi, a Rural Development Scheme was launched by the Ministry in U.P. Commenting on the problem of relationship of cities and villages, Mahatma Gandhi wrote, "We have to make a choice between India of the villages that are as ancient as herself and India of the cities which are a creation of foreign domination. Today the cities dominate and drain the villages so that they are crumbling to ruin. My *khadi* mentality tells me that cities must subserve villages when that domination goes. Exploiting of villages is itself organized violence. If we want Swaraj to be built on non-violence, we will have to give the villages their proper place.'[1]

Village Industries

Apart from taking the message of freedom to the villagers in their homes, Mahatma Gandhi devoted attention to the social and economic problems of the village. On the social side, he laid emphasis on the abolition of untouchability. He also interested himself in the revival of cottage industries. Mahatma Gandhi wrote, 'Our villages are on the verge of destruction owing to the disappearance of village industries. They can be revivified only by a revival of village industries. Among these industries the spinning-wheel occupies the centre. The others easily arrange themselve around the wheel. Thus everybody will learn the value of industry.'[2] He realized that the spare time of the villagers must be usefully spent. It was on this account that he laid so much emphasis on cottage spinning with the aid of *charkha* (spinning-wheel), and the wearing of hand-spun cloth. On the social side, he realized that the caste system, which had relegated

[1] *Harijan*, 20 January 1940
[2] *Harijan*, 25 March 1939

permanently a section of the community to a type of work unworthy of human dignity, was in need of a radical change. In the *ashrams* which are named after him, stress was laid on the practical abolition of caste by encouraging interdining and working together. Thus the tanning of leather in these *ashrams* was done by Brahmins and Rajputs, along with Harijans.

Ending Departmental Anarchy

The need of co-ordination among developmental departments of the provincial governments was felt by all workers who had experience of development work in the field. The departments, which carried on work of this nature in the villages of the United Provinces, were Revenue, Agriculture, Animal Husbandry and Veterinary, Co-operative, Education, Rural Development, Cane Development, *Gur* Development, Forest, Irrigation, Public Works and Public Health. In these departments, there was lack of co-ordination from top to bottom and from the provincial headquarters to the field worker. Duplication and overlapping resulted owing to this departmental anarchy. The same work was being done by the workers of different departments. Seed-stores were run by three separate departments, viz. Agriculture, Co-operative and Rural Development. Advice on sanitation was given by the Public Health, Rural Development and Co-operative departments. Libraries in villages were run by the Education and the Rural Development departments separately. This departmental anarchy and lack of co-ordination was the main obstacle in the way of a coherent and planned development of villages.

Manohar Das Chaturvedi, a brilliant forest officer, who was appointed the Provincial Rural Development Officer, made the following observations on this state of affairs and also suggested a remedy:

"The multiplicity of departments dealing with the development of the countryside in these Provinces is indeed baffling. To deal with the simple needs of the rural population in watertight compartments is neither possible nor desirable. Excessive departmentalization had led in the past to overlapping, inefficiency, mutual jealousy, dissipation of effort and the frittering away of the limited resources of the State. The poor cultivator can ill-afford the luxury of having separate experts to advise him in matters relating to agriculture, welfare of cattle, co-operation, better living, marketing, health and sanitation. What he wants is a single friend, philosopher and guide who can deal with his difficulties on the spot and offer simple practical solutions.... The need of the hour is neither the expansion of the existing departments, nor the creation of new ones. What is required is the co-ordination of all development departments with the object of organizing a concerted drive for the development of the countryside viewed as a whole and not piecemeal. All overlapping and duplication must be courageously rooted out and various development departments be fused into a single development department with one common field staff which should carry out the behests of various departments in the villages."

A New Organization

To effect co-ordination from the provincial headquarters to the village, the following organization was suggested:

I. *Co-ordination of Development Work at the Provincial Headquarters*

(i) *The Development Committee of the Cabinet:* The Chief Minister as Chairman, Ministers in charge of Development Departments as members, and the Provincial Rural Development Officer as Secretary.

(ii) *The Provincial Development Board:* The Board consisted of Secretaries to Government in Development Departments, the Provincial Rural Development Officer and the Development Secretary, and the Secretary of the Finance Department. Attached to the Board was a Provincial Bureau of Statistics.

(iii) *The Provincial Rural Development Officer:* This officer was the head of the Provincial Rural Development Department and Secretary of the Development Committee of the Cabinet. His powers were the same as those of the head of a depatment and of a secretary to the provincial government. He directed the rural development activities through the District Officer and the District Development Officer.

II. *Co-ordination at the District Headquarters*

The largest organization in a province, with ramifications penetrating into the remotest village, is the Revenue Department. In the United Provinces, it employed 27,443 *patwaris,* 832 *qanungos,* 200 *tahsildars,* 380 deputy collectors and about 150 ICS officers. Previously, all development work was carried through the agency of the Revenue Department under the guidance of the collector. With progressive departmentalization, the district officer had assumed the role of a disinterested critic of various schemes, often launched within his jurisdiction without his knowledge.

The District Officer, aided by the District Development Officer, is the best person to co-ordinate and supervise development work. So far as the developmental work is concerned, he should be empowered to make entries in the character rolls of all local officers of the development departments, such as Public Health, Agriculture, Veterinary, Education, Co-operative and Irrigation. In his own turn, he should submit a fortnightly demi-official report on development work to the Provincial Rural Development Officer, who should be empowered to make an entry in the character roll of the District Officer, as far as development work is concerned.

The District Development Officer

The rural development work in a district was entrusted to joint magistrates or deputy collectors in the Rural Development Scheme earlier launched in the United Provinces in 1935. These officers were designated district rural development officers. Later on, under the second scheme launched by the first Congress Ministry, such officials were designated as secretaries of the District Rural Development Association, a body with a non-official chairman and a membership consisting of local heads of development departments, members of the Provincial Legislature, and other non-officials. Usually, the secretary was also a subdivisional officer, and had plenty of work to fully occupy him, and rural development was regarded merely as an appendage, not to be taken too seriously. Aided by a couple of clerks, he was supposed to administer development work among a population of about a million. It required a heroic person, inspired by lot of faith to work in such circumstances.

If rural development work, which should include the consolidation of holdings, the administration of work of all *panchayats* and agricultural improvements, is to be done on a district-wide scale, a much bigger organization is required. In this organization, the district development officer has a key role to play. M.D. Chaturvedi thus defined the functions and qualifications of the district development officer:

"While various departments must maintain their separate identities at the top at the headquarters of the Government for purposes of actual execution of rural schemes, they must function through the District Development Officer. Distribution of seed and plants, technical advice to private owners of wood-lands and management of State-owned blocks, execution of village schemes such as renovation of groves, control of erosion, planting scattered trees, creation of grazing grounds and fuel and fodder reserves will best be carried out through the District Development Officer."

Rural Development Organizer

The success of the scheme of development greatly depends upon the personnel selected for guiding groups of villages in a development circle. In the selection of rural development organizers, the choice should fall on individuals who come from the cultivating classes of villages and have a progressive social outlook. They should be at least matriculates, and if young ex-soldiers, who have the additional asset of army discipline, are available, they should be preferred. Apart from educational qualifications, I used to impose three tests upon a candidate who came for selection before me at Fyzabad; first, his willingness to drink water from the hand of a sweeper to test his social and cultural fitness; second, his ability to lift a bar-bell, about a maund (37 kg) in weight, as a test of physical fitness, and third, his ability to handle a plough in the field.

After selection, the candidates were given training in essentials of Agriculture, Horticulture, Animal Husbandry, Co-operation, *Panchayat*

Work, Rural Hygiene and Sanitation, etc. in agricultural colleges and at specially equipped training-centres.

PANCHAYATGHAR, A MULTI-PURPOSE BUILDING IN THE VILLAGE

As a result of the experimental work carried out by me in the Fyzabad District in 1937-38, as Secretary of the District Rural Development Association, of which Dhirender Mazumdar was the Chairman, the term *panchayatghar* acquired a new meaning. It became a new type of organizational institution which could become an effective lever for developing the villages and raising the villagers from their age-long slumber. We were groping for a programme and searching for an organization, and in the *panchayatghar* institution we discovered a new type of organizational institution which caught the imagination of the village people and channelled their energy into constructive work. The villages began to throb with new life.

The importance which the Government of the United Provinces during the regime of the first Congress Ministry attached to it can be gauged from the following remarks of Dr Katju:

"I regard a *panchayatghar* as the very pivot of the whole rural development plan. A *panchayatghar* does not merely mean a building where villagers can come together and meet and discuss village topics. It is much more than this. It should be a living monument and symbol of village unity and organization and the centre of all village activities. It should inspire every resident of the village—man, woman and child—as an embodiment of their corporate life."

The idea of a *panchayatghar* embodies much more than the name signifies. The *panchayatghars* which we built were not only the meeting-places of the *panchayats* of the villages, where they drew up developmental programmes for their villages and settled village disputes, but they were also the nuclei of developmental work in the villages under the Rural Development Scheme.

A *panchayatghar* was built for a group of 12 villages to start with. Each *panchayatghar* had 5 rooms, housing a library, a small dispensary, a cattle-unit centre and a store for seeds and implements. In the central hall, a museum of posters and pictures of agricultural interest as well as of local cottage industries, and crops was maintained. In the evenings, it served as the village club where the villagers came to listen to the radio and at night, it served as an adult school.

Attached to each *panchayatghar* was a well, which provided irrigation for a nursery of fruit-plants. In some places, co-operative stores were also housed in the *panchayatghar*. It also served as a village guest-house and a meeting-place where developmental officers, such as agricultural and veterinary inspectors, members of the district health staff and rural development workers addressed the villagers.

In the United Provinces, an extensive development programme was launched in selected villages through the agency of organizers who were given special training in the elements of Agriculture, Animal Husbandry, Co-operation, Sanitation and Public-health problems. It was soon realized that a central institution in the form of a *Panchayatghar* was essential to co-ordinate the efforts of all development departments. In the *panchayatghars*, we got buildings in which all development work was concentrated.

Self-help

Charity from the Government or private persons cannot serve any useful purpose in stimulating the villagers into action. Self-help supplemented by aid from the Government can create enthusiasm among the villagers. The basic principle which we adopted was that one-half of the cost be met by the villagers in cash, or in kind or in both and the remaining half be met by the Government. Every family in the village was made to contribute in some shape or form—in cash, in kind or in labour—to the construction of the *panchayatghar*. In villages where the *panchayatghars* were constructed by the villagers on this principle, they regarded these buildings as their own, as they had made a substantial contribution, in one form or another, to the raising of them. In some villages, batches of 30 to 40 persons gave free labour for two or three days: some gave free service of their carts and bullocks in the carting of bricks, some gave bricks, timber, cement, iron rods as well as cash. The levy of one rupee per plough also helped. Funds collected by the panchayats which were lying idle were also utilized. In one village, where the crops were suffering from the depredations of wild cattle, the villagers caught the animals in large numbers and later on sold them, the sale proceeds being utilized in constructing the *panchayatghar*.

Improved Implements

The *panchayatghars* served as agencies for the demonstration and sale of improved agricultural implements, such as chaff-cutters, iron ploughs and threshers.

Rooms with cement floors served as seed-stores, and seeds of improved varieties of crops supplied by the Department of Agriculture were stored and given to the villagers.

The significance of the U.P. Scheme of Rural Development lies not merely in what was achieved in the villages of U.P. More than that, it provided ideas of organization, which on the achievement of Independence blossomed into the Community Development and National Extension Service Scheme.

CHRONOLOGY
GOVERNORS-GENERAL OF INDIA
CHIEF EVENTS, DEVELOPMENT OF SCIENCE, TECHNOLOGY, EDUCATION, BOTANICAL GARDENS, AGRI-HORTICULTURAL SOCIETIES, RAILWAYS, IRRIGATION AND AGRICULTURE

GOVERNORS-GENERAL

Warren Hastings (1772-1785)

1772	The Revenue business and Treasury removed from Murshidabad to Calcutta. The law courts are also transferred, under the name of Sadr Diwani Adalat, composed of governor and two councils for civil cases, and Sadr Nizamat Adalat for criminal proceedings, composed of Indian law officers, exclusively subject to review of the governor and council. Under these were District Courts, and the collectors have revenue and judicial authority. These were continued till 1793
1773	Establishment of a bank
1783	First Map of Hindoostan by Rennel
1784	The Asiatic Society founded at Calcutta with Sir William Jones as President
1786	Grain *gola* built at Bankipore, Patna

Earl (Marquess) Cornwallis (1786-1793)

1787	The Royal Botanic Garden started by Colonel Robert Kyd. He is appointed honorary Superintendent
1790	Raja Ram Mohan Roy laid the foundation of Bengali prose by writing a treatise criticising Hindu idolatory
1792	Sanskrit College constituted at Benares
1793	Permanent Revenue Settlement of Bengal
	Dr William Roxburgh appointed Superintendent of Botanic Garden, Sibpur
1794	Surrey School at Madras

Sir John Shore, Lord Teignmouth (1793-1798)

1793	11 November. Dr William Carey the first Baptist missionary lands in India

1795	Commencement of the publication of *Flora Indica* Lieutenant William Frazer starts a stud farm at Pusa for breeding horses
1797	Tippu Sultan of Mysore introduces plants from Mauritius in Lal Bagh, Bangalore

EARL OF MORNINGTON (MARQUESS WELLESLEY) (1798-1805)

1800	18 August. Fort William College, Calcutta, established
1803	Lalluji Lal writes *Prem Sagar*, the first book in Hindi prose, on the advice of Dr John Gilchrist
	Encourages research in natural history and establishes an *Institution for Promoting the Natural History of India* with a menagerie and aviary at Barrackpore. Commissions Indian artists to paint 2,660 folios of water-colour drawings of plants, rare birds, fishes and insects

SIR GEORGE BARLOW (1805-1807)

BARON (EARL OF) MINTO I (1807-1813)

1808	William Moorcroft appointed as first Veterinary Surgeon and in charge of Pusa Stud farm

EARL OF MOIRA (MARQUIS OF HASTINGS) (1813-1823)

1813	Panchayats are established for administration of justice
1814	N. Wallich as the Superintendent of the Botanical Garden, Calcutta
1817	Hindu College founded at Calcutta by Ram Mohan Roy and David Hare
	Saharanpur garden taken over by the East India Company. Dr Govan appointed first Superintendent
1819	Ranjit Singh conquers Kashmir
	Major Waugh presents Lal Bagh, Bangalore, to Marquis of Hastings
	Montstuart Elphinstone appointed Governor of Bombay
1820	The Western Jamuna Canal constructed by G.L. Blane
	William Moorcroft discovers the collection of Kangra paintings of Raja Sansar Chand
	Dr Carey founded Royal Agri-Horticultural Society
1821	Carey and Marshman of Serampur publish the first vernacular newspaper *Serampur Darpan*
1822	The Native Education Society founded at Bombay
	Preparation of an Atlas of India
1823	First steamship built in India, the Diana, launched at Kidderpore
	Colonel John Colvers appointed General Superintendent of Irrigation at Delhi

William Pitt, Lord Amherst (1823-1828)	
1824	*Journal of the Agricultural and Horticultural Society* published. Dr William Carey appointed Secretary of the Society and Mr W. Leycester its President
	Rangoon occupied by the British
1825	The Steamship Enterprise of 500 tonnes leaves Falmouth for Calcutta
1827	Amherst effects reforms in the internal administration, viz. extended employment of Indians in civil courts
Lord William Bentinck (1828-1835)	
1830	The Eastern Jamuna Canal opened for irrigation
1831	Construction of Grand Trunk Road
1835	Medical College established at Calcutta
	Cultivation and manufacture of tea started in Assam
	Macaulay's minute on educational policy making English as the medium of instruction and the promotion of Western learning
Sir Charles Metcalfe (1835-1836)	
1835	Calcutta Medical College opened
George Eden, Earl of Auckland (1836-1842)	
1836	A chamber of commerce established at Madras
	Upper Anicut on the Cauvery constructed by Arthur Cotton
1839	Maharaja Ranjit Singh dies at Lahore
1840	Major Proby Cautley's report establishes the practicability of a Jamuna canal scheme
Baron (Earl of) Ellenborough (1842-1844)	
1842	December. The Hindustan, the first P. and U. steamer arrives at Madras
	Work on Ganga Canal started by Proby T. Cautley
1843	Medical School established at Madras
	Annexation of Sind
	Bengal Coal Company formed
Sir Henry (Viscount) Hardinge (1844-1848)	
1845	7 May. The Court of Directors inquire of the Indian Government regarding the construction of railways in India
	3 December. First Anglo-Sikh War at Mudki, Firozshah
1847	College of Civil Engineering founded at Roorkee
	Government Botanic Garden started at Ootacamund
1848	Work on Godavari anicut delta scheme started

EARL (MARQUESS) OF DALHOUSIE (1848-1856)

1849	Second Anglo-Sikh War
	Upper Bari Doab Canal construction starts
1853	February. Sir John Lawrence appointed Chief Commissioner of the Punjab
	First railway line laid near Bombay
	November. Telegraph from Calcutta to Agra began; completed March 1855
	Cheaper postage introduced
1854	8 April. The Ganga Canal opened
	Educational Despatch of Charles Wood recommends the creation of the Department of Public Instruction in Bengal, Madras, Bombay, North-West Province and the Punjab
1855	The first jute-spinning mill set up near Serampore

VISCOUNT (EARL) CANNING (1856-1862)

1857	Universities established at Calcutta, Bombay and Madras
	Uprising against the British
1858	1 November. Government transferred to the Queen from the East India Co.
1859	Income Tax imposed and paper currency created
1860	Dinabandu Mitra writes a drama *Nil Darpan* satirising the indigo planters of Jessore and Nadia
1861	Famine in North-West Province
1862	The Penal Code for India came into operation
	The South Indian railway from Negapatan to Trichinapali opened

EARL OF ELGIN I (1862-1863)

1862	The Agri-Horticultural Society of Nagpur established. It marks the commencement of agricultural development in the Central Provinces
1863	8 January. The First Agricultural Exhibition held at Calcutta
	Madras Department of Agriculture founded by Sir William Denison, Governor of Madras
	The Madras Irrigation Company formed

SIR JOHN (LORD) LAWRENCE (1864-1869)

1864	Terrific cyclone in Bengal; 30,000 perished
	Bankim Chander Chatterji writes the first novel in Bengal, *Durgesh Nandani*
1865	The Indo-European Telegraph from Karachi, Iran and Turkey opened

1865	Famine in Orissa, 15 lacs die
1867	Indian Museum at Calcutta opened
1868	Famine in Rajputana, Upper Province
	The Punjab Tenancy Bill passed to protect tenants
	November. Delhi and Ambala linked by railway
1868-1869	Severe famine
1869	Cattle Plague Commission appointed

EARL OF MAYO (1869-1872)

1870	Railway from Bombay to Allahabad opened
	October. Railway bridge over Sutlej opened
1871	A.O. Hume appointed Chief Secretary in the Department of Revenue, Agriculture and Commerce
1872	Lord Mayo assassinated by a Pathan criminal on a visit to the Andamans

BARON (EARL OF) NORTHBROOK (1872-1876)

1873	Remodelling of the Western Jamuna Canal
1874	Sir John Strachey establishes a Provincial Department of Agriculture in North-West Provinces of Agra and Oudh
	Sir Edward Buck appointed first Director
	Simms park established at Coonoor
	Severe famine in Bihar
1875	Establishment of Indian Meteorological Department
1876	Cyclone over deltas of Ganga and Brahmaputra; 220,000 perished
	Famine in Madras and Bombay Presidencies

BARON (EARL OF) LYTTON I (1876-1880)

1877	Famine in the Punjab, Central Province and Upper Provinces. A million people died
	Veterinary College started at Babugarh
1878	Lloyd Botanic Garden established at Darjeeling
1879	Work started on Sirhind Canal in the Punjab
	The Deccan Agriculturists Relief Act, 1879

MARQUESS OF RIPON (1880-1884)

1881	Director of Agriculture appointed in Bengal and Punjab
	Department of Revenue and Agriculture instituted in the Government of India
	Railway from Ahmedabad to Agra opened
1882	24 November. The Sirhind Canal opened in the Punjab
	Veterinary College established at Lahore

1883	A Director of Agriculture appointed at Bombay
1884	Manufacture of surgarcane crushers started at Nahan on the initiative of Raja Shamsher Parkash

EARL OF DUFFERIN (MARQUESS OF DUFFERIN AND AVA) (1884-1888)

1885	Coffee cultivation declines in Mysore and South India due to leaf blight
	11 March. Bengal Tenancy Act passed by Council
1886	School of Agriculture attached to agricultural farm at Saidapet, Madras
	Veterinary College started at Bombay
1887	Empress Cotton Mill started by J.N. Tata at Nagpur

MARQUESS OF LANSDOWNE (1888-1894)

1889	Severe famine in Ganjam
	Howman's visit—Dairying
1890	Imperial Bacteriological Laboratory opened at Poona
	Botanical Survey of India formed
1891	Dr J. A. Voelcker's report on improvement of Indian agriculture
1892	Census of India showed a population of 287,289,783
	Petroleum discovered in Assam
1893	The Betwa Canal in the U.P. opened
	Veterinary colleges started at Madras and Calcutta

EARL OF ELGIN II (1894-1899)

1895	Imperial Bacteriological Laboratory started at Mukteswar under Dr Lingard
1896	Plague Research Laboratory established at Bombay with Haffkine as its Director
	Anti-rinderpest serum prepared at Mukteswar under the guidance of Dr Lingard
1897	Indigo cultivation declines due to competition of German aniline dyes

BARON (MARQUESS) CURZON (1899-1905)

1899-1900	Famine in Deccan, Central India, Rajputana, Punjab
1900	Land Alienation Act passed to protect cultivators from moneylenders in the Punjab
1901	J. Mollison appointed Inspector-General of Agriculture
1905	Setting up of Imperial Agricultural Research Institute at Pusa in Bihar

1905	Full time Directors of Agriculture appointed in the provinces Agricultural College at Poona starts

EARL OF MINTO II (1905-1910)

1906	*Agricultural Journal of India* started
1907	Tata Iron and Steel Company set up at Jamshedpore in Bihar

BARON HARDINGE OF PENSHURST (1910-1916)

1912	Samuel Stokes settled down at Kotgarh
1914	First World War starts
1915	Construction of Sarada Canal started in U.P.

BARON CHELMSFORD (1916-1921)

1917	British declaration on Indian self-government

EARL OF READING (1921-1925)

1921	Indian Central Cotton Committee established
1923	Tariff Board set up. Cotton excise abolished

LORD IRWIN (1926-1931)

1926	Royal Commission on Agriculture headed by Lord Linlithgow appointed Cotton excise duties abolished
1929	Imperial Council of Agricultural Research started. T. Vijaya Raghavacharya appointed first Vice-President

EARL OF WILLINGDON (1931-1934)

1931	Indian Lac Cess Committee established
1932	Imposition of protective tariff for sugar

SIR GEORGE STANLEY (1934-1936)

MARQUESS OF LINLITHGOW (1936-1943)

1936	Indian Central Jute Committee established
1937	Provincial autonomy. Congress ministries elected
1939-1945	Second World War
1940	*Indian Farming*, a monthly journal, started by the ICAR

VISCOUNT (EARL) WAVELL (1943-1945)

1944	Indian Central Sugarcane Committee established Dr W. Burns report on '*Technological Possibilities of Agricultural Development in India*'
1945	Sir Pheroze Kharegat's *Memorandum on the Development of Agriculture and Animal Husbandry in India*

VISCOUNT (EARL) MOUNTBATTEN (1947)

1947 Indian Central Oilseeds Committee established

SOURCE: Dates and events from 1772 to 1894 are based on James Burgess, *The Chronology of Indian History: Mediaeval and Modern*, Edinburgh, 1912.

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