The Industrialization of India

Dietmar Rothermund

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Preface

My interest in industry began in my childhood, long before I became a student of history. My father was the chief engineer of a large foundry with 600 workers at Henschel, Kassel. The company produced locomotives, but during the Second World war it was involved in the production of the Tiger tank. I visited my father several times at his place of work and asked him many questions. In the early 1950s he had a young Indian trainee, Satish Rastogi, he was the first Indian I met and I learned much from him. I later on visited him at TELCO, Jamshedpur, where he then was the chief engineer of the TELCO foundry. After TELCO I also visited the steel mill at Rourkela in 1961. I was later on told that people there thought I was an East German spy, because I asked so many pointed questions. I was amused by this suspicion. It seems that by picking my father’s brain, I had absorbed a good deal of technical knowledge. During my stay in India, I often visited factories and workshops and talked to industrialists as well as labour leaders.

In 1992 I joined the Indo-German Consultative Group, which consisted mostly of Indian and German industrialists, with a few professors added to the team. Prime Minister P.V. Narasimha Rao had asked Chancellor Helmut Kohl to convene this group, which then met every year, alternating between India and Germany. We had the task to produce a letter to both heads of government, indicating prospects of Indo-German cooperation. After our discussions we also visited important places. I still remember the impressive tour of ISRO in 1999. I learnt a great deal by talking to the Indian members of the group to which I belonged from 1992 to 2002. Prof. Ragunath Mashelkar, Director General of the Council of Scientific and Industrial Research, was also a member of this group. I got to know him there and kept in touch with him in later years. My assessment of the work of the CSIR in this book owes much to my discussions with him.

My colleague and friend, Prof. B.B. Chaudhuri, asked me then to contribute a chapter on the industrialization of India to his edited volume on the economic history of India from the 18th to the 20th century, (see bibliography) He kindly permitted me to reproduce much of the text here. I up-dated it. I had written two books after this text: India: The Rise of an Asian Giant for Yale University Press, in 2008 and Contemporary India. Political, Economic and Social Developments since 1947 for Pearson Publishers in
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New Delhi, in 2013. In both these books I also referred to industrialization, I added some of this information to the present text.

Dossenheim near Heidelberg, October 2019

Dietmar Rothermund
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Introduction: Studying the Industrialization of India

The industrialization of India has many aspects. One way of studying it could be to divide the text into separate sections on the major industries. But here a different approach has been adopted. The text has been divided into 10 chapters, which are devoted to different historical periods such as the beginning of industrialization in the 19th century, the impact of the First World War and of the Great Depression, the rise of state interventionism in the Second World War, the Nehru era, the period of stagnation, 1965-1980, the up-swing after 1980, the impact of the economic reform of 1991, etc. The emphasis is on the general political atmosphere, which influenced the pattern of industrialization. In each period all relevant industries will be discussed. This survey concerns industrialization in terms of manufacturing. The programming of software is also included, although by official definition it belongs to the service sector. The "tourist industry" is excluded. But as it is important for the Indian economy it will be briefly mentioned in this introduction. "Incredible India" is definitely very attractive, but in earlier years international tourist agencies used to avoid India, because there were not sufficient luxury hotels. This has changed in recent years. While in the 1990s about 2.5 mill. foreign tourists came to India every year, there were about 10 mill. in 2018 when earnings from tourism reached 28 billion $. Of this more than 10% are due to medical tourism. Foreigners save money by getting expensive operations done at cheaper rates in India. The employment created by the "tourist industry" amounts to about 42 million jobs. Its importance is growing rapidly.

Industrialization is a process, which is moulded by different forces. There are the economic forces, which emanate from the society concerned and there are the policies of political leaders who wish to foster industrialization in the interest of the development of the nation. The vagaries of political decisions as they determine the development of Indian industries are therefore highlighted in this book. But the internal dynamics of industrial development are also analyzed. Issues of industrial policy have been hotly contested in India. I had a glimpse of this in an interview with Finance Minister Dr. Manmohan Singh in October 1995. I knew that he was advocating the privatization of the public sector. Most of the firms in this sector were suffering heavy losses. The government had nevertheless invested more in this sector in order to increase employment. This had succeeded,
but the workforce had proved to be unproductive. The government had
then made some feeble moves towards privatization, calling them "disin-
vestment" – an accurate description, but a negative term. I asked Dr. Singh
to what extent he had progressed in this field. He then raised his hands,
touched his turban in a gesture of despair and said: "The cabinet is against
me on this issue". Elections were approaching and Dr. Singh knew that he
had no chance to go ahead with an unpopular policy. These frank discus-
sions impressed me very much. In my arrangement of the present text, I
was guided by such experiences.

In January 1996 I convened a conference on "Liberalizing India.
Progress and Problems" in the Nehru Memorial Library, New Delhi, with
my friend, Prof. Ravinder Kumar, who was then the director of this re-
markable institution. I was lucky to get some of the best economists of In-
dia as contributors and discussants. Dr. Singh gave the inaugural lecture,
which was his political testament as he soon lost his office due to the elec-
tions held in that year. I edited the proceedings of this conference, whose
results have also left a mark on the present text.

With this background, I started writing the text, which was first pub-
lished in 2005. Much has happened since then and I have done my best to
add new information to the present edition.
India and the British Industrial Revolution of the 18th century

India was industrialized even before Europe, if one defines the work of skilled artisans as industrial activity. Jawaharlal Nehru was convinced that the great tradition of Indian workmanship would also help India to make rapid progress in the world of modern industry. He did not realize that the skills of Indian artisans had actually prevented an early rise of modern industry in India. They could work miracles with the most elementary means of production. Since there were many of them in various crafts, they could always cope with any demand. Modern industry implies the substitution of capital for labour and the replacement of the skills of artisans by the functions of machines. It enhances the productivity of labour in this way. But as long as there is an ample supply of cheap skilled labour, this kind of substitution is not required.

The assertion that skills may prevent industrialization will surprise all those who conceive of skills as an essential element of human resources and think of "skilled labour" as the mainstay of industrial productivity. But skills are of different kinds and those which are useful in one context may not fit in with another. The skills of Indian artisans consisted of their dexterity. This is an attribute of the integration of various procedures of doing things with one’s hands. It is usually directed towards completing one specific piece of work after another. Industrial production consists of deconstructing dexterity and simulating its functions by means of mechanical devices. Workers who operate such devices must be trained so as to service them according to their functions. "Unskilled workers" can perform this kind of service in most cases. A "skilled worker" in this context is one who knows about the process of production and can instruct others to keep it going and may even be able to repair or adjust the respective devices if they do not function properly. This kind of skill is very different from the dexterity of the artisan. It will also command a higher price in the labour market, the more so when the maintenance of expensive capital goods depends on such skills. The evolution of industrial skills is a complex process, which requires an adequate environment.

British colonial rule in India certainly did not contribute to the creation of such an environment. At home the British had an advanced political system, which had long since made the transition from a land revenue state to
a modern type of government. In India they followed the pattern set by predecessors like the Mughals and maintained a land revenue state. British revenue officers used to debate the point whether land revenue was a tax or a rent. Keynes, when he was still working at the India Office in 1909, endorsed the point of view that it was a rent. He stated: "By immemorial right the State is part landlord of the country and can derive its revenue from this source of wealth without injustice to individuals or disturbance to industry." (Keynes 1971: 38) Because a substantial amount of the income of the colonial state was rent rather than tax, Keynes thought that India was very lightly taxed. However, this colonial rentier state did not act as a dual landlord who converts the rent derived from agriculture into industrial capital. Keynes did not comment on this, but one of India’s greatest nationalist economists, M.G. Ranade, had even earlier criticised the British colonial state for its sins of omission rather than of commission. He argued that this state as a capitalist power had done nothing for productive investment in India. (Ranade 1920: 26-30)

This book does not deal with British colonial rule of India. We shall first turn to a subject, which has not been discussed in the relevant literature: the rise of a modern industry in Britain in competition with the traditional industry of India. This rise was facilitated by a mercantilist policy, which was abandoned once Great Britain was sufficiently advanced in industrial development. By shifting to a policy of free trade and denying mercantilist protection to India, the British postponed India’s industrialization without having to resort to any outright obstruction of industrial growth. Moreover, the draining of silver from India in the first half of the 19th century caused a severe deflation, which put a brake on Indian economic development. We shall turn to this problem in the second section of this text. In subsequent sections we shall then deal with the fragmented and stunted industrial development after 1850, paying attention to the different branches of Indian industry. The sequence war - depression - war will then be highlighted. The rise of state interventionism in the Second World War marks the transition from the colonial economy to that of independent India. The instruments of interventionism were subsequently utilised for setting India on a path of rapid industrialization. In the Nehru era this seemed to be quite successful, but soon after his death structural problems led to a prolonged industrial recession. A serious drought made matters worse. A "plan holiday" not only affected the public sector but also caused a stagnation of the private sector. There was an up-swing in the 1980s, which will be analysed in detail. A balance of payments crisis upset India in 1991, but it also triggered off a determined attempt at economic reform.
After discussing what this reform has meant for Indian industrial progress, we shall turn to a specific aspect of recent development: information technology and the production and export of software. Finally we shall describe the development of Indian industry in the 21st century.

The political economy of industrialization in India has been analysed by several authors. Sometimes this analysis has been pursued in order to criticize the trend towards globalization. (Swamy 1994) This is undoubtedly an important subject, but the approach in the present text is that of looking at the interaction of technological change, the policy environment and exogenous factors such as wars, price movements in the world market etc. While tracing this interaction in historical time brackets, special attention will be paid to the evolution of technological capability and the progress of research and development (R&D). This capability implies the transition from "know-how" to "know-why", from operational skills to innovative improvements. (Lall 1987: 14) Thus the gradual emergence of India as a leading industrial nation will be the central theme here.

A history of the evolution of technological capability in India could focus on individual industries, but this would not do justice to industrialization as a comprehensive process, which is affected by historical constellations. Therefore references to specific industries have been integrated in the text. Another aspect which deserves attention is the emergence of industrial leadership. Only Jamshed Tata has been singled out for special treatment in a section of this text. But other important industrialists have also been mentioned in their particular historical context. Phenomena like industrialization seem to fit well into a deterministic interpretation of history. But industrialization is a creative process in which human agency is of great importance. This will be reflected in the following pages.

The impact of the trade in Indian textiles on the development of the British textile industry and the "de-industrialization" of India

India had exported cotton textiles even in the days of the Indus civilization. Indian weavers had great skills in this field, they could produce even the finest textiles on simple looms. First the Dutch and then the British discovered that Indian textiles found a ready market in Europe. In supplying this market by re-exporting these textiles to continental Europe, the British helped to expand this market. This created the demand which later on contributed to the rise of the British cotton textile industry. The trade in Indian textiles was resented by the manufacturers of woollens, the sup-
pliers of the major British export industry. Actually they were not hurt by the competition of the Indian textiles. They had long since adopted new lines of production. Their light woollens with combed yarn sold very well. They were called "worsteds" after Worstead near Norwich in England. They belonged to the New Draperies with which the weavers of Northwestern Europe competed with those of Italy ever since the 16th century. The English weavers captured a large share of this market: The export of English woollens increased steadily. Its total value amounted to 3 mill. Pounds around 1700 when re-exports of Indian cotton textiles only fetched 340,000 Pounds. (Rothermund 1981: 36-37, 61) In the course of the 18th century the import and re-export of Indian cotton textiles increased very rapidly. In 1700 the British Parliament had enacted legislation prohibiting the import of printed Indian textiles for the home market. Importing them for re-export was still permitted. This legislation fostered import substitution by British cotton printers. They required white cotton cloth, bleached to precise specifications in India. This became an essential semi-finished input for the London cotton printers whose production increased by leaps and bounds in the first half of the 18th century. They often employed up to 400 workers in one plant and invested heavily in mechanical equipment. (Aiolfi 1987: 169-176) In fact, they were the vanguard of the industrial revolution. (Rothermund 2001: 495-506)

The rise of the London cotton printers was paralleled by a dramatic increase in the supply of piecegoods from Bengal in the period from the 1720s to the 1740s. The East India Company was good at tapping new sources of supply, but in the 1740s this was not very easy because wars affected the conduct of trade. (Rothermund 1999 c: 283) From 1745 to 1760 there was a decline in the export of white cotton piecegoods from Bengal. The difficulties of adequate supplies of semi-finished goods for their booming business must have caused the London printers to look for import substitution. It would be more convenient to get cotton cloth woven in England. But this presupposed a supply of cotton yarn – and handspinning was highly labour intensive. One weaver normally depended on the output of about six spinners. Labour was expensive in Britain thus there was an urgent need to reduce costs. This induced inventors to apply their minds to the task of enhancing the productivity of labour with mechanical devices. The first of a line of such creative men was James Hargreaves (1720-1778), an illiterate handloom weaver, who invented a spinning machine in 1764, which he named "Jenny", this was not the name of his daughter, but a local slang for "engine". This spinning-jenny could spin several threads at once. Spinners had the tricks of their trade literally at
their fingertips. Hargreaves’s major achievement was the invention of a mechanism which could replace this work of nimble fingers. This was an exemplary case of the deconstruction of dexterity in the interest of mechanisation. But the thread produced by Hargreaves’ “jenny” was a soft one, more suitable for the weft than for the warp. Five years later Richard Arkwright invented an improved spinning machine, which he then provided with a waterframe in 1775. This gave rise to the establishment of spinning mills driven by water power. Arkwright’s machine produced a strong thread suitable for the warp. Arkwright produced the thread with rollers running at different speeds. For this he needed gears supplied by watchmakers. (Allen 2009: 204) This showed the combination of different skills in the construction of new machinery. Moreover, while the source of power for Arkwright’s machine was originally a watermill, he later replaced this with James Watt’s steam engine. Earlier Samuel Crompton had invented the “mule” around 1780. This machine could produce finer and stronger yarn suitable for mechanical looms, and in 1784 Edmund Cartwright promptly invented such a loom. The industrial revolution picked up speed.

In contrast with the rapid progress of mechanical spinning, Cartwright’s loom took a long time to replace the handloom. Weavers with improved shuttle looms were still getting better results than the mechanical loom. Thus the number of handloom weavers increased in England from about 100000 in 1788 to 240000 in 1830. It was only by 1860 that their number dwindled to 10000. (Paulinyi/Troitzsch 1997: 307) It is, therefore, wrong to assume, that the weavers, “whose bones bleached in the plains of Bengal”, were the victims of industrial powerlooms. They had been outproduced by British handloom weavers working with improved looms and industrial yarn. Cartwright’s powerloom was initially a slow and cumbersome machine. He and his brother were the only entrepreneurs who invested their money in weaving mills equipped with this machinery. But both failed by about 1793. It took a number of further improvements to make powerlooms a paying proposition. But by 1830 about 100000 had been installed in British mills. (Paulinyi/Troitzsch 1997: 310) The rise of the powerloom depended on advances in the production of machine tools which enabled mechanics to work on metal parts with great precision. The legendary Henry Maudslay (1771-1831 who established his workshop in 1797 was a pioneer in this field. He invented the industrial turning lathe, followed by numerous other machine-tools. He did not apply for patents, but concentrated on expanding his production, which made him the lead-
ing industrialist in this field. (Paulinyi/Troitzsch 1997: 332) The synergies of all these inventions contributed to the industrial revolution.

Economic historians have been puzzled by the fact that this revolution was sparked off by the British cotton industry, which was smaller than the contemporary French one and which even in the British context was initially a minor industry. (Davis 1973: 311-312) The solution of this puzzle may be that due to the trade in Indian textiles the scope for import substitution as well as the export market were enormous in this field. Therefore this industry could forge ahead at a rapid rate. Unfortunately this sealed the fate of Indian weavers in the export business. The mechanical devices which have been described above, did not require much capital investment and could have been easily reproduced in India. But as they were invented in order to save labour, nobody felt the need for them in India. The debate on the crucial question why India did not make the transition to capitalism has usually centred on "capital" rather than on "labour". Only in recent years British historians have highlighted the role of labour and its wages in the industrial revolution. (Allen 2009: 34) In India the "Jenny" would not have been profitable, (Allen 2009: 194) It was the surfeit of labour, which prevented the transition to capitalism in India. Of course, if this assertion is true, modern industry should never have had a chance in India as there was always plenty of labour. The crucial problem is the cost and the productivity of labour. When food prices rose during the second half of the 19th century, labour became more expensive in India without adding anything to its rather modest productivity. At the same time textile machinery had reached a stage of maturity that it could enhance the productivity of labour enormously without requiring too much investment. It was at this stage that capital was substituted for labour even in India – but only in a very limited field of industrial production.

The industrial revolution in England put an end to the demand for Indian textiles in Europe and British textiles then entered the colonial market. This has often been referred to as the de-industrialization of India. But this process was regionally differentiated. It undoubtedly affected Bengal most severely, where more and more weavers had been employed for the production of white cotton cloth for export. South Indian weavers, working mostly for the home market, were able to survive for quite some time. (Specker 1988: 333-346) Moreover, the first half of the 19th century was a period of deflation. The silver, which had been pumped into India in the 18th century in payment for Indian textiles, was drained out of the country now as the British collected a great deal of revenue but spent hardly anything in India. Under such conditions the prices of raw cotton and food
grain remained depressed and weavers working for the home market could make both ends meet, although at a very low subsistence level. The depressed state of the economy and the cheapness of production for the home market postponed the rise of a modern Indian industry for several decades. It was only when prices rose again and Indian weavers could no longer subsist by making use of cheap inputs that Indian industry could achieve a modest take-off in the late 1850s. In the second half of the 19th century handloom weavers were often among those who suffered most from acute deprivation as noticed by various Famine Commissions. This was a reflection of the rise of food and cotton prices, which directly affected the weavers.

The prices rose because silver flowed back into India at the time of the new investment in railways. Soon silver depreciated in the world market and blessed India with a gradual inflation. This context has hardly been discussed in the debates about the de-industrialization of India in the early 19th century and the gradual rise of a modern Indian industry in the late 19th century. Moreover, the debates on de-industrialization have been dominated by ideological assumptions, which prevented a more realistic appraisal of actual historical processes. (Roy 1999: 12-47) Weavers, for instance, have been discussed in rather general terms without taking into consideration that this category encompasses a scale of occupations, which reaches from humble "menials" producing coarse cloth in the villages to highly skilled silk-weavers who manufacture expensive saris. Actually the weavers at both ends of this scale were less exposed to the menace of "de-industrialization" than those in intermediate positions such as the Bengal weavers of fine white cotton cloth mentioned above. The "menial" weaver with low skills was usually also an agricultural labourer and would weave coarse cloth only when his rural clients demanded it. But the highly skilled weaver had always participated in commercialized production for a limited market in expensive goods, which faced hardly any competition from imported textiles. (Roy 1999: 91-92) The weavers who competed with imported textiles were those who produced goods, which were traded regionally beyond the confines of the village. Some of them then used imported yarn for the warp as it was stronger and reserved the softer handspun yarn for the woof. In this way a market for industrial yarn was created. This provided the initial stimulus for the growth of a modern cotton textile industry in India. The crucial point here – as originally in England – was the cost of spinning, the most labour intensive part of textile production. When feeding the spinners became costlier than buying industrial yarn, modern industry could get a foothold in India.
Western India: The cotton textile industry

The mills established in India in the mid-19th century were spinning mills only. Their yarn was not just supplied to Indian weavers, it could also be exported to East Asia and competed successfully with British yarn in that region. The infant Indian industry could not hope for protection, it had to compete in the world market. Again, its most important asset was cheap labour. The Factory Acts were then imposed on India at the behest of British capitalists who wanted to reduce this kind of competition.

The amount of capital required for a cotton mill was fairly limited (about 0.5 mill. Rs), but capital was generally risk-averse in India. This cannot be attributed to peculiar psychological features of Indian entrepreneurs, it was rather due to the simple fact that land prices rose steadily under the impact of population pressure and the above mentioned gradual inflation. Thus investment in land competed with investment in industry. Moreover, rural credit and trade in agricultural produce always absorbed the liquidity in the Indian economy like a huge sponge. The seasonal rhythm of the demand for this credit dominated the money market. The banks reserved as much money as possible for the harvest time. Therefore they would not wish to commit funds to investment in industry. (Gadgil 1924: 221) Those Indian capitalists who nevertheless invested in industry were mostly traders active in the cotton trade who knew their business and could calculate the risks of moving from trade into production. They invested their own money and whatever they could borrow from relatives and friends. They usually did not abandon trade after becoming industrialists. This is why India produced very few pure industrialists with a long-term approach to investment. Most of the industrialists remained basically traders who took up industry as a sideline.

The first successful cotton mill was established by the Parsi entrepreneur C.N. Davar in Mumbai (Bombay) in 1854, it was a spinning mill and started production in 1856. Mumbai remained the major centre of this industry in subsequent years, but Ahmedabad had also made an early start with the Ahmedabad Spinning and Weaving Co. established in 1858 by the versatile Ranchhodlal Chhotalal, a Nagar Brahmin. Several others followed,
but the initial spurt of mill construction came to an end with the American Civil War, which interrupted the supply of American cotton to British mills and thus created a sudden demand for Indian cotton. The prices of raw cotton increased very rapidly. Indian cotton traders profited from that, but mills and handloom weavers were hit by the price rise. The cotton boom collapsed as soon as the war was over. The business of the Indian cotton exporters was almost wiped out. Only big British firms which streamlined the supply by setting up cotton presses upcountry and shipping the cotton bales by rail right to the docks of Mumbai could survive the fierce competition. (Vicziany 1979) This meant that the flow of capital from trade to industry also dried up. No new cotton mills were established in India from 1865 to 1871. It was only in the mid-1870s that investment in this field revived. In Mumbai 32 new mills were started in those years. The British textile industry was, of course, not at all interested in the proliferation of Indian mills. But the British manufacturers of textile machinery were eager to sell their products to Indian entrepreneurs and found good customers in India. For some time Mumbai was still the main centre of this industry. The foundation of the Bombay Millowners Association (BMOA) in 1875 reflected the new confidence of the Mumbai industrialists as well as the leading role of their city in this line. But new upcountry centres also emerged as entrepreneurs realised that being closer to the cotton growing regions was of some advantage to them. Tata’s Empress Mill was started in Nagpur in 1877 and the same year saw the establishment of the Solapur Spinning and Weaving Co.

The small town of Solapur in Southern Maharashtra had been reached by the railway in 1860 and had then remained the railhead for about two decades. It emerged as a major centre of the raw cotton trade just at the time of the American Civil War. When investment in the textile industry started once more in other centres, the Solapur entrepreneurs also dared to join the party. But Solapur also sponsored another industry: the production of handwoven bedspreads. These were made of thick cotton cloth with attractive woven patterns. The weavers concerned were not local Maharashtrians but migrants from neighbouring Andhra, the Padmasalis, who had obviously left their rural homes, because they found more scope for their work in this expanding textile town. (Roy 1999: 74) From a small beginning in the late 19th century they extended their operations throughout the 20th century. Solapur provided a striking example for the fact that handloom weavers could very well co-exist with the cotton mill industry. The "de-industrialization" debate mentioned above has detracted attention from the resilience of the handloom weavers. Of course, they had to look
for niches in a competitive market. But when they could offer specialties like the Solapur bedspreads, they were also helped by the extension of the railway network. Railway construction under British rule was aimed at facilitating the transport of raw materials from the interior of the country to the ports and of imported goods from the ports into the hinterland. It was certainly not planned with a view to encourage the growth of a wider home market for Indian goods. The structure of freight rates favoured shipments over long distances on a single line. This raised the cost of shifting shipments from one line to another in cross-country traffic. But it nevertheless opened up new trade routes for special products.

The years after 1876 were very favourable for the export of Indian yarn to East Asia, where it almost completely replaced British yarn. This export boom was fueled by the steady decline of the Indian exchange rate from 1876 to 1893. The Rupee depreciated by about one third in this period. At the same time the circulation of silver Rupees in India increased by one third – far in excess of the growth of India’s population. (Rothermund 1970) This caused an inflation, which created a great deal of liquidity, which was also conducive to further investment in industry. Cotton mills proliferated in this period. There were only 47 in 1875 but 142 in 1893. The number of spindles increased from 1.1 to 3.6 mill. and that of looms from 9000 to 31000. The ratio of spindles to looms remained roughly the same at about 120 :1. By 1913 this had changed considerably when there were 271 mills with altogether 6.8 mill. spindles and 104,000 looms (65:1). These figures reflect the decline of the export of Indian yarn and the rise of composite spinning and weaving mills.

The decline of the Asian demand for Indian industrial cotton yarn in the 1880s was paralleled by a rising demand for Indian raw cotton. The rapidly growing Japanese cotton spinning mills depended on Indian raw cotton. British shipping companies such as P&O charged high freight rates for it. The new Japanese shipping line NYK (Nippon Yusen Kaisha) and the Tatas of Mumbai combined to challenge the British monopoly. Jamshed Tata visited Japan in 1893 and persuaded NYK to start a line from Kobe to Mumbai. He supplemented it with his own shipping line, which took turns with NYK in servicing this connection. They lowered the freight rate and caused a fierce price war waged by P&O, which reduced the freight rates to negligible amounts. Tata's line folded up. The ships did anyhow not belong to him, but to business partners. NYK survived with Japanese government support. A compromise was arrived at by restoring a reasonable freightrate charged by NYK and P&O alike. Indian raw cotton exports increased dramatically. By 1913 28 % of India’s raw cotton was consumed...
by Japan. Of course, this was paralleled by a displacement of Indian cotton yarn by Japanese yarn in the Chinese market. (Akita 2018: 279 f.)

When the government closed the Indian mints to the free coinage of silver and introduced a gold-exchange standard with the Rupee as a token currency maintained at a rate of 1 s 4d, this was accompanied by a deflationary shock. The Mumbai mills now found themselves between the devil and the deep sea. Their yarn exports dwindled as Japanese and Chinese mills competed with them, and as far as the sale of cloth was concerned they faced the competition of the growing number of upcountry mills, which were not only closer to the cotton fields but also to the rural consumers.

Employment in the cotton mills increased from 60,000 millhands in 1883 to 260,000 in 1913. Throughout this period from 1893 to 1913 an average mill seems to have employed about 950 millhands. The growth of the industry was obviously not accompanied by a rise in labour productivity. But labour was cheap and the payment of wages was not necessarily geared to productivity. Different mills had different wage rates and a feeble attempt of BMOA to standardize wage rates in the 1890s failed completely. Of course, there was no plan to define minimum wages in the interest of the workers. BMOA was interested in scaling down wages to an average rate. But even in this respect it was impossible to discipline its members.

Whereas millhands could be recruited very easily, technical personnel initially had to be imported. Only expatriates had the necessary qualifications. This changed when the Victoria Jubilee Technical Institute was established in Mumbai in 1887. Indian spinning and weaving masters were trained in this institute. In subsequent years they replaced most of the expatriate staff. Technical education was otherwise not encouraged under colonial rule, therefore this initiative in Mumbai deserves to be highlighted. This institute had initially only two departments: Mechanical Engineering and Textile Engineering. It was one of the oldest engineering colleges in Asia. In 1997 it was renamed Veermata Jijabai Technological Institute. Nowadays it has nearly 3000 students, among them about 69 doctoral candidates. With a staff of 150 teaching a wide spectrum of subjects, including automotive engineering, computer technology and robotics, VJTI contributes bright people who promote the industrialization of India – and it has done so for more than one century.

The amount of capital invested in the Indian cotton textile industry before the First World War may be roughly estimated at 160 mill. Rs if an average mill required an investment of 0.5 to 0.7 mill. Rs. This was about one half of the total amount of capital invested in various industries in In-
dia around 1913. At this time the total amount of rural indebtedness was estimated at 5 bill. Rs. and the value of all agricultural land at about 40 bill. Rs. (Goldsmith 1983: 46,63) This shows that industry still played a rather marginal role in India. Moreover, it was concentrated in a few regions. The Western part of India in which the cotton textile industry was the major one and where production for the home market was predominant was somewhat better off in this respect than the Eastern part, which was dominated by a few industrial enclaves whose production was mainly geared to the export market.

At the time of the protest against the partition of Bengal in 1905, the Swadeshi movement arose for the first time in Eastern India. It stressed the need of relying on indigenous (swadeshi) industrial production rather than importing industrial goods from Great Britain. Its impact remained rather limited, because the nationalists who promoted it had hardly any experience in the field of industrial production. But the "Swadeshi" message was repeated again and again in subsequent nationalist campaigns.

Eastern India: jute, tea and coal

The difference in regional economic structure was reflected by the kind of entrepreneurs engaged in the process of industrialization. As has been mentioned above, capital in India tended to move from trade into production. The trader was familiar with the demand for the goods which he then produced as industrialist. This is why the cotton textile industry was almost entirely an Indian business. Export-oriented production would thus be a natural extension of the activities of British agency houses in Calcutta. They had their fingers on the pulse of the world market and good connections with partners in London. It was therefore no accident, that industry in Eastern India was controlled by British – or more precisely Scottish – entrepreneurs. Even as late as 1970 the Bengal Chamber of Commerce was almost completely staffed by scotsmen in its higher ranks – as I noticed when I visited this chamber at that time and interviewed its staff.

The blow, which the Crimean War (1853-1856) had dealt to the export of Russian hemp, suddenly propelled Indian jute into the limelight. This fibrous plant had been known in India since ancient times, its name is derived from the Indian word jata (matted hair). In 1795 a British botanist, W. Roxburgh, had sent a consignment of jute to London, but nobody had taken any interest in it at that time. However, when Russian hemp became scarce, Scottish traders started supplying raw jute to the infant jute indus-
try of Dundee in Scotland. They soon noticed that setting up jute mills in Calcutta would be profitable, the more so as the export of Indian produce increased and jute textiles were in demand as packing material. It would be rather circuitous to ship raw jute to Dundee and then jute bags back to Calcutta. The jute mill owners in Calcutta also remained basically traders. They were not only engaged in the jute business, their firms usually also owned tea estates and tea processing plants as well as coal mines.

The first jute mill was started by George Acland in Calcutta in 1855. It was only a spinning mill, selling its yarn to handloom weavers. A big trading firm, the Borneo Company, established a combined spinning and weaving mill in 1859. By 1868 five mills were operating in Calcutta, they had altogether about 1000 looms. Within the next 15 years this industry grew at a fast rate. By 1883 there were 23 mills operating more than 6000 looms and employing close to 50,000 millhands. During the subsequent decade growth slowed down, but the two decades from 1893 to 1913 were a period of rapid expansion. The number of mills increased from 28 to 64, the number of looms from about 10,000 to 36,000 and the number of millhands from 70,000 to 216,000. Looms and millhands trebled, but the number of mills did not increase to the same extent as the size of the average mill in terms of looms nearly doubled. There were about 8 millhands per loom in 1883, 7 in 1893, and 6 in 1913. Output per loom and per worker may be estimated by looking at the consumption of raw jute by the mills which amounted to 120,000 t around 1883, 172,000 t in 1893 and 820,000 t in 1913. Consumption per millhand thus remained at 2.4 t from 1883 to 1893, but increased to 3.8 t in 1913. Consumption per loom declined from 20 t in 1883 to 17 t in 1893 and then increased to 22 t in 1913. (Goswami 1991: 4-5) The variations in the productivity per loom reflected the problem of excess capacity which plagued the jute industry again and again. At a later stage this put a brake on further investment in machinery, but in the glorious days of initial expansion of the jute industry optimism prevailed. Most of the machinery was new and the export markets were expanding. World trade in grain and cashcrops increased by leaps and bounds. Therefore jute products for packaging were in great demand. The American market was particularly attractive and the mills of Calcutta captured more and more of it, while the share of the British jute industry in that market declined. By 1913 the United States absorbed about 40 per cent of the production of the Calcutta mills. American imports were controlled by a few firms which could put pressure on the Indian industry as far as pricing and supplies were concerned. There was also an important shift in American demand from jute bags to cloth as bag-stitching factories
had been set up in the United States. (Goswami 1991: 57) This deprived the Indian industry of an important element of value-added production.

Organization and financing of the jute industry was in the hands of British managing agencies. Originally such a managing agency did exactly what its name indicated, it provided the management of a firm and received a commission at about 10 per cent of the turnover. But once it had made a mark in this field, it would be entrusted with the management of more firms and finally it turned into a holding company, floating companies and managing them as well. The agency usually owned only a minority of the respective shares. It could nevertheless control the respective company as long as the rest of the shares were widely distributed. Although most of the companies were Rupee companies, i.e. their capital was raised on the Calcutta stock market, less than a fifth of the shares were in Indian hands. These Indian shareholders were usually professionals or landlords who were only interested in dividends and not in having any say with regard to the management of such companies. It was only at a later stage that Indian traders bought shares with a view to become directors on the board of jute mills.

The fact that the jute industry remained for a long time an exclusive field dominated by a few big British managing agencies was not due to sinister machinations. There was, of course, the Indian Jute Mills Association (IJMA) founded in 1884, which tried to work like a cartel, restricting output in order to support the price level. It was no accident that this association was formed at the beginning of the decade of slow growth mentioned above. At that time the phenomenon of excess capacities made itself felt and the association tried to cope with it by imposing output restrictions on its members. But for the most part the restrictions were observed only on paper. Even the leading members of IJMA violated them secretly. After all, this industry operated in a competitive world market and it could neither dictate prices nor withhold the supply of raw jute to its competitors abroad. In fact, the best grades of raw jute were usually exported, while the Calcutta mills absorbed the cheaper varieties and produced coarse gunny cloth. Their consumption of raw jute increased over time, but the lion’s share of raw jute was always exported.

It was through the trade in raw jute that Indians could penetrate the jute business after all. Jute was cultivated by small peasants in the rice fields of Bengal. There were normally two rice harvests per year, one of the lesser varieties in summer (aus), and the second one of the better type of rice in winter (aman). Jute replaced the first type and hardly ever the second one. Thus jute was cultivated because it provided an extra income to the peas-
ant – at least in the good times before the First World War. Later on it more often happened that the traders and the mills depressed the price of jute and the peasants continued to grow it, because they were forced to do so by their creditors. There was an elaborate network of intermediaries who bought the jute from the peasants and finally sold it in the spot market in Calcutta where the agents of the mills would buy it. But as the whole trade expanded a new type of intermediary appeared on the scene: the Marwari. These people came from distant Rajasthan and were very clever traders and moneylenders. In Western India they had penetrated the field of rural credit, in Calcutta they soon found out that the jute trade offered opportunities which had not been utilised before. From 1905 they operated the fatka bazaar in Calcutta in which jute futures were traded and speculators could try their luck. (Goswami 1991: 85) This type of business can be judged in different ways. The millowners would complain that it attracted "sharks" who swallowed the simpleminded and drove up prices. A more detached view would be that hedging and trade in futures would tend to stabilise prices, provided that there was keen competition and nobody was able to corner the market. The Marwaris seem to have operated in a competitive market. For a commodity whose prices were affected by seasonal volatility, this type of trade was very suitable. At least the Marwaris were making money in this game and soon controlled a large part of the export trade in raw jute. As we shall see later on, this was a good preparation for entering the jute industry after the First World War.

The Indian tea industry was another export-oriented one as there was initially hardly any consumption of tea in India. The British had become the world’s greatest tea-drinkers in the 18th century. Indian demand for tea developed only in the 20th century and it is only recently that home consumption of tea has greatly reduced Indian tea exports. Ever since the days of the Opium War, the British had looked for other sources of tea so as to reduce their dependence on China for this article. It was then discovered that Assam was suitable for tea cultivation. There were some humble beginnings even before 1850 and a "tea mania" in 1859-60 when all kinds of adventurers established tea estates, usually with the intention of selling them quickly at a high price. (Chaudhuri 1983: 311) By 1864 India exported 1500 t tea. British tea estates proliferated in the second half of the 19th century. Tea exports amounted to 87,000 t with a total value of nearly 100 mill. Rs. in 1900, ten years later exports had risen to 115,000 t valued at 124 mill. Rs.

British managing agencies played a pioneering role in this field. These agencies were finally in a position to buy and sell firms, providing attrac-
tive balance sheets by means of window dressing. They could control captive markets, e.g. sell coal from mines owned by them to factories also owned by them etc. Trading as a means of capital control was made into a fine art by them. They could make the best out of the scarcity of capital and the scarcity of managerial and technical personnel. Indigenous labour continued to be cheap in India, but managers and engineers had to be imported. The recruitment in this field was another specialty of the managing agencies. Indian entrepreneurs, once they expanded their industrial activities, also established managing agencies and followed the same rules of the game.

The tea-plantations established by the managing agencies depended on wage labour. Unlike the growing of raw jute by innumerable Bengal peasants, growing tea was a semi-industrial activity. Each estate needed a plant for the treatment of the tea-leaves, which had to be carefully supervised as even small mistakes could spoil them. The estate managers were expatriates, the labour was not recruited in Assam but from more distant places such as Southern Bihar. By 1900 about 500,000 labourers were working in the tea-plantations. Managing agencies such as Shaw Wallace owned several plantations and were also in charge of exporting the tea. The Tea Association of India was more effective in its field than IJMA in the jute industry. As we shall see later on, the Tea Association astutely managed the stabilisation of the tea price at the time of the Great Depression. Only very few Indian entrepreneurs were active in this field. This was also due to the fact that almost all tea estates were held by Sterling companies registered in London. The Marwaris who had bought shares in the Calcutta stockmarket of the Rupee companies operating jute mills found it difficult to extend their activities to London. (Goswami 1989: 308)

The third field of industrial entrepreneurship in Eastern India, the collieries, was different from the two others as this industry was hardly export-oriented. Coal was needed for the jute mills and the tea-plantations as well as for the river steamboats. In addition it was consumed by the various Indian railways. Some of the railway companies had their own collieries. A major player in this field was the East India Railway Company, which charged such high freight rates for coal that all consumers except this company itself were penalised in this way. In Western India it was cheaper to buy British coal which was shipped to India by steamer. The cost of mining in India was rather low as labour was cheap and there was a great deal of open cast mining. Most Indian coal has a high ash content. For ordinary use as fuel this did not matter, only coking coal for the steel industry had to be mined in deep shafts later on. Unlike in most other
parts of the world, where subsoil rights are vested in the state, such rights belonged to the landlord (zamindar) in Eastern India. For those who controlled coalfields this was a windfall, but since they themselves were unable and unwilling to operate mines, they readily leased the rights to the managing agencies. Some of them were badly cheated, because they had no idea of the value of their subsoil property. There were very few Indian entrepreneurs who dared to invest capital in coal mining in the early years. It was only at a much later stage when Indians active in the coal trade started acquiring mines.

The limited industrial development of Eastern India remained for a long time an expatriate affair. Nobody prevented Indian entrepreneurs from joining the ranks of industrialists in this region. But the many informal ties, such as membership in the exclusive Bengal Club, which facilitated the access to "commercial intelligence", worked against Indian participation. Moreover, the British entrepreneurs had easy access to their compatriots in government. Thus the entire atmosphere of industrial development was very different in Western and Eastern India. The coal and tea industries also gave rise to the phenomenon of enclave economies. An economic enclave is an area in which capital, labour and food supply comes from the outside. The local population is only marginally involved in the activities of the enclave and it usually does not benefit from them. The Jharia coalfield in Southern Bihar is a case in point. It was opened up in 1894 when the East India railway reached this area. Mining started in a small way and the local population supplied sufficient labour. Migration to the tea plantations from this area receded accordingly. Around 1900 the Bengal-Nagpur railway was linked to the Jharia field and thus by 1902 coal production was stepped up once more, but the real breakthrough came in the period from 1905 to 1908 when coal production increased from 3.3 mill. to 7 mill. t and labour recruitment nearly doubled from 40,000 to 70,000 miners. In this way a crucial threshold was crossed, because labour now had to be recruited from distant places and food supply could also no longer be provided locally. The railway transported foodstuffs to the Jharia market which emerged as a major source of supply for the miners. Once the enclave was established in this way, the local people hardly benefited from it. At the most they participated as casual labour in the open-cast mines. Since this provided a slightly better income than the amelioration of the rather poor agriculture in the immediate vicinity of the mines, the local area became completely irrelevant for the food supply of the miners. (Rothermund 1978: 1-19) In later years when coal was also taken by truck to dis-
tant places, the coal trucks did not return empty to Jharia but carried loads of vegetables.

The managing agencies, which owned the collieries, did little for the technological improvement of coal mining. At the most they sent a British engineer to look after boilers and winches. The raising of the coal was usually left to raising contractors who recruited their own groups of miners. The capital required for starting a mine was fairly small, dividends were high and the re-investment of profits minimal. The Katras-Jherriah Coal Co. controlled by the famous managing agency Andrew Yule is a case in point. An analysis of the income derived from this company by Andrew Yule from 1900 to 1916 yields striking results. Katras-Jherriah was started with an investment of about 0.5 mill. Rs in 1900, by 1916 the agency had collected about 5 mill. Rs. in those 16 years of which 25 per cent were due to its commission, 33 per cent were derived from dividends and 42 per cent from the sale of shares. (Papendieck 1978: 221) The agency had seen to it that Katras-Jherriah always showed much higher profits than other coal companies under its control and this facilitated the brisk trade in shares. By manipulating prices within the group of companies controlled by it, the agency could attribute profits and losses as it suited its interest.

Although Eastern India was mainly known for the three industries mentioned so far, there had nevertheless grown up a small engineering industry based in Calcutta. Jute textile machinery was mostly imported, but there were other items such as boilers and winches etc. for which an ancillary engineering industry was useful. This was provided by such British companies as Burn & Co., John King & Co., Turner, Morrison & Co., Jessop & Co. and Martin & Co., of which Martin was the youngest, while Burn could trace back its origin to the 18th century. In 1895 these five companies formed the Engineering and Iron Trades Association (EITA). This association continues to exist at present. It grew in membership and strength and also changed its name from time to time. In 1986 it was renamed Confederation of Engineering Industries and in 1992 it became the Confederation of Indian Industries (CII) and celebrated its centenary in 1995. It is now represented world-wide. The founding members were owners of rather modest engineering workshops in their time, whereas among the present members there are many major industrialists. There was a long way to go from those early days to the present.
At present the leather industry is one of India’s major export industries. Its rapid rise has taken place in recent years and we shall return to this success story later on. But the beginnings of this industry can be traced back to the 19th century and to the expansion of the demand for Indian hides and skins abroad. India always had a large population of cattle as well as of sheep and goats. But initially the removal of dead cattle and of the remnants of sheep and goats was the unpleasant duty of low caste or even out-caste people living on the periphery of villages. They flayed the dead animals and even ate the carrion. The leather they produced in a rough and ready manner, was used mostly for leather buckets or other containers for carrying water and irrigating the fields. These were not traded commodities, providing them was a service rendered to the village community, which looked after the maintenance of those people. (Roy 1999: 161)

The leather worker had to acquire only few basic skills. He had to wield a knife so as to remove the rests of flesh without piercing the hide. He had to know how to cure the leather by either drying it in the sun or salting it. And finally he had to tan it with the bark of some trees collected in nearby woods. There was only a very limited demand for more sophisticated products such as shoes for the rich and boots and saddles for the army.

In the final decades of the 19th century there were several new developments which brought about a great change in the life of the Indian leather workers. The railways provided means of transport for cured hides and skins. Municipal slaughterhouses came up in Indian towns. The healthy cattle slaughtered there yielded better hides than the dead animals in the villages. Peasants who had earlier been glad to pass on dead cattle to the menials free of charge now became aware of the market value of hides. The market demanded hides, which were cured and tanned by better methods than those practised in the villages. All this contributed to a shifting of tanneries to the outskirts of towns and to a rural-urban migration of the leather workers.

The traditional shoemakers (mochi) who had earlier made Indian-style decorated shoes and sandals were quick to copy European designs and supplied urban customers with "boots". But the entrepreneurs in the new leather industry emerged neither from their ranks nor from those of the tanners and other leather workers. The "capitalists" who soon dominated this new industry were mostly Muslim traders who were also involved in other lines of trade. (Roy 1999: 189) In the new leather factories the old tanning practices were supplemented by more sophisticated ones such as
chrome-tanning. This process had been introduced in America at the end of the 19th century. It greatly speeded up the process of tanning and yielded a better finished product. Indian tanneries shifted to the production of intermediate goods which could get a proper finish abroad. German firms based in Calcutta controlled a great deal of the export of hides. (Roy 1999: 165) Their business collapsed very suddenly at the beginning of the First World War. But by that time the Indian export trade in hides was already well established.

Compared to the present position of the Indian leather industry, these humble beginnings appear to be very elementary, indeed. But they did imply a revolutionary shift from a kind of village craftsmanship, which hardly deserved to be classified as such, to an industrial activity and a large-scale rural-urban migration of the respective workers. These people escaped from a life of despised menials only to become exploited proletarians, but they did prepare the ground for a major Indian industry. This industry developed in response to the demand of the world market. Its evolution was a gradual one. There were no pioneering entrepreneurs who took great risks and planned for the future. This was very different with regard to a commodity like steel, which was produced in Western industrialised countries in great quantities. There seemed to be no demand for Indian steel at all. Nevertheless a bold Indian entrepreneur emerged who felt that the industrialization of his country required the making of steel for which raw materials like iron ore and coal were readily available.

The vision of Jamshed Tata: The steel mill at Jamsheedpur, the Indian Institute of Science at Bengaluru

From the survey of the conditions under which industry had to grow in India, it is clear that they were not conducive to the rise of genuine industrialists who would have a bold vision of the future and take big risks so as to make their dreams come true. Therefore it is even more surprising that one such visionary did arise in India in the late 19th century: Jamshed Tata (1839-1904). He made money at a young age as a trader, supplying the British-Indian troops sent to Abyssinia in 1868 with provisions. He then invested in cotton textile mills. He established the Central India Spinning, Weaving and Manufacturing Co. in 1874 with a capital of 1.5 mill. Rs. This company built a mill at Nagpur close to the cotton country and as it was opened in 1877 when Queen Victoria adopted the title of Empress of India, it was named Empress Mill. Initially Tata had equipped it with
low-cost British machinery, but when the yarn did not meet his specifications he imported the latest type of American machinery with ring spindles, which even the Lancashire mills had not tried at that time. In 1886 he bought a "sick" mill in Bombay and re-named it Swadeshi Mill. At first this venture was a flop and he had to put his personal fortune at risk in order to salvage it. But in due course this mill also became a major asset. 

(Lala 1981: 13) The choice of the name "Swadeshi" was obviously not fortuitous. The Swadeshi movement became important only at later stage, but the term itself was already known among the nationalists who had founded the Indian National Congress in 1885. Jamshed Tata also traded in imported steel. Therefore he knew about the demand for this commodity in India. His plan to establish a steel mill in India was thus not a pipe-dream, but he would have been on safer ground if he had limited his activities to the cotton textile industry in which he had been so successful. At the turn of the century he visited the United States and inspected steel mills there. He then invited American experts to explore the field for him and to select a suitable site close to the coal mines and iron ore deposits of Eastern India. This is where Jamshedpur came up after his death. His sons, Dorab and Ratan, continued Jamshed's work and also saw to it that the steel mill was built according to his wishes. The capital invested in this mill amounted to 23 mill Rs. This would have been enough to build about 40 medium-size cotton textile mills. It could have easily been a costly flop, if the First World War had not turned it into a profitable venture.

Jamshed Tata insisted on building a steel mill, because he conceived of it as a strategically important component of a national economy. He also was eager to raise the capital in India and his heirs actually managed to do so. The huge amount was subscribed within three weeks in 1907 by altogether 8000 investors (Lala 1981: 24). Among them there were 15 maharajas for whom this was their first foray into industrial finance. Some maharajas were inspired by patriotism. The British saw to it that they did not associate themselves with the Indian National Congress, but there was no objection to their participation in the Indian Industrial Conferences, which had been held since 1904 as a sequel to the annual Congress session. At the 1908 session in Chennai (Madras) the Maharaja of Baroda had presided over the Industrial Conference and in 1909 in Lahore it was the turn of the Maharaja of Darbhanga to deliver the presidential address. He referred to the experience required for the conduct of large scale industrial ventures and then mentioned "the great Tata engineering enterprise", expressing his hope that it will be "the pioneer of many similar successful schemes". He also referred to the need for establishing institutions for scientific and in-
dustrial education: "They have to be multiplied if we are to hold our own in the race of industrial competition". (Darbhanga 1909)

In emphasising the need for scientific and technical education, the Maharaja of Darbhanga echoed Jamshed Tata’s earlier concern. He had sponsored the Indian Institute of Science, which was established in Bengaluru at about the same time as the steel mill at Jamshedpur. He did not live to see the fulfillment of his dream, but without his determination neither the steel mill nor the institute would have been established. The British frowned upon these schemes. Who would buy Indian steel, and who would employ scientists trained in India?

Jamshed Tata had given a grant of 3 mill. Rs for the foundation of the Indian Institute of Science. This investment has yielded high returns in the field of fundamental research. But there is one aspect of the work of this institute in which Tata’s hopes have been somewhat disappointed. He had conceived of this institute as a source of technological progress, which would directly contribute to the growth of Indian industry. The same idea was later on behind the establishment of the Council of Scientific and Industrial Research in 1942. But Indian industry has usually imported technology from abroad and thus Jamshed Tata’s original idea is still not fully implemented. The Government of Madras showed some interest in research at the Indian Institute of Science whose scientists played an active role in the Chemical Industries Committee set up by that government in 1909, but it made little use of the institute in subsequent years. (Tyabji 1995: 147)

In stressing the technological aspect of Jamshed Tata’s plan it should not be forgotten that his ideas went beyond that. He actually had a kind of institute of advanced studies in mind, which would also include subjects such as archaeology, history and philosophy. (Lala 1981: 36) The full scope of his vision was never realised, but he had certainly set a new standard for Indian industry and had provided a personal example for all future Indian industrialists. This is also true of his initiatives in the social sphere. He instituted a pension fund for his staff in 1886 and started paying accident compensation in 1895, whereas no other Indian industrialist had even thought of such a measure. Human resources were more important to him than capital and raw material. He had started as a trader, but he had realised that industrial production requires more ideas than the mere buying and selling of commodities.

Another early visionary industrialist was Laxmanrao Kirloskar (1869-1956). He operated on a much smaller scale than his senior contemporary Jamshed Tata, but he also blazed a trail for future generations. Kir-
loskar was a Maharashtrian Brahmin born in Belgaum (now in Karnataka). He was good at mechanical work and studied to be a technical draftsman. Later he taught in this field in a Mumbai technical institute but then resigned from this job and started a bicycle shop. The plague drove him out of Mumbai in 1896. He returned to Belgaum, where his brother taught in a high school. They established the firm Kirloskar Brothers, which eventually turned to manufacturing agricultural equipment. One of their products was an iron plough. In 1910 the Kirloskars shifted to Kirloskarvadi in the small princely state of Aundh whose ruler had offered them free land and some financial assistance. In subsequent years they manufactured irrigation pumps, cane crushers, oil engines etc. Much of this machinery was designed by Laxmanrao Kirloskar himself who was not only a pioneering industrialist but also a very talented engineer. The next generation then expanded industrial production to include all kinds of machine tools. (Baldwin 1959: 285) Another Kirloskar company, Mysore Kirloskar Ltd. at Harihar, was started in the midst of the Second World War soon to become the largest machine tool manufacturer in the private sector in India. While Jamshed Tata had been a visionary entrepreneur with a keen eye for the prospects of modern industry, Laxmanrao Kirloskar was a born engineer who also managed to start a promising company, which grew from humble beginnings to one of India’s major engineering concerns.
Indian nationalists would frequently quote Friedrich List’s plea for protective tariffs for infant industries, but the British would, of course, never listen to that. The First World War, however, had the practical effect of a protectionist regime, because trade links were cut and India was largely left to its own devices. Moreover, India proved to be a valuable support base for the British empire. When a railroad had to be built in Mesopotamia as an important measure of the British war effort, Tata’s steel mill got the contract of supplying 1500 miles of rails. This was the decisive breakthrough for Indian steel production. Similarly the Indian cotton textile and jute industries derived great benefits from the war. Coal mining also benefited from the war. Before the war about 500,000 t of coal had been imported through Mumbai, where British coal was cheaper than Indian coal mined in Eastern India, from where about the same amount was shipped to places East of India. In the course of the war 1 mill. t were exported per year, while total production which had amounted to only 11 mill. t annually during the pre-war years, peaked at 28 mill. t in 1919.

The cotton textile industry nearly doubled its output during the war from about 0.7 to 1.3 bill. yards. The amount of yarn produced during the war remained more or less the same. Thus the increase in cloth production was mainly achieved by reducing the amount of yarn sold to the handloom weavers as well as curtailing the export of yarn. However, Indian cloth production could not compensate for the reduction of imports and thus per capita availability of cloth declined from 12.6 to 9.8 yards. (Morris 1983: 604) This was a strong incentive for a postwar expansion of the industry even though imports were bound to increase once more after the war.

Unlike most Indian industries, which benefited from the indirect protection caused by the war, the export-oriented jute industry was initially affected very badly by the outbreak of the war. But the worst affected were the peasants producing jute, because the price of raw jute dropped rather suddenly. Mill consumption of raw jute actually increased to about 1 mill. t in 1915 and remained rather stable until the end of the war. Trench warfare caused a huge demand for sandbags. This was a windfall for the jute industry. The import of looms was restricted by the war, the problem of
excess capacities disappeared for some time. Consumption of raw jute per loom increased to 26 t and to 4 t per millhand. Net profits as percentage of paid-up capital increased by leaps and bounds. In the five years before the war they had amounted to about 22 per cent for the industry as a whole. For the three years from 1915 to 1917 they amounted to an average of about 70 per cent, but in 1918 they shot up to 162 per cent. (Goswami 1991: 94-95)

Industrial war profits were substantial for all industries, particularly towards the end of the war. In the meantime the exchange rate of the Rupee had risen from 1 s 4d to 2 shillings. This was an incentive for the import of investment goods. Since no machinery could be imported during the war, most industrialists placed large orders as soon as the war was over. (Bagchi 1972) Of course, the high exchange rate led to a reduction of Indian exports. If this had continued, India would have faced a balance of payments crisis. But the Rupee soon dropped to 1 s 3d. This also put an end to the investment boom. Moreover, the industrialists soon noted that they were faced with excess capacities.

Indian industry in the 1920s

The only industry which prospered during the 1920s was the jute industry, although it was once more plagued by the problem of excess capacities. By 1923 about 10,000 new looms had been added to the 40,000 operating during the war. But mill consumption of raw jute had declined to 940,000 t bringing the rate of consumption per loom down to ca. 19 t. The number of millhands had increased during the war and by 1923 they numbered 330,000. Consumption per millhand thus decreased to 2.8 t. However, by 1929 – just before the onset of the Great Depression – the jute industry reached a peak of mill consumption of raw jute of about 1.2 mill. t. Consumption per loom thus increased to about 22 t and 3.5 t per millhand. Net profits had, of course, never again attained the dream levels of the war years. But they amounted to a comfortable average of about 50 per cent for most of the mills in the period from 1920 to 1929. The expatriate elite controlling these mills could enjoy the leisurely laid-back posture of gentlemanly capitalism. Perhaps the manipulation of profits attributed to different companies under their control was one of the most rewarding activities of these gentlemen. There were wide variations of the rates of profit of mills belonging to the same group. The two largest groups, Andrew Yule and Bird-Heilgers, which together controlled 20 big mills tolerated differ-
ences of profit rates of individual mills from about 30 to 70 per cent in the mid-1920s. At a first glance one would attribute this to careless management, but if we keep in mind how Andrew Yule managed the Katras-Jherriah Coal Co. mentioned above, we may suspect that the same tricks were also used with regard to the jute mills.

In this period the Marwaris emerged as a major force in the jute industry. The British expatriates often made disparaging remarks about them but could not prevent their acquisition of shares which then secured them positions on the boards of directors. By 1918 there were only 3 Marwaris out of altogether 114 directors of jute mill companies, by 1930 nearly 60 per cent of all European companies had Marwaris on their board. (Goswami 1991: 109) Some of them also ventured to step out of the relative anonymity of boardrooms and established mills of their own. Some Marwari traders had prospered enormously during the war by, for instance, trading in appreciating silver. Starting a new jute mill after the war was more expensive than in earlier times. It cost about 5 mill. Rs. to establish an average mill containing about 500 looms. But this was no problem for men like Ganshyamdas Birla and Sarupchand Hukumchand who both established mills in 1922 and even joined IJMA. (Goswami 1991: 105) They surely knew that this conservative monster did not have sharp teeth and that they could defy it with impunity – as even its most faithful members did. The old guard did, of course, bewail the fact that these upstarts barged in although there was hardly any reason for being afraid of them. By the end of the 1920s jute mills owned by Indians accounted for about 6 per cent of total capacity and 6 to 8 per cent of production. (Goswami 1991: 106) In terms of net profits as a percentage of paid-up capital these Indian mills ranged far below the British controlled mills. This was due to the fact that the British firms had invested their capital mostly before the war whereas the Indians had to invest much more into similar types of mills. Thus their net profit rates paralleled those of the British companies before the war.

In contrast with the jute industry, the cotton textile industry did not do well in the 1920s. After the post-war investment boom it suffered from excess capacities and labour trouble. The structural divide between the Mumbai mills and the upcountry mills became more pronounced in this period. The latter were closer to the consumers and usually also to the cotton fields. The Mumbai mills tried to move upmarket, but in doing this they faced the competition with Japanese and British textiles. They also had higher labour costs due to the living conditions in the metropolis. By 1925 the profits of the Mumbai millowners had dwindled and they were in the red.
When they tried to reduce their costs by means of "rationalization" and retrenchment, they triggered off widespread strikes in the city in 1928. (Chandavarkar 1998: 100) The Communists who had captured the All-India Trade Union Congress at that time were very active in those strikes. Commentators spoke of a "strike for leadership" indicating that political rather than purely economic issues were at stake. This phenomenon remained restricted to Mumbai. The upcountry mills had no such problems.

The production of cotton cloth was affected by these ups and downs in the 1920s. From 1916 to 1923 the production had stagnated at about 1.6 bill. yards per year. The doubling of looms due to the investment boom then showed its effect. Production rose considerably and peaked at 2.4 bill. yards. In 1928, the year of the strike in Mumbai, it dropped to 1.8 bill. yards. But in 1929 it rebounded and reached once more 2.4 bill. yards.

The years of the late 1920s were also a time of great agitation concerning the exchange rate of the Rupee. Indian industrialists wanted to have it restored at the pre-war rate of 1 s 4 d. By 1927 the British had managed to push the rate up to 1 s 6 d. This had been achieved by a policy of deflation, which had annoyed Indian business interests. The idea behind it was to peg the Rupee at this rate to the gold standard, which was then done by means of the Currency Act of 1927. In this way the Rupee was the only currency in the world, which returned to the gold standard at a rate higher than the pre-war parity. The British authorities defended this by maintaining that Indian prices had adjusted to this level. Sir Purushottamdas Thakurdas, Mumbai’s most influential capitalist who was called "King Cotton" because of his position in the cotton trade as well as in the mill industry, had written a trenchant minute of dissent as member of the respective currency commission. He also added a prophetic warning with regard to what would happen in the event of falling prices. The effect of the Great Depression fully justified this warning only a few years later. (Rothermund 1992: 37) But the British were adamant and would not listen to Thakurdas.

The tense atmosphere of this time increased the interest in Indian nationalism among a substantial section of the business community. The establishment of the Federation of Indian Chambers of Commerce and Industry (FICCI) in 1927 was a sign of the solidarity of this section as against the British interests represented by the older chambers of commerce such as the Bengal Chamber of Commerce or the Bombay Chamber of Commerce. Indian millowners in the cotton textile industry were particularly affected by the high exchange rate as it constituted an import bonus. (Rothermund 1992: 138) In general, Indian industrialists avoided a con-
fronation with the colonial government as they were interested in being in the good books of the rulers. But the sequence of events in this period annoyed them so much that they could see the virtues of Indian nationalism.

The impact of the Great Depression

The Great Depression, which reduced agrarian prices by half, had a differential impact on Indian industry. The cotton textile industry could derive some benefit from import substitution, but it also faced the competition of the handloom weavers who would always forge ahead when prices of raw cotton and food grain were low. Due to stiff Japanese competition, the British for the first time granted protective tariffs to the Indian cotton textile industry, but they also introduced imperial preferential tariffs. This actually amounted to market sharing between British and Indian industrialists. A precedent for this had been established in 1924 for the steel industry, when Indian steel was about to succumb to Belgian and German competition. (Adarkar 1941: 64-66) The British who had earlier defended the orthodoxy of free trade felt rather uneasy when they had to deviate from it so as to defend protectionism. The Montagu-Chelmsford reforms of 1919 had granted "fiscal autonomy" to India and this implied that the Government of India could regulate tariffs in the interest of India. A Fiscal Commission debated the details of this new departure in 1922 and the Panjabi entrepreneur, Lala Harkishen Lal, when giving evidence before this commission, supplied it with the term "discriminating protection". This was almost as tricky a term as "responsible government" which Lord Curzon and Edwin Montagu interpreted in rather different ways. "Discriminating" could mean "judicious" as well as "selective" – at any rate, it called for criteria for its application. "Natural advantage" was supposed to meet this need. If India had the raw material required for the respective industry and if there was a suitable home market for its products, India had a "natural advantage" as far as this industry was concerned and this justified "discriminating" protection. This kind of definition was very useful as it avoided a reference to "infant industries" which are supposed to be protected according to Friedrich List’s theory. The Indian steel industry which was covered by "discriminating protection" in 1924 and the cotton textile industry, which enjoyed increasing protective tariffs in the 1930s were certainly not infant industries. "Discrimination" could also justify the granting of preferential tariffs although such tariffs cannot be defended in terms of economic theory. They are a reflection of political expediency. Indian industrial-
ists did not like them, of course, but they knew that they were the price for getting protection under British colonial rule. (Chatterjee 1992)

A striking incident of this period was the "conversion" of Homi Mody, chairman of BMOA, who initially criticised the scheme of imperial preference settled at the Ottawa conference in a speech in the Indian legislative assembly on November 10, 1932 and then recommended the scheme in his speech of December 5, 1932. His earlier arguments had been very convincing, whereas the second speech showed that he had been forced to eat his words. It seems that the Government of India had told him in no uncertain terms that without the acceptance of imperial preference the Indian textile industry could not expect a further extension of protective tariffs. But Mody was not only forced to eat his words, he was compelled to enter into a pact with the British cotton industry, which was concerned about losing the Indian market. This pact, which came to be known as the Mody-Lees Pact, was concluded in 1933 and implied a market-sharing arrangement. Indian and British interests agreed in reducing the share, which the Japanese had acquired in the Indian market, but the British industry would have preferential access to it. (Rothermund 1992: 146-150) Indian nationalists attacked this pact and the socialists among them saw in it the harbinger of a "fascist compact" between British and Indian capitalists. This was a real fear articulated at that time. But actually the criticism contained in Mody’s first speech reflected more accurately the interests of the Indian textile industry than anything that he said and did after his "conversion". The Mody-Lees Pact was a shotgun marriage to be followed by a divorce at a later stage.

The phenomenon of market-sharing was also evident in the relations between the Indian industry and the handloom weavers. However, in this field there was no "pact" but only a tacit tolerance as far as the millowners were concerned. The handloom weavers were the darlings of Gandhi and the National Congress and it would not have been "politically correct" for the millowners even to mention the fact of competition. As pointed out above, cheap food and cheap cotton would foster handloom production. The steep fall of agrarian prices after 1930 had been a boon for those weavers, whereas the mills could not adjust the wage rates in keeping with the food prices. In fact, the depression years were the only years, which witnessed a substantial increase in the real wages of Indian labour. In 1930 and in 1931 the relation of mill production to handloom production was roughly 1.5:1, but this changed dramatically in 1932 when handloom production surpassed mill production. Gandhi’s emphasis on the use of hand-woven cloth as well as the reduced demand of the rural masses for cloth of
finer counts produced by the mills may have played a role in this respect. At any rate, it seems that the handloom weavers were the real pioneers of import substitution at that time. But obviously supply exceeded demand in 1932 and there was a correction in 1933 when the old relation (ca. 1.5:1) was restored. In the next five years the mills steadily increased their output from 3.4 to 4.3 bill. yards. There was another surge of handloom production to about 2.3 bill. yards in 1935 to be followed by a correction and another surge to 3 bill. yards in 1938. The handloom sector experienced in this way much greater cyclical fluctuations than the mill industry. But this also showed its dynamic resilience. British imports into India receded from 0.5 bill. yards in 1930 to 0.2 bill. in 1938, whereas Japanese imports increased from about 0.3 to 0.4 bill. yards in that period. (Rothermund 1992: 159) Thus there was only a slight decrease of total imports. However, Indian import substitution should be measured in terms of the demand of an increasing population, which would have otherwise led to more imports. In fact, the growth of the Indian textile industry in the depression years was mainly due to this demographic factor. (Leue 1982)

The handloom weavers who participated in this growth depended to a large extent on mill yarn and this is why spinning mills prospered in this period and even new centres appeared in the midst of the depression. Coimbatore had even earlier catered to the demand of the handloom weavers with a couple of spinning mills, but whereas there were only 9 mills in 1932, this number increased to 24 in 1938. (Leadbeater 1993: 83) This reflected the expansion of the handloom sector outlined above. However, in addition to mill yarn there was also a considerable production of handspun yarn in the 1930s. Surges in the supply of this yarn paralleled the surges of handloom production mentioned above. These surges occurred whenever a sizeable amount of cotton was left in the Indian market after the demand of the mills and of the exporters had been met. The handspinners were thus the most important element of the flexibility of the Indian market. Gandhi had advocated handspinning for a long time and had asked his followers to ply the charkha whenever they had some time to spare. But this was only a symbolic gesture and would not have caused the massive production of handspun yarn in the period from 1932 to 1938. The depression helped to implement Gandhi’s ideas in an unexpected way.

The number of looms and spindles of the Indian cotton textile industry increased by about 16 and 13 per cent respectively from 1930 to 1938 when there were altogether about 200,000 looms and 10 mill. spindles. (Rothermund 1992: 162) The expansion was restricted to the upcountry mills, it
had even taken place in the princely states in which labour was cheaper and not protected by British laws. Mumbai had stagnated and could only survive by moving up-market and producing cloth of finer counts. In doing this it competed directly with British imports. This is why market-sharing was more of an issue for BMOA than for millowners elsewhere. In general, however, protectionism did help the Indian cotton textile industry in the 1930s. Otherwise the Japanese would have been able to capture a much larger share of the Indian market. Their industry was fairly new and equipped with modern machinery. They had a cheap labour force of young women who were almost kept like slaves on the mill compound, and with the drastic devaluation of their currency in 1932, they could indulge in "exchange dumping". They were substantial importers of cheap Indian raw cotton. They would have imported more of it, if they could have exported more cloth to India. Without a protective tariff, which kept them at bay, they could have "de-industrialized" India at least as far as the cotton textile industry was concerned.

The jute industry, which was mostly export-oriented, could not benefit from a protective tariff. Moreover, it had to reduce the prices of jute goods in keeping with the fall in prices of produce as it would have been incongruous if the packing material remained expensive while the prices of the contents had been reduced by half. World trade in primary produce remained more or less the same in terms of volume inspite of the dramatic decline in its value. Accordingly the demand for jute bags should have remained fairly stable. But the need for cutting expenditure also led to the emergence of substitutes such as paperbags and of new ways of mechanical handling, storage, and shipment of grain. (Goswami 1991: 132-133) The jute industry, however, wanted to continue doing business as usual. For cutting costs it mostly relied on squeezing the poor peasants who could not even shift to the production of rice, as rice prices had also fallen in an unprecedented manner. By 1933 rice was even cheaper than wheat. (Rothermund 1992: 87)

The production of the jute industry (again measured in terms of mill consumption of raw jute) receded from 1.2 mill. t in 1929 to 0.8 mill. t in the next year, and it remained at that level until 1934. Then there was a recovery and by 1937 it reached about 1.3 mill. t. In the meantime the number of looms stagnated at 61,000 from 1930 to 1934. The number of millhands had been cut down rather drastically from 343,000 in 1929 to 257,000 in 1933 in keeping with the cut in production. IJMA would also have liked to seal a good number of looms and asked the Government of Bengal to help in this matter. This government actually issued an ordi-
nance for this purpose in 1932, which had no substantial effect, but it was anyhow meant only as a gesture to assure the creditors of the jute companies and it did have this psychological effect. By 1935 there was an improvement in the prospects of the industry and new looms were installed, bringing the total up to 68,000 in 1938. It remained at that level until 1946. Total investment in jute mill machinery amounted to 35 mill. Rs. for the period from 1935 to 1938. This was a small amount when compared to the 156 mill. Rs. spent on such machinery in the 1920s. (Rothermund 1992: 196) There were about 10 per cent more looms in 1938 than in 1933. The employment of millhands had risen more or less to the same extent.

Although the jute barons had been rather nervous in the first years of the Great Depression, by 1937 they dared to embark on a confrontational course against the "newcomers" – mostly Indians. There had always been a temptation to get rid of these newcomers by means of a price war. But as long as the going was good, the expatriate elite indulged only in occasional verbal attacks against them and did not declare war on them. This they did in March 1937 when IJMA withdrew all restrictions. The big groups then increased production by about one third and thus sent prices tumbling down. Net profits had all along been rather low in the depression years of the 1930s, in 1938 they turned negative for almost all mills due to the effects of the price war. The big groups had enough in their war chest to weather the storm, but some of the smaller Indian companies did fold up. By 1938 IJMA extended olive branches to the survivors, because the shakeout had run its course and the big groups did not want to forego profits any longer. The price war could be conducted with the connivance of the newly elected Government of Bengal, because it was dependent on the European bloc in the legislative assembly in which the jute interests were well represented. (Goswami 1991: 135-147) Soon after the price war and the shake-out, the Second World War started, which once more created a huge demand for sandbags. The jute industry again enjoyed a windfall.

One Indian industry, which profited from import substitution with a vengeance, was the Indian sugar industry. India had earlier imported refined sugar from the Netherlands Indies. As no British interests were involved, the Government of India did not hesitate to impose a prohibitive tariff on this imported sugar. (Adarkar 1941: 194) Sugar mills mushroomed in India in the years of the depression. The demand of the home market could be met within a very short time and India was on the verge of becoming a sugar exporting country. But then imperial interests were at stake. The lobby of the sugarcane planters of the British colonies in the
West Indies saw to it that in the World Sugar Agreement of 1937 India was classified as a sugar importing country, i.e. it was not to be granted an export quota. (Rothermund 1992: 179)

An encouraging rate of progress in import substitution could also be noted in the Indian cement industry. Cement is an essential ingredient of all modern construction. The raw materials required for making it were readily available in India. Imported machinery could be easily operated by Indian engineers. The first cement company started operating in 1914. There were further additions in the 1920s. But a major milestone in the progress of this industry was the formation of Associated Cement Companies (ACC) in 1936 under the leadership of the Tatas. Ten units were merged in ACC and production steadily increased. Imports dwindled almost to insignificance. In 1930 they had still amounted to about 100,000 t; by 1939 imports had come down to 7,000 t whereas indigenous production had exceed 1 mill. t by 1937. ACC established its own engineering workshop for maintaining equipment in 1942. Only five years later, this workshop produced the first entirely Indian-made cement factory. (Lall 1987: 58) Thus in this field import substitution could progress to the manufacture of equipment in a rather short period of time.

The Indian steel industry had been the first one to be blessed with "discriminating protection " in 1924. It was a blatant case of market-sharing. British steel had priced itself out of the world market where German and Belgian steel was predominant. These competitors would have also captured the Indian market, eliminating British imports as well as the Tata Iron and Steel Co. (TISCO). If the British had not been interested in protecting their share of the Indian market by means of a preferential tariff, TISCO would not have survived – particularly in the period when India had an overvalued currency maintained by the British in the interest of India’s creditors. The Steel Protection Act was renewed in 1927 for a period of seven years. In this period TISCO increased its share of the Indian market from 30 to about 75 per cent. Of course, this was a larger share of a market, which had dwindled under the impact of the depression. From a peak at 1.6 mill. t in 1927, Indian steel consumption had receded to 0.8 mill. t in 1933. With TISCO having captured such a large share of the market, further protection seemed to be unnecessary. But in the meantime the Ottawa Agreement had brought everything under the regime of imperial preference. If the British wanted to retain their share of the Indian steel market in keeping with this regime, they had to extend the Steel Protection Act. Although protection was continued in this way, there were at
first no new entrants in the Indian steel industry and TISCO remained its only beneficiary.

The tiny Mysore Iron and Steel Works (MISW) at Bhadravati was more of an experiment in a progressive princely state than a serious challenger of TISCO. This Mysore company had originally been established in 1918 as Mysore Distillation and Iron Works. The idea was to use Mysore’s forest resources for the distillation of industrial chemicals. The charcoal, which was a by-product of this process, could then be used for smelting iron. This venture was started at a rather inappropriate time. Soon after its establishment new chemical technologies were discovered in the West which helped to produce synthetic chemicals which were cheaper than those extracted from the forests of Mysore. Moreover, iron prices dropped by half after the war. The 28,000 t blast furnace operated at Bhadravati was turning out only very little steel. Most of the time it had to work at much less than full capacity. A mill making steel pipes and a rolling mill were added in the 1930s. But it was not until the energy of the nearby Jog Falls was harnessed so as to provide cheap electricity to Bhadravati that MISW came really into its own. (Baldwin 1959: 68-79)

While MISW was a pigmy as compared to TISCO, the Bengal Steel Company established in 1937 could become a serious competitor, but its production grew only during the war when Indian steel was once more in great demand. This second major steel company owed its origin to an interesting combination of British and Bengali entrepreneurship: Martin Burn. As mentioned earlier, both Burn and Martin were founding members of the Engineering and Iron Trades Association established in Calcutta in 1895. Burn & Co. was an old agency house in Calcutta going back to the late 18th century. Martin & Co came up in the late 19th century and got a Bengali partner, Sir Rajendra Mookerjee, before 1914. Another Bengali Brahmin family, Banerjee, joined in due course. In 1926 Martin & Co. acquired Burn & Co and was renamed Martin Burn. Its steel venture was called Indian Iron and Steel Company (IISCO). The Martin and Mookerjee families owned about 40 per cent each of Martin Burn. (Hazari 1966:60).

The tea industry was in a class of its own. The Tea Association established a powerful cartel together with likeminded associations abroad and managed to support the tea price by means of rigorous restrictions of production and export. Its agents entrenched themselves in the customs offices and practically usurped the powers of government in enforcing the export quotas fixed by the Tea Association. (Rothermund 1992: 197-198)
Indian entrepreneurs would have never been able to stage such a coup under British colonial rule.

For those industries, which produced goods for the home market, the depression years were a rather unfortunate period, inspite of the modest chances of increased import substitution, because the buying power of the rural masses was severely reduced. Only the small minority of urban salaried men enjoyed a windfall due to cheap food prices and low wages of servants etc. They could afford to buy imported goods, the more so as the British maintained an overvalued exchange rate of the Rupee, which acted as an import bonus. The Ottawa Agreement added to the predicament of Indian industry. It guaranteed British preferential access to the Indian market for about 160 industrial goods, whereas only 10 types of Indian goods, mostly raw materials, were granted free access to the British market. These were goods which the British would have bought from India anyhow, because they could not have procured them more cheaply from elsewhere. But the broad spectrum of British goods which enjoyed privileged access to the Indian market prevented the diversification of Indian industry. The colonial fragmentation of Indian industry was thus continued. Linkages among different industries could not develop. The progress of industrialization depends on synergies. When different industries grow in isolation from each other, such synergies cannot emerge. This experience enhanced the tendency among Indian industrialists to look for perfect protectionism, which could only be achieved in independent India.
4. The rise of state interventionism in the Second World War

The Second World War once more had an effect similar to that of the First World War as far as the Indian economy was concerned. As the war progressed, the government procured more and more goods for the war effort. For this a new administrative machinery was established. The British did not sequester Indian industries, they were left in private hands, but they were subjected to a strict regime of control. Prices were dictated on a "cost plus"-basis, i.e. the British calculated the costs and permitted the Indian industrialists a margin of profit, usually about 10 per cent. The industrialists quickly got used to this system, which guaranteed profits without risk. The administration of this system gave rise to an interventionist mechanism, which had not existed in British India before the war. All this remained in place after independence. The "Transfer of Power" also implied the heritage of the interventionist state.

A very constructive initiative of the Government of India during the war was the establishment of the Council of Scientific and Industrial Research in 1942. The British government had set up a Department of Scientific and Industrial Research at home obviously in view of the importance of advanced technology for the war effort. Prof. A.V. Hill was sent to India to advise the government on setting up a similar institution there. But instead of creating a government department it was decided to adopt a council model. The council of scientists is an autonomous society with no direct executive tasks. It emerged only later on as the apex body of the network of national laboratories with a Director General with the status of a secretary to government. (Desai 1993: 211) There was very little that this council could do during the war, but it emerged as a major instrument of industrial research in independent India.

*The emergence of the instruments of intervention*

Before the war the British administration in India was of a rather rudimentary type. The departments of government could only enunciate policies, they had no executive organs, which could buy and store grain, procure goods for the army etc. Orders were issued under the Defence of India Act, which created such organs. Thus the Cotton Cloth and Yarn (Control) Or-
der of June 1943 created a Textile Control Board, which included representatives of the millowners, it also empowered a Textile Commissioner to dictate terms to the mills. (Leadbeater 1993: 167) The war put an end to almost all imports and thus completed the trend towards import substitution. At the same time British demand for the war effort increased. The Indian mills could not expand as no investment goods could be imported either. They had to make use of installed capacity by working more shifts. In this way they managed to increase cloth production from about 4 bill. yards at the beginning of the war to 4.7 bill. yards in 1944. Handloom production declined slightly from 1.8 bill. yards in 1939 to 1.6 bill. in 1944. Per capita availability of cloth also declined and prices rose. The war profits of the millowners were considerable, though the government tried its best to tax them. A post-war investment boom, like that which had followed the previous world war, did not occur this time. The reasons for this will be explained later on. By the end of the war the machinery of the mills was worn out and the future looked bleak.

The fate of the jute industry was somewhat different. It reached its peak of production at the beginning of the war. The value of its exports amounted to about 480 mill. Rs at that time. The volume of exports then dwindled to about one fourth in 1945, but the value of these reduced exports nevertheless totalled 570 mill. Rs. Since raw jute prices had remained low – due to the decline in the volume of production – profits were very high. But the partition of India which separated the mills in India from the jute fields in East Pakistan reduced the prospects of postwar investment in an industry which appeared to be doomed. There had been substantial changes in the ownership of the industry during the war, particularly after 1942. By the end of the war more than a quarter of the mills were controlled by Indians. This change was more dramatic than that in the first years of independence when the big British managing agencies, which were still in control by the end of the war, held on to their mills until the 1960s. (Goswami 1989: 301-302) The reluctance of Indian entrepreneurs to replace the expatriates in the jute industry was probably due to its uncertain future. The problems of this industry were further aggravated by Pakistan’s refusal to devalue its currency when India did it in 1949, following the devaluation of the Pound Sterling. One of the chief motives of Pakistan’s refusal to devaluate was the expectation of earning more from jute exports to India. (Bose 1983: 999) But this was a foolish policy as it provided a strong incentive for the extension of jute cultivation in India. Of course, it took some time before this could compensate for the loss of East Bengali jute.
The rise of new industrial firms

The war economy provided the setting for the enormous expansion of two Marwari industrial groups, the Birlas and the Dalmia Sahu Jains. The Birla family had migrated from Rajasthan to Mumbai in the 1860s, in the 1890s they had opened a branch in Calcutta where they started jute mills. In subsequent years they started or bought up industries in a big way. The 1940s provided them with numerous opportunities of benefiting from the wartime command economy. (Hazari 1966: 51) The other Marwari group, the Dalmia Sahu Jains, were of more recent vintage. Ramkrishna Dalmia from Rohtak (now in Haryana) joined the sugar bonanza of the 1930s and then entered the cement industry. In the 1940s he took over three of Andrew Yule’s jute mills and also got hold of the Punjab National Bank. Ramkrishna was joined in his activities by his brother Jaidyal whose son-in-law Shanti Prasad Jain also became a partner. (Hazari 1966: 64) These worthy gentlemen were known for their sharp practices and their skills in the fine art of tax evasion. Due to all this they emerged as one of the four major industrial groups of independent India.

The Tatas also extended the scope of their industrial activities considerably during the war years. In 1940 Tata Chemicals was established and in 1944 Tata Locomotives was set up at Jamshedpur close to TISCO. The manufacture of locomotives for the Indian railways was an urgent task as they could not be imported during the war and many of the older locomotives needed replacement. This line of production was stopped 18 years later. Tata Engineering and Locomotive Company Ltd. (TELCO) as it was then called shifted to the manufacture of trucks in the 1950s and became the largest private company in terms of sales. (Lall 1987: 175)

Another company, which prospered during the war, was Hindustan Aircraft Ltd. (HAL) in Bangalore (Bengaluru). Initially the princely state of Mysore was eager to establish a plant for the manufacture of automobiles and got Walchand Hirachand, a Gujarati Jain entrepreneur residing in Solapur, interested in this scheme. While exploring suitable partnerships for this venture in the United States in the late 1930s, an associate of Walchand met an American engineer and entrepreneur, W.D. Pawley, who was just planning to set up an aircraft factory in China. Walchand invited him to set up such a factory in India. Initially the British did not like the idea, but when they were hard pressed during the war in 1941, they permitted Walchand to go ahead with his plans. In 1942 the new plant was sequestered by the government and turned over to the United States Air Force with W.D. Pawley as its technical director. Walchand withdrew
completely from this venture and thus it remained a public sector enterprise even after the war. (Baldwin 1959: 136) During the war HAL grew by leaps and bounds, finally employing 16000 skilled workers who formed the nucleus of Bengaluru’s high-tech manpower at a very early stage. But immediately after the war employment dropped to 3000 as there was no further work on airplanes and the company just managed to survive by making buses and railway carriages. (Baldwin 1959: 137) It took several years before the new Indian Air Force could make use of HAL.

HAL was not the only project with which Walchand Hirachand (1882-1953) was associated. He was an extraordinary industrialist who sponsored many firms, which made a mark in India. (Piramal/Herdeck 1985: 393 f.) He was both impetuous and tenacious. Making quick decisions, he stuck to his guns once he had made up his mind. He was not interested in accumulating wealth, but always aimed at leadership. He was an ardent nationalist, but had to be circumspect so as not to spoil his relations with the British authorities. His family had migrated from Gujarat to Maharashtra and he was born and lived in Solapur. This city owed a lot to his munificence. One of his early ventures was in shipping. In 1919 he bought a steamer, SS Loyalty, from the Maharaja Scindia of Gwalior. With this he started a shipping line with some of his friends, which he called The Scindia Steam Navigation Co. It was the only Indian shipping line and it had to struggle for survival as the British controlled the sea. It did succeed. From 1929 to 1950 Walchand was the chairman of this company. From shipping he progressed to shipbuilding and founded the Scindia Shipyard at Visakhapatnam in 1940. The place was bombed by the Japanese in the war, but this did not discourage the unflappable Walchand who pursued his plans nevertheless. The first ship built in India, Jal Usha, was launched by Jawaharlal Nehru in 1948. The shipyard was nationalized in 1961. Its present production will be mentioned later on.

Walchand was also a pioneer in the automobile industry and founded Premier Automobile Co. in Mumbai in 1945. The first car was produced in 1949. In 1955 there was a tie-up with FIAT. The small FIAT cars were used as taxis all over India. In the car business Walchand had to compete with Birla, who had established Hindustan Motors and produced the Morris Oxford under the Indian name Hindustan Ambassador. In Walchandnagar near Nasik Walchand started a big industrial complex, which is still active today. Walchandnagar Industries has helped in the production of the Agni V ballistic missile and has participated in other defence projects. Walchand also bought a large tract of land in Ravalgaon near Nasik and did agricultural experiments there. During the sugar boom of the 1930s he
also became a "sugar baron". He was successful in so many endeavours that he may be called the most creative Indian industrialist.

In the last years of the war another industrial company was founded, which later on acquired great fame: Bajaj Auto Ltd. The Bajajs are Marwaris who had established their headquarters in the cotton country at Wardha near Nagpur. Jamnalal Bajaj was an ardent nationalist who was thrown into jail at the time of Gandhi’s campaign of 1920. He later on became the treasurer of the National Congress. At his invitation Gandhi made the Sevagram Ashram near Wardha his permanent residence in 1934. Wardha then came to be known as the secret capital of India and Bajaj saw to it that the Mahatma could receive his many visitors there. Jamnalal Bajaj died in 1942 and Gandhi deeply mourned his death, stating that he would never again meet a man like him. The next generation expanded the vast business empire established by Jamnalal. They added Bajaj Auto Ltd. to it which then emerged as India’s leading manufacturer of scooters and autorikshaws. (Lall 1987: 170) Due to the nationalist fame of Jamnalal, the Bajajs remained politically well connected in independent India, but being in the private sector, they also had to face the restrictions, which India’s planners imposed upon the growth of private industrial enterprise.

**Economic policy after independence**

The first few months after the attainment of independence were a period of insecurity. The aftermath of partition and the refugee problem overwhelmed the inexperienced new government. Crisis management was mostly directed by Lord Mountbatten who had stayed on in India as Governor General at Nehru’s request. Mahatma Gandhi, who had not taken much interest in economic affairs in his earlier years, suddenly asserted his influence in favour of dismantling wartime controls. He persuaded the government to liberalize the food market. The authorities concerned did this very reluctantly, expecting a rise in prices. But Gandhi had predicted a fall rather than a rise in prices as supplies were adequate. His prediction came true and he triumphantly published the prices in his journal "Harijan". (Rothermund 1999a: 129) This seems to have inspired the government to adopt the same approach with regard to cotton cloth, which had also been subjected to controls during the war. The millowners warned that the lifting of controls would lead to a rise in prices as they were unable to meet the increasing demand. But the government did not listen to them and abolished the respective controls in January 1948. The prices
then did rise by about 30 per cent within the next few months and controls were re-imposed in August 1948. The order passed for this purpose also contained the crucial provision that composite mills had to supply a certain proportion of their yarn to the de-centralised sector and that the yarn of spinning mills should be totally reserved for that sector. (Leadbeater 1993: 167-168) This put the entire cotton textile industry on the wrong track as we shall see when discussing its subsequent development. The brief experiment in liberalization thus led to a stronger dose of interventionism rather than to a further relaxation of controls.

Why did the millowners warn the government instead of rising to the occasion by stepping up their production? There were several reasons for this strange behaviour. First of all, they were saddled with worn-out machinery. About three quarters of the looms had been installed before 1925. In fact, nearly half of all looms were of pre-First World War vintage. (Rosen 1958: 131) In the 1930s the millowners had not imported much new machinery except for urgent replacements. During the war they could not import machinery at all. Now they could have invested their wartime profits and imported machinery. But there was a major constraint with regard to the availability of foreign exchange. India did have large Sterling reserves in the Bank of England, but it could draw on them only to a limited extent. In fact, the interim government was forced to sign a moratorium concerning British debts to India in August 1947 just prior to the grant of independence. (Bruchhof 1998: 241) Actually, the debtor twisted the creditor’s arm. But there was an additional reason for India to accept this moratorium: Great Britain was on the verge of bankruptcy and its creditors were interested in avoiding such a calamity. Thus the millowners could not import machinery at that time. Moreover, they had already received signals, which discouraged them. Gandhi’s preference for handloom production was translated into a policy of preventing the further growth of mills. The most radical policy statement had emerged from the Congress Chief Minister of Madras, T. Prakasam, who in October 1946 had prohibited the setting up of new mills and the expansion of existing ones in his state. (Leadbeater 1993: 165) This was not just due to Gandhian idealism. Prakasam had other interests, too. His government was in league with the handloom capitalists of this province. (Tyabji 1995: 220) But, of course, Gandhi could be quoted in defence of the handloom weavers. It was an irony of fate that Gandhi’s heritage thus clashed with his more recent conviction concerning the abolition of wartime controls. The short episode of liberalization during the first half of 1948 was soon forgotten and Gandhi’s spirit was invoked in order to justify a regime of control,
which finally ruined the Indian cotton textile industry. Perhaps he would have criticised it, if he had not been killed in January 1948.

It is interesting to note that the Indian cotton textile industry showed an interest in R&D at an early stage. The idea was born in Ahmedabad in November 1946. Vikram Sarabhai who was later on to become one of India’s leading nuclear physicists, belonged to a famous family of Ahmedabad millowners. It was he who persuaded the millowners to establish the Ahmedabad Textile Industry Research Association (ATIRA), which was then registered in 1947. In the course of subsequent decades ATIRA could register more than hundred patents. It also set an example for other regions. Similar associations were established in Coimbatore in 1951 and in Mumbai in 1954. (Garde 1995: 210-215) With this kind of initiative one could have hoped for the emergence of a dynamic textile industry in independent India. But a misguided textile policy of the Indian government achieved what British textile interests in the period of colonial rule had not been able to do, i.e. impose such restrictions on this industry that many of the Indian mills turned "sick".
5. The Nehru era: Planned economy, protectionism and forced industrialization

The idea of economic planning for the future growth of Indian industry was conceived many years before the attainment of independence. One of the first enthusiastic planners was M. Visvesvaraya, the Ex-Dewan of Mysore, who published a 10-year plan for India (Visvesvaraya 1934). He was a great admirer of Japan and hoped to reproduce its success in India. The steel mill at Bhadravati was his "baby". Full of optimism, he predicted that his plan would double the income of India within ten years. He also specified the financial dimensions of this plan: 100 mill. Rs. per year of which 20 mill. should be provided by the central government and 80 mill. by the provinces. Industrial investment under this plan was primarily the task of the state. He admitted that the government could finance the plan only by taking up loans. Planning would have to be entrusted to experts. Economic Councils should be set up at the centre and in the provinces.

When the National Congress formed ministries in the provinces in 1937, a National Planning Commission was established under the chairmanship of Jawaharlal Nehru. The respective ministers participated in the deliberations of this commission, but Nehru also recruited several experts who were not members of the Congress party. The resignation of the ministries at the beginning of the war put an end to the work of this commission. Nehru nevertheless managed to publish the plan in 1940, which had emerged from this work. It was mainly a qualitative plan with no particular reference to its financial dimension. Import substitution in the field of the manufacture of investment goods was stressed and licensing as a means of avoiding ruinous competition was also mentioned. There was a plea for a delinking of the Rupee from the Pound and for the nationalisation of the Reserve Bank of India, which belonged to private shareholders. Thus some of the main features of the planned economy which was to emerge in independent India were already visible in this plan.

In the midst of the war a British plan emerged, which owed its origin to a suggestion of Winston Churchill, who wanted to divert the attention of Stafford Cripps from the shock of his futile mission to India in 1942. He asked Cripps to draft a plan, which would show to the Indians that the British were their true friends. (Mansergh 1971: 171) Cripps took this very seriously and produced a substantial plan, which was also backed by his
cabinet colleague, Ernest Bevin. They started by stressing the need for an increase in agricultural productivity and for mass education. But they also included a "Programme of Industrial Development". Just like Nehru’s commission, they recommended a policy of licensing, and they even recommended the establishment of "Public Corporations". (Mansergh 1971: 374) Unfortunately they could not provide any funds for the realization of this plan. When the Viceroy, Lord Linlithgow, received this Cripps-Bevin Plan, he decided to keep it a closely guarded secret, because he felt that public opinion in India would take it as a cruel joke, because the government was not even able to solve the problems of immediate wartime planning at that time. (Mansergh 1973: 116)

The next plan document was produced by a group of Indian industrialists in 1944. Among the authors were P. Thakurdas, J.R.D. Tata, and G.D. Birla. The group also included two bright Tata directors, Ardesher Dalal and John Matthai. Dalal had been a member of the Indian Civil Service before he became a director of TISCO in 1931. Matthai was a professor of economics who had served the Government of India as Director-General of Statistics before he joined Tata Chemicals as director in 1940. The document produced by this group was known as the Bombay Plan. (Thakurdas 1944) It was a 15-years plan aimed at doubling the national income. The planners must have taken note of Visvesvaraya’s plan, but they were obviously satisfied with a more modest target, i.e. 15 instead of 10 years. On the other hand they planned for a much larger budget: 100 bill. Rs for the period of 15 years instead of 1 bill. Rs for 10 years. Unlike Visvesvaraya’s budget, which depended mostly on provincial contributions, their plan was a central one. India’s Sterling reserves accumulating in the Bank of England were part of their budget, but there was also a certain amount of "deficit spending" – as justified by the new theory of Keynes. In a second part, published one year later (Thakurdas 1945), the planners discussed employment and distribution. In this they projected that the three sectors of the economy (agriculture, industry and services) should employ 58, 26 and 16 per cent of the population respectively by the end of the plan period in 1962, a very optimistic projection, indeed.

The Bombay Plan of 1944 and the Statement of Economic Policy of 1945

The Bombay plan envisaged a "mixed economy", the state would invest in heavy industries and the private sector in the production of consumer goods. Leftist critics called it a fascist plan (Parikh and Roy 1944). On the
other hand, Dr. Gregory, the economic advisor to the Viceroy, Lord Wavell, subjected the plan to scathing criticism from the point of view of liberal economics. Wavell did not publish Gregory’s criticism, but rather tried to take the wind out of the sails of the planners by appointing one of them, Ardeshir Dalal, as member of his executive council in charge of a newly established Department of Planning and Reconstruction. (Mansergh 1973: 847, 967) Dalal took up this job with great enthusiasm. He tried to put life into the Council of Scientific and Industrial Research and suggested that it should be provided with a series of national laboratories. His main aim, however, was to provide funds for the investment in Indian industry. In doing this he soon encountered the difficulty of having to define the term "Indian" in this context. He had assumed that it would refer to industries owned by Indians, but under the Government of India Act of 1935 all foreign companies registered in India had guarantees that they could not be discriminated against. The British could thus plead that constitutional law prevented them from excluding such companies from any investment in "Indian" industry. (Mansergh 1974: 526, 1099, 1218) Frustrated by this, Dalal resigned from the executive council in 1945 and rejoined TISCO.

There was, however, a kind of political testament, which Dalal left when he resigned his post. This was the Statement of Industrial Policy of April 1945. It contained important elements of the Bombay Plan and committed the Government of India to the continuation of state interventionism after the war. According to the Government of India Act of 1935, industry was a provincial subject and the central government had only been able to intervene in this field due to wartime emergency measures. Since the war was coming to an end, the central government had to think of specific legislation so as to preserve the powers of intervention. The statement outlined the main features of this kind of legislation. It clearly advocated industrial licensing and a regime of controls, which would guide the investment of capital. It also announced a plan of government assistance to essential industries, including the ownership of such industries "for which adequate private capital may not be forthcoming". Some of such industries were listed in the statement, e.g. aircraft, automobiles, chemicals, iron and steel etc. Government support to R&D in addition to the activities of the Council of Scientific and Industrial Research was also indicated. There was, of course, no reference as yet to socialist planning, but among the reasons for the imposition of government controls it was specifically mentioned that "excessive profits to private capital" and "the unhealthy concentration of assets in the hands of a few persons" should be avoided. (Marathe 1986:
289-312) The pattern for future industrial policy resolutions was set by this statement of 1945.

The years between the end of the war and the attainment of independence were rather chaotic. The interim government, appointed in August 1946, had other worries and could hardly devote attention to economic planning. But the National Congress was sure of popular support. It had once again formed ministries in most provinces. The fact that the Congress had become a party of the peasants in the years of the Great Depression made it rather independent of the rather small group of urban capitalists. But being beholden to the peasants also had its price. The British-Indian land revenue system had collapsed under the impact of the depression. It was politically impossible to revive it or to replace it with any other form of taxation. Furthermore, as the countryside was mostly controlled by the richer peasants, land reforms could not be pursued beyond a certain point. The rights of the big landlords could be abolished as their votes could be neglected, but any attempt at a more equitable land distribution which would alienate the substantial peasants was very risky. By relying on the conservative rural forces, the Congress party could afford to defy the interests of capitalists. Nehru could even speak of a "socialist pattern of society" and dictate his terms in the field of industrial policy as long as he did not try to make the peasantry fall into this pattern.

Armed with the interventionist machinery, inherited from the wartime British administration, Nehru could embark on his ambitious plan to industrialize India at a rapid pace. The first landmark on this path was the Industrial Policy Resolution of 1948 which demarcated three sectors, one exclusively reserved to state initiative, one left to private enterprise and an intermediate one in which both public and private investment would be possible. The details would be settled by the government. As mentioned earlier, small scale industries in the private sector were specifically encouraged both in order to prevent the concentration of wealth as well as to create more employment. This resolution provided only general guidelines. It more or less echoed the statement of 1945 described above. Nehru was at that time not yet in full control of this policy. The powerful Home Minister, Vallabhbhai Patel, who also influenced the selection of the finance ministers was not in favour of "socialist" economic planning. (Tyabji 1989: 108-109) Nehru had to wait until Patel’s death in 1950 before he could come into his own.
Central control of the Indian economy

In the meantime initiatives had been taken to frame the legislation, which would empower the central government to control industry. An Industries (Development and Control) Bill had been introduced in 1949. The select committee then replaced the term "control" by "regulation", perhaps because this sounded less aggressive. Homi Mody, when commenting on the bill in the legislature, had criticised its sweeping character and had warned that if the powers to be granted to government would be strictly applied "private enterprise will be left in name only". (Marathe 1986: 67). In 1951 the Industries (Development and Regulation) Act was finally passed. It was frequently amended in later years, but its basic framework remained the same. With this the heritage of wartime state interventionism was firmly entrenched in independent India.

The legal framework of industrial control was essential for Nehru’s policy, but he also needed an instrument of continuous guidance of the process of industrialization. Therefore he had seen to it that the Planning Commission was set up by a cabinet resolution of 1950 with the Prime Minister as ex-officio chairman. Initially Indian industrialists were not averse to economic planning. The Bombay Plan had also recommended that the state should invest in those industries which required a great deal of capital but would not yield an immediate profit. Bold visions and high risks for which Jamshed Tata had been known were thus left to the state rather than to private entrepreneurs. The private sector trailed behind the public sector and thus enjoyed in some respects a "free ride". Administered prices of public sector output often meant a kind of subsidy to the private sector. The system of licences which was introduced so as to prevent "ruinous competition" and to save scarce resources benefited those industrialists who knew how to obtain the right licence at the right time. Entrepreneurial talent was thus diverted to manipulative practices. Industrialists who were first and foremost traders – as indicated above – were well adapted to such practices. This was, of course, not what Nehru had intended, but he unwittingly fostered this tendency by creating an economic environment in which competition and risk-taking were not encouraged. Financial manipulation rather than industrial enterprise were fostered in this way. The managing agency system was not abolished in independent India. Indian capitalists had operated it skilfully during the war and continued to do so now. Nehru regretted that India had hardly any true industrial entrepreneurs but mostly traders and manipulators, social engineering could not change that and Nehru had to work with the "industrialists" as they...
existed. For this reason he also did not touch the managing agency system although he detested it. It was abolished only much later. This system enabled the capitalists to own interlocking companies whose capital they could shift so as to get the highest profit. If industrial enterprises suited them, they would invest their capital accordingly, but if it paid to divert funds to the rural credit market, they would do that, too. The "Dual landlord" would channel agricultural income into industry, the managing agent could do the reverse: divert industrial capital to rural usury. (Bettelheim 1971), This was Nehru's nightmare, but he had to live with it. It was only in 1969 under Indira Gandhi that the managing agencies were abolished by legislation. 

The high point of Nehru's assertion of the central government's control over industry was as the Industrial Policy Resolution of 1956; in subsequent years it was cited again and again like a "mantra". Actually it reiterated much of what had been stated in the preceding documents of this kind. But it articulated the main ideas more forcefully. State governments from now on had hardly any role in determining industrial policy and the spheres of activity of the public and the private sector were clearly demarcated, although it was also stated that these sectors did not constitute watertight compartments. In actual practice this gave the public sector a chance to enter into all kinds of industrial fields beyond the "commanding heights" while on the other hand the government jealously guarded the public sector against any infringement by the private one. (Marathe 1986: 45-49)

India's industrialization was pushed ahead behind a wall of protective tariffs or outright import restrictions. This was a predictable reaction to the half-hearted protectionism introduced by the British in the inter-war period. Moreover, India's colonial integration into the world market had not benefited its economic development. Linkages, which would have evolved in a national market, could not do so in a colonial economy. For instance, India's demand for textile machinery would have led to the rise of the respective industry if a national government had encouraged it with a modest protective tariff for an infant industry. Under colonial rule such machinery was always imported from Europe and the owners of Indian textile mills would have resented the imposition of such a tariff. Finally an attempt was made to establish a plant for manufacturing textile machines shortly before the outbreak of the Second World War. It was then diverted to other uses. The production of textile machinery had to wait until Nehru's new regime created the necessary conditions for it. Linkages among various industrial activities then did develop in India. In this respect Nehru's
policy was successful. In his lifetime he witnessed a dramatic increase in industrial production. The index of industrial production (1950=100) reached 280 in 1964. But Nehru had totally neglected the agricultural base of the economy and this became very obvious soon after his death when two bad harvests in succession delivered a fatal blow to economic planning. The first Five Year Plan, which was a rather modest one, still placed a major emphasis on agriculture, but the second one revealed Nehru’s preference for industrial growth.

The neglect of the agricultural base was deliberate. Agriculture was in the hands of millions of small peasants whose activities were not amenable to central planning. Moreover, theories of "unbalanced growth" were very fashionable in the 1950s and Nehru was obviously influenced by them. A big push provided by large-scale investment in industry would in due course also affect agriculture and propell it along to the "take-off" into self-sustained growth of the national economy. Nehru even kept agricultural prices down in order to enable the industrial sector to benefit from low wages. Agricultural production expanded nevertheless. But this expansion was due to the increasing cultivation of marginal soils, which made Indian agriculture highly vulnerable, as the catastrophe of 1965/66 then showed. Seen with the benefit of hindsight, Nehru’s industrial triumph was a Pyrrhic victory. But at the time when he won this victory, it looked like a great success.

The initial five-year plans

The initial five-year plans were designed along the lines of the Soviet model by Prof. Mahalanobis, a leading economist and statistician. For the first one he used a simple two-sector model distinguishing between investment goods and consumption goods. For the second plan he retained the emphasis on investment goods but sub-divided the other sector into three: (a) industry generally, (b) agriculture and cottage industry, (c) services, education and health. The second plan was also much more ambitious in its financial dimensions. The first one had claimed only about 7 per cent of GNP. Industry got only a marginal share of 3 per cent of total plan expenditure, whereas agriculture got 37 per cent and transport etc. 26 per cent. The second one claimed 12 per cent of GNP and industry got 20 per cent, agriculture and transport etc. received only slightly more than that. The same pattern was reproduced in the third plan which claimed 15 per cent of GNP. All plans contained ambitious targets with regard to the rate of
industrial growth to be achieved during the plan. The only time when the actual target reached was higher than that envisaged in the plan was for the first one. There was an increase of 7.3 per cent per year as against the 7 per cent mentioned in the plan. This was undoubtedly due to the fact that the industrial base had been very modest to begin with. The dynamic thrust of the second plan, which was supposed to attain a rate of 10.5 per cent per year actually reached only 6.6 per cent. There was an improvement in the third plan period when 11 per cent had been aimed at and 9 per cent were actually achieved. In the subsequent fifteen years of recession and stagnation these growth rates appeared like a distant dream of a glorious past.

The ambitious second and third plans required a great deal of foreign aid, which some of the industrialized nations provided in good measure. India’s Sterling balances in the Bank of England had been exhausted by 1957. The Suez war of 1956 had led to an increase of import prices. The government had to curtail the import of capital goods for the public sector. The aim to secure state dominance in the investment field could not be reached. (Swamy 1994: 58) Projects which had been started earlier such as the Rourkela steel mill could be continued only by means of foreign aid. Originally the Government of India had made contracts with German suppliers of the relevant equipment like any other customer. When India faced a foreign exchange constraint, these suppliers could not have provided sufficient credit to the Government of India. Their national association (VDMA) became an ardent advocate of development aid to India, involving the German taxpayer in this venture so as to save their business. Needless to say, the German authorities concerned did not recommend the virtues of liberalization to India at that time, because the Government of India was a good customer whose ambitious plans deserved further encouragement. Official development aid became a prominent feature of India’s industrialization.

There were two major flaws in the Indian industrial policy: the obsession with import substitution and the setting of physical targets of industrial production. Import substitution is profitable only up to a certain point. If it is pushed too far, the economy concerned may find itself saddled with industries in which it has no comparative advantage. The setting of physical targets tends to divert production into channels, which prove to be dead alleys because of a mismatch of supply and demand. (Ahluwalia 1985: 110-113) These two flaws were interrelated. Planners thought any type of machine tool was needed in India and set their targets without studying the market. They even did not care to check what the private sec-
tor was doing. The production of industrial lathes by HMT in the 1960s is a case in point. This public sector company had a contract with the German firm Fritz Werner whose lathe was reproduced in India. A considerable target had been set, but then it turned out that the lathes could not be sold, because Kirloskar was making much cheaper ones. HMT had faithfully met its physical target and was now at a loss. At this stage the German engineer who was in charge of the production in India had a good idea. He knew that his German company was in short supply of this kind of lathes and suggested that HMT should export them to Germany. At first the German company was flabbergasted, but when the engineer assured his bosses at home that these Indian lathes had been made to German specifications, they agreed. HMT then celebrated this export as a major achievement. There was no reference to the fact, that the overproduction of these lathes was due to faulty planning. In subsequent years the two flaws mentioned here contributed to an industrial recession. But during the Nehru era such problems were not yet discussed.

**The growth of the Indian steel industry**

A look at the progress of various industries gives an impression of the achievements of the Nehru era. The most prominent symbol of the "commanding heights" was the steel industry. It was reserved for the public sector. TISCO with its proven track record was permitted to continue its work in the private sector, but its further expansion was stymied by industrial policy. One of the worst features of this policy was the absurd system of steel price controls. It had emerged from wartime controls, which were first only applied to steel needed for the war effort. In 1944 these price controls were extended to steel produced for commercial purposes. In April 1946 the wartime controls were abolished, but instead of this a dual system of market and retention prices was introduced. TISCO was only entitled to the retention price and had to pay sales proceeds, which exceeded this price into an Equalisation Fund, which was used for subsidising steel imports. (Rosen 1958: 25) The retention price was sufficient for keeping TISCO in operation, but it did not permit the accumulation of funds required for an expansion of the existing plant. This was an absurd arrangement, because if import substitution was the aim of industrial policy, such an expansion should have been supported. But, of course, expansion in this field was reserved for the public sector. Therefore it made sense to make TISCO
pay for import subsidies rather than permit an expansion of private sector capacity.

The Tatas were also pioneers in making machine tools for the steel industry, but they could utilise them only within TISCO, as they had no licence to sell such machinery. (Lall 1987: 95) In this way even the public sector steel mills had no access to this machinery, a striking example of counterproductive industrial policy. TISCO’s expertise was also not utilised for the construction and management of the public sector steel mills. At the most they provided some training to plant operators. This bypassing of Indian expertise was due to the fact that the Soviet Union had not only provided the respective aid, but had also offered a turnkey job. The plant constructed by the Soviets at Bhilai in Madhya Pradesh was actually a copy of an old Soviet plant. It embodied a proven, old-fashioned technology which was good enough for the manufacture of rails and similar products. The Soviets relied on the old Open Hearth furnaces and even refrained from installing oxygen injecting lances in these furnaces, not to speak of other state-of-the-art features. (D’Mello 1988: 475) However, the Soviets took good care to train the respective Indian engineers, and whenever there was any technical problem, troubleshooters were dispatched from Moscow. Bhilai was treated as a prime example of constructive development aid. It did work well and continued to do so also in later years.

The plant at Rourkela in Orissa, however, was not a turnkey job and it was initially not even part of German development aid as mentioned above. It included a huge rolling mill for the production of steel plates. Its furnaces were of the most up-to-date design. An initial contract with two German firms (Krupp-DEMAG) for the construction of the plant was cancelled by the Indian government, which preferred to deal with 35 suppliers of specialised equipment, driving a hard bargain with each of them separately. This was a mistake, because equipment makers are not in the business of producing steel. Coordination became a major problem. Finally an old Yugoslav engineer was hired to act as general superintendent and the operation of the rolling mill was entrusted to an American team. When operational problems of this kind emerged, a new contract was made with the German government for the dispatch of German steel workers. In subsequent years after all initial difficulties had been overcome, Rourkela produced steel plates which were of strategic significance for India. The third major steel plant in the public sector was erected at Durgapur, West Bengal, with British aid. Like Bhilai it was also mainly producing rails, sleepers, structurals etc. Its capacity was smaller than that of the other mills. Its
technology was outdated as it corresponded to the standard of British steel production in 1940.

In 1960 when Indian steel production had to rely mostly on TISCO and there was only a small contribution from the public sector, the total output of steel ingots amounted to 3.4 mill. t, and of finished steel to 2.4 mill. t. By 1965 this had increased to 6.5 mill. t of ingots and 4.5 mill. t of finished steel. Output had thus almost doubled within five years. This pace could not be maintained in subsequent years as we shall see when discussing the period of stagnation.

Another Tata company, TELCO whose birth in 1944 has been recorded earlier, took rapid strides in the 1950s. It entered into a partnership with the German company Daimler-Benz and produced its Mercedes trucks at Jamshedpur. Daimler-Benz acquired a minority share of 16 per cent in TELCO and provided help in the indigenization of the manufacturing of those sturdy trucks which were soon to be seen everywhere in India. Daimler-Benz helped with technology as well as with the training of the workers. Production started in 1954. The technology transferred was that of a 5-ton truck with a pre-war engine. TELCO upgraded it to a 7.5-ton truck by redesigning most of its parts. It also replaced the original precombustion engine with one operating with direct injection. In 1969 the agreement with Daimler-Benz came to an end. The Mercedes star was replaced by a Tata-T as the trademark. TELCO exported these trucks to other Third World countries. (Lall 1987: 176) This annoyed Daimler-Benz somewhat, but this did not preclude subsequent cooperation. For TELCO these exports were not very profitable as domestic demand was high, but the company wished to demonstrate its international competitiveness in this way. TELCO like TISCO showed an enormous capability in building its own machine tools, but it was similarly debarred from selling them to other companies, because it had no licence for that. (Lall 1987: 177) This again demonstrated the counterproductive effect of ill-considered policies.

The public sector also registered some progress in making machine tools. The leading public sector firm, Hindustan Machine Tools (HMT), has been mentioned earlier in the context of faulty planning due to the obsession with physical targets. The firm was undoubtedly beset with such problems, but this should not detract from the achievements, which it showed nevertheless. With the exception of the rather simple machine tools made by Mysore Kirloskar Ltd. India had not been able to produce more advanced machine tools under British rule. The British-Indian government procured such machine tools for the railway workshops and ordnance factories from Great Britain. Although the government was obliged
to call for tenders, it used to define its requirements in such a way that only certain British firms could supply these machine tools. (Baldwin 1959: 150). Establishing a sophisticated machine tool plant in the public sector was thus a major element of India’s strategy of import substitution. Needless to say, this was bound to be a difficult task. It was not easy to recruit skilled labour and the public sector wage rates were not very attractive. Qualified workers would soon shift to private sector enterprises. (Baldwin 1959: 159)

**Industrial diversification: HMT, HAL, MICO, ALIND**

HMT was established in 1953 and its first plant was a turnkey job of the Swiss machine tool manufacturer Oerlikon. The Swiss also contributed a great deal to the training of HMT staff. The plant started production in 1956 and the output was rather modest in the initial years. Originally Oerlikon had a small share (10 per cent) in HMT, but it withdrew from this collaboration in 1959. There was a difference of opinion about the diversification of production, which the Indian government insisted upon, whereas Oerlikon wanted to concentrate on the production of a single type of lathe. HMT then expanded vigorously. A second plant in Bengaluru started production in 1961, a third was established at Pinjore, Panjab, in 1963, a fourth one at Kalamassery, Kerala in 1965. In the interest of diversifying its production HMT also started a watch factory in Bengaluru in 1961. The watches were made under licence of the Japanese firm CITIZEN. (Matthews 1988: 2063) In the stagnant 1970s when the demand for machine tools was affected by the industrial recession, watches were churned out in increasing numbers. Unlike many other public sector enterprises, HMT was always able to show profits. (Lall 1987: 145) From the very beginning HMT was eager not to get stuck with "reverse engineering", i.e. simply copying machinery made elsewhere. A powerful R&D-division was set up and even in the 1960s HMT produced a range of lathes, drilling, boring and turning machines based on in-house design. (Lall 1987: 149)

HAL, the other great public sector enterprise in Bengaluru, whose rise during the war has been described above, returned to its earlier activities when the Indian Air Force (IAF) needed more fighter planes. Initially this was restricted to reproducing British planes in India. However, the small "Gnat" manufactured by HAL, soon proved to be inadequate for the huge Indian subcontinent. The radius of its operation was restricted to 300 km.
The German engineer Prof. Kurt Tank who had earlier worked for Messerschmidt then designed a new jet fighter for the IAF, the HF 24. The radius of its operation was about twice that of the Gnat. The plane was excellent, but its engines could not yet be made in India. It was supposed to be equipped with British engines. But then India displeased the leading Western nations by taking a stand in the Congo on the "wrong" side of the political divide. An Indian brigade was part of the UN-forces stationed there from 1960 to 1963. The Indian troops got involved in fighting and suffered losses. The UN-forces supported the new central government against the secessionist Moishe Tshombe of Katanga who was backed by the Western powers. The UN Secretary Dag Hammarskjöld died in a mysterious plane crash on his way to a meeting with Tshombe at that time. The Congo was a hotbed of intrigues and India lost out. This was then reflected in the denial of aircraft engines which were essential for the HF 24. The engines, which were finally supplied for it, were not yet proven and the plane remained underpowered. Only two squadrons of the HF 24 were put into service. But about that time India had to change its policy with regard to defence supplies. It could no longer rely on Western sources and was compelled to turn to the Soviet Union after 1963. The MiG fighters then became the mainstay of the IAF.

Another pioneering venture, which came up in Bengaluru in the 1950s, was the Motor Industries Company (MICO), a private sector enterprise set up in 1953. It originated from the plans of a Delhi entrepreneur, Raghunandan Saran, who died in a plane crash in 1953 and thus did not live to see the rise of MICO to prosperity. Saran was an Oxford graduate who was close to India’s nationalist leadership, but he was not only politically well connected, he had also established his credentials as an industrial manager in charge of the Ashok Motor Company in Chennai (Madras). He conceived of the idea of starting a factory making electrical equipment for automobiles, and as his brother had the agency of the German company Bosch in India, he turned to that firm for advice. Bosch put Saran in touch with a German-born British citizen, Mr. Lang, who had earlier set up a similar plant in South Wales. He joined MICO as its technical director when it was started in 1953. He soon found out that he had much more to do than to look after the technical side of the new enterprise. One of his major feats was that he persuaded the Nizam of Hyderabad to invest 5 mill. Rs in the new venture. (Baldwin 1959: 225) Recruitment of skilled labour was another problem. He had to design a long term training programme to get people who would produce such items as spark plugs with the necessary precision. Once all these initial problems were overcome,
MICO emerged as one of the leaders of Indian industry and has retained its pride of place ever since. Bosch retained a majority share in this enterprise, which turned out to be its most successful venture abroad.

The Indian aluminium industry provides another interesting example of the acquisition of advanced technological capability at an early stage in the industrial history of independent India. India has considerable resources of bauxite and is therefore predestined to manufacture aluminium products. One such product is aluminium wire, which can be used in cables for the transmission of electricity. This attracted the attention of Seshasayee Brothers (Travancore) Private Ltd. These Tamil Brahmin brothers from Tiruchirapally had been in the electricity supply business in Tamil Nadu from the 1920s. Due to the good offices of W.D. Pawley of HAL they had made contacts with the government of the princely state of Travancore where they established Fertilisers and Chemicals Travancore Ltd. (FACT), which started production in 1947. A year earlier, in 1946, the Seshasayees had established Aluminium Industries Ltd. (ALIND) at Kundara near Cochin in order to manufacture aluminium cables. This factory was started with technical assistance of Aluminium Laboratories of Canada (ALCAN). It started production in 1950. The usual process of drawing aluminium wire is that of reheating ingots and passing them through a rolling mill. But in the meantime an Italian inventor, Properzi, had developed a continuous casting process, which permitted a much more economical production of aluminium wire. A staff member of ALIND visited Properzi who had all the know-why but obviously not much of know-how with regard to the actual production of wire. He could only pass on the information that ALCAN and an American firm at Davenport, Iowa, had acquired his machines. It turned out that ALCAN had done little with it, but at Davenport the ALIND-engineer found the process in full swing. He then transferred it successfully to India. (Baldwin 1959: 283) This shows that with good leadership Indian industrial firms could quickly advance to the frontiers of new technology. But this story is rather exceptional, as otherwise lack of vision and bureaucratic hurdles often impeded this kind of progress. The pioneering ventures of the Seshasayees were also rather unique as far as the pattern of ownership is concerned. At FACT and ALIND the major shareholder was the state government. The Seshasayees held only a minimal amount of shares – at ALIND only 4 per cent. (Hazari 1966: 252) They controlled the firms as managing agents. This was a strange symbiosis of public sector ownership with private sector industrial leadership. It could have served as a model for other public sector enterprises in India, but ob-
viously this particular constellation was so unique that it could not be found anywhere else.

Another striking case of industrial leadership was the unusual career of V. Ramakrishna, a Kamma from Bezwada District in Andhra Pradesh. He left home as a teenager before the First World War to study at Edinburgh, later he went to London where he studied at the London School of Economics. He then proceeded to Oxford and finally passed the exam for the Indian Civil Service. In the year of India’s independence he retired from this service and started his second life as a versatile industrialist. His father had been active in a cooperative sugar mill (KCP). V. Ramakrishna soon acquired a large share of KCP and used this company as platform for further acquisitions such as Andhra Cement, more sugar mills etc. He established plants for making cement blocks and for making wallboards out of bagasse, the dry refuse which otherwise bothers the sugar mills. He had scores of practical ideas. Thus he did not only think of making cement and then branching out to manufacturing equipment for cement plants, he also thought of building cheap houses with cement blocks and wallboards. This again led him to the manufacture of inexpensive power presses for making cement blocks etc. Instead of keeping trade secrets he freely shared his ideas with all who were willing to pick them up and even helped those whom others in his position would have considered to be potential competitors. He seemed to be confident that he would always be able to stay ahead of others in whatever line of production he might take up. (Baldwin 1959: 303-311) The mode of control of his business empire was typical for him. KCP remained his central stronghold, he and his family owned 26 per cent of its shares. In some of the smaller companies the Ramakrishna family held more shares. (Hazari 1966: 255) But obviously leadership was more important to V. Ramakrishna than actual ownership.

As stated earlier, the Indian cement industry had achieved a major breakthrough by producing the first entirely Indian-made cement factory in 1947. It progressed further in the Nehru era. Public sector plants were added to those operated by ACC which still had a leading edge both in producing cement as well as producing equipment. It also provided excellent training for technical staff in this field. (Lall 1987: 57) Cement production had exceeded 1 mill. t even before the war, it reached the level of 11 mill. t by 1965. Cement technology had progressed from wet to dry kilns in the 1950s. This innovation implied greater productivity and a reduction of energy consumption. The new technology was readily absorbed by the Indian cement industry. But after 1956 the imposition of price controls reduced profitability. (Lall 1987: 55) This, of course, dampened the
vigour of the producers with regard to the upgrading of their plants. Given the advantages of the dry kiln process, this should have replaced the wet kiln process very rapidly. But most Indian producers, even ACC, still continued running their old wet kilns for many years. India should also have been able to emerge as a major exporter both of cement and of the relevant equipment, but policies always stymied such positive developments. In 1962 ACC was permitted to enter into a partnership with two British manufacturers in order to expand its equipment manufacturing activities. By now it could even take on turnkey jobs abroad. But subsequently it seems to have lapsed into a strange technological lethargy. (Lall 1987: 65) This may be due to the general environment created by the policies of the government, which stifled any kind of innovative spirit, particularly if it manifested itself in the private sector.

Inspite of the rather hostile attitude of India’s planners to the private sector, which they saw as a haven of unrepentant monopoly capitalists, the private sector had prospered under the regime of a "mixed economy". This actually confirmed the prejudices of the planners, because in the 1950s four big groups actually controlled two thirds of the capital stock of all private industrial firms in India. These four groups were the Tatas, the Birlas, Martin Burn, and Dalmia Sahu Jain. In the period from 1951 to 1958 the total capital stock of private industrial firms had increased from about 4.6 to 10 bill. Rs, i.e. by 120 per cent. The shares of the four big groups in this cake had increased even somewhat faster. Tatas capital stock grew from 1.5 to 3. 7 bill. Rs, Birlas from 0.6 to 1.5, Martin Burn from 0.4 to 0.9 and Dalmia Sahu Jain from 0.3 to 0.7. (Hazari 1966: 33) The Tatas and Martin Burn concentrated on steel and heavy industry, the other two pursued their strategy of diversification and acquisitions in various fields in which they had excelled already in the 1940s. The Birlas who had a considerable interest in textiles also launched the manufacture and spinning of rayon in India.

The story of the Indian rayon industry provides an interesting case study of the erratic process of industrial licensing, which did not necessarily follow the priorities set by the planners. The rayon industry requires heavy investment and does not generate much employment, moreover, large amounts of foreign exchange were needed for setting it up. The restrictions imposed on the cotton mills favoured the rayon industry. Instead of investing capital in the modernization of the cotton mills, entrepreneurs rather turned to the manufacture of rayon, which promised much higher returns on the capital invested. The granting of licences in this field was fostered by a belief that India could not produce enough cotton to feed its cotton
mills. (Hazari 1966: 371) Thus man-made fibres seemed to be of crucial importance for import substitution. The lobbyists of the Birlas and others who were interested in manufacturing rayon must have harped on this theme when extracting licences from the authorities concerned.

The strangulation of the cotton textile mills

The way, in which the government strangled the cotton textile mills, which were still the largest Indian industry, stands in striking contrast to this benevolent attitude towards the new rayon industry. The cotton textile mills should have made a shift to automatic looms, because they guaranteed the production of cloth of higher quality. But, of course, they also saved labour. The millowners would have loved to install such looms, but the government prohibited this so as to protect employment. When the government realised that in this way it also prevented textile exports, which were urgently needed so as to earn foreign exchange, it partly lifted this ban in 1956 and permitted the installation of 14,600 automatic looms provided that they were used for export production only. Since automatic looms clearly represented the superior technology, millowners could not be expected to invest in looms of the old type and thus they stopped buying looms altogether. When the upgrading of machinery is prevented at one end of the production process, it discourages it all along the line. (Rosen 1958: 132-137) Thus cotton textile production was subjected to a technological paralysis. The Indian textile policy reminds one of the Luddites who smashed textile machinery in England around 1815. The policy makers did not have to indulge in such primitive behaviour, their rules and regulations served the same purpose much more effectively.

It was a tragedy that Nehru’s great ambition of industrializing India at a fast pace was counteracted by the very regime of industrial policies and licensing practices, which he had inaugurated. As long as he was alive, he could try to correct this to some extent – if he was able to see the problems generated in this way – but after his time the negative features acquired a bureaucratic weight of their own. But there were also positive features of the Nehru era, for instance, a rather liberal policy with regard to the import of foreign technology. There was then a general awareness that India needed this injection so as to be able to catch up with the advanced industrial nations. (Sridharan 1995: 151) In keeping with Nehru’s emphasis on the public sector, foreign collaboration was largely concentrated in that sector. Nehru also stressed research and technical education. The Indian
Institutes of Technology (IITs) were established at that time. Foreign donors were asked to help with the establishment of such institutes. Soviet aid was used for the IIT at Powai near Mumbai. The British helped with Kharagpur and New Delhi. American aid was used for Kanpur and German aid for Chennai (Madras). Ideally most of the graduates of the IITs should have manned R&D-divisions of Indian industries. But R&D (Research and Development) was still in its infancy in India in the Nehru era and claimed only a tiny fraction of GNP (less than 0.2 per cent). Unfortunately even in later years only a minority of IIT-graduates were absorbed by Indian R&D-divisions. Many of them emigrated, others took an additional MBA degree so as to qualify for positions in management which were more attractive in terms of salaries and career prospects.

The expansion of the scope of the Council of Scientific and Industrial Research (CSIR)

Another great initiative of the Nehru era was the enormous expansion of the scope of the Council of Scientific and Industrial Research. It was provided with a host of national laboratories, which were supposed to do applied industrial research. Two important laboratories still owed their origin to British initiative: The Indian Institute of Chemical Technology established in Hyderabad in 1944 and the Central Fuel Research Institute at Dhanbad 1946. After Nehru came to power there was a first round of five new laboratories started in 1950: The National Physical Laboratory in New Delhi, the National Chemical Laboratory in Pune, the National Metallurgical Research Institute in Jamshedpur, the Central Food Technology Research Institute in Mysore, and the Central Glass and Ceramic Research Institute in Kolkata. Soon after this first round the Central Drug Research Institute was set up in Lakhnau in 1951, the Central Road Research Institute in New Delhi in 1952, and the Indian National Scientific Documentation Centre also in 1952 in New Delhi. In 1953 a second round of five new institutes came up: The Central Electronics Engineering Research Institute at Pilani, the Central Electrochemical Research Institute at Karaikudi, the Central Leather Research Institute in Chennai (Madras), the Central Building Research Institute at Roorkee, and the National Botanical Research Institute in Lakhnau. This was followed in 1954 by the Central Salt and Marine Chemicals Research Institute at Bhavnagar. Thus even before the end of the First Five Year Plan, the CSIR had 16 research institutes in all major fields. There were fewer start-ups in subsequent years, but nevertheless
there were another seven during the Nehru era: The Central Mining Research Institute at Dhanbad (1956), the National Environmental Engineering Research Institute in Nagpur (1958), the Central Mechanical Engineering Research Institute at Durgapur (1958), the Central Institute of Medicinal and Aromatic Plants in Lakhnau (1959), the National Aerospace Laboratories in Bengaluru (1959), the Indian Institute of Petroleum at Dehra Dun (1960), and the National Geophysical Research Institute in Hyderabad (1961). Finally there were a few institutes set up in 1965 and 1966 after Nehru’s death. They must have been in the planning stage when Nehru was still alive. These were the two Structural Engineering Research Centres at Roorkee (later Ghaziabad) and Chennai (Madras) established in 1965, the Industrial Toxicology Research Centre, Lakhnau (1965), the National Institute of Oceanography, Goa (1966) and the Centre for Biochemical Technology, Delhi (1966). (CSIR 1995)

This was a formidable array of 28 national research institutes and one would have expected a flood of bright ideas emerging from them. It was obviously Nehru’s ambition to accelerate industrial India’s transition from "know-how" to "know-why". But unfortunately most of the CSIR-institutes turned into ivory towers, which had hardly any contact with Indian industry. The council model of scientific organization, which initially seemed to be best suited for this purpose, proved to be counterproductive at this stage. The institutes were left to themselves and produced their own internal hierarchies, which were not necessarily conducive to original research and inspiring team work. Moreover, in the competition for government funds highly focussed departments such as the Department of Atomic Energy or the Department of Defence Research (DRDO) were better placed than the rather heterogenous CSIR. Thus after 1958 the CSIR lost its pride of place to those departments. (Desai 1993: 213)

Creative research management in the CSIR was a problem, but industrial management, particularly in the public sector, was even more problematic. Nehru had spoken of the "commanding heights of the economy", which should be controlled by the state rather than by private capitalists. But who were the "commanders" destined to occupy these heights? Fortunately Nehru did not think of appointing party cadres to such positions as they had no experience in this field. His only other option was that of appointing civil servants of the Indian Administrative Service (IAS) who were also inexperienced in industrial affairs. But even more than their lack of experience it was their otherwise admirable training, which made them unfit for industrial management. They were trained to preserve law and order by obeying and enforcing rules made by the government. This made
them risk-averse in such cases where rules could not guide their decisions. Moreover, they were generalists who were supposed to be able to handle any administrative task. They were frequently transferred from one post to another. This was also practised in the industrial field as illustrated by the case of a high civil servant who was in charge of Hindustan Antibiotics, Pune, in the 1960s and was then sent to Rourkela as director general of the steel mill. He had to leave Pune because a fly was found in a bottle of penicillin and he had to face the consequences. He had a sense of humour and said about his transfer to Rourkela that his superiors obviously thought that a fly in steel was less conspicuous than one in a bottle of penicillin.

India has several other services besides the IAS, e.g. the Indian Foreign Service, the Indian Police Service, and even the Railway Accounts Service. Thus it would not have been an unusual measure to create an Indian Industrial Service. Instead of this a Central Management Pool was created in Nehru’s time and later on the big public sector enterprises generated enough recruits for their higher positions internally. But there was then no infiltration of industrial cadres into the relevant secretariats. The formulation of industrial policies was left to the "generalists" who were hardly in a position to reflect on the consequences of their decisions for the industries concerned.

The immediate consequence of the catastrophe, which struck India after Nehru’s death, was a "plan holiday" and a decline of investment in the public sector. Of course, the demise of the great man which serves as a convenient point to mark a period of Indian history, had not caused that catastrophe. It was the great drought, which impaired the harvests of two years in 1965 and 1966, which was a turning point in recent Indian economic history. But there are still debates about the relative weight of the causal factors, which led to India’s industrial decline after 1965. The great drought – it is argued – may have only been coincidental with it. The war with Pakistan was another important factor. It was mainly won, because India had stepped up indigenous defence production after the 1962 border war with China and was thus better prepared for meeting this new challenge. Once this war was over, there was no immediate need for further investment in defence production. But even this may have been only one of many causal factors, which will be discussed below. But whichever factor one may single out for special attention, there can be no doubt about it that Indira Gandhi who became Prime Minister in 1966, started her new career at a very inopportune time. She was immediately faced with massive American pressure concerning the devaluation of the Rupee. She succumbed to this pressure, because she urgently needed American aid. (Swamy 1994: 82) Actually this aid was then not granted. because President Johnson and Indira Gandhi disagreed on issues of international politics. Thus while she had done what she was expected to do with regard to devaluation, she was left in the lurch by the Americans as far as their part of the bargain was concerned. Therefore she had to face the negative consequences of devaluation without being able to balance that with an inflow of American funds. Devaluation had been suggested by the experts of the World Bank who felt that this would fix India’s problems as it was bound to lead to a reduction of imports and a promotion of exports. In recommending this they had not thought of India’s need for essential imports of petroleum and investment goods and the rather limited elasticity of demand for its exports. Thus the only immediate result of this measure was a doubling of prices of imports.

In 1967 Indira Gandhi would have liked to regain lost ground by advocating a bold new plan, whereas the big industrialists were in favour of a
cautious plan. But anyhow, the scarcity of resources did no permit a bold plan. The tussle over this finally ended in the announcement of a "plan holiday". (Swamy 1994: 84-85) With the first oil price hike in 1972, there was then an imported inflation, which caused political problems and impeded economic development. The Government of India had always been sensitive to the danger of inflation. Financial stability as well as public peace were at stake. Accordingly Indira Gandhi tried to repress inflation. But repressed inflation unlike an open inflation does not motivate entrepreneurs to take up credit and invest in expanding production. On the other hand repressed inflation does not imply an end of inflation. It only accentuates the problems of a stagnant seller’s market. (Schelkle 1994: 196) Investment in the public and the private sectors were curtailed in this way. Moreover, the striving for technological self-sufficiency, which characterised this period of stagnation, was encouraged by the sudden rise of prices for imported technology and machinery. Instead of opening a path of export-led growth for India, the devaluation had reinforced its inward-looking tendencies.

Whereas most economists attributed the prolonged industrial stagnation to the lack of investment, there were also others who looked at the demand side and suggested that import substitution had run its course and mass consumption was constrained by a skewed income distribution. There was also some evidence of successive peaks of industrial production, which indicated the beginning of a downward trend. In 1962 the capital goods sector had peaked, followed by the intermediate goods sector in 1963, manufacturing in 1964, and durable consumer goods industries in 1965. (Swamy 1994: 94) Moreover, the rise of prices of agricultural produce due to the drought burdened food budgets and thus limited expenditure on industrial products. Rich peasants who benefited from the price rise did not immediately expand their demand for industrial goods. Therefore agrarian recovery would not automatically lead to industrial growth. When this argument was discussed around 1980 it sounded very plausible. There was certainly an element of truth in it. But according to this demand side hypothesis, India should have been condemned to further industrial stagnation. However, when massive plan expenditure was resumed in the 1980s, there was a new upsurge of industrial growth. Obviously the Indian economy needed continuous pump-priming by the state. In the years of stagnation the private sector could have occupied the arena vacated by the state. But as pointed out earlier, the private sector was used to enjoying a "free ride" and when the vehicle slowed down it lost its momentum. The private sector had been deprived of dynamism by counterproductive in-
Industrial policies. In addition, the high prices of imported investment goods also acted as a brake on the acquisition of new machinery and technology in the period after 1966 and the government had followed a policy of technological self-reliance in those years. This quest was enhanced by the security environment created by the wars with Pakistan of 1965 and 1971. (Sridharan 1995: 152-153)

The cult of self-reliance and the MRTPA-FERA-regime

Technological self-reliance as such is certainly to be welcomed, but it turns negative if it is translated into self-sufficiency, i.e. the proverbial attempt at re-inventing the wheel. The inward looking policy of promoting self-sufficiency was endorsed by the framers of the fourth Five Year Plan. The magnificent network of CSIR-laboratories was particularly affected by this policy. Instead of interacting with their peers abroad, while at the same time catering to the needs of Indian industry, they became inward-looking and hidebound. Later on it took much time and effort to turn them around and make them shed the habits, which they had acquired in this period. In the period when technological self-sufficiency was a cult, the scientists of the CSIR officiated as its high priests. Every application for the import of foreign technology needed their approval and they often delayed it without being able to provide the relevant technology themselves. (Lall 1987: 34) This is certainly not what Nehru had hoped for when he inaugurated so many CSIR-institutes in quick succession in the 1950s. The Scientific Policy Resolution of 1958 summed up Nehru’s intentions in this respect. Unfortunately this scientific endeavour was interpreted later on in terms of an import substitution, which could be achieved by prohibiting the import of technology. However, as a critical observer commented, import restrictions on technology do not support import substituting technology. (Sikka 1995: 96)

Indira Gandhi who presided over the period of stagnation actually did not share Nehru’s socialist convictions. She was more pragmatic, but when it suited her political designs she adopted a leftist pose. This was particular so at the time when she tried to get rid of the conservative old guard in the Congress party. It was in keeping with this line that the Monopoly and Restrictive Trade Practices Act (MRTPA) was passed in 1969. It imposed a ceiling on the growth of private sector companies and empowered the government to define who was supposed to be a monopolist. A leading Indian economist who had conducted a study of the concen-
tration of economic power in the private corporate sector actually pointed out that India had no monopolists in the conventional sense of the term as the usual practices of collusion in restricting output and fixing prices made no sense in a seller’s market like India. Moreover, all big Indian industrialist houses had diversified interests and had not aimed at achieving a monopoly in any special field. (Hazari 1966: 359) Thus MRTPA was actually a misnomer, it should have been called the Industrial Ceilings Act, the ceiling was to be maintained by the government by withholding further licences etc. In fact, the big business houses had not established monopolies as such, but they had tried to monopolise licences, often applying for them only in order to prevent others from getting them and then not starting the respective production at all. The government had responded to this by "overlicensing", i.e. issuing the same type of licence to others, which actually contravened the very idea of licensing. An Industrial Licensing Policy Enquiry Committee had reported on all this in 1969 and MRTPA was an outcome of these deliberations. The growth of the assets of the big business houses did decline after 1969. (Swamy 1994: 126) MRTPA had shown its teeth, but it also impeded industrial growth in general, contributing further to stagnation and recession. The policy embodied by MRTPA was extended by means of the Foreign Exchange Regulations Act of 1973 (FERA). It imposed a ceiling on foreign direct investment. Foreigners could have at the most a share of 40 per cent in Indian firms. This impeded the inflow of foreign technology. (Lall 1987: 30-31) Both measures increased the scope of political and bureaucratic discretion and thus put a brake on industrial activities in many respects.

Putting a ceiling on industrial growth in the private sector by means of the MRTPA had the pernicious effect that more and more companies were subjected to it in the course of time. The ceiling had been fixed at 200 mill. Rs in terms of gross capital assets. A company, which crossed that limit, automatically fell into the MRTPA-trap. The original idea of preventing the concentration of economic power was soon forgotten. Like spiders in their net, bureaucrats could just sit and wait for their prey. Needless to say that the upgrading of technology was postponed due to the effects of this act. (Marathe 1986: 274-275)

At the other end of the scale the government also faced a problem of fixing ceilings. The support of small scale industry was a high priority of Indian planners. But what did support mean in this context? Should small industries be supported in order to be able to grow or was the policy aimed at keeping them small. Sometimes planners would stress the first alternative, but at the same time opt for the second one, when they had to define
smallness in financial terms. In the 1970s they had to adjust the financial limits several times so as to accommodate those entrepreneurs whose firms were growing, but who did not want to forfeit the privileges of officially recognised smallness. (Tyabji 1989: 178-179) When the Janata government came to power in 1977, Charan Singh, the champion of rural India, wished to cut the Gordian knot by suggesting that the household-centred cottage industry should be singled out for support and no other industry deserved to be called "small". (Tyabji 1989: 194-196) Singh’s term of office was cut short by Morarji Desai in 1978; in 1979 Singh returned to power as prime minister of a caretaker government, which could hardly take care of anything. Thus his valiant attempt at defining "small" in a new way was soon forgotten. In subsequent years the government returned to the game of defining smallness in keeping with political expediency.

In the 1970s the international security environment contributed to Indian complacency. In earlier years security concerns had led to the quest for self-reliance. But after the outcome of the war of 1971 had assured India of regional hegemony this quest had turned into a habit of inward-looking self-congratulation. It was only the Soviet invasion of Afghanistan and the subsequent increase of the American military presence in the region, which shook up India and alerted it to its serious technological deficiencies. This led to a policy shift in the 1980s, which will be discussed later on. But the fifteen years of complacency and industrial stagnation were a loss to India. On the other hand, Indian agriculture picked up speed in this period due to the "green revolution". This was no mere coincidence, because Indira Gandhi had been irked by India’s dependence on American grain shipments and tried her best to help Indian agriculture. This meant giving up her father’s policy of keeping agrarian prices down so as to prevent a rise in industrial wages. Of course, this policy had already been subverted by the consequences of the drought of the mid-1960s which had led to a sudden rise in agricultural prices. The rise in prices had then induced many peasants to invest in agricultural production. Marginal soils were abandoned, hybrid varieties were introduced, irrigation was extended and the use of fertilizers increased by leaps and bounds. The Indian fertilizer industry was challenged by this new development. Import substitution was particularly urgent in this field. Both the internal demand for fertilizers and the prices of fertilizers in the world market increased in the 1970s. Thus the Indian import bill for fertilizers increased from 1 to 5 bill. Rs from 1970 to 1975, whereas India’s production of nitrogenous fertilizer increased only from 0.8 to 1.5 mill. t, and of phosphatic fertilizer from 0.2 to 0.3 mill. t in this period. This was a clear signal for stepping up produc-
tion in this line. But it took some time before agricultural growth could be translated into industrial growth, the more so as two oil price shocks in the 1970s created an energy crisis which severely affected the potential for industrial growth. India’s indigenous oil industry was still in its infancy, and as long as oil prices were low in the world market, India had no incentive to develop it. India could rather use its potential as a bargaining counter so as to obtain cheap deliveries from abroad. The oil price shock then caught India unawares and it took some time to step up indigenous oil production and coal mining.

Coal, oil and steel in the period of stagnation

Coal mining increased from 70 mill. t to 103 mill. t from 1965 to 1975. In the same period crude oil production rose from 3.5 to 8 mill. t. The rather slow growth in this vital energy sector was due to various reasons. Before the nationalization of coal mining in 1973, the collieries were to a large extent in the hands of scores of private owners, mostly former coal traders who had bought the mines from British managing agencies. The new owners had inherited from those agencies the rather negligent methods of running the mines, leaving the actual work mostly to raising contractors. As nationalization was expected, these owners had no incentive to invest anything in their mines. Nationalization then changed the pattern of ownership, but not that of the operation of the mines.

The oil industry had been exclusively in the public sector from the very beginning. The big international oil companies had made it a point not to find oil in India. They preferred to find oil in places where it was not consumed, like in Arabia, in order to sell it at a good price to consumers elsewhere. Only the Soviet Union had helped India in finding oil in the 1960s. (Rothermund 1968) But as oil prices in the world market were low in subsequent years, India had taken it easy and had not tried hard to advance oil production at a more rapid pace.

Steel production was also expanding only at a very slow rate, it increased from 6 mill. t in 1965 to 8 mill. t in 1975. In addition to the steel mills mentioned earlier another large plant had come up in the public sector: Bokaro. It is located in Bihar, about 40 km to the East of Dhanbad. This unfortunate venture could almost serve as a symbol of the stagnant 1970s. Originally the Indian government had hoped for American aid for this project and President Kennedy had indicated that he would support it, but then the American legislature turned it down. Why should American aid
be spent on fostering state capitalism in India? After this rebuff the Indian government withdrew its request for American aid for Bokaro in 1963 and started to look elsewhere for foreign sponsors of this project. When the Soviet Union offered its help in May 1964, the Indian government stopped looking for alternatives. This greatly enhanced the bargaining power of the Soviet Union, which was now less inclined to offer favourable terms to India than in 1955 when the Soviets were newcomers in this field. (D’Mello 1988: 477-480) Bokaro’s problems were great and took a very long time to be solved. Whereas Bhilai had been a reproduction of an old plant working well in Russia, the Bokaro plant had to be designed from scratch and this proved to be a major handicap. Moreover, unlike Bhilai, which was devoted to simple products like rails and structurals, Bokaro was supposed to be a second Rourkela, producing steel plates etc. A very competent Indian steel consultant, M.N. Dastur, who had earlier worked in America, had drawn up a comprehensive plan for this new plant with a capacity of 4 mill. t. When the Soviets agreed to build the plant, they rejected Dastur’s plan and insisted on their own design. When the Soviet design was submitted, it turned out to be expensive and not very satisfactory. The Indian government then asked Dastur to prepare a cost reduction study. But on the very day on which he submitted it in March 1966, the Indian government accepted the Soviet plan. Obviously, Dastur had been commissioned to do his study only in order to provide an alibi, as the government was faced with questions in the Lok Sabha. Dastur felt that Nehru’s death in May 1964 had brought about a change in government policy concerning the encouragement of the acquisition of Indian technological capability. (D’Mello 1988: 478) Dastur’s company had a staff of about 800 people when he was working on the Bokaro plan. The Soviet rebuff and the Indian government’s indifference was a great blow to this competent Indian company, which could have been a leader in this field. (Lall 1987: 106) The Soviet plans were by no means superior to Dastur’s and their execution was very much delayed. The first stage producing 1.7 mill. t was commissioned in 1978, it had been due in 1971. The second stage which was supposed to take the plant to full capacity of 4 mill. t was commissioned in 1984, but production did not exceed 2.5 mill. t. (Lall 1987: 82) Moreover, the Soviet authorities did not trust Indian engineers very much. A large number of Soviet experts down to the level of foremen stayed on at Bokaro for quite some time. In 1975 there were altogether 333 such experts, their services were phased out very slowly, but even in 1984 there were still 42 around, including the General Superintendent in charge of the operations of the steel plant. (D’Mello 1988: 480)
While work in Bokaro was still going on, the Soviet Union had also been entrusted with the expansion of the Bhilai plant. The first expansion had been undertaken from 1962 to 1968, the second one, which was supposed to enhance the output from 2.5 to 4 mill. t, was started in 1974. This expansion was designed by MECON (Metallurgical and Engineering Consultants), an Indian public sector consultancy firm, which had earlier existed under the name Central Engineering and Design Bureau (CEDB). In 1968 a shotgun marriage had been arranged between a similar Soviet agency, Gizpromez, and CEDB, which the latter did not enjoy very much. In fact, the know-how passed on by Gizpromez to CEDB was not new to the Indian engineers, but the link-up served Soviet interests very well as Soviet equipment and technical services could be sold more readily in this way. Under its new name MECON the former CEDB was actually totally dependent on Gizpromez. (D’Mello 1988: 480-481)

The Indian steel industry was plagued by specific problems with regard to its raw materials. As mentioned earlier, Indian coal has a high ash content and good coking coal required for blast furnaces is scarce. Therefore India should have adopted at an early stage an alternative process of producing sponge iron, which could then be converted into steel by means of electric arc furnaces. (Sidhu 1983) Here again innovation and technology transfer proved to be a problem. But not only coal, also iron ore had undesirable qualities affecting the process of steel making in blast furnaces. (Lall 1987: 83). At some places where rich ore mines were explored, they happened to contain ore only in the form of dust, which required pelletisation, i.e. the compression of this dust so as to form small balls. All this taxed the patience of the managers and engineers concerned. On top of all this, the steel industry was subjected to price controls. The low cost of steel was actually a subsidy to other industries which consumed steel. This is why most public sector steel plants were always in the red, while only TISCO managed to show a profit, although it was faced with the same price controls. Of course, under such conditions TISCO’s profits were meagre and did not permit enough re-investment, which was urgently required for upgrading productive capacity.

Steel making had not experienced major technological changes in earlier years, but just when the new Indian steel mills were being built, there were some major new features in blast furnace smelting. The basic oxygen process (BOP) replaced the old Open Hearth and Bessemer furnaces. BOP required the injection of oxygen into the molten metal. This required some experience in the field of process technology. For Bokaro Dastur had recommended it, but the Soviets refused to adopt it as they had not yet experi-
mented with it at home. Thus India was stuck for quite some time with an antiquated technology. Even by 1980 less than one third of India’s steel furnaces were BOP-ones. Another new process in steel making was continuous casting. Whereas earlier steel ingots had to be reheated before being fed into the rolling mill, continuous casting avoided this intermediate step and saved time and energy. It required, of course, a careful control of the entire process as interruptions would be disastrous. India’s adoption of this process was much delayed and it was restricted to some plants only. (D ’Costa 1999: M2-M16) Due to the tortuous path of Indian industrialization in this field, there was much delay before India could benefit from this technological progress. But whereas coal, oil and steel showed at least slow rates of progress, there were some industries, which even exhibited definite signs of decay.

The further decay of the textile industry

The most tragic case of industrial decay was that of the cotton textile industry, which used to be the premier industry of India. Under normal conditions it would have prospered in independent India and could have generated an enormous export potential. But as indicated above, a doctrinaire interpretation of the Gandhian heritage had led to a textile policy, which favoured the "decentralised sector" and penalized the mills. Gandhi had emphasised handspinning and handweaving for the generation of employment in the countryside. Even at the time when he started his propaganda for handspinning, it had become obvious that this type of khadi-cloth was too expensive for poor people and he had then reduced his own apparel to a minimum in order to demonstrate that one could get along with it. (Rothermund 1999 a: 44) He did not create a fashion in this way and his followers who dressed in khadi as a matter of party discipline were always overdressed as compared to him. They were not so poor as not to be able to dress "decently". However, the supply of khadi could never be enough for the masses of India and thus it remained a fairly marginal product. Nevertheless it remained the ideal type of cloth for the policy makers who did their best to privilege the decentralised sector. They did not notice – or did not care to do so – that this sector was quickly usurped by the powerloom, which Gandhi certainly did not have in mind when advocating khadi.

Initially such powerlooms were old ones, discarded by the mills and operated by ex-millhands or ex-handloom weavers who had "graduated" to
such means of production after finding out that they could not make both ends meet when sticking to their traditional looms. Since electricity was required for operating powerlooms, they would not work in the remote villages of India. Actually they tended to concentrate in larger centres, where labour and marketing facilities were readily available. The town of Bhewandi in Maharashtra is a case in point. Thousands of powerlooms housed in ramshackle sheds are running here day and night, producing an awful noise and millions of yards of cloth. Gandhi would have looked aghast at this terrible avatar of his idealised cottage industry. The "decentralized sector" is decentralized only as far as ownership and operation are concerned. The workers who earn wages, which amount to about one third of that earned by regular millhands, are not benefited by this kind of "decentralization". They are working for entrepreneurs who profit from a policy, which puts the mills at a disadvantage. It is suspected that some millowners have actually connived at the spread of this perverse development as they could not expand their mills, which were slowly starved of new investment. Moreover, the "decentralized sector" is hard to control and thus provides possibilities for the investment of black money. To that extent it belongs to the "parallel economy", which is a bane of Indian economic development.

The result of the government's textile policy was a split in the mill sector. Composite mills, which – as we have seen earlier – were established because they permitted a more flexible response to the forces of the market, were discriminated against, while spinning mills producing yarn for the decentralized sector were favoured. By the early 1980's there were about 525 spinning mills in India with a total number of about 10 mill. spindles. Since most composite mills were sick, it was estimated that only about 138,000 looms were actually in operation in the mill sector, while about 1 mill. looms were at work in the decentralised sector. (Goswami 1985: 1610) One could be tempted to attribute this state of affairs to a deliberate policy of "divide and rule", but this would give too much credit to a government, which hardly ever gave much thought to its textile policy once it had embarked on the course of positive discrimination in favour of the decentralized sector. It thus did not notice that it had raised a Frankenstein of powerloom production, while condemning the composite mills to increasing "sickness". In addition to general industrial policy, there was also the specific policy of taxation. In earlier years taxes had been assessed in terms of the number of looms, later on excise was levied on the amount of cloth produced. The highest amount of excise had to be paid by the mills. Composite mills had to pay excise for their yarn and then again for
The further decay of the textile industry

the cloth. Powerlooms had to pay 30 per cent and handlooms 70 per cent less than the mills. Many powerlooms and handlooms were unregistered and thus escaped paying excise altogether. (Lall 1987: 115)

The ills of the mills were mainly due to such policies, but even when the government created the National Textile Corporation in 1968 in order to take over sick mills so as to combat unemployment, there was no proper diagnosis of this "sickness". (Leadbeater 1993: 227-228) It was usually attributed to individual mismanagement or to sinister machinations of millowners who diverted funds rather than investing them in the modernization of their mills. Of course, there were black sheep among the millowners, but this would not explain the endemic sickness of the whole industry. It could be argued as well that an industry, which is crippled by official discrimination and thus gives no scope for dynamic entrepreneurs, will inevitably get the management which it deserves, i.e. manipulators who can even convert "sickness" into a profitable game.

The phenomenon of the "sickness" of mills should also be seen in the larger context of India’s economic policy and not merely in relation to the specific textile policy. When the Indian textile mills were established in the period of colonial rule, they enjoyed no protection and had to face tough competition in the world market. Therefore they had to upgrade their technology in keeping with world standards. Protectionism changed all that, the mills as an important element of industrial organization were no longer required. Import substitution in a sheltered home market could be achieved much better by the powerlooms, which had low overheads, worked with low wages and did not need to aim at a world standard quality of production. Even without the government’s destructive textile policy, protectionism would have favoured the powerlooms and worked against the mills. The Indian millowners, however, had lobbied for protection for a long time and did not see that they were doomed in this way.

Actually the Indian textile industry should have been busy with adjusting to technological progress at the time when stagnation and decay overwhelmed it. In Europe labour productivity in spinning and weaving started to rise very rapidly at that time due to the introduction of new machinery. The engineers designing this new machinery were driven by the need to save labour as wages were rising. Once again the availability of cheap labour in India made it unnecessary to catch up with this new development. The powerloom sector needed sturdy, old-fashioned machines and not shuttleless looms introduced by the Swiss firm, Sulzer, at that time. There had been some agreements on technological cooperation with such leading European firms and Indian textile machinery firms, but in the
mid-1960s several factors combined to prevent further technology transfer. The drought of 1965 had also affected the cotton crop and this had ushered in a recession in the textile industry, which led to a decline in the demand for textile machinery. In addition, the textile policy, which discouraged the expansion of the mills, also prevented investment in new machinery. The devaluation of 1966 doubled the prices of imported machinery. This should have encouraged Indian textile machinery makers to step up their production in the interest of import substitution. But they could not rise to this occasion, because of the other negative factors mentioned above. They rather specialised in making spare parts for existing machinery. As wear and tear affects some parts of textile machinery more than others, they concentrated on the wearing items. (Desai 1988: 150-160) One could almost speak of an ancillarization of the respective Indian industry, except for the makers of spinning machinery, as the spinning mills did very well.

In the period of recession and stagnation the textile mill industry was relegated to a secondary position by the decentralized sector, which forged ahead not only with regard to cotton cloth, but in the field of man-made fibre textiles as well, which the mills were not supposed to handle. Cotton cloth production by the mills amounted to 4.4 bill. metres in 1965 and 4 bill. metres in 1979, whereas the production of the decentralized sector had increased from 3 to 5 bill. metres in those years. In addition the decentralized sector produced nearly 1 bill. metres per year of cloth made from man-made fibres in the 1970s. Thus the mills were not only falling back in quantitative terms, but the more advanced type of production was also captured by the decentralized sector. The days when that sector was only the poor country cousin of the mill industry were gone, by now the mills were the poor relations whose future was no longer what it used to be.

If one looks at this development of textile production in India from a different perspective and forgets about the sick mills and the exploitation of labour in the powerloom sheds, one could even celebrate the rise of the decentralized sector as an example of industrial adaptability. Production was certainly enhanced in this way at a rather low cost. The powerloom sector even gave rise to a small-scale ancillary industry manufacturing spare parts and even the simpler type of powerlooms. All this may even be called an "appropriate technology" for a poor country. Of course, technological progress could not be expected along these lines. Only determined modernizers could show the way out of this impasse. And, in fact, in the midst of the prevailing gloom of the textile mills, there was one shining example of the rise of one unusual company: Reliance. It was due to the
industrial leadership of Dhirubhai Ambani, a trader in synthetic yarns, who broke through the sound barrier of "export pessimism" and managed to set up a modern textile mill, producing mostly cloth made of man-made fibres, which he exported to a large extent. Political connections must have helped him to enter a field, which was actually reserved for the decentralised sector, but export earnings were also a strong argument. These earnings enabled him to import modern machinery and get it installed by foreign experts. As far as textiles were concerned, Ambani did little for R&D and for the increase of Indian technological capability. When Reliance later on entered the petrochemical industry, this was a very different story, which will be told in the context of describing that industry. In the textile industry, Ambani's chief contribution was to show what could be done if one dared to invest in a modern mill aimed at the export market. By 1982 his mill had 51,000 spindles and 940 looms. He exported textiles worth 19 mill. $ at that time (Lall 1987: 125) It is said that he also relied on additional production by "decentralised" powerlooms controlled by him. About 40 per cent of the textiles marketed by Reliance are supposed to be made in the powerloom sheds of Surat. (Goswami 1985: 1612) It is amazing that Reliance started its meteoric rise in the period of stagnation. It was founded at the beginning of this period in 1966 and by its end it was by far the biggest textile company in India.

While Reliance concentrated on man-made fibres, there was also some progress in the 1970s with regard to new varieties of cotton. Indian cotton was notorious for its short staple fibres which made the spinning of industrial yarn of good quality very difficult. For finer varieties of yarn and cloth, cotton often had to be imported. But in the mid-1970s Indian scientists succeeded in breeding new varieties of long staple Indian cotton. Whereas the fibres of the old varieties were only 20 mm long, the new ones had a length of 22 mm. These new varieties soon replaced the old ones in most Indian cotton fields. But cotton was not only improved in quality in the 1970s, there was also a significant increase in cotton production. In the early 1970s there was an average harvest of 1 mill. t. which rose to 1.3 mill. t in the late 1970s. The area under cotton had only marginally increased, but there was a significant increase in the yield per acre.
The other old textile industry of India, the jute industry, had been crippled by the partition of India. As pointed out above, it took some time to step up the production of raw jute in India after the jute fields in East Bengal were lost to Pakistan. By 1955 raw jute production had reached a level of 0.8 mill. t and then remained at that level until 1975. The manufacture of jute textiles rose from 1.1 to 1.4 mill. t per year. Imports of raw jute closed the gap between internal supplies and the consumption of the jute industry. About 40 to 50 per cent of jute textiles were exported. But after 1975 there was a remarkable decline in exports of jute manufactures. In the period from 1970 to 1984 an annual average of 1.2 mill. t of jute products were manufactured in India. In the early 1970s only half of this production was absorbed by the home market, but after 1975 this increased to about 70 per cent and by the early 1980s it reached about 80 per cent. The Indian jute industry had two major competitors in the world market: Bangladesh and the synthetic fibre industry in Western countries. It could have faced the first one as the conditions of production were more or less the same in both countries, but synthetic fibres not only became progressively less expensive, but the respective factories could also be established close to the consumers, whereas jute products were burdened with increasing shipping costs. Moreover, the Western manufacturers of synthetic fibres spent more on R&D and product development. If it had not been for the expanding internal demand, the jute industry would have been ruined. But in the internal market the government was a major customer buying bags for the Food Corporation of India etc., and the government worked with the old "cost plus" formula and did not permit the jute industry to earn much of a profit. Moreover, for a long time the government had also charged a jute export duty for purely fiscal reasons. (Sarkar 1986: 2188-2197)

The tea industry was somewhat more dynamic. It retained a share of about one third of world tea exports until 1975, at the same time it was able to satisfy an increasing internal demand for tea. Per capita consumption of tea in India increased from about 250 g in 1955 to 450 g in 1975. With a growing population this was a major achievement. Tea is not a luxury drink in India. Poor people often take tea with a good dose of sugar and this helps them to start a hard day’s work. In the export market, Sri Lanka and African countries like Kenya were India’s major competitors. To some extent the rising internal demand helped India to compensate for a loss of export markets in the case of tea just as in that of jute products.
Like all other Indian industries, the cement industry also reflected the general stagnation prevalent in this period. From 1965 to 1980 production increased only from 11 to 19 mill. t. There was an acute scarcity of cement in the 1970s. At the same time capacities were underutilised. The government had to ration cement and a black market developed. Instead of exporting cement – which India could have certainly done by now – cement had to be imported. (Lall 1987: 55) The system of price control imposed upon the cement industry had a very bad effect on industrial growth in this field. In the 1970s the rise in capital costs discouraged new investment. Old units whose machinery had been written off could still operate at a profit, but new units could not hope for that. Accordingly by 1977 more than half of the capacity of the cement industry was outdated, having operated for more than 20 years. (Marathe 1986: 245) Then there was another perverse mechanism which discouraged investment. Whenever the utilization of capacity was affected by factors beyond the control of the industry, eg. power shortages etc., the availability of cement in the market declined and the ordinary consumer had to pay higher prices. The system of dual prices then worked in such a way that the profits of the manufacturer would be higher when his output was lower. (Marathe 1986: 253) This may explain why the increase in output of the cement industry was so meagre in this period.

In the midst of the stagnant 1970s there was one major new departure which augured well for the future: Bharat Heavy Electricals Ltd. (BHEL) was established in 1973. This was the largest engineering manufacturer in India with about 75,000 employees. Of course, it was a public sector enterprise. It originated from the merger of a number of public sector enterprises in this field, which had come up at different times and embodied different foreign technologies. The earliest of these ventures was a plant at Bhopal, Madhya Pradesh, built as a turnkey job by a British firm. Next in line were two plants at Hardwar in Uttar Pradesh and at Tiruchirapally in Tamil Nadu constructed with Czech collaboration in 1965. To this was added another plant at Hardwar completed in 1967 with Soviet collaboration. This last plant was in charge of building heavy power generating equipment. The confusing mix of technologies of different pedigree made it very difficult to acquire indigenous technological capability and therefore BHEL was established which built up a central R&D division in Hyderabad with sub-divisions in the various plants. By 1982 the central R&D division had a staff of 950 and the different plants altogether another 4500. This greatly facilitated the development of know-how and know-why. About 50 patents had been registered by BHEL-engineers by that time and
70 were pending. Inaugurated in the period of technological self-sufficiency, this promising venture could have become inward-looking. But a fortuitous development exposed BHEL to international competition as early as 1978. Several World Bank financed projects were granted to India, and they had to be open to international bidding. Due to this, the Indian government also had to permit the import of the respective equipment. This provided a challenge to BHEL and it won four out of five World Bank projects against prominent international bidders. (Lall 1987: 155) This gave BHEL a head start for further development in the expansive 1980s.

With regard to the acquisition of technological capability in India and its projection into the future BHEL can certainly be rated very highly, the more so as internationally the supply of large power plant equipment is in the hands of very few companies which founded the International Electrical Association in the 1930s, a mighty cartel, which still exists. Of course, critics could also point out that for about 60 per cent of its components BHEL had to continue to rely on imports. It also indulged in some costly ventures such as setting up a Central Foundry Forge at Hardwar and a Seamless Steel Tube Plant at Tiruchirapally in order to manufacture components for which it could not find suppliers in India. BHEL’s hopes to sell products of these plants to other customers so as to be able to fully use the capacities installed in these captive plants did not come true. By a strange irony of fate some of the equipment of these plants also suffered due to power failures. (Surrey 1988: 363-372) A more judicious policy of importing components rather than aiming at self-sufficiency may have been less costly. It may be even argued that the Indian consumer would have been served better, if the State Electricity Boards had been run more efficiently, being at the same time free to import state-of-the-art equipment instead of having to wait for BHEL’s learning process. However, if this process has led to permanent gains, it was certainly worth the effort.

With the benefit of hindsight one can easily see that India should have followed a more open policy after 1965 instead of continuing with import substitution, protectionism and rigid bureaucratic controls. State investment receded under the impact of drought and devaluation. Private investment should have been encouraged at that time, but the MRTPA-FERA-regime discouraged it. Bank nationalisation also did not help to foster private investment. The Indian banking system needed a reform. Following British precedent it consisted of trade banks rather than investment banks. Some banks had become house banks of big business firms. This kind of captive credit system certainly did not contribute to sound banking practices. Proper regulation and adequate incentives could have produced
a better banking system. But nationalization only created a parallel bureaucracy and a system of administered credit. The nationalized banks did overcome the urban bias of the earlier private trade banks. While there were only 4000 branches of banks in 1950, there were nearly 50,000 such branches by 1980. The lead bank scheme, whereby each district was assigned to a specific nationalized bank, had helped to spread banking in the countryside. But the district bank manager behaved like an additional district officer and not like a private banker. The staff of the nationalized banks proliferated just like that of other public sector enterprises. In the late 1970s there were more than 500,000 bank employees and their numbers grew incessantly. Under such conditions there was not much scope for dynamic private enterprise. The art of evading controls, cornering licences and manipulating bureaucrats was more profitable than risk-taking and innovative ventures.

The period of stagnation and recession ended with another year of turbulence like that of the mid-1960s, which had signalled its beginning. In 1979 the Janata government collapsed and was replaced by a weak caretaker government. There was another drought, which was worse than the one of 1965. India was also hit by the second oil price shock which inflated its import bill. Moreover, the Soviet invasion of Afghanistan and American arms aid to Pakistan compelled India to step up its expenditure on up-to-date armament. (Swamy 1994: 173) At this stage Indira Gandhi returned to power in 1980 and soon had to turn to the International Monetary Fund for a substantial loan. As usual, the IMF tried once more to plead for a devaluation of the Rupee, but recalling the consequences of this measure in 1966, Indira Gandhi did not succumb to this pressure again. Instead she tried to adjust to American interests in other fields. She toned down the FERA-regime and announced that foreign corporations, which brought along sophisticated technology and finance to India, would be very welcome. (Swamy 1994: 180) Although Indira Gandhi did refuse to devalue the Rupee, it depreciated nevertheless and this eased the problem of exporting some products whose prices were otherwise too high.

India’s valiant attempts at meeting the challenge of the oil shocks as well as the renewed increase of industrial investment under the economic plans led to another phase of industrial growth in the 1980s. The sixth plan (1980-84) had aimed at an industrial growth rate of 8 per cent per year and achieved 5.9 per cent. The seventh one (1985-1989) was more successful. It had envisaged a rate of 8.7 per cent and attained 8 per cent. Thus Rajiv Gandhi could be proud of getting close to the record rate reached in the last years of his grandfather’s reign. Unfortunately for him, this victory on the economic front was not matched by an equal success in the political sphere. Politics and economics do not always arrive at a stable and predictable equation. But the period of political instability after Rajiv Gandhi’s defeat in 1989 certainly did have an adverse effect on the national economy.

The success stories of the oil and cement industries

The IMF loan obtained at the beginning of this period was obviously invested wisely. Among other things, India stepped up its oil production – particularly due to the exploitation of off-shore oil resources (Bombay High). Thus oil production increased from 10 mill. t in 1980 to 33 mill. t in 1990. Similarly the production of coal showed a massive increase from 119 to 225 mill. t. Most of this was due to the rapid expansion of open cast mining, which permits cheap production as compared to underground mining, which is about four times more expensive. (Parikh 1999: 127) The advance in steel production from 10 to 14 mill. t was less conspicuous. Moreover, India had not yet made much progress in the field of import substitution of specialised steels. India’s import statistics for the item "iron and steel" showed an average annual import bill of 10 bill. Rs in the 1980s.

A unique success story was the rapid increase of cement production from 19 to 49 mill. t in the 1980s. Compared to the meagre results of the years from 1965 to 1980, this was a surprising achievement. A policy change in 1982 resurrected the cement industry as if it had been touched by a magician’s wand. A partial de-control and positive discrimination in favour of new investment encouraged the establishment of 8 new cement
plants in the 1980 s with a total installed capacity of more than 6 mill. t. All the new plants adopted the dry process of cement production whereas most of the older plants were still stuck with the wet process. Actually the Indian cement industry was now divided into a retarded sector with outdated technology and a sub-optimal size of plants and a progressive sector with new technology and larger plant size, i.e. about 0. 8 mill. t capacity per plant. The structure of this industry provides an object lesson of the discouraging effects of the wrong type of policy. Of the 26 old plants 18 had been started in the late 1930 s, four had come up between 1948 and 1956 and only two in the early 1960 s. They all had a sub-optimal plant size with an average capacity of about 0.6 mill. t. (Gokarn and Vaidya 1993: 33-41) No new plants had come up between 1964 and 1981, a striking reflection of the period of policy-induced paralysis. Once the spell was broken, the thrust of increasing cement production continued throughout the 1990 s. By 1999 nearly 100 mill. t of cement were produced in India.

Heavy plan expenditure must have also contributed to this success story as it increased the demand for cement. Since cement production is to a large extent in the private sector, this contributed to the growth of that sector. The public sector did not grow as fast as the private sector after 1982. (Swamy 1994: 181) Of course, its dimensions were still formidable. The paid-up capital of the Steel Authority of India (SAIL) which controlled all public sector steel mills far surpassed that of the 52 largest private sector companies. It amounted to about three-and-a-half times the total capital of all those companies. And there were more such public sector giants, e.g. Indian Oil and the Oil and Natural Gas Corporation. (Swamy 1994: 192)

Cars and machine-tools

Among the special growth points of the private sector was also the automobile industry. The 1980 s saw for the first time a major spurt in the production of passenger cars as well as of commercial and utility vehicles. For a long time the licensing regime had restricted the production of cars to a few companies, which turned out a limited number of reproductions of rather ancient foreign models. Average output per year amounted to about 70,000 automobiles from 1960 to 1975. But from 1980 to 1990 this production increased from 120,000 to 366,000. Of course, this step ahead was also accompanied by a surge of imports of car parts as well as machine tools for making cars. Particularly the new entrants into the industry relied on imports rather than investing heavily in R&D with a view to import substitu-
Critics deplored that this led to large-scale dependence on foreign technology without any beneficial effects in terms of export performance. (Narayana and Joseph 1993: M13-M20) But car exports could hardly have been expected in view of the large internal demand, which made the actual production look like a drop in the ocean. For most Indians, however, owning a car was anyhow at the most a distant dream. They would rather look for a bicycle. In this field production had only progressed from 1 mill. to 2.3 mill. in the period 1960-1975. In the 1980s it increased from 4 to nearly 7 mill. per year.

The machine-tool industry also experienced a remarkable expansion in the 1980s. Up to 1974 the total value of machine-tool production had remained under 1 bill. Rs From 1975 to 1980 it had slowly edged up from 1 to 1.8 bill. Rs, but in 1987 it stood at 3.7 bill. Rs. However, this enhanced production was unable to cope with the increase of internal demand. The value of imports of machine-tools increased from 1 to 2 bill. Rs in the period from 1980 to 1987. This was, of course, also due to the fact that certain types of sophisticated machine-tools were simply not made in India. On the other hand the export of Indian machine-tools remained always marginal although there was a market abroad for simple machine-tools as manufacturers in highly industrialized countries moved upmarket and stopped producing simple machines. From 1980 to 1987 exports amounted on the average to about 10 per cent of Indian production, but if it had not been for special export incentives there would have been no such export at all, because it would have been unprofitable. The lion’s share of these exports was due to HMT with about 50 per cent, followed by Praga Tools and Bharat Fritz Werner with nearly 20 per cent each and Mysore Kirloskar and Widia (India) with about 3 per cent each. (Suvrathan 1991: M13-M19)

Plan expenditure in the 1980s was massive when compared to the earlier plans. The sixth plan (1980-1984) claimed 19 per cent of GNP and the seventh one (1985-1989) even 24 per cent. However, industry, which had been given high priority earlier, was now scaled back to 14 and 13 per cent of plan outlay respectively in these two plans. Instead top priority was given to energy (27 and 28 per cent respectively) as it had dawned upon the planners that the bottleneck in energy supply impeded industrial growth. The industrial growth rates mentioned above showed that this policy was highly successful. But whereas the physical bottleneck of energy constraints had duly alarmed the technocrats, they did not see the point that human resources are also important for industrial progress. In 1985 the Union Ministry of Education was renamed Ministry of Human Resources
Development. But this was only a noble gesture, which was not reflected in plan outlay, which remained at 6 and 7 per cent respectively in these two plan periods for both education and public health.

The period of the industrial up-swing was characterised by a growth of total factor productivity. Especially the productivity of labour showed a positive trend. Unfortunately this was accompanied by a decline of employment in the manufacturing sector. One of the reasons for this was the rise of real wages after a long phase of wage stability. (Ahluwalia 1991: 192-194) The advance in productivity was undoubtedly also due to the greatly enhanced plan expenditure on energy. India’s progress with regard to industrial productivity was paralleled by an increase of competitiveness. Whereas the regime of government control and protectionism had undermined competitiveness from the 1950s to the 1970s, it showed signs of improvement in the 1980s, although this did not quite compensate for the ground lost in those previous decades. (Kathuria 1995: 167)

The up-swing of the 1980s tended to favour the private corporate sector. But nevertheless small scale industry did survive. It has always been favoured by India’s planners as it was supposed to counteract economic concentration and also generate more employment. Over the years the number of items reserved for production in this sector had been substantially increased. From 47 items in 1967 the respective list had been expanded to 846 by 1988. The number of units had increased from 258,000 in 1972 to nearly 1 mill. in 1988, but the average number of workers per unit had declined from 12 to 6. Thus total employment had only increased from 1.6 to 3.6 mill. The planners had also hoped that fostering small-scale industries would counteract the concentration of industrial activity in the industrially developed states. But actually about 40 per cent of all small-scale units were located in the four industrially most developed states (Gujarat, Maharashtra, Tamil Nadu, and West Bengal). (Sandesara 1993: 223-229)

The liberalization of foreign trade

Economic policy in the 1980s was characterised by increasing liberalisation, i.e. de-regulation of the home market, and reduction of non-tariff as well as tariff barriers with regard to foreign trade. Imports surged due to this policy, but this also led to an enormous increase of revenue from customs duties, which accrued to the central government. This facilitated further investment in the public sector. Unfortunately it also led to unproduc-
tive over-staffing. The creation of jobs is always a high priority for politicians. Creating more employment in the public sector was perhaps also a reaction to the decline of employment noted above. But if the jobs created are unproductive ones, this amounts to a heavy burden for the national economy. Of course, the vision of politicians is usually limited by the horizon of impending elections. Therefore they tend to neglect long term costs and focus on short term benefits. However, sometimes politicians do manage to have a long-term vision at least in some respects. Rajiv Gandhi’s ambition to lead India into the 21st century with a strong emphasis on technological progress at least freed the administrative machinery from the incubus of the earlier cult of self-sufficiency in this field. There were several compulsions, which made a new departure an urgent need. India’s dismal export performance threatened the balance of payments. A renewed recourse to the IMF was considered to be humiliating. Furthermore, India’s security environment deteriorated and necessitated the upgrading of defence technology. American support for Pakistan as a "frontstate" was ostensibly directed against the Soviets in Afghanistan, but those in charge of India’s defence knew from earlier experience that Pakistan would use its American armament against India if there was another confrontation.

At this juncture, it was the government and not the private sector, which spearheaded a change with regard to the acquisition of technology. In fact, it was noticed that current practice in the import of technology by the private sector had serious flaws. There had been a repetitive import of shallow technology packages (Sridharan 1995: 176), which did not lead to a virtuous circle of adoption and innovation. The private sector would go along with this flawed procedure as its horizon was limited by the specific licences for producing narrowly defined items. The import of the specific technology required for this purpose was part of this procedure. Investment in long-term R&D was thus discouraged by the prevailing economic regime. It took some time before the more liberal approach to foreign collaboration and transfers of technology also induced the private sector to discover the virtues of R&D. Nevertheless, it was a fortunate consequence of the new industrial up-swing that private sector entrepreneurs not just resumed their "free ride", but also discovered that they could forge ahead on their own. The rising imports were mostly due to their demand for investment goods. Some entrepreneurs also found export outlets for their production and tried to meet the standards of the world market. But "export pessimism" was only gradually overcome. This pessimism was not an irrational feeling, it was based on hardnosed calculations. As long as an industrialist could produce goods for a sheltered home market, he would not go
in for the expenditure of upgrading his products so as to be able to compete in the world market. Moreover, Indira Gandhi’s refusal to devalue the Rupee in 1980 deprived India of a competitive exchange rate. The lack of export diversification also prevented export-led growth. All this had made export pessimism a foregone conclusion.

Although the policies introduced in the 1980s had in general a rather positive effect on industrial growth, there were also some negative features. First of all, the emphasis on durable consumer goods as the main engine of growth led to a neglect of investment goods and of the upgrading of technological capability. Of course, industry is not an end in itself, it has to cater to the demand generated by the people. But this kind of demand was that of a limited strata. Moreover, such goods usually had a high import content and the private sector producers who thought of quick profits did not necessarily think of long term R&D with a view to foster import substitution. Another unintended effect of the new policy was a shift toward the chemical industry at the expense of the metal-based industries, which had earlier been at the forefront of India’s industrial growth. India had a greater comparative advantage in this latter field, whereas the raw material for the chemical industry had to be imported and Indian products then required a high degree of protection. In many instances it would have been more cost-effective to import the finished product rather than the raw material, e.g. petroleum. The intention to give a chance to the private sector while at the same time limiting the scope of the public sector contributed to the shift from the metal-based to the chemical industry. Due to earlier policies, the metal-based industries were mostly in the public sector while the private sector had done pioneering work in the chemical industry. Thus the encouragement given to the private sector would automatically tilt the balance in favour of the chemical industry. In addition, while the private sector was benefited by import liberalization, the public sector was controlled more rigorously in this respect and thus lost its competitiveness. (Kelkar and Kumar 1990: 209-22) In the happy mood of rapid industrial growth, the policy makers did not think of the long term consequences of their actions. Of course, in fairness to them it must be stated that critics could only analyse their mistakes with the benefit of hindsight.

**The progress of the petrochemical industry**

The Index of Industrial Production (1980=100) registered indeed a phenomenal growth under "Chemicals": 1990= 254. The petrochemical indus-
try made an important contribution to this remarkable progress. But this was only true of the more recent period, whereas the earlier learning process was rather frustrating and costly. Petrochemicals are a rather peculiar family of products. Most of them are derived from the operation of naphtha crackers, which do not just yield one product but a whole line of by-products. The respective processes have been developed by a small group of transnational corporations. Vertical integration is highly profitable in this field as downstream products are progressively more expensive. Big oil companies like Esso or Shell have accordingly entered this downstream business, vice versa big chemical companies like Dupont have bought up oil companies. Giant size is not only characteristic for the producers but also for construction companies specialised in setting up petrochemical plants. Thus Bechtel Corporation, which is in this business, happens to be the largest non-manufacturing company in the world. Whereas India could go ahead with establishing huge public sector steel companies, the petrochemical industry did not lend itself to such a procedure. The cooperation of the international giants was required. The industrial policy established in the Nehru era had laid down that both the public and the private sector could enter this line. Moreover, even foreign companies could set up factories owned and operated by them. Accordingly Union Carbide (India) Ltd. had started a factory in 1965, then Shell opened a much bigger factory in 1968 as a joint venture with the Mafatlals, textile industrialists of Mumbai. Their venture was called National Organic Chemicals India Ltd. (NOCIL). NOCIL in turn entered into a joint venture with the German company Hoechst, Polyoolefin Ltd., also in 1968. The latter plant was exclusively devoted to the production of high density polyethylene from which plastics are made. These private sector plants were built and operated by the foreign partners. They held equity in these firms and covered the foreign exchange expenditure for the imported machinery.

The government then decided to start a public sector company called Indian Petrochemicals Corporation Ltd. (IPCL). Negotiations with some foreign companies broke down over the issue of control and management. This greatly delayed the establishment of IPCL, which began to operate only in 1973. Since the government wanted to go it alone it had also established Engineers India Ltd. (EIL) in 1965 for the purpose of designing and constructing petrochemical plants. But to begin with EIL did very little as the government entrusted the German firm Friedrich Krupp with the construction of one part of the plant (aromatics from which products like nylon are derived) while shopping around for partners in other fields (e.g. synthetic rubber etc). Even later on EIL did not develop much of techno-
logical capability and was only entrusted with rather elementary engineering tasks. The foreign companies derived the main benefit from their operations in India and the transfer of technology was hedged in by so many restrictions that very little was of permanent benefit to the Indian side. The foreign corporations also established direct subsidiaries in India for the marketing and servicing of the products of the plants established with their cooperation. Thus even in this field there was very little that the Indian side could learn in this early period. (Khanna 1984: 1319-1340) Moreover, the plants were of sub-optimal size and economies of scale are very essential in this capital-intensive industry. Only tariff protection of synthetic fibres enabled Indian producers to enter this field at all. The welfare effects of this kind of industrialization were doubtful. It could be justified only as a beginning of future progress.

A new period of India’s petrochemical industry started when Reliance entered the field and set up a 10,000 t polyester (synthetic fibre) plant in 1982, which was at that time the largest plant of its kind in India. By international standards it was still rather small, but for Reliance it was a first step in a new direction. Ambani’s progress from trading in synthetic fibres to mill owner and then to producer of synthetic fibres made sense and he pursued this path with determination. He was also one of the first Indian industrialists to resort to the stock market for raising capital. The net block of Reliance Industries rose from 106 mill. Rs in 1976 to 6 bill. Rs in 1985. In the same period the amount of share capital of the company grew from 59 mill. Rs to 574 mill. Rs. (Chandrasekhar 1992: 99) In subsequent years Reliance Industries branched out into areas of petrochemical production beyond synthetic fibres, e.g. plastics etc. Their subsequent achievements will be described in the section devoted to the 1990s.

The Mumbai textile strike of 1982 and the doom of the mills

Whereas the chemical industry forged ahead in the 1980s, the fate of the Indian cotton textile mills became even worse than in the previous period of recession and stagnation. In 1982 the Mumbai labour leader, Dr. Datta Samant, started a strike of the millhands, which lasted for 18 months. He had earlier been quite successful in other industrial fields. A strike of the highly skilled workers of the automobile industry in Mumbai had led to a settlement according to which wages were related to the productivity of labour. This was a positive result both for the workers and the company concerned. It was Samant’s reputation as an independent labour leader,
which attracted the dissatisfied textile workers. They drafted him; it was not his own initiative to start this strike. But once he became their leader, he behaved in an autocratic manner and was fully convinced that he was right. Being a medical doctor and not an engineer or economist, he obviously thought that his prescription would also work for the textile industry, but this patient was already seriously ill and labour productivity had never been a strong feature of this industry. The millowners and the millhands survived the endless strike by adopting a strange stratagem. The mills sub-contracted production to the powerlooms and merely finished and sold the cloth, many striking millhands meanwhile worked at the powerlooms. In this way both millowners and millhands contributed to the doom of the Mumbai mills. (Leadbeater 1993: 218) From 1980 to 1985 mill production of cotton cloth declined from 3.4 to 2.6. mill. metres, whereas the production of the decentralised sector increased from 4.9 to 6.6 mill. metres.

Interestingly enough, the production of cotton textile machinery was not affected negatively by this tragedy of the mills. The Economic Survey only quotes figures concerning the value of the machinery as different types of machines come under this category and therefore their numbers are irrelevant in this context. The value of the Rupee was more or less stable in the period from 1970 to 1985. Thus the figures for the value of textile machinery provide an adequate standard of comparison. In 1970 this value was only 0.3 bill. Rs. There was a steep increase to 3 bill. Rs in 1980, by 1985 a further increase to 3.6 bill. Rs. could be noted. Undoubtedly a large amount of this new textile machinery was absorbed by the powerloom sector. The days when most of the powerlooms in the decentralized sector were worn-out secondhand machines were gone.

The Coimbatore spinning mills were in the vanguard of supplying yarn to the powerlooms. They also provided the background for an amazing success story in the field of textile machinery. The Lakshmi Machinery Works (LMW) of Coimbatore started production of spinning machinery in 1966. They had a very close cooperation with a Swiss firm, which supplied not only the machines that make machines but also technical training and continuous technology transfer in subsequent years. Initially LMW did not do much R&D of its own. But it pursued strict quality controls and could even do turnkey jobs abroad such as setting up a plant in Sri Lanka. It diversified its products from ring frames to open-ended rotors. Finally it launched its own improved speed frame in 1982. (Lall 1987: 131) This development of a leading maker of textile machinery was obviously due to the growing demand of the powerlooms for yarn. LMW would not
have prospered if it had depended on the demand generated by the moribund mill sector.

The new textile policy of 1985

In 1985 the government finally announced a realistic textile policy. Whereas it had turned a blind eye to the emergence of the powerloom sector so far, pretending that the decentralised sector was mainly populated by the handloom weavers who deserved its full support, it now recognised the powerlooms, but also insisted on the equal treatment of powerlooms regardless of their installation in mills or in the decentralised sector. Positive discrimination was restricted to genuine handlooms only. By now there were more than 800,000 weavers working on powerlooms and they were doing a good job at supplying the poor with cheap cloth. Recognising their existence eliminated some of their illegal privileges, but also gave them access to credit etc. The weak point of the new policy was its rather vague references to the handloom weavers. (Goswami 1985: 1614) Reacting to criticism concerning this latter point, the government issued a specific order in 1986, which reserved the weaving of saris and dhotis to the genuine handlooms. This order caused an uproar among the powerloom operators in the decentralised sector and their suppliers, the spinning mills. (Leadbeater 1993: 225, 251) However, the new policy did not impede the rise of the powerloom sector. As reported above, this sector had overtaken the mill sector in the 1970s. This trend continued unabated. From 1975 to 1990 mill production decreased from 4 to 2 billion metres and that of the decentralised sector sky-rocketed from 4 to 11 billion metres. The greatest increase was that from 6.5 to 11 billion metres in the last five years of this period, which should have been affected by the new textile policy. It is obvious that this massive increase of production of the decentralised sector could not be attributed to "genuine handlooms". The control of the decentralised sector is obviously very difficult. The earlier decision in favour of this sector could not be reversed by a stroke of the pen. Nor could the positive discrimination in favour of the "genuine handlooms" yield immediate practical results.

The new textile policy also initiated a major shift in the collection of excise. Since it was hopeless to collect it from the decentralised powerlooms, it was wiser to slap it only on yarn which was produced in mills and could thus be more easily controlled. In order to privilege handlooms, hank yarn, which was exclusively used by them, was exempted. But this immedi-
ately gave rise to another little industry: reeling hank yarn and supplying it to the powerlooms.

The mills lost more and more ground, although they should have been encouraged also in view of their potential contribution of high quality fabrics to India’s exports. But instead more mills turned "sick" and had to be taken care of by the government. An event of great symbolical significance occurred in 1986 when the Empress Mill in Nagpur was closed. This was the mill founded by Jamshed Tata in 1877. In his time he would have pledged his personal fortune to save this mill – as he had done with the Swadeshi Mill in Mumbai. But his heirs did not feel called upon to do so in view of the destructive policy of the government. Instead they complained bitterly about this policy, but did not lift a finger to save the mill. The National Textile Corporation, which had already absorbed many "sick" mills, refused to take the Empress Mill under its wings. Finally the Government of Maharashtra stepped in so as to save the millhands from unemployment. (Leadbeater 1993: 186, 221) Actually, this was only due to a special concern for the political situation in the city of Nagpur. As the example of the Mumbai strike has shown, millhands can shift to the powerloom sector. This is particularly true of Maharashtra, which is home to about half the total number of all powerlooms in India. But the sudden occurrence of unemployment in an important urban centre is something which the government must avoid.

Rajiv Gandhi’s new government did not rest content with simply announcing a new textile policy. As a supporting measure it introduced a Textile Modernisation Fund in August 1986, which was supposed to assist mills with cheap credits etc. An amount of 7 bill. Rs was put at the disposal of this fund for the next five years. In January 1987 another measure was introduced which was aimed at turning around sick mills. A Board of Industrial Finance and Reconstruction (BIFR) was established for this purpose and vested with considerable powers. BIFR could order a change of management, arrange for the merger of mills or put them up for sale. The officers in charge had judicial powers, but, of course, they belonged to the IAS and had no idea of what they should do with their powers in such a complex situation. BIFR thus remained more or less ineffective in subsequent years. Very often it helped to save bankrupt firms in the "public interest" and imposed "sacrifices" on the creditors while enabling the owners to profit from such measures. (Anant and Goswami 1995: 279). Some time later the government planned to abolish BIFR, leaving the task of dealing with sick mills to the respective creditors. Actually all such remedi-
al devices could hardly cure the ills of the mills. After having crippled them for years, the government had merely offered them some crutches.

The progress of the fertilizer industry and of steel mills

One field in which Indian industry took enormous strides in the 1980s was the production of fertilizers. As indicated above, the steep rise of the import bill for fertilizers in the 1970s made the increase of indigenous production a high priority. From 1980 to 1985 the output of nitrogenous fertilizer rose from 2.1 to 2.7 mill. t and that of phosphatic fertilizer from 0.8 to 1.4 mill. t. The latter was a particularly encouraging feature, as Indian peasants had concentrated too much on nitrogenous fertilizer in earlier years and had neglected a proper balance of fertilizers. But the total off-take of fertilizers had greatly increased from 4.9 to 7.8 mill.t in this period. This meant that imports still had to fill a large gap and thus the import bill for fertilizers increased from 8 to 13 bill. Rs in the 1980s. This provided a strong incentive for going ahead with further import substitution. By 1990 India produced a total amount of fertilizers of 9 mill. t. The import bill in that year was 17 bill. Rs.

One item for which India has to rely entirely on imports is potash, which is also important for a balanced application of fertilizers. In general the relation of nitrogenous fertilizer to potash should be around 3 : 1. Looking at All-India statistics one can see that this has never been achieved. In the early 1960s the relation was about 9: 1, it improved to about 6: 1 in the 1970s and 1980s, but in the 1990s it once more relapsed to 9:1. This is alarming, because the soil, which is deprived of this essential nutrient, will deteriorate. The price of potash fertilizer is about the same as that of nitrogenous fertilizer, approximately Rs.4000/t. In 1999 India imported 54 per cent of the required 1.7 mill. t of potash from Russia/Belarus, about 15 per cent each from Israel and Jordan and 8 per cent each from Canada and Germany. Since this is an irreducible item of the import bill, stepping up import substitution with regard to such fertilizers, which can be produced in India, becomes an even more important task.

While fertilizer production showed significant progress, steel production remained sluggish, although another public sector steel mill had been put up in Visakhapatnam (Vizag), Andhra Pradesh, in the 1980s. This is India´s most advanced integrated steel plant, but it is also supposed to be one of the world´s most expensive plants of its kind. Unfortunately it turned "sick" by the 1990s and the government then intended to sell it to

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private entrepreneurs. The Soviet Union was involved in building this plant, too. Dastur had been asked to provide the design. Again he was to be disappointed. He had submitted a first draft in 1977 and then updated it in 1979 so as to include recent technological developments. The agreement with the Soviet Union had then been signed in June 1979. As in previous cases, the Soviets once more saw to it that they were in control of the whole planning and engineering process, whereas Dastur was assigned a back seat. Import content was high, particularly in view of the fact that equipment supplied by Indian firms also had a high import content. (D’Mello 1988: 483-484) The subsequent contributions of the Soviet Union were only marginal, particularly as far as the rolling mills were concerned. Two rolling mills were supplied by the Czechs and a third one by Germany. Instead of thinking of upgrading the manufacture of flat products such as steel sheets used for cars – the new plant was mainly geared to making structurals etc. When Indian car production picked up, steel sheets had to be imported. (D’Costa 1999: M2-M 16) India also did not yet produce steel suitable for the manufacture of high quality ball bearings for machine tools.

Indian steel mills unfortunately also had the distinction of being among the most inefficient users of energy. In the mid-1980s they consumed on the average about 11 gigacalories per ton of steel, whereas steel mills in most industrialized countries consumed only 5 gigacalories. This was true even for Korea, a relative newcomer in this field. Japan was satisfied with 4 gigacalories. (Pachauri 1995: 150) As far as productivity per worker was concerned, India also had a miserable record: ca. 55 t per worker per year as against 420 t in Korea or 602 t in Japan. Of course, this was due to the fact that steel mills were supposed to generate employment without any regard for actual needs. In Vizag the management even had to induct illiterate tribals into the work force who had helped with the construction of the mill and faced unemployment after that work was completed. (D’Costa 1999: M2 – M 16)

Although India was saddled with enormous bills for essential imports, which it could not match with a suitable export performance, a balance of payments crisis had been averted for quite some time by Indian manpower export to the oil-exporting Gulf states. The flow of private remittances had modest dimensions to begin with but soon grew into a mighty stream. It increased from 4.1 billion Rs in 1975 to 30 billion Rs in 1984. In addition the government wooed the Non-Resident Indians (NRI) by permitting them to "park" their savings in India at high interest rates. These "parked" amounts were freely convertible and could be withdrawn at short notice.
This made the balance of payments highly vulnerable. A crisis in the Gulf states could cut off the remittances and instability in India could cause the NRIs to withdraw their money. Indian politicians used to be rather complacent about this. When I asked Indira Gandhi in 1981 whether she was not afraid of a crisis in the Gulf states, which would cut off the flow of remittances, she confidently replied: "The Arabs need us". But in 1991 the combined effect of the Gulf War and of internal political instability in India dramatically affected the "invisibles" in India’s balance of payments.
8. Balance of payments crisis, structural adjustment and liberalization: Indian industry and economic reform

The crisis of 1991 was more sudden and severe than that which had struck India a decade earlier. The IMF was again ready to provide a substantial amount of credit to India, the more so as India had paid back the previous one within a few years. Usually the IMF insists on a programme of "structural adjustment" as part of its conditionalities. This is often resented by the recipients as it constrains their economic policies and affects their national sovereignty. In India, the new Finance Minister, Dr. Manmohan Singh, who had earlier served in international organizations, did not need to be told what had to be done. He devalued the currency, restricted government expenditure etc. on his own. In all this he had the full support of Prime Minister P.V. Narasimha Rao who trusted his judgement in economic and financial matters. As expected, the policy of structural adjustment initially slowed down industrial growth, but then Indian industry surged ahead once more; this time the private sector was in the vanguard. This was a very encouraging sign.

What happened to Indian industry in this crucial period can be shown by means of the general index of industrial production (1980/81= 100). The weights attached to different industries had been revised in 1980. Textiles had a greater weight earlier, they had been scaled down because other industries had forged ahead. Without this revision, the general index would have looked somewhat different as a comparison of the respective figures will show. In 1990 the general index stood at 212 and that for textiles at 126. The general index figures for 1991 and 1992 were 214 and 219 respectively. This indicated a stagnation under the immediate impact of the crisis. From 1993 (232) to 1996 (305) there was once again a steady increase. In the same period cotton textiles also improved their position from 160 to 191, but their growth remained very much behind that of industry in general.

If we turn from index figures to those for actual production, we notice a very encouraging growth in the field of fertilizers. where production increased from 9 to 11 mill. t thus reducing the need for imports, which remained at an average of 3 mill. t in those years. The output of crude oil was less encouraging, it stagnated at about 33 mill. t throughout the 1990s. This meant that imports had to be stepped up from 16 to 33 mill. t
to meet the demand of Indian industry for more energy. Coal production increased from 225 to 308 mill. t in the same period, but this was not enough to fill the gap.

The restructuring of the cotton textile industry in the 1990s

The total production of cotton cloth increased from 15 bill. sq.metres to 20 bill. from 1990 to 1996. This increase was entirely due to the decentralized sector as the production of the mill sector stagnated at around 1.9 bill. sq.metres throughout. This meant that by 1996 the share of the mill sector in cotton cloth production had dwindled to less than 10 per cent. Whereas in 1951 there had been 280 composite textile mills in India producing 70 per cent of all cloth, by the 1990s 100 of these mills had been closed and 80 were sick. (Garde 1995: 218) However, there was a significant restructuring of the mill sector particularly when the new industry engaged in manufacturing ready-made garments created a growing demand for high quality cotton cloth. Ready made garments contributed a great deal to increasing exports. Indian fashion designers and textile institutes were a great help in this development. But the production of the respective cloth was a problem. Only a limited number of mills rose to the occasion and invested in new textile machinery in order to meet this demand. Old shuttle looms were replaced by air jet shuttle-less looms etc. Eleven big mills out of a total of 91 which were still in a healthy condition emerged as the leaders of the mill sector. They accounted for only 5 per cent of the weaving capacity, but had a share of 20 per cent in total production and more than 50 per cent of sales. In keeping with this they accounted for about one third of the profits. There was thus a new kind of stratification of the mill sector: 11 very profitable mills as against 80 which were just about viable. The profitable mills were also able to work with a better labour force which had emerged from the chaos of the big strike in a chastened mood and was more interested in productivity as this would secure higher wages. Most of the 11 leading mills were famous old ones located in Mumbai such as Bombay Dyeing or Standard, there was one each in Ahmedabad, Solapur and Banswara (Rajasthan) and two in Bengaluru. (Roy 1996: M 31-M 41)

The new demand for high quality cotton drove up the prices of raw cotton. From 1990 to 1996 India’s consumption of cotton had increased by 44 per cent. (Bremer Baumwollbörse 1998: 66) Moreover, bad harvests had doubled the world market prices of cotton from late 1993 to May 1995 when they reached about 115 US-cents/lb. Subsequently they declined to
about 66 US-cents/lb in April 1998. (Bremer Baumwollbörse 1998: 60) The price rise had prompted Indian peasants in areas which were actually not quite suited for cotton cultivation to switch to this cashcrop. They had to buy seeds and dig wells, got heavily indebted and became highly vulnerable. In Andhra Pradesh several hundreds of peasants committed suicide in the late 1990s when their crops failed and they could neither service their debts nor feed their families. This was the seamy side of the resurgence of the demand for cotton cloth. The story of the Andhra peasants was part of a massive thrust of an increase in cotton production in the mid-1990s. From 1980 to 1996 raw cotton production just about doubled and reached 2.4 mill. t, but yield per acre had only increased by 60 per cent. Accordingly the area under cotton had to be expanded to 9 mill. ha. Most of this expansion happened in the mid-1990s. From 1960 to 1993 the area under cotton had remained more or less at the same level of ca. 7.5 mill. ha. Due to the sudden price rise of cotton in 1994 the area then grew very suddenly. Many peasants who took up this type of cultivation were new to it. The foodgrain which seems to have lost most ground to cotton was the humble jowar (millet). Peasants who relied on jowar for their food and had shifted to cotton were thus in a terrible bind.

The restructuring of the mill sector reflected the pattern of income distribution in the Indian economy. Inspite of a general increase of per capita income, per capita cloth consumption had stagnated. Obviously the demand of the poor remained limited due to their purchasing power. They could only afford cheap cloth – mostly produced by the powerlooms – whereas the demand of the wealthier sections was circumscribed by their smaller number. Unless exports could be increased and/or the purchasing power of the poor substantially enhanced, the production of 11 modernised mills was obviously taking care of the needs of India’s better-off citizens.

**Machine tools and steel in the 1990s**

The production of machine tools showed in general a positive trend. The total value of this production amounted in 1990 to 7.7 bill. Rs and 15.7 bill. in 1996. But from 1991 to 1994 this value had stagnated at an average of about 9.5 bill. Rs. This stagnation was obviously a reflection of "structural adjustment", which for some time dampened the demand for investment goods. A similar pattern was shown by the production of automobiles, which stood at 366,000 in 1990, receded to 335,000 in 1992 and then
increased steadily to 783,000 in 1996. The further development of these important industries in the 21st century will be discussed later on.

The steel industry crept along its slow growth path as in earlier years although more capacities had been added. The Vizag plant had extended its capacity to 3 mill. t in the 1990s but had then turned "sick" as mentioned earlier. Bhilai had been expanded to a total of 4 mill.t and in its new section it had introduced BOP-furnaces and continuous casting. Total production of steel ingots progressed from about 13 mill. t in 1990 to 16 mill. t in 1994 for all Indian steel mills. Their total rated capacity was higher, but capacity utilization was always somewhat deficient, whereas in other countries steel mills often resorted to "capacity stretching", i.e. producing more than their rated capacity. The Indian steel mills were beset with peculiar problems. Most of them had an ill assorted equipment of various ages supplied by many different firms. They also invested very little in R&D. In the 1990s they spent less than 0.5 per cent of total sales in this way, whereas, for instance, in Korea the public sector firm POSCO stepped up its R&D expenditure from 1 to 2 per cent. (D’Costa 1999: M 2-M 16) The only positive development was the emergence of some private sector steel companies like Essar and Ispat, which produced high quality steel and even managed to export some of it.

The reform measures after 1991 had suddenly subjected the steel industry to some degree of international competition. It tried hard to cope with this, but as the new possibilities of using more imported steel in India coincided with a period of recession in domestic demand, inventories were building up. The steel industry was faced with excess capacities and the inadequate use of installed capacities now appeared to be a blessing in disguise. But, of course, this was not a healthy situation. The attempts at exporting Indian steel were also not very successful due to oversupply in the worldmarket. Moreover, countries, which are otherwise pledged to uphold free trade, resort to "anti-dumping" measures even if they cannot prove that the respective goods are offered below production costs. Under such conditions foreign companies were not exactly attracted to starting ventures for the production of steel in India. Nevertheless, a British company and a Korean one (POSCO) did show an interest in such ventures.

The pharmaceutical and petrochemical industries

An industry, which experienced an almost explosive growth in the 1980s and 1990s, was the Indian pharmaceutical industry. Around 1975 there
had been less than 1000 firms in this field. In the 1980s there had been a considerable expansion so that by 1990 there were 15600 firms. But then within the short span of five years 7400 more were added to that number. Only about 7000 of the 23000 firms existing in 1995 had a turnover of more than 120 mill. Rs. As in so many other fields, small was also considered to be beautiful here. The government had exempted smaller units from excise and from the price control regime. This was an invitation to establish any number of small plants of sub-optimal size. They had a propensity to exit soon as they could not face the competition of the bigger players. But even big firms like Ranbaxy or Glaxo had only a 6 per cent share of a national market which was estimated at 80 bill. Rs. Foreign firms had a share of about 37 per cent of that market. Since Indian drug prices were in general higher than international prices, this industry did not have any export potential in the early years. (Madanmohan 1997: M107-M110) The enormous proliferation of manufacturers in this field had nevertheless the positive effect that there was a widespread acquisition of technological capability. A shake-out was bound to come, but keen competition would lead to a general improvement of the quality of that industry. In the meantime, however, even big companies indulged in practices such as producing several different brands of drugs for curing the same disease. Probably they counted on novelty as an argument in sales promotion. Swarms of medical representatives visited every nook and corner of India in order to convince doctors of the virtues of new brands of medicine. In this game novelty was of some advantage. We shall return to this industry later on, which has in recent years attained a formidable size.

The Indian petrochemical industry advanced in a big way in the 1990s. Ethylene cracker projects were the most important ones in this field, as ethylene is an intermediate product required for various types of fibres and plastics. The public sector IPCL had a capacity of 430,000 t in the mid-1990s and was adding 400,000 t more to it at two different sites. NOCIL at Thane, Maharashtra, had a capacity of 75,000 t and was adding 320,000 t to it at the same site. Reliance was planning for 750,000 t at Hazira, Gujarat, and 300,000 t at the Assam Gas Cracker Complex. There were several other projects also. By now the argument that India was producing petrochemicals in plants of sub-optimal size behind high tariff walls did also no longer hold true. In the 1995 budget customs duties on major petrochemicals were substantially reduced. This trend continued.

Reliance Industries had staked its claim to leadership in this field in 1982 and had followed this up with massive investments in subsequent years. The crowning event was the commissioning of two giant plants at
Jamnagar on the Westcoast of Kathiawar, Gujarat, in January 2000. Reliance had invested a total amount of 55 bill. Rs in these plants. One of them had the capacity to produce 1.4 mill. t paraxylene and the other 0.6 mill. t of polypropylene. Paraxylene is an intermediate product from which polyester (synthetic fibre) is derived. It belongs to the aromatics branch of products, whereas polypropylene belongs to the olefines branch and also enters the production of polyester. Having started with a polyester plant in 1982, Reliance had thus moved upstream. Investing in the production of paraxylene was a very important strategic move as a shortage in the supply of this essential intermediate product had affected the Indian petrochemical industry. Bombay Dyeing, another major textile firm, which had entered the field of petrochemical production, had concentrated on DMT, the intermediate stage between paraxylene and polyester, and had suffered from the shortage of paraxylene.

The idea of building up a major petrochemical industry in India had been given much encouragement by the exploration of the off-shore oil resources at "Bombay High" in the oil-rich continental shelf at the Westcoast of India in the early 1980s. As we shall see when discussing the Indian oil industry, this had levelled off within a few years and India became once more dependent on massive oil imports. However, this is more important in the context of India’s energy household than in that of the petrochemical industry, which consumes rather marginal amounts of petroleum. The energy household would be much improved with further advances in the use of solar energy. So far the cost of cells for the conversion of sunshine into energy has been a major barrier in this field. A breakthrough is expected here. Indian physicists should be in the vanguard of research in this field, and Indian industrialists should then take up the manufacture of the relevant equipment which would easily find a global market. The Central Electronic Ltd. (CEL), a public sector enterprise, is even now the fifth largest manufacturer of solar cells in the world and exports such cells to many countries. The Rajasthan Solar Energy and Electronics Ltd. (RASEL), a public sector enterprise established in 1993, manufactures solar cells for use in telecommunication and in electric pumps. About a quarter of the world’s solar electric pumps were operating in India’s villages in the 1990s. (Pakrashi 1995: 260-262) A team of scientists in Kolkatta associated with Bharat Heavy Electricals (BHEL) and the Indian Association for the Cultivation of Science had successfully developed a new silicon solar cell technology. This is based on the "amorphous silicon thin film" (a-Si) method, which was first discovered in the USA in 1976. The Indian team then began to work on this in 1978. In 1986 this project
was made a special technology mission and in 1990 a pilot plant manufacturing a-Si cells was commissioned at the Solar Energy Centre, Gwalpahri, Haryana. (Barua 1995: 238-243) The sun lavishes its favours on India, and if solar energy could be produced at an economical rate, India would certainly experience a magnificent "take off".

The defence industry

A very important element of Indian industrial production, which is often omitted in general accounts of Indian industry, is the defence industry. It includes the ordnance factories and such public sector companies, which mainly produce equipment for army, navy and air force. There are altogether 39 ordnance factories employing a total of 170,000 workers. They produce ammunitions, guns of various sizes, tanks, trucks, army vehicles etc. The total value of their production amounted to 19 bill. Rs in 1993. Then there are several public sector shipbuilders producing various types of ships for the navy and for commercial freight carriers. Besides they do extensive repair work. India’s rocket systems are manufactured by Bharat Dynamics Ltd. (BDL). HAL which manufactures planes for the air force has been mentioned earlier. Last but not least, there is Mishra Dhatu Nigam (MIDHANI), which produces special steels and alloys for the defence forces. The value of the production of some of these firms is also very substantial, e.g. HAL ca.10 bill. Rs in 1993, BDL 2 bill. Rs and for the three shipbuilders a total of 9 bill. Rs. (Banerjee 1995: 446-448)

A special feature of India's defence industry is the Integrated Missile System under the direction of Dr. Abdul Kalam (1931-2015) who later on became India's President His mentor was Dr. Vikram Sarabhai (1919-1971) who was the chairman of the Department of Atomic Energy but also the founder of ISRO (Indian Space Research Organization). Sarabhai was not in favour of building an atom bomb. He wanted to launch satellites for civilian use such a communication, remote sensing etc. He knew that in this he would have to depend on foreign cooperation and tried his best to distance space research from atomic energy and defence. A separate Department of Space was established in 1972, a year after his death. Dr. Kalam was his intellectual heir, but his career also showed the close links between the spheres, which Sarabhai wanted to keep at a distance from each other. He began his work as a young aeronautics engineer with DRDO in 1958, After working there for a few years, he joined ISRO and was sent to NASA (USA) in 1963 for advanced training. Back with ISRO he
concentrated on satellite launching rockets. Sarabhai's successor, Prof. Satish Dhawan, also relied on Kalam for this work. He was very successful in this line, but then he returned to DRDO in 1982, where he was entrusted with the Integrated Guided Missiles Programme in 1983. It was called "integrated", because it encompassed a whole range of specialized missiles, which were produced simultaneously: Prithvi, a short range ground-to-ground missile (1000 kg, 350 km), Trishul, a short range maritime missile, Nag, an anti-tank missile, arwind, a medium range ground-to-air missile, and finally Agni I, an intercontinental ballistic missile (2500 km), which was first launched in 1989. Agni II, with double this range, followed ten years later. All these were indigenous products. The greatest challenge was finding the proper fuel. Liquid fuel was difficult to fill, but easy to ignite, solid fuel was easy to handle, but difficult to ignite. Kalam preferred solid fuel, but for Prithvi he had to accept liquid fuel, also for the other early missiles, only Agni II was completely powered by solid fuel. It was very similar to the rockets launching satellites, but those were heavy and stationary and had to give much thrust to the satellites to put them into orbit. The defence missiles had to be mobile and usually had no stationary launching pads. But the basic technology was similar. A director of ISRO told me after the successful launch of a satellite, that the thrust of its rocket could propel a ballistic missile over a range of 8000 km. Dr. Kalam was present at the tests of India's atom bombs in 1997, he attendend it incognito under the pseudonym "General Prithviraj". When he became President it was wrongly stated in the press that he was the "Father of the Indian Atom Bomb". He had always been an aeronautics engineer, not a nuclear physicist. "Father of India's Rockets and Missiles" would have been a more accurate description. Being a modest man, he would never have made such a claim for himself.

The Indian oil industry

A less favourable picture emerges when we look at the public sector oil industry. As stated earlier, the output of oil stagnated while the demand for energy was increasing very rapidly. The major reason for this was that this industry needed a major upgrading of its technology, such as horizontal drilling etc. The Indian public sector enterprises could not afford this technology, because they were hamstrung by the government’s pricing policy, which set the price for crude oil produced in India at about half the price prevailing abroad. Similarly at the intermediate level, the government dic-
tated the price to refineries by means of a "cost plus" formula. Finally, fur-
ther downstream the government indulged in subsidising kerosene con-
sumed by the masses. This it could afford to do only because it depressed
prices upstream. (Kelkar 1996: 30) Within such a system it was practically
impossible to attract foreign investment, which was urgently needed in
view of the technological deficiencies, which threatened to reduce the
share of Indian oil in the rapidly expanding energy market even further.

Unfortunately India has not only failed in investing more in the expan-
sion of its oil industry, there have also been instances of misusing the exist-
ing capacities. The flogging or beating of wells is a method of extracting a
maximum of oil regardless of the resulting damages. "Bombay High" has
been a scene of such malpractices and many wells had to be closed, be-
cause they had been damaged beyond repair. Only in the end of the 1990s
a rectification programme had been introduced so as to prevent a further
shortfall of oil production. (Parikh 1999: 130)

Another problem, which plagues the Indian oil industry, is the inade-
quate infrastructure. Oil is mostly shipped by rail in India, which is ten
times as expensive as the transport via pipelines. Around 2000 India had
only crude oil pipelines of about 3000 km, and pipelines for oil products
of ca. 4200 km. (Parikh 1999: 131) This network had to be urgently extend-
ed.

India’s export industries

The deficiencies of the Indian oil industry necessarily led to a steady in-
crease of the Indian import bill. This raises the question of India’s export
earnings. A look at some of the major Indian export industries shows that
they follow different trajectories, some decline while others experience
sudden growth. A surprising trend can be noticed in one of India’s pre-
mier export industries, the tea industry. Tea production remained more or
less constant, but demand in the home market increased to such an extent
that exports were greatly reduced. Per capita availability of tea in India in-
creased from about 300 g in the 1960s to 650 g in the 1990s. By 1995 India
exported only about 20 per cent of its tea production of 760,000 t. The in-
come derived from this export in 1995 amounted to 11.7 bill Rs (350 mill.
$). Tea thus had only a share of about 1 per cent in total Indian exports.
India’s share of world tea exports had declined from 33 per cent in 1970 to
11 per cent in 1995. This reflected not just India’s declining export, but
the rapidly expanding tea export of African countries. In one respect India
had set the pace for the world tea industry by introducing a new type of machinery: CTC= crush, tear, curl. This type of machine was invented in Assam in the 1930s but it found wide application only in the 1950s. It has two steel rollers, which rotate in opposite directions. As the designation CTC indicates, the machine performs these three operations at once. It greatly speeds up the processing of the tea leaves. The tea produced in this way yields a rich brew preferred by many tea drinkers, except those who prefer fine Darjeeling tea made of whole tender leaves. CTC-processed tea is very well adapted to teabags which have conquered the world market and are by now also very popular in India. (Rothermund 1999 b: 154-155)

Another leading Indian export industry is that of gem cutting and polishing. The major activity in this field used to be the polishing of small diamonds. They were bought in London from the Diamond Trading Corporation, which controlled most of international trade in this commodity. There were about 60 Indian firms registered with this corporation as "sight-holders" as they were entitled to buy the rough stones "at sight" in London. About a quarter of all diamonds in the world market are "industrial diamonds", they are unfit for jewellery and are left to makers of cutting and grinding tools. Indian diamond traders and jewellers found a way to capture these industrial diamonds for pretty ornaments, which sparkle just as much as big precious stones. About a million modestly paid workers are working in centres like Surat in Gujarat. I visited a workshop of a diamond company where thousands of workers processed diamonds. The talented daughter of the proprietor designed beautiful jewellery, making use of the tiny diamonds. The company got a German partner in Pforzheim who then sold his business to the Indian partner and continued as his sales agent in Germany. In a similar way but on a much bigger scale, the Gujarati trader Mehul Choksi bought up an American chain of jewellery shops, which then sold his brands of ornaments. With brands like "Nakshatra", he made a splash in the world market. He got the famous Indian actress Aishwarya Rai as brand ambassador. In recent years another Gujarati firm, Kiran Gems, have done even better than Choksi after having learned their trade from him. India finds hardly any diamonds on its soil and imports raw diamonds in great quantities. Raw diamonds are mostly bought in London. Antwerp in Belgium used to be the biggest centre of diamond processing. Jews were dominant in this field there, now Indians have almost totally displaced them.

In India this whole business is in the hands of Gujarati Jains from Palanpur. The sight-holders with their offices in Mumbai send the rough stones via commission agents to hundreds of small workshops, many of them lo-
cated in Surat. The average workshop has about 10 workers. The "owner" is a foreman rather than a capitalist. The lion’s share of the profits are made by the commission agents and the sight-holders. (Kashyap and Tiwari 1984: M 99 – M 103) The polished diamonds were exported to Western countries where jewellers use them.

To some extent the putting-out system described here is still in operation. But as the business boomed, it also gave rise to vertical integration. Big firms emerged, which organized diamond processing in India, but also manufactured jewellery and marketed it abroad. The exact amount of the value added in India in this gem cutting business is a matter of guesswork, because the specifications in the Economic Survey are somewhat ambiguous for imports. The item listed is "precious stones, worked and unworked". But since India is a major exporter in this field, it must be presumed that most of the imported precious stones are "unworked". For the year 1995 the value of exports in this category was 176 bill. Rs and for imports 70 bill. Rs. The exports constitute 16 per cent of all Indian exports and 12 per cent of total world exports in this category. This shows the magnitude of this line of production. The rapid expansion of this type of business has occurred fairly recently. In 1985 exports and imports amounted to 14 and 11 bill. Rs respectively. Of course, the Rupee depreciated from 12 to 33 Rs per USDollar from 1985 to 1995. But even if one deflates the 1995 figures accordingly, they would indicate a growth of exports by about 200 per cent within ten years. Moreover, the value added has increased even more dramatically. If the example of the Gujarati firm mentioned above is followed by others, the share of this line of production in Indian exports may increase even more.

Leather and leather goods are another major item of Indian exports. We have earlier referred to the humble beginnings of this industry. In the period during which India concentrated on import substitution and delinked itself from the world market, the leather industry could hardly expect any stimulus from external demand. In 1970 total Indian export of manufactured goods had a value of 7.7 bill. Rs and leather and leather goods amounted to about 10 per cent of this type of export. It remained at this level in subsequent years. In 1980 the value of leather exports reached 3.9 bill. Rs, but by 1990 it amounted to 26 bill. Rs and in 1995 to 58 bill. Rs. Again the more recent figures have to be deflated when compared to that of 1980. Even then the increase from 1980 to 1995 approximates 280 per cent. Leather requires treatment in numerous tanneries and thus it was a major blow to this export industry when the High Court of Tamil Nadu ordered the closure of about 400 out of 800 tanneries in that state, because
their effluents endangered the environment. Two CSIR-institutes, the Central Leather Research Institute (CLRI) and the National Environmental Engineering Research Institute then came to the rescue of these tanneries by providing "green" technologies to them. (Mashelkar 1999a: 7) This prevented a huge loss in Indian export earnings. In general one can speak of a success story of export-led growth in this field. As pointed out earlier, this Indian industry owed its origin to a demand generated in the world market. In the period of "export pessimism" its potentiality remained latent. When it could respond to export demand once more, the industry imported foreign leather technology and largely bypassed the CLRI which had been set up in 1953. It is only in recent years that this institute has been able to demonstrate its usefulness to an ever increasing extent.

Cotton textiles are, of course, still a major export product of India. Nowadays the powerlooms rather than the mills are the chief contributors to these exports. The figures given in the Economic Survey sum up cotton yarn and all kinds of materials. For 1980 they show a value of 4 bill. Rs and for 1995 of 86 bill. Rs, even when deflated the latter figure still indicates an increase of about 500 per cent within 15 years. The Indian spinning mills have done extremely well, contributing about 30 per cent of total world production in their field. They upgraded their technology and in this they were ably supported by textile machine manufactures such as Lakshmi Machine Works, Coimbatore, whose achievements have been mentioned earlier. This company also scored a high rank as far as investment in R&D is concerned. Indian yarn had a growing export market but the crisis, which started in Thailand in 1997 and then depressed prices throughout Southeast Asia was a big blow to India’s spinning mills. (Chandra 1999: M17-M24) The greatest success story, however, was that of the export of ready-made garments of all types of textiles. In 1980 this had amounted only to 5.5 bill. Rs, in 1990 it had reached 40 bill. Rs. and in 1995 it totalled 123 bill. Rs. In terms of USDollars, this meant an increase from 2.2 to 3.7 bill. within the five years from 1990 to 1995. By 1995 India’s exports in this line amounted to 11 per cent of world exports.

The jute industry, which once used to be a leading export industry, has become a minor one. In 1980 the value of jute exports stood at 3.3 bill. Rs and in 1995 at 6.2 bill., but due to the devaluation of the Rupee, this was less than half of the 1980 figure in terms of USDollars. The lion’s share of jute textile production was consumed in India. As pointed out earlier, the trend of declining exports had started in the 1970s. By the mid 1990s about 1.4 mill. t of jute textiles were produced in India of which only 0.2 mill. t were exported. The acreage under jute had remained more of
less the same since the 1950s. There were about 0.8 mill. ha under jute. But the yield had increased significantly. The total jute harvest had amounted to 0.9 mill. t in 1970, 1.3 mill. t in 1980 and 2.2 bill. t in the mid 1990s. The production of jute textiles had increased accordingly in keeping with the growing demand for them in the home market.

The most interesting of Indian export industries, which has come up only in recent years is, of course, the computer software industry. This will be discussed in the section dealing with information technology.

The private corporate sector, which had a share of about 86 per cent of net value added in organized manufacturing in the early 1990s, was the major force of industrial progress in the new period of economic reforms. In the 1980s non-financial private corporate enterprises had on the average contributed only about 10 per cent to net value added in the Indian economy. By 1995 this share had risen to about 19 per cent. One would have expected that this progress was made at the expense of the public sector, but this was not so. The private non-corporate or "informal" sector receded, whereas the public sector more or less maintained its previous position. (Shanta 1999: M 86-M 91) Of course, the public sector had never been in the forefront of organized manufacturing in spite of its enormous capital assets.

Thus while industrial growth was quite encouraging in the 1990s, the economic reformers were still saddled with the problems of the public sector, which was handicapped by its huge army of unproductive labour, which could not be easily disbanded. Privatization of public sector enterprises was actually urgently required both for reasons of general policy and for the alleviation of budget constraints, but without an "exit policy" for sick units and surplus labour no investor could be found who would take over such enterprises and turn them into productive ones. Massive "golden handshakes" seemed to be the only way out, but their cost would necessarily depress the prices, which the government could hope to get for these enterprises. This has so far slowed down the process of privatization.

The other option of government is to start with privatization by offering the most lucrative and attractive public sector enterprises for sale, but this invariably leads to the outcry that the government wants to sell the "family silver". The official term for the campaign of privatization is "disinvestment". This is certainly a very accurate designation of what is at stake. But it sounds rather negative. Those who are concerned about the sale of the "family silver" will not be happy to hear about disinvestment. But when budget constraints have to be met, even the "family silver" cannot be spared. Moreover, liberalization and privatization are necessary for increas-
ing India’s export potential, which has not at all been fully realised. Un-
fortunately, the wave of reform, which had arisen in 1991, receded after a 
few years when the exigencies of political life caught up with the reform-
ers.

The new vision of the CSIR

When it was still at its height, the wave of reform had also given a new 
lease of life to the CSIR-institutes. Many of them had lapsed into a state of 
isoiation and lethargy in the stagnant 1970s from which they now recov-
ered. A dynamic new director general, Prof. R.N. Mashelkar, took charge 
of the CSIR in 1995. He had earlier headed the National Chemical Labora-
tory, Pune, for which he had obtained international contracts with clients 
such as Dupont and General Electric. Now he infused this spirit in the 
CSIR in general. He would have liked to remove the non-committal "and" 
from the name of the CSIR and called it Council for Scientific Industrial 
Research so as to stress the direct link between "scientific" and "industri- 
al". But even though he could not change the name, he changed the policy 
of the CSIR and provided incentives to its institutes to opt for more con-
sultancy work. The institutes could keep the major part of fees earned in 
this way for investment in their own work, in addition they got matching 
grants from the CSIR to reward them for such initiatives. All these ideas 
were embodied in the CSIR VISION 2001 published in 1996. This new ap-
proach soon led to promising results.

Government expenditure on the CSIR-institutes is quite impressive. It 
amounted to nearly 30 bill. Rs in 1992. But when compared to the expen-
diture on the 48 laboratories of the Defence Research and Development 
Organization (DRDO) which totalled 79 bill. Rs in 1992 or the Depart-
ment of Space (DOS), which finances the Indian Space Research Organiza-
tion (ISRO) and got 40 bill. Rs in 1992, the funds allocated to the CSIR ap-
pear to be modest. At least they are almost of the same dimension as those 
given to the Department of Atomic Energy. (zu Putlitz and Schmitt 1995: 
374) Until recently the defence laboratories worked exclusively for the 
armed forces and their factories etc., but recently five of them have re-
ceived permission to work for the private industrial sector also. This means 
that in addition to the CSIR-institutes other government-sponsored R&D 
resources will become increasingly available to Indian industry.

The CSIR-institutes constitute a huge reservoir of scientific manpower. 
Their total strength including supporting staff is about 23,000. In addition
to the 28 institutes inaugurated in the Nehru era which have been mentioned above only a few had been established in the subsequent decades. The Centre for Cellular and Molecular Biology in Hyderabad (1977) and the Institute of Microbial Technology, Chandigarh (1984) reflected the new advances in biotechnology. A rather unusual institute was established in 1981 in New Delhi: The National Institute of Science, Technology and Development Studies (NISTADS). It is devoted to technology assessment and forecasting, but it has also sections dealing with the history, philosophy and sociology of science. With a staff of only 57 scientists it is one of the smaller CSIR-institutes as compared to the National Chemical Laboratory with a staff of 339 scientists. (CSIR 1995) But it may provide interdisciplinary perspectives, which the institutes devoted to a single discipline would not do.

In the process of turning around the CSIR-institutes, the new director general had also urged them to register patents. So far the Indian record in this field is rather disappointing. There are several reasons for this, first of all the process of getting a patent is very cumbersome. According to the testimony of those who have got a patent, it takes three years to do so in India. Good patent lawyers are rare in India and the authorities concerned work at a slow bureaucratic pace. Moreover, the reputation of scientists depends on their publications. Many of them feel that while applying for a patent, they must keep their findings secret and stop publishing. Actually these fears are unfounded. As soon as the patent is filed, the scientist may go ahead with publishing the results of his research. But there are also other reasons for the reluctance of scientists to participate in this game. I had a discussion with 17 professors of the IIT Chennai (Madras) in 1995 who had registered patents. Their experiences were frustrating. After all the hassle, they were disappointed by the lack of response of Indian industry. The habit of buying technology abroad works against Indian patents. Of course, there may be another hurdle, which is difficult to overcome. Inventors are usually not production engineers and the translation of know-why into know-how is not an easy task. However, the CSIR-institutes with their ample equipment should be able to bridge the gap between invention and production.

The air of optimism, which swept through the early 1990s, unfortunately lost some of its momentum even in the run-up to the 1996 elections. The fruits of economic liberalization had not yet reached the mass of the voters and therefore populist politics were adopted, which watered down the reforms. The Congress party lost the elections inspite of this, but it could not be replaced by a stable alternative. A host of regional parties
emerged, which then formed a United Front government, which depended on the "tolerance" of the Congress party. The instability, which had prevailed in the years from 1989 to 1991, returned with a vengeance. New elections were held in 1998, but the new government was brought down in 1999 and it was only with another new election in November 1999 that some semblance of stability was restored to Indian politics. Such years of turmoil are not conducive to the formulation of long-term economic and industrial policies.

The late 1990s were a period of reduced growth of industrial production. In 1995 industrial growth had peaked while in subsequent years it levelled off. The energy sector was affected by the sluggish development of coal production, stagnating at about 300 mill. t in the late 1990s. Coal washeries are essential for the treatment of Indian coal so as to reduce its high ash content. The transportation of unwashed coal unnecessarily burdens the railways and the burning of such coal in power stations leads to air pollution. The government wishes to encourage private sector investment in coal washeries, but nothing much has happened in this respect. In the meantime coastal power stations rather import coal from abroad. New technologies such as the gasification of coal would be very promising, but India has not yet made much progress in this field, although it has an abundance of coal reserves and could easily cover all its energy requirements from this cheap source. (Parikh 1999: 126-129)

Since coal could not meet the growing demand for energy, the consumption of petroleum products increased from 78 mill. t in 1995 to 100 mill. t in 1999, which strained India’s balance of payments. Natural gas, which is another important source of energy, has so far only contributed less than 10 per cent to India’s energy supply. Such gas often emerges at oil wells, but in the absence of adequate installations it was simply flared and thus literally went up in smoke instead of contributing to India’s energy supply. (Parikh 1999: 136)

Inspite of a general industrial recession in the late 1990s some branches of industry showed promising results. The production of automobiles reached 670,000 in 1999. About 2 mill. two-wheelers (motorcycles and scooters) and 12 mill. bicycles were produced in that year. This was a major advance when compared to earlier production figures. Cotton textiles totalled about 13 bill. sq.metres in 1999. The value of textile machinery produced in 1999 attained a level of about 12 bill. Rs indicating a growth of capacity in the textile industry. But whereas India showed no surprising advances in the fields of traditional industrial production, it emerged all of
a sudden as one of the leading nations in the field of information technology.
9. The new frontier of Information Technology

At present the world is in the midst of a new industrial revolution. While earlier revolutions of this kind were based on mechanical and then on chemical engineering, the present one is based on various aspects of communications engineering, which encompass computer hardware and software, satellites, the internet etc. In this field India is showing considerable technological capability. It has many assets, which help it to become a leader in this new industrial revolution. First of all, by inventing the zero Indians have shown an aptitude for abstract mathematical thought at an early stage. In recent times a network of research institutes and high class institutions of scientific and technical training have produced sufficient manpower, which can rise to challenges in this field.

The first serious attempt at launching a new approach to telecommunications in India was made with the establishment of the Centre for the Development of Telematics (C-DOT) in New Delhi in 1984. It was supposed to help in digitalising the Indian telephone system. It achieved its first breakthrough with the construction of a Rural Automatic Exchange System which served to link the Indian countryside with the urban centres. It was geared to the rugged conditions of rural operations and was subsequently exported to other developing countries. (zu Putlitz and Schmitt 1995: 382-383)

Supercomputers and rockets: Denial-driven innovation

This success of C-DOT was soon paralleled by an amazing advance in computer engineering. In this case one could speak of a "denial-driven innovation". (Mashelkar 1999b: 5) India had imported one Cray-XMP supercomputer in the 1980s, but when it placed an order for another one, the US-government insisted on conditionalities which Rajiv Gandhi found too restrictive. He therefore decided to go ahead with an Indian project in this field. In 1986 the CSIR National Aerospace Laboratory in Bengaluru developed a new device, which made Cray Research Inc. sit up and negotiate with India. In 1987 the Centre for Development of Advanced Computation (C-DAC) which was modelled on C-DOT was set up in Pune. It worked on a computer based on massive parallel processing which
promised to be faster and cheaper than Cray’s products. The U.S. government responded to this by permitting the export of Cray XMP 14 to India in 1988 and two years later the American authorities came to the conclusion that supercomputers are not required for the design of nuclear bombs – the main reason for withholding this export earlier.

India could have responded to this by shelving its own supercomputer programme, but by now this had progressed to such an extent that India was able to export its PARAM supercomputer to Canada, Germany and Russia in 1991. An upgraded model, PARAM 10,000, was launched by C-DAC in 1998, and according to the old saying "if you can’t lick them, join them", Cray decided to set up a subsidiary in India. But, of course, the Indian tests of nuclear bombs in May 1998 put a stop to this rapprochement. (Mashelkar 1999 b: 7) This would only be a temporary setback. At any rate, India’s technological capability in producing supercomputers will not be affected by "denial" any longer. In its initial stages, the American policy of denial was a challenge which prompted India to rise to the occasion. Another amazing Indian achievement was the supercomputer KABRU designed by Hari Dass, a mathematics professor in Chennai. Kabru is a mountain in the Himalayas never scaled by a mountaineer. Dass climbed his "mountain" by an unusual method: he combined a set of 144 ordinary computers with Intel Xenon chips and a Linux operating system and made it perform at a speed of 1.4 Teraflops in 2004.

A less conspicuous venture, which has only led to spectacular results in recent years, was the Indian conquest of outer space. The Indian Space Research Organization (ISRO) in Bengaluru did pioneering work in this field. At first the rockets and the satellites launched were of modest size. One of the earliest satellites, launched in 1975, was appropriately named "Aryabhatta", after the Indian mathematician who lived around 500 A.D. and introduced algebra. In subsequent years India upgraded both the dimensions of its satellites and the rockets used for putting them into orbit. Some of the heavier satellites depended on the European Ariane rockets for their journey into orbit. But in March 2000 India could celebrate a big success: A satellite weighing 2000 kg was launched by ISRO’s own rockets. It is to be hoped that this impressive technological capability will be reserved for peaceful purposes, because with such rockets one could also propel powerful intercontinental ballistic missiles. Of course, they would need redesigning as rocket launching satellites are technically different from ballistic missiles. In commercial terms these rockets are very profitable because they can transport several satellites at once, adding "piggyback" satellites to the basic load. India would now be in a position to export ad-
vanced products in the field of rocketry to Europe, but in this it faces ob-
stacles inherent in the structure of the European Space Agency (ESA). This 
agency is obliged to farm out its orders to the respective industries of its 
member states and cannot buy Indian products. Free trade, which is other-
wise recommended again and again to countries like India, is thus blocked 
when vested interests are involved.

Just as in the case of the supercomputer, ISRO’s spectacular success is 
also due to "denial-driven innovation". In 1991 India concluded a contract 
with the Soviet Union for the supply of cryogenic engines and the transfer 
of the respective technology. Subsequently the Russian President, Boris 
Yeltsin, had encountered American resistance to this deal. This was less 
due to military reasons as to commercial ones concerning the tough inter-
national competition in the field of launching satellites. Yeltsin had to give 
in to American pressure, the technology transfer was cancelled. (Thakur 
1994: 142) India was compensated for this by getting a few more cryogenic 
engines, but for further technological development it had to fend for itself. 
An Indo-German agreement for the supply of such engines was also con-
cluded in 1993. But there was no transfer of technology. India had to de-
velop this technology on its own. This was done with great success as the 
capacity of the rockets used for the subsequent launches have shown.

Communication satellites have served India well for various purposes 
such as telephone and television transmission. Even the printing of news-
paper editions at distant centres is done via satellite. In earlier years India’s 
national newspapers had to send planeloads of newspapers to such distant 
places. With the help of satellites these papers can be printed simultane-
ously in those places. TV-broadcasting is also facilitated in this way. Satel-
lites are also used for obtaining current information on landuse, forest cov-
er, floods etc. India has made progress in all these fields. The transponders, 
which are the main operative parts of the satellites, are very expensive de-
vices. The international rates for hiring a transponder are about 1 to 2 mill. 
$ per year. So India saves a large amount of foreign exchange by putting its 
INSAT (Indian National Satellite System) into orbit. At present about 90 
Indian transponders are in operation. The transponders work best with 
digitalized transmission. In this way information can be "packetized" and 
by means of split-second time intervals several messages can be sent sepa-
rately. This permits multiple access to the transponder. The mode of trans-
mision is called Time Division Multiple Access (TDMA). A state public 
sector firm, Gujarat Communications and Electronics, established in 1975, 
has been highly successful in designing the equipment for this kind of 
transmission. (Datta Chaudhuri 1995: M 13-M 18) This will also help to ex-
tend telecommunications to India’s 600,000 villages of which only about a quarter have so far access to the telephone network. The means of connecting rural phones to the satellite is via "wireless in local loop" (WILL) attached to a "very small aperture terminal" (VSAT). This is the route along which further progress in the implementation of information technology can be expected. (Chandrashekar 1998: M 2-M 9)

India’s spectacular achievements in the field of high-tech hardware from supercomputers to satellites is not paralleled by advances in the more mundane field of "commodified" computers, i.e. PCs, servers etc. This is due to the lack of R&D in India as well as to declining import duties and the consequent lack of protection of an "infant industry". Moreover, technology in this field is so complex that advances in supercomputers cannot be translated into similar achievements with regard to minicomputers. The government was caught on the horns of a dilemma in this respect. India needed a rapid expansion of minicomputer availability. The life cycles of hardware are becoming shorter and shorter. Under such circumstances protectionism would have meant that India would have to invest heavily in catching up with the leading producers of hardware abroad. This would have been like the proverbial race on a ladder. But in order to avoid such a race, India had to depend more and more on imports. The way in which declining duties influenced the transfer of computer technology to India is clearly shown by a case study of a company, which in the late 1990s controlled about one third of the Indian minicomputer market. (Mathur and Sinha 1997: M70-M76) The company concerned was established in 1976. It manufactured calculators and then contacted a foreign company in 1980 so as to obtain technology transfer for the making of computers. It managed to produce some computers in this way. In 1991 the foreign company entered into a joint venture with the Indian company of which it acquired 26 per cent equity. The Indian company dropped its earlier lines of production and concentrated on assembling the computers of the foreign company. Technology transfer was restricted to the making of boards and cards. The equipment installed for this purpose could also be used for making such items for other firms. To this extent the Indian company did benefit from this limited technology transfer. The foreign company benefited from the joint venture by getting access to the Indian market. The date of the beginning of the joint venture is significant, because in 1991 the Government of India had abandoned its policy of demanding the phased indigenization of products based on imported components. A decisive cut in duties for such imported parts in the budget of 1995/96 further encouraged import dependence. In fact, more and more computers
were imported readymade, even assembling them in India was given up. By 1996 only 40 per cent of the computers sold in India were produced in India as against 80 per cent in 1991. However, as stated above, increasing computer availability was the main aim of government policy, because India’s standing in the production of software could not be maintained without a rapid spread of suitable hardware in the country. PC availability is very low in India with a total of 2.5 mill. of which only about 1.4 mill. were connected with the Internet around 2000.

The success of customised computer software

The same dilemma, which the government had to face with regard to computers, initially also appeared in the field of software production. Should the government protect an infant software industry in India or encourage the import of state-of-the-art software? The software policy announced in 1986 adopted the latter course and annoyed the Indian software industry, which had started to produce indigenous software packages for office work, databases etc. (Kumar 1987: 290-294) When one discussed software at that time, one thought of this type only, customized software for individual clients was not yet thought of as the mainstay of the Indian software industry. In the light of subsequent developments this policy proved to be a wise one. India could never have hoped to rival Microsoft in the field of standard software packages. On the other hand India needed the exposure to such software in order to find its real strength in developing customized software. The business, in which Microsoft was a leader, depended on high investment in design, testing and marketing. It was a supply-side affair, whereas the production of customized software is demand-driven. The Indian software industry quickly adjusted to the new policy. The government tried its best to support software export. Technology parks were set up for this purpose in Bengaluru, Pune and Bhubaneswar. Foreign companies were encouraged to establish subsidiaries, which could be completely owned by them, if they aimed at 100 per cent export of their production. India did not have to start from scratch in this field as the use of computers had already spread in the 1970s and competent programmers and systems analysts had been trained. With the boost given to the right type of software production by the new policy, exports increased rapidly. While they only had a total value of 44 mill. Rs in 1981 they shot up to 580 mill. Rs in 1987 – and this was only the beginning of an amazing success story. (Lakha 1990: 49-56) In 1999 Indian electronics and computer software ex-
ports amounted to 193 bill. Rs (4.28 bill. $). If one compares the software export figures with those for gems and readymade garments mentioned earlier, one can see that software was now more or less in the same class as these other leading exports.

The progress of computerization in the Western industrialized countries had radically shifted the composition of investment in this field. Whereas earlier hardware had claimed the lion’s share of investment, by 1990 the proportion of hardware to software was 30: 70, and about 70 to 80 per cent of the cost of software consisted of the wages of the experts who designed it. Paradoxically enough, this highest form of capitalist technology had suddenly spawned a new demand for labour. Of course, this new type of highly skilled labour made skilled labour in the field of mechanical production redundant as software controlled machines could get along without continuous human intervention. India could enter this new type of labour market with its large reservoir of trained manpower.

India soon excelled in the customized production of CAD and CAM for special clients. By now Indian firms are not only good at routine jobs in this field, but can even claim world leadership. There is an international scale called the Computer Maturity Model for Software (CMM), which has five levels. Only nine firms worldwide have attained the highest level and five of them were based in India in 2000. (Bajpai and Radjou 2000: 452,465) But although there are such high levels of achievement, there are also lower levels in the category of "body-shopping". This means that Indian experts are sent abroad by their firms at home in order to do jobs on the spot for foreign clients at Indian wages, perhaps with some travel allowance but no salary upgrade putting them on par with foreign experts. Anybody dispatched abroad in this way would be tempted to look for a change, employers therefore imposed bonds, which would make job-hopping prohibitively expensive. (Lakha 1990: 54) This is why bright young graduates in this field would prefer to emigrate rightaway before getting into the clutches of people who operate "body-shops". This is the seamy side of an otherwise glamorous industry.

The rapid development of information technology has completely upset the old corporate hierarchy of India. The four richest men of India were in 2000 all in this field and hardly anybody had heard of them a few years ago. Most of the old companies have missed the bus, except for the Tatas who once more showed their acumen in judging the directions of technological progress. Tata Consultancy Services is the leading firm in the software business. In the 1980s this firm employed a mere 300 people engaged in conventional consultancy work, by 2000 it had a staff of 15,000 and sev
eral offices abroad. The public sector has very little to show in this field. Nevertheless, there was one competent public sector firm in this business: Computer Maintenance Company (CMC). The Government of India established this firm in the 1970s in order to take over the installations of IBM after the American company was thrown out of India. CMC accomplished this and then did very well in the Indian software boom. It worked on computerizing Indian railway ticket reservations. Subsequently it won a large contract of London Underground for computerizing the time-tables and train scheduling in what is supposed to be one of the world’s most complex rail networks. (Lakha 1990: 54) After the government decided to privatize public sector enterprises, CMC was transferred in several steps to the Tatas and in 2015 in was totally merged with TCS. It had 12600 employees at that time-

The fact that Indian software producers have done well in the export market is very encouraging, but what is even more encouraging is that the Indian home market has increased its demand for software from 21 to 74 bill. Rs in the few years from 1995 to 1999. This is an important development, because an industrial production which depends too much on exports is highly vulnerable.

The software boom in India has actually attracted some Indian emigrants who have done well in Silicon Valley and are returning to India to start up their own companies. In a knowledge-based industry like this, the old concept of brain-drain is no longer appropriate, because mobile brains will float back and forth in pursuit of further challenges. There is a very different kind of danger for which a leading Indian scientist has recently coined the term "brain sink". (Kochhar 1999: 1531-1533) He means by this that too many bright people perceive the frontiers of knowledge only in this field. Other fields, which deserve as much attention, are thus deprived of scientific manpower. This warning is quite appropriate, because such manpower needs years of training and specialists cannot suddenly shift their attention from one field to another.

The new age of information technology and India’s software boom have swept away the earlier spirit of "export pessimism", which had prevailed for such a long time. The reasons are simple, you may, for instance, manufacture a cheap typewriter which you can only sell in the home market, because its performance is not up to international standards, but computer software must conform to international standards from the very beginning. There is no distinction between the home market and the world market in this respect. Moreover, service is an integral part of this industry. Performance and credibility are directly linked here, but thoroughness also
has to be matched with flexibility and speed. Indian firms have obviously been very good at this. About 60 per cent of Indian software exports go to North America. The intervening time zones give India a special advantage in this respect. American clients who place their orders in India may get their software solutions via satellite when they step into their office next morning. As of now, India is in a unique position of advantage in this area. There are, however, built-in limits to continued progress along these lines. First of all even in India there is no unlimited supply of the highly skilled manpower required for this kind of work. About 70,000 young graduates finish their studies in computer science in India every year. Many of them "graduate" from India to places elsewhere. Other Asian nations may also compete with India. Therefore India has to "move upmarket", i.e. develop new ventures in the rapidly expanding global communications industry. Private enterprise is best suited for expansion in this field, but governments can also play a supportive role. They should not try to direct innovation but rather facilitate it by creating new institutions. The Tamil Nadu Institute of Information Technology (TANITEC) is a case in point. It is jointly funded by the state government and industrial firms. It wishes to emulate Stanford University, which was the seedbed of Silicon Valley firms. (Bajpai and Radjou 2000: 455, 463-465) Small nations like Israel and Ireland, which have only recently emerged as leading software producers, have set a good example for Indian states like Tamil Nadu. Bengaluru and Hyderabad may face a powerful challenger when Chennai (Madras) forges ahead in this field.

Developments in information technology are incredibly fast. The present industrial revolution moves at a much higher speed than the first one and progresses along numerous lines. The mechanical loom, the steam engine, the railway dominated the industrial scene for more than a century. The life cycles of computers and other electronic equipment are much shorter. Fortunately this field is also so difficult to control that antediluvian industrial policies cannot cope with it. It is to be hoped that India’s progress in this new line will enable it to throw off the shackles of such old policies. The policies adopted by the Government of India since 1986 in this particular field augur well for the future. Rajiv Gandhi deserves some credit for this. The setting up of a National IT Task Force in 1998 is another encouraging sign. For once, government policy has succeeded in setting an industry on the right track of progressive expansion instead of hampering it with misguided controls. However, as far as the recent Indian advances in the field of computer software are concerned, it may be wrong to credit the government with too much wisdom. The free development of
this line of business owed much to the fact that government could not catch up with it. This is even demonstrated by conventional export statistics which rarely reflect accurate data for the export of computer software as it does not follow the usual trade routes but is delivered via satellite.
10. Indian industry in the 21st century

The change in outlook among entrepreneurs

Nowadays many Indian entrepreneurs are aiming at being internationally competitive. This is a far cry from the attitudes of an older generation growing up in the age of protectionism and government control. In those days I had a conversation with a young Indian industrialist. He told me that his family had invested in sugar mills in the past. They now wished to invest in modern industry. I told him that he should take care of quality management in this case. He replied confidently that this is not necessary, as they could sell any dirt, which they produce. I was flabbergasted, but I kept quiet. In 2007 I told this story to Mukesh Ambani. He said that this man would get nowhere with this attitude under present conditions. I could see that Indian industry had changed under new management. Ambani himself operates internationally with great skill. In 2007 he completed a pipeline across India from oil- and gas sources, which he had opened in the Bay of Bengal to his factories in Gujarat. He had heard that such a pipeline had just been completed in China. The Chinese equipment was lying idle, so he hired the Chinese and they built the pipeline for him very fast. Recently he has entered a partnership with the Arab oil company ARAMCO. They have taken one-fifth share in his petrochemical company. Such deals were unheard of only thirty years ago.

The fact that India still has to make up a great deal for retarded industrialization in the past means that it is less encumbered with "ripe" industries and with a workforce, which is highly skilled and highly paid but lacks flexibility in the adjustment to new tasks. One of these new tasks is due to the shifting border between industry and service. Earlier there used to be hard and fast borders between industrial production, trade, provision of commercial intelligence etc. There are many changes here, which can been seen today. Take the book business: Publishers produce a book, they need a considerable print-run to be able to fix a reasonable price, they also have to maintain big inventories. Today you may locate a title by online-research, place an order via "e-commerce" and the book will be produced for you by new methods of scanning etc. Internet publishing is a further step in this line. Anybody in the world can cut in on this business. There is no reason why Indian entrepreneurs could not also participate in it. Similar
combinations of service and production could be imagined in other fields, too. Many office operations which were earlier done by armies of clerks sitting at desks in counting houses are farmed out today to individual people sitting at home at their computer. Communication technology makes it irrelevant whether the person concerned sits at a computer next door or in India. Outsourcing of operations like payroll accounting, flight reservations etc. is already standard practice. The next step is hiring an "applied service provider" (ASP) who takes care of all IT-work of a firm. Since it is expensive to have IT-experts as permanent employees and the investment in hardware and software which becomes soon obsolete is also a risky business, many firms will rather turn to ASP, the more so as new methods of encryption ensure that the data concerned will not be treated as "public domain". ASP-work will probably emerge as another Indian export industry. All such activities are termed IT-Enabled Services. It is in this field where India faces the challenges of the future and it is to be hoped that it will rise to the occasion.

But information technology does not only revolutionize all kinds of commercial transactions, it also opens up new avenues of scientific research which in turn will lead to new industrial applications. The recent successes in the mapping of the human genome herald the beginning of new ways of medical research. This mapping does not yet tell us anything about the complex interaction among the genes. But the genetic code is like a supersoftware. In future "geneware" may be designed like software. It could be useful for the "debugging" of genetic faults. India's great achievements in software design may be paralleled in this new field. On the other hand, DNA as a medium of information storage could also provide lessons to the IT-expert.

At present the development of traditional industries and the improvement of infrastructure may be more relevant than the future perspectives, which have been mentioned here. The subsequent text will concentrate on subjects such as the production of steel, cars and cycles, the improvement of roads and railways, the management of ports and airports, the performance of the textile industry etc.

**Steel, cars and cycles**

In steel production, India attained second position after China, replacing Japan with 106 mill. t. In 2003 it stood at 39 mill. t. in 2012 at 72 mill. t. with another great leap forward in the years after 2013 it reached the
present position. Before the reform of 1991, SAIL (Steel Authority of India Ltd.) had been by far the largest steel producer in India. Now it contributed only about 5 mill t. and had a revenue of 7,5 billion $ annually, whereas Tata Steel was way ahead with 30 mill. t. and a revenue of 20 billion $. The third largest steel producer was another firm in the private sector: Jindal Steel with a revenue of 3 billion $. It was founded in 1959 by O.P. Jindal who died in 2005, leaving his sprawling industrial empire to his wife and four sons. He also held coal and ore mines. Of about equal size is VISA Steel with headquarters in Kolkata. Another major company in the private sector is Essar Steel of Mumbai. Compared with the combined production of the private sector, which amounts to more than 100 mill. t., the share of SAIL is diminutive. This is a far cry from the earlier reservation of "the commanding heights of the economy" from which the private sector was to be excluded.

The Indian automobile industry had a similar success story. It became the fourth largest producer of automobiles in the world in 2018 (5, 17 mill.), surpassing Germany (5,12 mill.). The lion’s share in this growth belongs to Maruti Suzuki, which accounted for about half of India's passenger car production. This company had a strange history. Sanjay Gandhi, Indira Gandhi's son, had returned from an apprenticeship in Great Britain with the dream of setting up a car factory. Due to his prompting the Government of India established the company called Maruti (Maruti=Hanuman, the monkey, valiant companion of God Rama). Sanjay was unable to produce cars, so the government looked for a private partnership with a foreign firm in 1982. Volkswagen was initially asked, but was put off by the demand for rapid indigenization inserted into the contract by the government. The Japanese company Suzuki then signed the contract, trusting that the government would not throw them out once the joint venture had progressed. They were right, the goal of indigenization was reached much later. By 1991 65% had been indigenized. In the meantime Suzuki had introduced new models and had become irreplaceable. Suzuki had started as a minority shareholder, in 1992 it then held 50 per cent and by 2013 56 %. In 2015 it could celebrate the production of a total of 15 mill. vehicles in India. It had three factories in India with a total output of 1,7 mill. units per year. As there were plenty of used Marutis in the market, the company established its own market platforms for them called Maruti True Value. It has many centres throughout India, they also contribute to new sales as 30 % of customers who turn in their old car buy a new car at the same time. The company refurbishes used cars and resells them with a guarantee. As resale value is an important item in the decision of buying a car,
Suzuki has been very successful in holding a market share of 53% in India in 2018. Its most recent hit is the S-PRESSO priced at Rs.369000 (5200 $). The second position is held by Hyundai of South Korea (16%). Hyundai arrived in India only in 1996 and opted for Chennai as its Indian headquarters. It has two factories in Tamil Nadu with a total capacity of 600,000 units annually. It is also India’s second largest exporter of cars. (250,000 per year).

Chennai (Madras) is by now the star of Indian automotive production with 40% of vehicles produced. It is also the home of the huge TVS Group, which is engaged in many industrial activities. It produces two-wheelers and three-wheelers. Its most spectacular company is Sundram Fasteners headed by Suresh Krishna, a grandson of the legendary T.V. Sundaram Iyengar, who had founded the parent company in 1911. Suresh Krishna is an unusual industrialist. He is neither an engineer nor a business graduate. He studied literature in the USA and at the University of Munich, Germany. His fluency in German has later on helped him in establishing good relations with German companies. When he returned to India, his family asked him to start a firm of his own and he opted for "Nuts and Bolts" (Sundram Fasteners) becoming soon a premier automobile supplier. Most German Mercedes cars are held together by his fasteners. He is proud of the reputation of his company. Once a German firm in the same business offered him a big deal making fasteners for them as wages were lower in India. They would sell them under their trademark. Suresh Krishna initially rejected their profitable offer. Finally the German company agreed that the names of both companies would be on the head of the screws. As a daring entrepreneur, he was the first Indian industrialist who also opened a factory in China in 2005. He embodies the best qualities of the new Indian industrialist. His company is now considered to be the flagship of the sprawling TVS Group.

Chennai is also the home of Ashok Leyland, producing commercial vehicles (trucks and buses). The original company was founded in 1948 by Raghunandan Saran, an Oxford graduate, freedom fighter and friend of Nehru. We have already come to know him when discussing the rise of MICO-Bosch. Saran’s father was a car dealer in Delhi. He knew something about this field and, therefore, Nehru sent him to Chennai to start an automobile factory there to help industrializing the South. Saran called his company Ashok Motors after his son. He started his business with assembling Austin cars, but then he felt that public transport was more important than passenger cars. The British firm Leyland invested in his company, which was then called Ashok Leyland. Later on the company was ac-
quired by the Hinduja Group, an Indian international enterprise with headquarters in London. It produced many excellent trucks and buses, but was always second to its more aggressive competitor Tata Motors.

In Western India, Mumbai and Pune are the centres of automotive manufacturing. Tata Motors (earlier TELCO) and Mahindra & Mahindra are the leaders here. TELCO was earlier known for its trucks manufactured in cooperation with Mercedes. It then continued its own line of trucks and also launched its own line of passenger cars. In addition, Tata acquired the Korean firm Daewoo in 2004, introducing a new line of trucks with them. The most successful passenger car was Tata Indica with a 1.4 l motor, launched in 1998, upgraded in 2008 and called Indica Vistara. It cost Rs. 600000 and sold very well. By contrast Ratan Tata’s NANO (Dwarf), which was very well designed and very cheap became a terrible flop. MICO-Bosch had designed a new motor for it, around 600 cc later upgraded to 800 cc. Nano was initially supposed to cost Rs. 100000, but the upgraded versions cost about Rupees 300000, still cheap if compared to the Indica at 600000. The great mistake was marketing it as the cheapest car. Indian car owners buy their car because it gives them prestige. Nobody wants to be seen in a cheap car. Accordingly the sales of the Nano remained very limited and the company had to kill it to the great regret of Ratan Tata. The company was much more successful at the other end of the spectrum. It bought the British firms Jaguar and Land Rover in 2008 for GBP 1.7 billion from the Ford company, which had held the two companies since 1990. The two companies were amalgamated in 2012. Mahindra & Mahindra had also shown an interest in this deal, but then withdrew. Tata left these prestigious cars to the care of its own management in England, but contributed to its R&D. Tata benefitted very much from this deal. Within a few years the company showed an annual profit of GBP 1 billion. The "dream factory" of the Jaguar LandRover Co, was at the Coventry Campus of the University of Warwick, where the Tatas jointly with British partners set up the National Automotive Innovation Centre (NAIC) in 2016. (The Telegraph, 24 Sept. 2019). The inspiring genius behind all this was Prof. Lord Kumar Battacharyya (1940-2019). After his studies in India he had come to Great Britain in 1961 He became a professor of manufacturing systems at Warwick University in 1980 and founded the Warwick Manufacturing Group (WMG), creating a link between the university and British industry. NAIC fitted into this scheme very well. Bhattacharyya had been made a life peer in 2003, in the House of Lords he represented the Labour Party. He headed WMG until his death. It is said he helped the
Tatas to clinch the deal of 2008. They obviously benefited from their contact with this great man.

Mahindra & Mahindra are outstanding manufacturers of automobiles, but their major focus is different from that of the other companies in this field. They are the largest producers of tractors in the world, producing about 200,000 annually. They are also known for having brought the Jeep to India, initially as importers and then as manufacturers under licence from the American producers. In recent years the sturdy SCORPIO, an affordable SUV at RS. 100,000, has attracted much attention. Mahindra & Mahindra was founded in 1945 as a steel trader. Keshub Mahindra, the son of one of the founders, studied at the Wharton School, the University of Pennsylvania’s prestigious business school. He then joined the company and in due course became its chairman in 1963, handing over this job to his nephew, Anand Mahindra, in 2012. He could fully develop his capacity as a creative entrepreneur only after the Indian reform of 1991. He completely restructured Mahindra & Mahindra, establishing six divisions, each under its own president (automobiles, tractors, infrastructure, financial services, telecommunication, automobile parts). This made the company much more agile. Keshub Mahindra's reputation as a great industrialist prompted the American company Union Carbide to appoint him as non-executive chairman of Union Carbide India Ltd. Unfortunately this company caused a gigantic industrial accident. In 1984 there was a gas leak in its Bhopal plant, killing about 15,000 people. Keshub Mahindra was deeply affected by this tragedy. I could feel this when I interviewed him in 1985. In 2010 the court finally arrived at a verdict, sentencing him to two years in jail for homicide by negligence. He was immediately granted bail, but the verdict was a heavy burden for him. His career had otherwise been a shining success. He had led Mahindra & Mahindra to a great height in Indian industry. Under Anand Mahindra the company progressed further. He even opened a new factory in Detroit, where no new plant had been started in the last 25 years. In order to assure the good quality of its design, the company acquired the Italian firm Pininfarina in 2015.

Foreign companies have also entered the Indian automobile market, manufacturing their cars in India. Hyundai has already been mentioned as it is a major producer in India and also an exporter from India. Most of the others are less conspicuous as far as their sales are concerned. Mercedes, for instance, sells about 15,000 passenger cars annually, Volkswagen about 36,000. Both of them are equipped to produce many more cars in their factories in Pune. General Motors, which sold Chevrolet cars in India, has totally withdrawn, Ford has a joint venture with Mahindra &
Mahindra. The French companies Renault and PSA (Peugeot, Citroen) are trying to get ahead in the Indian market. Renault entered India in 2005 and sold in recent years about 50,000 cars annually of its popular model KWID, PSA has teamed up with the Birla Group and has chosen a Citroen for entering the Indian market. The Japanese have followed Suzuki in entering India. The famous company Honda entered India in 1995 and began manufacturing cars in 1997 at Greater Noida (Delhi). It did not do too well for some time and suffered losses from 1998 to 2004. In 2015 it started making a profit and sold about 20,000 cars annually. More successful was Toyota, which established a joint venture with Kirloskar, India’s great maker of pumps and machine tools: Toyota Kirloskar Motor, in which Kirloskar has a share of 11%. Toyota’s sales have been very good, about 120,000 annually in recent years, with a production capacity of 300,000 per year. The Indian market for cars will expand steadily as many more people can afford cars, which are more expensive than the unfortunate Nano, that died in its childhood, survived by its mourning father, Ratan Tata.

Next to cars, the ubiquitous three-wheelers (autorikshaws) are the hallmark of Indian traffic. Bajaj Auto Ltd. is the world’s largest manufacturer of three-wheelers. In some countries the name Bajaj refers to these vehicles. Pronounced as "bajai" it has entered the Indonesian language. Production and sales are very efficiently organized by the Bajajs. I got to know Rahul Bajaj at the meetings of the Indo-German Consultative Group and he invited me to visit him in his plant in Pune. I was impressed with the orderly procedure of manufacturing and the central supervision of sales. A computer centre immediately records every sale in India and there is just-in-time supply of new vehicles. I asked Rahul Bajaj about his investment in R&D and he replied that he has a department of R&D with 500 staff members. They developed the new four-stroke engine of the autorikshaws, which were earlier driven by scooter engines adopted from the Vespa. In recent years this department must have grown. It surprised everybody concerned with the first "quadricycle" ever produced, the Bajaj Qute. It is a very cute car, but because of its technical specifications it cannot be called a car, therefore the new term "quadricycle" had to be adopted by the Indian authorities concerned. The new vehicle was first introduced in 2012, but because the Indian authorities refused to permit its sale, Bajaj had to export it. After adopting the new definition of "quadricyle", the authorities finally gave the green light in 2018. The Nano expired at about the same time and the Qute could take its place. But its technical specifications are quite different. It has an engine like a motorcycle: 200 ccm, one piston only, its top speed is 70 km/h. It weighs less than 450 kg and has a small turn-
ing radius of 3.5 m. It is ideally suited for coping with the traffic in India's crowded cities. The Bajajs had initially conceived of it as an upgraded autorikshaw. However, it has almost twice the price of a three-wheeler and it remains to be seen how it performs in the competitive market. At any rate, it is a testimony to the spirit of innovation of Indian industrialists.

Just like in the car market, foreign companies have also staked a claim in the market for three wheelers. The Italian firm Piaggio by now relies for a quarter of its earnings on its business in India. Its autorikshaw "Ape" manufactured in Baramati near Pune is selling well. Piaggio produced the Vespa, which was then introduced into India by Bajaj, licensed by Piaggio. As Rahul Bajaj told me, he had good relations with Piaggio, even making vintage Vespas for them, which they would no longer produce. He may not be afraid of Piaggio as a competitor. At the meeting of the Indo-German Consultative Group, he once proclaimed: "I am not afraid of anybody – except perhaps of you" pointing to the representative of Mercedes.

The market for motorcycles is another very competitive one in India. Royal Enfield, founded in 1905, is the oldest company manufacturing motorcycles, which is still in operation. It has surpassed Harley-Davidson in global sales in 2015. In India it belongs to the Eicher Group, a maker of trucks. The Bullet is its most popular cycle. The company's headquarters is Chennai. This city is also the home of the TVS company, which has been mentioned earlier. It produces motorcycles, scooters and three-wheelers in technological cooperation with the German firm BMW. Its most recent hit is called Apache. Bajaj Auto Co. is also in this market with a cycle called Pulsar, which has led the trend towards more powerful engines speeding up the vehicle. Another famous motorcycle is the BSA one. BSA means Birmingham Small Arms, which was the name of the parent company founded in 1861, which later on started manufacturing first-class motorcycles. BSA had a chequered career, partly due to mismanagement. In 2016 the company was bought by Mahindra&Mahindra at a price of GBP 3.4 mill. Mahindra has also a new subsidiary called Classic Legends, which manufactures the Jawa and Yezdi motorcycles, which used to be popular in India about 50 years ago. Their production was then discontinued. They are now powered by Mahindra Mojo motors (about 300 cc).

The market leader is the Hero MotoCorp, earlier called Hero Honda. The joint venture with Honda (1984-2010) had provided the company with advanced technology, but had also implied restrictions as far as the export of its vehicles was concerned. This and other disputes led to a break of the joint venture, when the company emerged with its new name from which Honda was omitted. Honda then became an aggressive competitor.
aiming at replacing the erstwhile partner as market leader by selling 6 mill. vehicles annually. So far it has not reached that goal, but it is close to it.

Hero is also the greatest producer of bicycles in India. Pankaj Munjal, chairman of the company, is an ardent campaigner for the Indian cycle industry. In a newspaper article he admonished the Indian government to give a "policy push" to his industry, arguing that India with 93 cycles per 1000 people is far behind China with 149. (Business Line, Feb. 6, 2013). Munjal further points out that while India produces annually 15 mill. cycles and exports 2 mill. China produces 84 mill. and exports 50 mill. He feels that the Indian cycle industry is overtaxed, moreover, in competition with China India is handicapped by the higher cost of capital and power. Pankaj Munjal was twice president of the All-Indian Cycle Manufactures Association. He recently shocked his colleagues by announcing his aim to manufacture a cycle at a price of Rs. 1999 (about 28 $). Atlas Cycles, Hero’s most important competitor, which used to be India’s largest cycle manufacturer in 1965 and produces 4 mill. cycles annually nowadays, whereas Hero produces 5 mill. Atlas would find it difficult to meet Munjal’s challenge. Its cheapest cycle cost about Rs. 8000, whereas Hero’s cheapest models are even now available at Rs. 3500. The Murugappa Group, Chennai owns several cycle manufacturers (Hercules, BSA, Montra), which aim at the high-end market of premium cycles. They would not be interested in taking up Munjal’s challenge.

*Machine tools: The case of Ace Micromatic Group*

Machines that make machines are the backbone of industrialization. For manufacturers they are crucial investment goods, which they often have to import at great cost. At present there is one company in India, which has successfully taken the lead in the production of highly sophisticated machine-tools at a reasonable cost: Ace Micromatic Group. The group consists of 11 companies to which recently a 12th has been added: Taurus Ltd. Manufacturing customized special purpose machinery, Taurus fits well into the group. The flagship of the group is Ace Designers Ltd., which was founded by three young engineers, A.V. Sathe, S. Shirgurkar and B. Machado in 1979. The three founders are still with Ace Designers, Sathe as non-executive chairman, Shirgurkar and Machado as managing directors. Ace Designers first provided only CAD-designs to others, in 1982 they ventured into producing computer numerical controlled (cnc) lathes. Their products were soon in great demand and the firm prospered but it was still
small, having 300 engineers and 300 skilled workers on their staff by 1995. I was fortunate to meet a group of their young engineers in that year when I was on a tour visiting Indian industrial centres. My meeting with the Ace Designers was due to an invitation by Professor Akilesh, Head of the Department of Management at the Indian Institute of Science in Bengaluru. He had regular meetings with those engineers every fortnight. As I was around at that time, I was asked to talk to the engineers and it was a memorable encounter for me. I could see that these competent and highly motivated young men would make their company a leader in their field. So it happened: S. Shirgurkar could proudly report 25 years later, that 70% of all automobiles made in India contained parts produced by machine-tools made by their firm. Ace Micromatic also supplied the breakpads for China's high-speed trains. This was only one part of their output. Altogether the Group produced a whole panoply of cnc-machine-tools. The "hand-holding" of their customers was a specialty of the group, i.e. they did not just sell their machines, but provided full service in instructing their customers in the use of their machines and being on the spot as troubleshooters whenever needed. Many of their customers are small workshops whose activities depend on a small set of machine-tools, I have visited such workshops, which often owned only one machine-tool and took the pieces they worked on to neighbours, who had another essential machine-tool.

Ace Micromatic is an important member of the Indian Machine-tool Manufacturers Association. It is also based in Bengaluru and was founded in 1946 by only 20 firms. In 1969 it sponsored the first Indian exhibition of machine-tools (IMEX), which held its 50th impressive show in Bengaluru in 2019. The Ace Micromatic Group has the lion’s share of this business, but there are others doing good work, too. One famous company, however, has not lived up to the high hopes expressed at its birth: HMT (Hindustan Machine Tools), founded in Bengaluru in 1953. Its beginnings have been referred to above. The lathes made by HMT were of good quality, but much too expensive. Kirloskar produced them at half the price. "Physical targets", set by the Government of India, spoiled HMT's chances. But even in new ventures, in which it succeeded initially, HMT finally suffered losses. In 1961 HMT had set up a subsidiary making watches. They sold very well at first, but then the Tatas established Titan Watches Ltd. in 1983. The market for HMT watches declined and by 2016, after making losses for a decade, HMT closed down this line of production. The remaining HMT has only 2500 employees and concentrates on machine-tools, but in this industry it is a small player compared to the Ace Micromatic Group.
Another leading firm making machine-tools is Bharat Fritz Werner founded in 1961. It was started as a joint venture of the Kothari Group with the German firm Fritz Werner. It became a purely Indian company in 1970, but retained its name – now abbreviated to BFW. The Kothari Group manufactures agricultural machines, including implements for drip irrigation, it is also engaged in the sugar industry and in petrochemicals. Its head Shyam Kothari, who died in 2015, was a brother-in-law of Mukesh Ambani. BFW grew rapidly within the Kothari-empire producing a great variety of machine-tools, In 2015 it launched the Dr. Kalam Centre of Innovation. BFW has an international reputation in its field second only to Ace Micromatics.

The Indian machine-tool industry in general is doing very well in recent years. It held rank 12 in global production in its field in 2017. The new policy of "Make in India" of the Government of India has helped this industry very much. It had a growth rate of 23% in 2016/17 and exported machines worth 55 mill.$$. In the subsequent year the growth was even faster and the future seems to look bright.

The quest for energy

Industry consumes energy. As has been pointed out earlier, the cost of energy is one of the major burdens of industrial progress in India. As far as exports are concerned, the cost of power cancels much of the advantage derived from low wages. The frequent occurrence of power failures plagues Indian industry. Industrialists have tried to cope with this by installing their own generators and thus relying on captive energy. It is estimated that about 10 per cent of energy consumed in India is generated in this way. The oil for these diesel engines is expensive and its use by many individual generators is rather wasteful. This reliance on captive energy is in many ways characteristic for the situation of Indian industry. It often exists in islands surrounded by a sea of backwardness. Future development consists of reclaiming more and more land from this sea.

In order to cope with the energy bottleneck, India has stepped up its coal-mining while Western countries have pledged to give up the reliance on coal. India has enormous coal reserves and the government has stressed the production of coal. In the fiscal year 2018/19 Indian coal production has attained 607 mill.t., but nevertheless 125 mill. t. had to be imported, which cost 8 billion $. The government has decided to attract foreign direct investment in mining, permitting 100 percent ownership (The Hindu,
Petroleum also plays a key role in the supply of energy to Indian industry. In recent years India has produced 35 mill. t petroleum annually, but imported 170 mill. t., for which it had to pay 93000 billion $. These data concerning fossil fuels seem to indicate that India has neglected renewable energy. But this is not so. In electricity generation India relies to about 33% on renewable energies. Hydroelectric power contributed about one third to this amount. Wind- and solar energy were also used to an increasing extent. In 2010 the Jawaharlal Nehru National Solar Mission was launched with a target of 20 Giga Watt by 2022. In 2015 this goal was augmented to 100 Giga Watt, by 2019 about 30 Giga Watt had been attained. Wind energy contributed 36 Giga Watt by that time. Massive investments in renewable energies were announced. Even the Indian Oil Corporation announced that it would invest Rs. 250 billion in renewable energies.

The further progress of the IT-industry

Earlier in this text the rise of the Indian IT-industry has been described. In the new century it startled everybody by its vigorous growth. It had benefited from solving the "Century 2 K" problem, as many companies worldwide were afraid of the computers swiching back to the 19th century instead of making the transition to the 21st. The Indian programmers fixed this problem and profited from it. But this was only the start of a fantastic rally. Foreign observers reported enthusiastically about "India's Booming Digital Industry" (swissnex, Bengaluru 2017). They also noted measures of the Indian government such as the introduction of a 12 digit personal identification number called "Aadhar" and of a personalized "DigiLocker" which could be used for downloading and storing documents in a "cloud". Aadhar, meaning "base", "foundation" or "support" encompasses biometric identification such as fingerprints and a reproduction of the iris. Industrial countries usually have compulsory registration at birth, all their citizens have birth certificates. India has none of this and Aadhar will serve this purpose. It is voluntary, but it is practically mandatory, because it is required for receiving payments such as pensions or wages under the rural works programmes etc. Registration was started in 2007, by 2014 603 mill. people had been registered and by 2019 nearly all Indians had joined it.

The digital boom has benefited the three leading Indian IT-companies: Tata Consultancy Services (TCS), Infosys and WIPRO. TCS has been mentioned earlier. By 2019 it had 436000 employees and had passed the threshold of a market capitalization above 100 billion $. Infosys came next to it
with 228000 employees. Its creative founder-chairman Narayana Murthy had invented the Global Delivery Model. He divided jobs into several moduls, which could be distributed among several partners. The customer got a seamless product and was not told who had contributed what to it. The third company, WIPRO had only 174000 employees. Its founder and owner, Azim Premji, had an unusual background. He had inherited WIPRO from his father who had started it in 1948 as a firm producing and marketing vegetable oil. Azim Premji was studying at Stanford University when his father suddenly died in 1966. As a young man of 21 he faced the challenge of heading the company and changing its purpose. He started manufacturing computers but then quickly shifted to software production and located his firm in Bengaluru. There he met the legendary Jack Welch of General Electric who was on a sales trip for his company. In India he noticed that he could get software for General Electric and found in Premji a good partner. WIPRO profited very much from this connection. All three IT-companies build magnificent campuses, Infosys even a university of its own in Mysuru and another one in the USA. Murthy cared much for his employees and was proud of the fact that he created many dollar millionaires on his staff. The export of customized software was the mainstay of India’s IT-industry. Domestic sales also increased. Recently India has earned export revenues of 135 billion $, but also revenue from domestic sales of 41 billion $.

**Overcoming the bottlenecks of infrastructure: Railways and Roads**

While Indian industrialists are certainly capable of meeting the challenge of international competition, they are handicapped by the bottlenecks of Indian infrastructure, which must be overcome. For computer software quite literally the sky is the limit, transmitted via satellite it can escape the down-to-earth problems of terrestrial transport. But industrialists who must ship their products by rail, road or sea are often in trouble. India’s railway network of about 67000 km is one of the largest of the world, and with its staff of about 1.7 mill. it is perhaps the biggest employer worldwide. The network was designed by the British to connect the interior of the country to the big ports, so as to facilitate export and import. In addition some lines were built for strategic reasons in Northern India. After independence, India has hardly added any miles to its existing network. The only exception is the Konkan Railway, connecting Mumbai with Mangalore via Goa, a distance of 737 km. Much of the track is single-line, The
The process of deciding on the construction of this rail connection was long and complicated and so was the construction itself, because of the difficult terrain. The Konkan coast is lashed by the Monsoon. This often causes landslides. Moreover, some of the tunnels had to be dug out by hand, because the soil is soft. Larsen & Toubro played a major role in mastering these problems. The new railway is characterized by innovations, such as anti-collision devices and the Ro Ro scheme, i.e. the swift rolling on and off of trucks on freight trains. But as far as its huge network is concerned, Indian Railways (IR) does not perform so well. It is unable to meet the demands of industrialists who depend on the timely delivery of their products. This is why the railway’s share of goods traffic has dwindled and more and more goods are transported by road. The income from freight transport has always been used to subsidize passenger trains. Fares of passenger are among the lowest in the world. But in view of the poverty of the people, this policy is understandable. However, this curtails investment in the improvement of the railways. By 2018 only about half of the track is electrified, the rest depends on Diesel-locomotives. All trains are rather slow, only a few express lines have high speed trains. But even that speed is hardly more than 150 kmh. IR manufactures all its locomotives and rolling stock in its own workshops and factories. It is one of the biggest industrial enterprises in India. But it is run like a government department rather than as an innovative firm.

Since the railways cannot cope with the traffic, the roads get more and more of it, but the Indian roads are in a bad shape. The rains of the monsoon and heavy traffic damage them and repairs are often delayed. Probably the construction of tollroads by private entrepreneurs would be the only solution of this problem. Actually the few Indian expressways are already tollroads. India has altogether 5 mill. km of roads, but half of this are local roads maintained by village authorities. Most of those roads are not metalled, they are "dirt roads" – almost a third of the produce harvested in India gets spoiled, because it cannot be transported to the market on time. Industrialists do not depend on village roads, but on the metalled network connecting the economic hubs of the country. The Indian government has stressed the improvement of "national highways". For this a National Highway Authority has been established in 1988. Under its jurisdiction there are about 100000 km of roads, the most conspicuous among them belong to the Golden Quadrilateral connecting Delhi, Kolkata, Chennai and Mumbai, which was completed in 2012. It consists of altogether 5800 km of four-lane highways. Expressways, which are defined as highways with limited access, cover only about 1500 km. They have been
built in the 21st century, the first of them was the Mumbai-Pune six-lane expressway completed in 2002.

In 2015 a new ambitious scheme was launched called "Bharatmala" (Garland of India). It encompasses two phases of road construction: Phase I 2017-2022, Phase II 2022-2024. In the first phase ca. 35000 km of highways would be built and in the second 49000 km. The total cost is estimated at 100 billion $. The project will also include the construction of 24 logistic parks serving as hubs. Transport between hubs would be done by 35t trucks, whereas other traffic would be done as usual by 10t trucks. This project should help to solve India's pressing logistic problems. It is connected with the Sagarmala Project launched also in 2015, which is aimed at the improvement of Indian ports. This will be discussed below.

Ports and shipbuilding

Indian ports are in a bad shape and recent endeavours of getting foreign entrepreneurs involved in constructing new ports may help to overcome this bottleneck. Unfortunately the Indian port authorities have often followed a disastrous policy of profiting from the delay, which they themselves cause. (Rangachari 1994: 367) Turnaround time, which is about eight hours in normal ports, could be stretched to eight days in Indian ports. The shipowner then has to pay enormous demurrage charges for this delay. Whereas most ports in the world are landlord ports, which only provide facilities but not labour, the Indian ports – following British precedent – have a special labour force employed by the respective port authority. This arrangement may have been useful when it helped to retain labour trained to load and unload ships speedily. But it can serve the opposite purpose if the authorities themselves are not interested in speed, but set the conditions of labour in such a way as to extract a rent from shipowners. Needless to say that Indian ports have lost all business of bulk-breaking and transshipment as no shipment, which does not have India as its final destination, would touch an Indian port. Such bottlenecks can be removed by determined measures by those who wish to assure that India’s future development is not obstructed by such intentional inefficiency.

In recent years a new daring entrepreneur has emerged who intends to turn around Indian ports: Gautam Adani. He is a remarkable businessman, whose father was in the textile trade. Gautam Adani was not interested in his father's firm, but took his own risks at an early age. A Gujarati Jain by birth, he opted for the diamond trade. He left his studies, became a dia-
mond broker when he was still a teenager and a millionaire at the age of 20. In his youth he had visited the Port of Kandla in Kutch and decided that in future he would build a port of his own, which he promptly did. This was the Port of Mundra about 134 km to the West of Kandla. Adani began his ambitious venture at Mundra in 1998. In 2003 India introduced Special Economic Zones (SEZ), following the Chinese precedent. Adani immediately applied for such an SEZ at Mundra and renamed his company Adani Port and SEZ (APSEZ). The port was quickly expanded and had berths which are 14 m deep. They can receive big ships. Altogether the port now handles more than 100 mill. t annually. Mundra has thus become the biggest port in India. Adani also wanted to have a foothold on the East Coast of India and found it in the Dhamra Port of Odisha. This port had originally been developed by Tata Steel in a joint venture with Larsen & Toubro starting in 1998. It served the Tata steel mill at Jamshedpur, which imported coking coal from Australia. The first ship carrying such coal arrived in 2010. The port was also used for exporting iron ore, which was mined in its hinterland. Its berths are 18 m deep. It grew rapidly and the builders had been assured of a long period of operating it under the BOT (Build, Operate, Transfer) rule. Nevertheless they turned it over to Adani in 2014 who served the Tatas well. But they soon started to build another port nearby at the mouth of the River Subarnarekha. The foundation stone of this new Kirtania Port was laid only in 2019 by the Chief Minister of Odisha and it remains to be seen how it will develop. The other ports of India, which are not yet under new management will have to be reorganized. They are managed by port authorities, which have their own labour force and control enormous properties. I once visited the secretary of the Mumbai Port Authority (MPA) labour union. He let me have a ride across the huge property (nearly 1000 ha) of MPA. It looks like a desert, old machines are dumped there. On one part of this land stands the famous Taj Mahal Hotel owned by the Tatas. MPA has 16000 employees. Across the Bay there is another port: Jawaharlal Nehru Port, which handles only containers and has 1600 employees. The great old port of Mumbai nowadays only receives half of the amount of cargo handled by Mundra Port. There are plans to put the land of MPA to different use, building parks and housing. The Port of Kolkata receives even less cargo than Mumbai, while Chennai receives about the same as Mumbai, but does this with a labour force of only 6000 employees. A special feature here is the dedicated port for the export of Hyundai cars. Kochi Port on the West Coast handles 22 mill. t. annually, It is also the major port for the Indian Navy.
The Indian government has in recent years embarked on an ambitious programme to improve India's maritime connections. This is called "Sagar-mala" (Garland of the Sea), an amount of 130 billion $ has been allocated to it. The programme includes work on six major ports. They will be added to those mentioned above. Only one of them, Paradip in Odisha, is in operation already for a long time. Its foundation stone was laid by Nehru in 1962. It is a natural deep-water harbour at the mouth of the Mahanadi River, handling about 100 mill. t of cargo every year. It is even now almost as important as Mundra Port. Including it in the new project must mean that it needs renovation. The other five ports under the programme are yet to be constructed. They serve specific needs, e.g. Wadhawan to the North of Mumbai as a port for landing coal and thus relieving Mumbai, which is supposed to give up handling the import of coal. Wadhawan will be the first foreshore port of India, i.e. its berths will be in the open sea which assures a depth of 20 m, which is important for large ships bringing coal. A similar task is reserved for Belikeri in Karnataka, which is to be dedicated to the export of iron ore, of which India sells a large amount to China. India's trade with China resembles colonial patterns: export of raw material and import of industrial goods. While Belikeri's purpose is well defined, it is not quite clear why Kanyakumari, the Southern tip of India must also be blessed with a modern port. The same is true of Sirkazhi near Nagapattinam in Tamil Nadu. Sirkazhi is located in a fertile, ricegrowing area and is a noted place of pilgrimage. Nagapattinam was a very important harbour for ancient and medieval Indian shipping, but historical reminiscences are surely not relevant for the Sagarmala project. Finally there is Sagardwip Port on an island in the Sunderbans near Kolkata. It faces the Bay of Bengal. There is already a port at Haldia on the other side of the Hugli River, which is under the administration of the Port of Kolkata.

The Sagarmala Project includes a very interesting initiative: CEMS, the Centre of Excellence in Maritime and Shipbuilding. It will be a world class institution, training engineers at two campuses in Mumbai and Visakhapatnam. About 70% of its cost will be contributed by the German firm Siemens, which will also manage it in the first two years. It will make a major contribution to the "Make in India" programme.

The history of Indian shipbuilding under British rule begins with the first Wadia Master Shipbuilder Lovji Wadia (1702-1874), a Parsi businessman. He got a contract from the East India Co. in 1736. With this he established a veritable dynasty of shipbuilders. (Wadia 1957) The last Wadia Master Shipbuilder died in 1884. Lovji did not only build ships but also a dry dock in Mumbai, the first in Asia. The Bombay authorities had made
many attempts at building such a dock, but only Lovji managed to get it done. Malabar teakwood was used for the Wadia ships and the British noticed that it was far superior to oak for shipbuilding. By the early 19th century the Wadias had built hundreds of splendid sailing ships for the British, they then made the transition to steamers. Ardaseer Wadia (1808-1877) launched the first steamboat in 1833 and called it *Indus*. He even experimented with constructing his own steam engines. In the 20th century the Wadias became prominent millowners in Mumbai and they are still active today. Mazagon Dock, the scene of the Wadias’ work continues even today. It became a public company named Mazagon Dockyard Shipbuilders in 1934 and was nationalized in 1960. It builds warships, including submarines, for the Indian Navy. Kalkota is equally famous for its shipbuilding, but its Garden Reach Shipbuilders and Engineers Ltd. (GRSE) was started only in 1884. It was also nationalized in 1960 and works for the Indian Navy, but also produces commercial vessels some of which it exports. With more than 3000 employees, it is a major industrial enterprise. The same is true of the other big shipyard on the East Coast of India: Hindustan Shipyard at Visakhapatnam founded in 1941 by Walchand Hirachand as Scindia Shipyard. The firm was nationalized in 1961. For the Indian Navy it has among other important ships also built the Arihant Class of nuclear powered submarines. Chennai is conspicuous by its absence from the list of shipbuilding sites. This is due to its lack of a natural port. It has a straight seashore beaten by strong waves. The very opposite is true of Kochi (Cochin), the port on the West Coast in the state of Kerala. Kochi is blessed with a magnificent natural harbour, which owes it origin to a medieval flood. At that time the barrier between the placid backwaters and the sea was broken. This access created a magnificent port which made it particularly attractive for the Indian Navy in modern times, which established its major port there. Cochin Shipbuilding Co. was incorporated as a government enterprise in 1970. In recent years it has been partly privatized by issuing shares to the public. It has about 2000 employees and is equipped to build large double-hull tankers and huge warships. At present the first totally Indian made aircraft carrier INS Vikrant is being completed there. Halfway between Kochi and Mumbai lies Goa, where the Portuguese colonial government started a shipyard in 1957, which was then taken over by the Government of India in 1961. Its specialty are patrol vessels for the Indian Coast Guard. This is an entity separate from the Indian Navy, it protects the Indian coastline covering more than 7000 km. Its personnel amounts to about 16000 men. It operates 175 vessels and 44 aircraft, mostly helicopters produced by HAL.
The Indian Navy, which is a major customer of India’s shipbuilders, is still rather small, if one considers its task of controlling the vast Indian Ocean. It has about 67000 personnel and 135 ships. The Indian Army with a strength of about 3.5 mill. and the Indian Airforce with 150000 surpass the navy. The Indian Navy was established by the British in 1612, but it was restricted to local service and was overshadowed by the Royal Navy. After independence this heritage was still predominant. Moreover the real test of the Indian Navy came only in 1971 when it proved its value by blockading Pakistan during the war of secession of Bangladesh. Geopolitics were averse to an expansion of the Indian Navy. In 1985 I had a conversation with an Indian military attache at the Indian Embassy in Germany. He happened to be a naval officer. I asked him why the Indian navy was so small and he gave the revealing reply: "We can only be as big as the superpowers allow us to be." These constraints are gone, and by now India faces a Chinese navy with a strength of 250000 personnel and 300 ships. Nevertheless, naval strength is not yet sufficiently stressed by India.

After dealing with the shipbuilding industry, we must also have a look at its opposite: the shipbreaking industry. India is the home of the largest shipbreaking yard in the world: Alang in Gujarat. This yard is located near Bhavnagar. 40000 workers dismantle here about 450 ships every year. This yields 3 mill. t of recycled steel per year. The dismantling of ships is not done in docks, but on the open beach. The ship is "stranded" at high tide, when the tide recedes, the workers come to take the ship apart. The work is hazardous. It is said that every day a worker dies in Alang. But the workers also suffer from the effects of handling toxic waste. Most of the ships taken apart these days were built in the 1970s and 80s. They contain great quantities of asbestos whose toxic nature was not yet recognized at that time. They also contain toxic metals. Moreover, their daily work exposes the workers to many risks. They are untrained and have to learn their job by doing. If they have an accident and must be rushed to a hospital, the nearest competent doctors and hospitals are in Bhavnagar at a distance of 60 km. The medical services maintained by the owners of the shipbreaking firms are of an elementary type. It was only in 2019 that work on a new hospital at Alang was begun. It will be managed by the Indian Red Cross Society. The owners make a good profit while the workers, who come from all over India, work for modest wages. Only the "gas cutters", who cut the steel with welding equipment, are a little bit better off. The whole operation causes a great deal of damage to the environment. The Japanese government will help India in caring for the environment at Alang. If the Indian government would enforce better standards immediately,
Bangladesh, which is a close competitor, may take over this business. Other factors already harm this business. The fall in steel prices has made the recycling of steel less profitable. So far, Indian shipbreaking still survives and guarantees a good income to those who control it. They exploit workers, who are driven by poverty to do this dangerous work.

Sofar Alang has been discussed in the context of shipbuilding/shipbreaking, but it would also fit into a study of waste and global inequality, which has attracted attention in social science research (Journal für Entwicklungs politik, Wien 2019. Vol. 35, 1/2.) Doing this would go beyond our task here, but the reader should keep in mind that the process of industrialization is accompanied by many problems.

Airlines and airports

Air transport is another crucial element of India's infrastructure. Earlier there were only two public sector airlines: Air India for flights abroad and Indian Airlines for domestic flights. After the reform of 1991 many new airlines entered the market. The most spectacular one was "Kingfisher", owned by the flamboyant tycoon Vijay Mallya, who produced a popular beer named after the same colourful bird. Unfortunately Mallya went bankrupt and fled from India. His airline disappeared. Jet Airways, which was even more prominent than Kingfisher, also perished, but Indigo prevailed. It was founded only in 2006, but is now India's biggest airline. It has a share of about half of the domestic market and operates 245 planes, mostly Airbus 320neo. Tata then teamed up with Singapore Airlines and started "Vistara", which aims at being a premium airline, whereas Indigo is a lowcost airline. But Tata also has a joint venture with the Malaysian airline "Air Asia", another lowcost airline. Tata had once been the pioneer of Indian aviation, starting an airline in 1930, which was then nationalized and became "Air India". J.R.D. Tata (1904-1993) was a trained pilot and sometimes flew the planes of Air India personally. He would have been pleased to see the Tatas return to aviation with a vengeance in the new century. Air travel rapidly increased and put more pressure on the inadequate Indian airports. The new method BOT (meaning "Build, Operate, Transfer") was now also applied to airports. This refers to the arrangement that a private-public partnership, which builds the airport, is entitled to operate it for a number of years and finally transfers it to the government. This was successfully practised in Bengaluru, where a completely new airport was established about 40 km from the centre of the city. The tortuous story of
this venture would be too tedious to tell. It did succeed in the end: A partnership was formed to which the Airport Authority of India belonged and three private firms: Siemens, Unique Zurich Airport and Larsen & Toubro. The German firm Siemens not only contributed a share of the capital but also supplied the electronic equipment of the airport, the company owning the Zurich Airport organized the Bengaluru airport and also sent one of its managers to be the first director of the new airport, Larsen & Toubro (L&T), India’s huge construction company, which is also engaged in shipbuilding and manufactures switchgear and other machinery, did the construction work. It was founded in 1938 by two young Danish engineers, who started their business in Mumbai. It became later on a completely Indian company. The partners were entitled to an operating period of thirty years with an option of applying for a renewal of their tenure. The airport started operating in May 2008. It was the first fully solar powered airport of India. It was named after Kempe Gowda (1510-1569), the founder of Bengaluru, an Amaranayaka of the Vijayapura empire.

Before the new airport started its work, Bengaluru was served for a long time by the airport of HAL, now called Hindustan Aeronautics. The chequered history of this company, which started during the Second World War, has been told in earlier parts of this text. In the new century it had grown, manufacturing a whole range of planes, among them – under a Russian licence – the famous MIG 21. The HAL airport was a good one, but by now much too small for a metropolis inhabited by 8 mill. people. Bengaluru is a major industrial hub of India and is sometime called the "Silicon Valley of India". Located at 920 m above sea level, Bengaluru has a "rustproof" climate and has attracted industries for a long time. As has been mentioned before, it is the home of Infosys and WIPRO. It also houses an exceptional company called "Mind Tree", founded in 1999 by ten IT-professionals. I had listened at that time to a talk of one of the founders, Ashok Soota, who had earlier served as Vice-Chairman of WIPRO. He was an inspiring man, led by him Mind Tree explored many new ideas, The company excelled in IT-Services and later cooperated with the German company SAP. Soota left the company in 2011, but it continued to prosper having 20000 employees and many outposts abroad. In 2019 it was taken over by Larsen & Toubro. Several members of the old management left Mind Tree then, as they considered it to be a "hostile take-over". But with a strong owner like L&T, Mind Tree will certainly continue to flourish. From modest beginnings in 1938 L&T have grown to be a global giant. It is among the five largest manufacturing companies in the world. Nowa-
days it has 44000 permanent employees plus about 300000 contract workers for various projects. Construction work is its major business, but it also manufactures machinery, switchgear and valves. The metro of Hyderabad has been built by L&T, and it is also involved in the metro of Mumbai. It also builds ships for the Indian Navy.

When we turn from Bengaluru to other Indian airports, we again meet Adani. The Government of India auctioned six airports to be managed for 50 years by private companies, Adani won all six contracts by making the highest bids. He had to offer a fee for every passenger landing at those ports. He offered Rs.177 for Ahmedabad and Rs. 116 for Mangalore and amounts in between these sums for the other four. He topped all competitors and offered the government a lucrative deal, but it was even more lucrative for him. He formed a special company, Adani Airports, for this purpose. In 2018 these six airports received 30 mill. passengers. (Business Today, 3 August 2019) Adani will have to invest a great deal in the upgrading and maintenance of these airports. But as his record in managing ports shows, he will perform this new task equally well. India has altogether 128 airports, including some small ones in remote areas and among high mountains. If Adani does well in the six airports he controls now, he may also take on more in due course.

Meeting the challenge faced by the textile industry

Another important task of the new century consists of meeting the challenge faced by the textile industry. This industry – at least the one in the organized sector – is in a bad shape as has been pointed out before. The informal sector has forged ahead in this field and supplies the home market with cheap goods. But India could well become a world leader in the manufacture of high class materials. This would, of course, require a change in government fiscal policy, which practically imposes "diseconomies of scale" and fosters a giant putting-out system. Overhauling the Indian textile industry and converting it into a modern one, which could meet global competition, should be made a national priority. In view of the present predominance of the powerloom sector it seems to be almost impossible to reverse the trend which has led to this phenomenon. As stated earlier, the new textile policy announced by the government in 1985 did not change this trend. The emergence of 11 leading modern mills, which has been discussed above is certainly a good sign. It could herald a new beginning. But perhaps the government should take even bolder steps
so as to revive this industry. It could abandon the collection of excise on textile production altogether and be satisfied with collecting sales tax only. It should also abolish all restrictions imposed on the mills. The textile sector would then reorganize itself. As the example of the cement industry mentioned earlier has shown, de-regulation can have astonishing effects and revive a moribund industry.

The termination of the Multi-Fibre Agreement (MFA) at the end of 2004 has exposed India to the full blast of global competition. This is not only a matter of competition in the export market; even India’s home market may be affected by imports from countries like China which also have cheap labour as well as a much more efficient textile industry. China is far ahead of India both in terms of cotton cultivation as in the equipment of its cotton textile industry. In the late 1990s China had 4.5 mill. ha under cotton while India had 9 mill. ha, but the yield per ha amounted to 1000 kg in China and only 300 kg in India. Accordingly India produced on the average 2.7 mill. t per year, whereas China produced 4.5 mill. t. (ICAC 2000: 1) As far as spindles are concerned, China had 42 mill. ring spindles and 578,000 open-ended rotors, for India the respective figures are 35 mill. and 351,000. China also leads in the installation of shuttleless looms of which it has about 46,000 whereas India has only about 10,000. India has, of course, more ordinary powerlooms – about 1.5 mill. – whereas China has only about 0.7 mill. (ITMF 1999: 11,19) In the late 1990s India had a share of about 3 per cent of the global market in primary textiles whereas China had more than 12 per cent. Most of India’s powerlooms produce grey cloth of poor quality. The powerloom sector does not have the resources to invest in new technology. China has forged ahead by investing in shuttleless looms, whereas India is stuck with old shuttle looms. In fact, about 50 per cent of such looms still operating all over the world are supposed to be in India. Production in India is also much slower than elsewhere. The average time from the procurement of yarn to the shipment of ready-made garments is about five to six months. This means that it is difficult to catch up with changes in fashion. Low wages are not the main element of competitiveness in this field. Capability is a crucial factor, it emerges from a proper combination of technological, managerial and commercial achievements. (Chandra 1999: M 17-M 24) Flexible adjustment to changes in demand was the secret of the success of the London cotton printers of the 18th century whose role as the vanguard of the industrial revolution has been described above. India risks another "de-industrialization" as far as cotton textiles are concerned if it does not wake up and reorganizes its industry. Actually India does have an advantage in
the field of cotton textiles, which have been marginalised in other parts of the world where man-made fibres predominate. Consumers who prefer cotton would turn to Indian products if they were readily available in good quality and at a competitive price.

Recent developments in the textile market have shown that higher quality goods made for the export market are also appreciated by Indian consumers. This enhances the capability of Indian producers. Two companies stand out as champions of the Indian textile industry: Raymond and Arvind. Raymond is headed by Gautam Singhania, who belongs to the family of JK Industries fame. They have sponsored many different branches of business. Raymond, founded in 1925 and acquired by the Singhaniyas in 1944, is now the largest producer of woollen suitings worldwide. The Raymond mills have a capacity to produce 31 mill. metres of woollens and wool-blended fabrics annually. Their readymade garments are known for their style and sold in more than 700 Raymond Shops in India and abroad. The Raymond Group has excelled both in efficient production and marketing. The headquarters of the Raymond Group is in Mumbai. Arvind Ltd., earlier known as Arvind Mills, is a leader in denim production and in cotton shirtings. It belongs to the Lalbhai family of Gujarat and has its headquarters in Ahmedabad. In 1998 it almost succumbed to a heavy burden of debt, but Sanjay Lalbhai, the present head of the group, weathered the storm and led his firm to new heights, supported by his two sons, Kulin and Punit. Denim and the blue jeans made from it were originally the mainstay of Arvind, this line is still important, but by now cotton shirts have forged ahead. Arvind produces the famous Arrow shirts, licensed by the respective American company. These and other shirts with different labels are manufactured to the tune of more than 5 mill. every year. Just like Raymond, Arvind also has its own stores, which have proliferated throughout India. Raymond and Arvind have shown how Indian industrialists can develop their business models very successfully and set worldclass standards.

Led by such industrialists, India will have a bright future. Moreover, India is literally a young nation, millions of young people are ready to join the workforce. Investment in their education and skills will yield high returns. This is an enormous advantage at a time when many highly industrialized countries are facing the problem of an aging population. India’s large workforce is still satisfied with rather modest wages, but cheap labour does not guarantee international competitiveness if other factors are expensive. A comparison of India’s manufacturing costs with those prevailing in the USA shows this very clearly. As far as spinning (ring spin-
dles) is concerned the total manufacturing costs in both countries are almost the same ($1.7 and 1.75 per kg of yarn respectively). In India the share of labour costs is only 3 per cent as against 30 per cent in the USA, but the share of power costs (17 and 10 per cent respectively) and of interest payments (34 and 12 per cent respectively) makes a difference, which practically cancels the advantage of cheap Indian labour. The manufacturing costs of weaving are lower in India than in the USA ($0.2 and 0.3 respectively per yard of cotton cloth). Here the share of labour costs is 11 per cent in India as against 48 per cent in the USA, but once more the difference in the cost of power (32 as against 13 per cent) and in interest payments (18 against 9 percent) reduces India’s competitiveness considerably. (ITMF 2000: 15, 17) These data show clearly what India has to do in order to get ahead: supply cheaper power and reduce interest rates. This would certainly apply to industrial growth and competitiveness in general.

New industries and the importance of patents

In many new industries – such as the chemical and pharmaceutical industries – India has a great potential. Patents are very important in this field and there are enough Indian inventors. But the practice of taking out patents as well as converting them into viable products is still in its infancy in India. Facilitating progress in this field should be another national priority. There has been a debate in India about the protection of intellectual property rights. Many have argued that this protection will only benefit the industrially advanced nations and harm India. The case of turmeric was an important point in this debate. The healing qualities of this spice have been known in India for millenia and it seemed to be a cruel joke when an American firm wished to patent the use of these qualities. India prevented this by taking action in the respective court. But such examples should not discourage India from taking out patents for such products which deserve to be patented. Earlier Indian patent law protected only processes of production rather than the product itself. India has now adjusted to the international practice of patenting products. India was involved in a rearguard battle in the international negotiations on TRIPS (Trade Related Intellectual Property Rights). (Watal 2015). It then passed its new patent act almost at the last minute in 2005. This law now protects products. But it contains a paragraph which is not to be found in any other law of this kind. It prevents "evergreening". This is a practice of pharmaceutical companies which apply for a new patent for a drug whose patent has lapsed,
maintaining that they have thoroughly renewed it. According to the Indian paragraph this argument will be rejected unless it is backed up by substantial clinical proof.

The Indian pharmaceutical industry has grown enormously in recent years. India is now called the "pharmacy of the world." In 2018 India exported medicine worth 18 billion $, but also sold medicines costing 17 billion $ in the Indian home market. In colonial India there were only very few pharmaceutical companies, one of the best was CIPLA (Chemical, Industrial and Pharmaceutical Laboratories) in Mumbai. It was founded in 1935 by Dr. Abdul Hamied and is now headed by his son, Yusuf. CIPLA became famous due to its invention of an inexpensive drug for curing HIV (AIDS). The firm still continues to be a leading one, but it has been surpassed by Sun Pharma, which was founded in 1983 by Dilip Sanghvi, who is now one of the richest men of India. By 2018 he had 52000 employees and an annual turnover of nearly 4 billion $. In 2007 he established the Sun Pharma Advanced Research Company. Its present size attained Sun Pharma only when it took over Ranbaxy Laboratories in 2014, which had been one of India's largest pharmaceutical companies, founded in 1961 by Ranabir and Gurbax Singh. Ranbaxy had clashed with the American firm Pfizer and lost a legal battle over a patent. This contributed to its downfall.

The second largest Indian pharmaceutical firm is Lupin Ltd., founded by a professor of chemistry, Dr. Deshbandhu Gupta, in 1968 in Mumbai. He had a social conscience and started the Lupin Human Welfare and Research Foundation in 1988, which is active in village development. His medical emphasis was on the fight against Tuberculosis. The company has about 50000 employees, it is active abroad, having a branch in Baltimore, USA, and in Germany it acquired the firm Hormosan in Frankfurt.

The third largest Indian pharmaceutical firm is Dr. Reddy's Laboratories, established 1984 in Hyderabad. Dr. Reddy at first concentrated on manufacturing materials for other producers, but then turned to making his own drugs. He also started his own Research Foundation in 1992. In terms of employees (22000), Dr. Reddy's Laboratories is of the same size as CIPLA. In India there are thousands of pharmacy firms, we only wish to mention one more: Piramal Group. It was founded by Ajay Piramal in Mumbai in 1984 and has the unique feature that it also produces glass packaging for medicines.

The great biodiversity to be found in India makes this country a veritable treasure trove of herbal medicines, many of which have been used in Ayurvedic medicine for a long time. Modern chemical analysis would permit the standardized synthetic reproduction of such medicines. But inspite
of a great deal of available empirical knowledge of the therapeutic qualities of many higher plants, not much progress has been made in advancing towards industrial production of plant-based drugs. This is where India can make an important contribution. (Dev 1995: 159-178) The matching of traditional knowledge with modern scientific methods is very promising in this field. Thus, for instance, Kerala scientists came to know from a local tribe about a plant which supports the immune system. They developed a drug which is now manufactured by an Ayurvedic drug company. The tribe concerned receives a license fee and 2 per cent of the net profits from the sale of the drug. (Mashelkar 1999 c: 12) This is a new approach to the utilization of traditional knowledge which is often assumed to be freely available – if it is taken note of at all. The richest man of India, Mukesh Ambani, whose rise was due to petrochemials, has also got interested in life sciences and founded in Mumbai in 2001 a Reliance Institute of Life Sciences (RILS). It offers course in advanced studies. In addition to academic and clinical courses it also offers practical training. Here the researchers of the new generation get going.

So far only allopathic medicine has been mentioned, but India also has a lively tradition of Ayurvedic medicine, which has persisted for millenia. There are two companies which are outstanding in this kind of pharmaceutical production: Dabur and Baidyanath. The firm Dabur was founded in 1884 in Kolkata by Dr. S.K. Burman. Even before founding his firm he had made experiments with Ayurvedic medicines to combat Malaria and Cholera. His firm is now led by the 5th generation of his family. In 2008 the firm Dabur Pharma Ltd. was separated from the main firm. The majority shareholder of the new firm is the German company Fresenius. Shri Baidyanath Ayurvedic Bhavan, also in Kolkata, was founded in 1917 by R.D. Joshi. In 1973 the firm established the Ram Dayal Joshi Memorial Research Institute in Patna. All Ayurvedic firms offer an ancient tonic called Chyawanprash, which has an annual turnover of 80 mill. $. It contains sugar, honey and butter, and among many herbs and spices as its main ingredient the Indian gooseberry (amla). Amla is credited with controlling high cholesterol. But as with all Ayurvedic medicines, there is no scientific proof of that. In recent years, interest in Ayurveda has also increased in Western countries. The production of Indian drugs may profit from this.
Our study of the industrialization of India actually deals only with the tip of an iceberg, if we consider the employment of labour. Census statistics show that India has 437 mill. workers, but about 94% of them work in the "unorganized" sector, which contributes only about 50% to GDP. The "organized" sector, which consists of firms employing more than 10 workers, are registered and pay taxes, encompasses the rest of the workforce. There are only about 5 mill. workers in manufacturing and among them are those who participate in the process of industrialization. The demographic dividend, which India enjoys at present as birth rates have declined, will accrue to the nation only when enough employment is generated. At present, however, India is adding annually about 13 mill. to the workforce of which only 8 mill. find employment. Employers, who could offer more jobs, are discouraged by rigid labour laws, which have accumulated over many years, starting under colonial rule and continued after independence by the Indian government supposedly legislating in the interest of the workers. These laws have empowered government agencies to control every decision, which an employer takes. Employers therefore hesitate to offer new jobs, as they face great trouble when laying-off workers. When talking to trade union leaders in India, I came to know that their most important work is to defend workers before labour tribunals. No wonder that most of these trade union leaders are lawyers. The industrialists rather invest their capital in machines than in hiring more workers. Or they find ways and means to circumvent the labour laws. "Casualization" has been a growing phenomenon under these circumstances. It means offering temporary jobs, which imply that the worker accepts his being fired at a specific date. Such workers are accordingly neither protected by labour laws nor are they members of unions. The Indian trade unions are affiliated to political parties. The three biggest ones belong to the Congress party, the Communist party and the BJP. The members rarely pay their membership fees. This means that their leaders cannot expect to be supported by them, they rather look to the employers for emoluments, which they get for preventing labour trouble. Collective bargaining is rare, the wages are mostly determined by awards of government authorities. All this applies to the "organized sector" only. The huge "unorganized sector" is not touched by trade unions. Indian agriculture depends on an army of landless workers. Their number increases every year. It amounts to about 150 mill. at present. Nehru, who had neglected agriculture, as it was not amenable to his type of planning, had hoped, that industrialization would absorb sur-
plus rural labour, but this has not happened. In fact, at present those who are in charge of the Indian economy are grateful to the inefficient agriculture for absorbing this labour like a big sponge, because it would otherwise swamp the cities. The Mahatma Gandhi National Rural Employment Guarantee Act, which promises to everybody who registers under it a modest wage for 100 days in a year, helps to maintain this precarious balance. The scheme is based on the experience that the landless labourer is usually unemployed for 100 days when he is not engaged in ploughing or harvesting and other agricultural work. India has a dual economy, but not one in which the rural sector provides a steady supply of labour to the urban one. Poverty is therefore still rampant in India.

As the Indian labour market cannot absorb enough Indian workers, many of them become migrants looking for work abroad and supporting their families at home with remittances. The Arab states in the Middle East are the main destination of these migrants. About 4 mill. Indian men have gone to those states and another 4.2 mill, mostly women, have worked in those states as domestic workers. Remittances amounting to 20 billion $ annually have been recorded in recent years.

Concluding remarks

This survey has shown that India has made remarkable progress in building up a highly diversified and interrelated industrial potential. In this process it has acquired a great deal of technological capability. At the end of colonial rule India had only three major productive industries, cotton textiles, jute textiles and steel – and they were almost totally unrelated to each other. Industrial policies have helped a great deal in giving a push to the industrialization of India, but some policies were also ill conceived and did more harm than good. Fortunately in recent years policies have become more realistic and in some respects, e.g. computers and software, they have proved to be forward looking and constructive. The skills and the ingenuity of the Indian people are admirable and if they are given full scope, India will have a bright future. In preparing for this future, one should not take the availability of human capital for granted – as Nehru did when he felt that the skills of India’s craftsmen could be the foundation of India’s industrialization. Human resources must be constantly nurtured and adapted to new situations. This is the main challenge of the future.
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