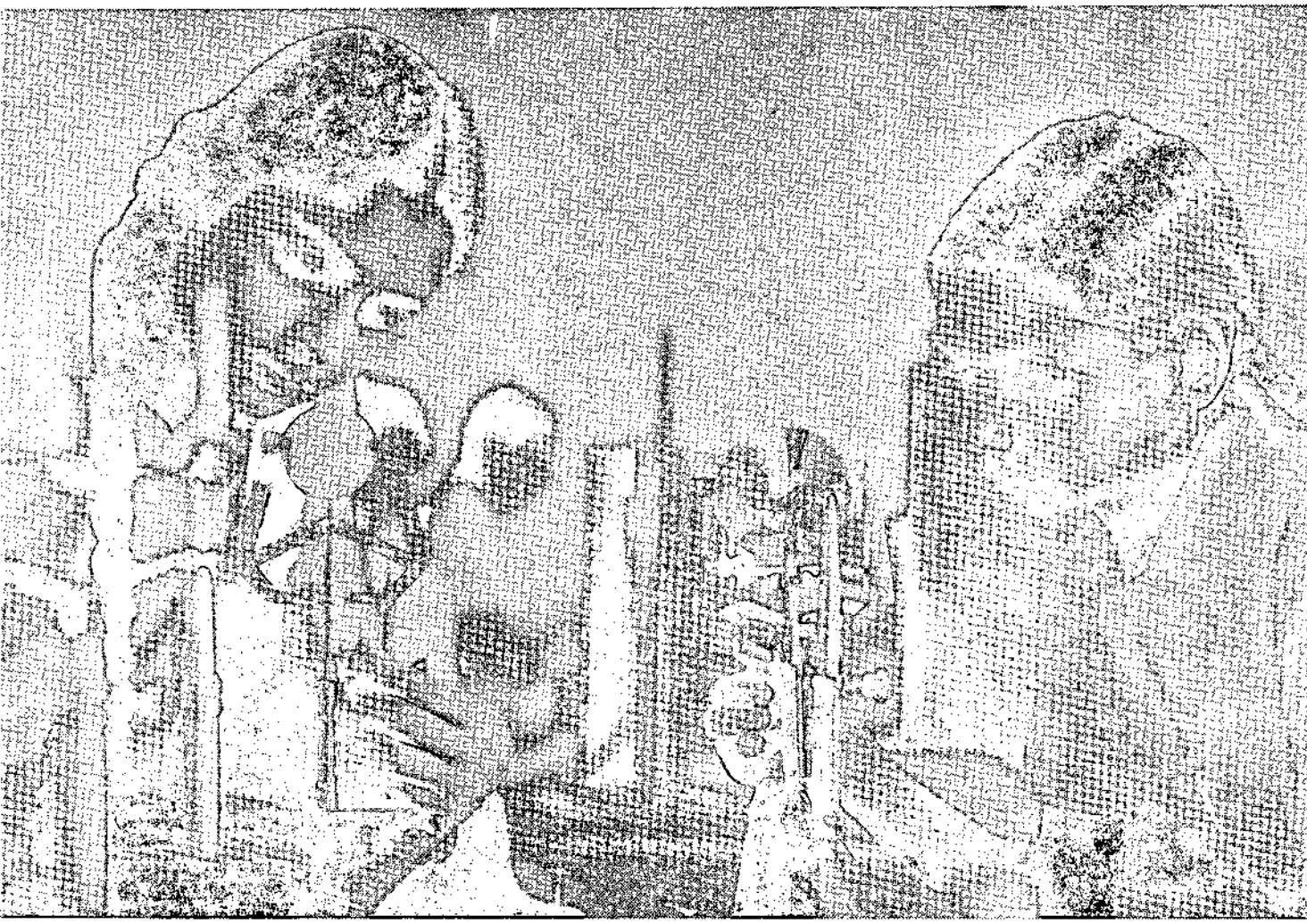
YOJANA

OCTOBER 11, 1964

EIGHTH YEAR 20

No-20



SCIENCE IN SCHOOLS

How Much for Laboratories?

POWER: A Doubling in Fourth Plan

U.P. Uses Too Little Fertiliser

25 PAISE

ABOUT YOJANA

Yojana seeks to carry the message of the Plan to all sections of the people and to promote a more earnest discussion of problems of social and economic development.

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The Cover: Photograph by T.S. Nagarajan shows two girls of St. Thomas School, New Delhi, in their newly fitted physics laboratory. (A feature on school science on pages 4-6)

The Next Issue of YOJANA will be a Special Number on

Technical Innovation

SOME OF THE ARTICLES ARE:

Dr S. Husain Zaheer:	Research and Technological Self-Sufficiency
Mr S. S. Kumar:	The Technical Development Organisation
Mr K. B. Mathur:	Making Heavy Electricals
Mr B. C. Mukharji:	Progress in Planning for Fertilisers
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YOJANA

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NEGLECT OF SOURCES

ALL cities worry about water. They want plenty of it and they want it pure. No city of India can claim to be satisfied on both counts. Parliament devoted time last month to discuss the dirtiness of Delhi's water. The monsoon this year was unusually heavy in the capital, and the floods carried sewage into the Yamuna above the water works: Memories were revived of the jaundice epidemic that raged in Delhi when the same mixture of sewage and water had taken place a few years ago. The people were therefore advised to boil the water they drank. Some physicians said that that was not enough, for even bathing in contaminated water would let the germs get into the body. One M.P. declared that he had not bathed for twenty days.

City people are supposedly more careful about their health than villagers. This cannot be very true, for we can see what goes on in urban slums. There may be a fastidious few, but the many do not care or cannot afford to. It is no doubt easier to warn city dwellers about public health dangers and carry out inoculation campaigns and the like. On the contrary, overcrowded houses, streets and eating places make it more difficult to stay clear of infection. Germs have no pity for the innocent. They respond only to strict regulations.

What happened in Delhi was bad enough. But such contamination of water is almost the permanent feature of all our villages and towns. The tragedy of Maddikera, a small town in Andhra Pradesh, was a fierce reminder of this bad fact. Thirty-eight children, the loved ones of their parents, went to school one morning, took the food and milk served to them and were dead. Three hundred more were lucky to live. It was first thought that the cause might be chemical poisoning from untinned vessels or from insecticide somehow getting mixed with milk powder. But tests showed that the mischief was that of the water used in the making of the meal.

School meals are one of the commendable developments in welfare and social care in our country. In Madras and Andhra Pradesh the movement has done much good. But the programme received a jolt when a few months ago some children died after having taken the school meal in a town of Madras. Chemical analysis showed that the deaths were due to gastro-enteritis that was already prevalent in the place. The ghastly tale of Maddikera was also murder from water. The midday meals for seven schools of the town were prepared at one place from water drawn from a well. A reporter of *The Hindu* who went to the spot described it as green, foul and filthy.

Drought and scarcity make the people of many parts of India drink whatever water they can get without a further thought. Elsewhere it is pure ignorance that makes us careless about what goes into us. There is a quaint belief that because water washes, all water is clean. Much is being done to provide a source of drinking water in every village in the country so that women do not have to walk long distances. But the question of maintaining the wells and tanks clean is not getting enough attention. Even the elementary knowledge that epidemics come from germs is not there in the villages.

Modern medicine has reduced the ravages of plague and smallpox—although a half of the population is still unvaccinated. New drugs have got malaria on the run —although the mosquitoes are now taking revenge in the form of a new fever that is spreading in many parts of the East Coast. As for water-borne diseases, they are still very much with us.

Unsafe water, says the World Health Organisation, has been giving disease to 500 million people annually in the world. Five million children die every year from diarrhoea. A large portion of them must be from our country. Of a total urban population of 320 million in 75 poor countries of Asia, Africa and Latin America, only a third gets piped water in the home; another fifth depends on street taps. If nearly a half of the urban people cannot get piped water, the plight of villagers can be imagined. As can be seen in many of our towns, pipes and taps are no guarantee that the water has been properly filtered.

The Third Plan document suggested that there should be a concentration of effort on the village water supply programme. It said that "to as large an extent as possible, supplies of drinking water should become available in most villages by the end of the Plan period". A guarded statement, this: neither a firm promise nor even a clear hope. There is no sign that "most villages" would be in command of good drinking water in the next eighteen months. It becomes another of the tasks carried over to the Fourth Plan.

The death of the Andhra children is a pointer to a defect in our national habits—our neglect of sources. There were teachers, parents and members of the committee organising the school meals at Maddikera who had evidently never bothered to peer into the well which a reporter on first look declared to be green, foul and filthy. In the month of Mahatma Gandhi's birth, it is pertinent to remember that whenever he went to a conference or a camp he first inspected the kitchen and the latrines. Gandhiji cared for sanitation as much as he cared for freedom and truth. "The one thing which we can and must learn from the West is the science of municipal sanitation", he wrote forty years ago, and he added that in spite of his horror of Western materialism he did not hesitate to take from the West what was beneficial. It may be hard for us as individuals and as a society to practise the other teachings of Gandhiji such as total non-violence, total non-covetousness and a total freedom from fear. But to attain personal and civic cleanliness is within our capacity.



TRACTORS FOR OUR FARMS

Introduction should be on co-operative, not individual, basis

By P. N. MATHUR

Gokhale Institute of Politics and Economics, Poona

THE progressive use of tractors in Indian agriculture seems to be an accepted policy. According to a former Minister for Agriculture of the Union Government, Dr Ram Subhag Singh, "the use of tractors has steadily increased from year to year, and from 8,500 in 1951 the number has increased to 31,000 in 1961. The annual demand has been estimated at 10,000 and six units have been licensed to take up the production of tractors and implements".

A baby tractor, suitable for Indian conditions and small farmers, was reported some time ago to have been designed and successfully tested by the Agricultural Engineering Division of the Mysore Agricultural Department. The claim was made on its behalf that it could cover an area of one and a half acres to a depth of three to six inches in eight hours. The four-wheeled tractor, it was said, could be used for different purposes like running a centrifugal pump, paddy huller, flour-mill or any other agricultural machine which does not require more than six h.p.

All this would indicate that the introduction of the tractor into Indian agriculture will gain further momentum. However, not sufficient thought seems to have been given to the institutional arrangements required for adoption of mechanised cultivation to any great extent in our country. The introduction of trac-

tors in our economy has so far been haphazard and dependent on the whims of some rich cultivators. It is not known whether the Government has any well-thought-out principles to govern the use of tractors.

A technological innovation such as the mechanisation of Indian agriculture will naturally have far-reaching effects on our rural structure. It is essential not only that there should be a wide-spread debate on the issue, but that there should be active experimentation with different types of organisation, on the basis of which long-range policies for achieving a transition in Indian villages from the bullock-cart to the tractor should be formulated. One of the most important advantages of the change-over may slip through our hands if the introduction of tractors continues to be unplanned. Here the economic implications of such a transition are examined.

ONE of the most important benefits of mechanised agriculture lies in its indirect effect on milk production. The use of tractors would make it possible to reduce substantially the number of bullocks required for Indian agriculture. This would enable the Indian cultivator to have fewer bullocks and thus to keep and feed a correspondingly larger number of milch cattle giving him an extra source of income.

Such a mixed economy of farming and dairy production is nothing new to the Indian cultivators; but milk production has remained more or less a secondary or even a marginal operation in large parts of the country. The main reason for this has been insufficiency of fodder. Replacement of bullocks by tractors would release fodder for dairy farming. A shift to milch animals, besides providing additional income to the cultivator, would also promote a more balanced diet for the people. It may be noted in passing that the fear that introduction of tractor farming would deprive agriculture of farmyard manure is ill-founded since milch cattle would continue to be tended, possibly in larger numbers.

The fodder required for three bullocks would be sufficient to maintain two she-buffaloes with one heifer each[1]. Assuming that the average yield of milk per she-buffalo is about 1,000 litres per year, the replacement of three pairs of bullocks would make possible the production of about 4,000 litres of milk per year. At the rate of 50 paise per litre the additional milk production would yield an income of Rs 667 per year for each pair of bullocks replaced.

A pair of bullocks usually cultivates about ten acres of land. The cost of its cultivation by tractor roughly comes to between Rs 30 to 50. Thus if the Indian cultivator has at his disposal a tractor service, he will find it advantageous to replace his bullocks with milch cattle and use mechanical power on his farm. He will then be able to get about 4,000 litres of milk per year with extra expenditure of only Rs 30 to Rs 50[2].

Use of tractors would thus lead to a revolution in the supply of milk. Let us now look at the obstacles if any to this change-over.

ACCORDING to 1961 Livestock Census of India, the number of bullocks more than three years old and used for work was only 69 million. Their replacement can, in the long run, increase milk production by about 48 million tonnes per year, which is about double the current milk production. The increased output would also raise the availability of milk to 13.3 oz. from 5 oz. per day per adult. Considering that the average daily requirement of milk in a balanced diet is 10 oz., the replacement of bullocks by tractors would enable us to meet the full needs of nutrition. The fodder thus saved will become available for milch cattle, solving in turn the problem of under-nourishment of the Indian people.

The transition, however, is not so very simple. Tractorisation does not mean that all bullocks will be eliminated. As at present, more than 50 per cent of cultivators are not in a position to own bullocks. They rely mainly on hiring them or getting them from friends. Those who cannot afford bullocks cannot certainly afford tractors. But if the bigger cultivators are persuaded to go in for tractors they will pass on the bullocks to the less well-off cultivators, probably at lower prices.

This will mean that in spite of introduction of tractors, no bullock-power will have actually been eliminated in the ordinary course of things. The feed for this bullock-power will simply be transferred to the smaller cultivators, and not released for the development of the dairy industry in any quantity.

Thus there are chances that if cultivation by tractors is introduced in an unplanned way, one of the most important benefits may elude us. The net result will only be an increase in capital intensity of agriculture without any appreciable benefits.

THERE is one further consequence which is to be guarded against. For long, we have been concerned with the stranglehold of certain powerful elements on our rural society—the fedual landowners and the rural moneylenders. Privately-owned tractors would encourage and strengthen the position of this very class. Apart from cultivating whatever land they have, they are likely to hire their tractors out to the less well off. Ownership of tractors being far more restricted than that of bullocks, it will give much more power to the owners, creating new vested interests in the rural economy.

To guard against such consequences, it is necessary to introduce mechanical cultivation through well-thought-out institutional arrangements that will guarantee benefits and will not put the clock back as regards the progress towards democracy and socialism.

The small-size of holdings, their continued fragmentation, the conditions of agricultural credit and the present cost-price structure combine to make it difficult for the great majority of cultivators to acquire tractors individually. Only those with large holdings would consider it worthwhile to invest in tractors. To cope with the situation, it might be necessary to create an institutional set-up which takes care of the long-term interests of the cultivator and also provides sufficient inducement to him to substitute a tractor for bullocks in cultivation and also to raise a dairy economy from the feed so released.

This can be done through creation of special service co-operatives which would enable the cultivators to buy and own tractors on a co-operative basis.

These co-operatives would acquire

(Continued on Page 28)

THE SCIENCE BIAS

Yojana Staff Feature

Laboratories for 36,000 schools in next 5 years

Report: Kali Biswas. Pictures: T.S. Nagarajan.

HISTORY is about chaps, geography is about maps and science is about labs. So goes a schoolboy tag.

"You in India seem to make too much fuss about equipment for laboratories. Science can be taught and children can be made science-minded much more simply, even without most costly laboratories," said a young British teacher, Miss Lee Bolton, who has taught science for two years.

Comparing British and Indian children, she told me, children here spent more time with books than with tools and only tried to get confirmation in the laboratory of what they had already seen in the books. "In good science teaching it should be the other way round," she declared.

This set me thinking. In one and the same breath Miss Bolton decried our fuss with laboratories and also criticised our students for not spending enough time in laboratories. Wasn't there a contradiction in what she said ?

Not really. What she meant was despite all our fuss, the equipment was not being put to use the way it should be. Also, the scientific attitude came from seeing and touching, and could be imparted with simpler equipment than the showy fixtures that some of our schools were keen on acquiring.

I wanted to test Miss Bolton's observations with educational authorities and experts; and I also looked up a few reports and papers. I went and talked to people in the National Council of Educational Research and Training (NCERT) to find out what our approach was to the problem of making our children science-minded.

Middle-class parents in towns and cities take their children to foreign films, buy Meccano sets, and have some of the gadgets and appliances from which children get to know about science and machinery. What about rural children who may not have seen motor pumps and electric fans (even if they would have seen jeeps and radios)?

A New Approach

NCERT has done some research in this field. After a careful study of the recommendations made by well-known science teachers and specialists it has prepared a simple syllabus for teaching science on new lines to students of primary and middle classes. *It has brought out a handbook for science teachers of primary and middle classes and proposes to bring out a series of books on scientific topics intended for supplementary reading of secondary school*

For younger students —a plan to train the eye





A major aim of educational policy is to make our students science-minded. More than two-fifths of all secondary schools will have elective science by end of Third Plan. Thousands of more schools will have laboratories in the Fourth Plan. How large should be these laboratories, and how can we create an interest in science among younger students before they go on to secondary schools? On these much thinking has been done. Picture at left of a girl in a physics laboratory and of girls in a chemistry room on facing page are from St. Thomas' School of New Delhi.

students. To popularise science among secondary school students NCERT has been publishing since 1962, *School Science*, a quarterly journal. Contributors include well-known scientists and specialists who write for school students on aspects of science and technology, on achievements in scientific fields and on classroom experiments.

The school syllabus NCERT has prepared is being supplied to selected schools and the final version will be brought out in the light of opinions received. The syllabus aims at helping children to acquire a knowledge of the environment, to develop scientific attitudes and skills, to have simple knowledge of things and tools and to take to collection of materials and to reading of science articles and biographies of scientists.

In the initial stages a child will learn simple experiments from nature. He or she will be taught to observe the plants and birds and insects and rocks and soils found within the village. Phenomena like monsoon and rain will be explained. The child will learn simple rules of health and sanitation.

"The idea is," said Dr. R.N. Rai, Head of the Science Division of NCERT, "to instil in the child a sense of observation and discovery, to learn from what he sees in and around his village rather than to teach him through books in the class-room. Gradually, with increasing age, his horizon will widen and he will be interested in knowing more about his community, State, country and the world."

The practical training a child gets in the formative stages will create in him a genuine interest in science and make him better equipped for higher studies. By the time he reaches the secondary stage he will have acquired a knowledge in the basic principles of science and developed an analytical and scientific bent of mind. He is likely to go in for the elective science course and learn the three aspects of science, physics, chemistry and mathematics. It is at this stage, and not until then, that he will require a laboratory for experiments.

Plan Targets

In the Third Plan more than 9,500 out of 21,800 secondary schools will have science as an elective subject in addition to compulsory general science in all the secondary schools.

In the Fourth Plan it has been proposed to lay more stress on teaching of science in middle and secondary schools. A sum of Rs 32 crore has been recommended for providing laboratory facilities to 16,000 secondary and 20,000 middle schools. It is also proposed to set up an Institute of Science in each State and appoint science supervisors in each district and ensure an adequate supply of science teachers.

Findings of COPP Panel

Laboratories are required for science education in the secondary stage and they are set up according to the syllabi prescribed by the

education departments of the States. The question naturally arises : what should be the standard of a school laboratory ? What should be the range of its equipment ? Is a costly laboratory essential for a secondary school ?

At the instance of the Delhi Administration, the Committee on Plan Projects of the Planning Commission set up a Panel for Science Laboratories and Equipment in 1961 under the chairmanship of Dr K.N. Mathur, Director, Central Scientific Instruments Organisation. It visited a number of school laboratories.

The Panel has recommended a list of essential, desirable and supplementary equipment, and the size and layout of laboratories for different subjects. It has also stressed the desirability of starting a workshop at each school for making improvised apparatus provided it is decided to encourage development of scientific hobbies.

In making the recommendations the Panel has kept in view primarily the syllabus prescribed by the Central Board of Secondary Education, Delhi. It feels, however, that the recommendations could be applied to high schools and higher secondary schools in other States as well, subject to minor variations.

The Panel has considered the functional requirements of a laboratory and laid stress on its design. As regards the total area of a laboratory the Panel considered the number of pupils working at a time, the minimum space required for each pupil for comfortable work, ancillary accommodation and special provision for certain laboratories.

As for location the Panel has observed : "In the interest of economical distribution of layout and services it would be advisable to locate the laboratories of chemistry and home science on the ground floor and those for physics and biology on the first floor over those laboratories if the school buildings have a double-storey structure. For a single-storey structure the grouping of home science with chemistry and of biology with physics may still be kept intact."

Regarding space in a laboratory the Panel has recommended that all the four laboratories, namely physics, chemistry, biology and home science, should be of the same size that is, 10.0 m × 6.0 m=60 sq.m (32′ × 20′=640 sq. ft) with a space of 6.0m × 3.7 m × =22.2 sq. m. (20′ × = 12′ = 240 sq. ft.) for ancillaries of each laboratory.

The Panel has also recommended suitable standards for laboratory lighting, besides giving list of services and fixtures and furniture that each laboratory should possess.

In preparing the list of equipment and apparatus the Panel has mentioned the minimum requirements for a class of 40 students working in batches of 20 each. The Panel has given a list of 267 articles required for physics laboratory—indicating against each the number of essential requirements. Similarly it has prepared separate lists of articles required for chemistry, biology and home science laboratories showing the essential requirements of each.

The Panel has laid stress on specifications and standards of equipment and apparatus and suggested that the Indian Standards Institution and the Central Scientific Instruments Organisation may lay down the standards of the items which are being manufactured in the country. It is not in favour of a centralised agency for manufacture of instruments. It has stated that "procurement of science instruments can be improved if, for the new schools, package units conforming to the prescribed equipment were available to the schools by bulk purchases made through a suitable agency."

An important recommendation is that full use of the laboratory should be made during the working hours and the possibility of two or more schools taking part in practical work should be examined.

Committee Report

MORE recently the Indian Parliamentary and Scientific Committee went into the question of 'science in schools'. In a report of that name, the Committee has referred to the valuable work done by NCERT and suggested that each State Government should make a survey of science curriculum textbooks and equipment and take suitable action in consultation with the Union Ministry of Education and the NCERT.

Some of the Committee's important recommendations are : urgent attention should be given to publishing textbooks; there should be more summer institutes for secondary school teachers so that the teachers could get to know the latest developments in their subjects; hobby workshops should be introduced; handbooks should be prepared for both students and teachers; and periodical conferences should be held at State and Central levels to review progress of science education.

Pre-lab Teaching

IT is good to know that there will be pre-laboratory science teaching. (It can't be different from the 'nature study' that I had as a primary school pupil fifty years ago—although present-day children will want to know more about aeroplanes than butterflies). The report of the Mathur Panel is also an assurance that we shall have some standards and norms for school laboratories. Even so Miss Bolton's major point was not answered—that we don't encourage children to handle things themselves but tend to give too high a place—in terms of money and attention—to laboratories.

So I asked the principal of the school, in which Miss Bolton spent two years before returning to London, the St. Thomas School in Delhi. Mrs Ayesha Jacob, the principal, said "Ah, Miss Bolton was a fine science teacher. We introduced science only recently because of the great demand for it, and Miss Bolton did a good pioneering job. And all she asked for was a carpenter's table, a few racks and of course a microscope. The students were excited."

"You said you had to introduce science because of demand," I asked Mrs Jacob. "Demand from whom ?"

"From parents and guardians of course," she replied. "To go in for science has become the fashion. It is not that all the parents really care much about science. But they want science because they believe that science will give their children more marks in the examinations.... We are spending nearly Rs 1,50,000 on our new science wing and I hope that we shall succeed in implanting in our children a true love of science instead of the examination approach of the parents".

Concluding the debate on

marriage age and number of children

35 TO 50 PER CENT FALL IN BIRTH RATE IF GIRLS WED AT 19

S. N. AGARWALA

MY article, 'Importance of Age at Marriage' (*Yojana*, April 12, 1964) has been commented upon by Mr Q. U. Khan (June 21, 1964), Mr V. Raja Rao (July 19, 1964) and Mr R. P. Goyal (August 30, 1964). All of them agree that if female age at marriage in India rises to 19, there would be a decline in the birth rate. While Mr Raja Rao and Mr Goyal are of the opinion that the decline would be of the order of 40 or 30 per cent, Mr Khan thinks that the decline would be only 16.7 per cent. Mr Rao and Mr Goyal have used the correct technique for estimating the effect of an anticipated increase in marriage age on fertility or birth rate and have come to conclusions very similar to mine. They have also replied satisfactorily to all the points raised by Mr Khan and I need not repeat them. I, therefore, briefly outline the details of the basis of my calculation, which I had not given earlier.

It has been found that a married woman in India has an average of 6.6 children during her entire reproductive period, that is, between ages 15 and 45. It has also been noticed that those women who marry between ages 15 to 19 give birth to a larger number of children (that is, have a higher completed maternity) than those who marry at the age of 20 or later. For instance, it has been found in the Mysore survey that rural females marrying between ages 14-17 give birth to a total number of 5.9 children, while those marrying between ages 18-21 give birth to only 4.7 children[1]. Dr D. N. Majumdar found in Kanpur that those marrying below the age of 15 give birth to 6.9 children while those marrying after 19 gave birth only to 6.0 children[2]. In studies in Calcutta[3], Madras[4], Lucknow[5] and Delhi[6] a difference between 0.5 to 1.0 child was found.

At the time of the 1961 Census, data on fertility were collected in different States of India. Mr. S. P. Jain, Deputy Registrar General of India, presented data for four States at the time of the Asian Population Conference held in New Delhi. He found that those marrying between ages 18-22 (mid-year 20.5) or later gave birth to a smaller number of children than those who had been married by 18. His findings are as follows:[7]

Table 1: Average number of children per woman of completed maternity

States		Marriage Age		
		Below 18	18-22	23 & over
Jammu & Kashmir	R	5.1	4.2	3.2
	U	5.2	4.2	3.7
Panjab	R	5.7	5.2	4.4
	U	6.0	5.5	4.7
Kerala	R	6.2	5.5	3.9
	U	6.2	5.5	4.0
Uttar Pradesh	R	4.2	4.0	3.7
	U	4.5	4.0	3.7

(R=rural, U=urban)

It is thus clear that women marrying at age 19 or later in India give birth to a fewer number of children. It has also been found that women who marry between ages 15 and 19 give birth to nearly the same number of children or have the same completed maternity.

If age-specific fertility rates corresponding to a given completed maternity are available and if the number of currently married women in various ages is known, total births can be obtained by multiplying the age-specific fertility rates by the number of currently married women in given ages. By dividing the total births in a year by the total population and multiplying it by 1,000, the birth rate can be obtained.

Fertility & Birth Rate

IT may be pointed out here that the relationship between fertility and birth rate is through the age distribution of married women and not *direct*. It will not be proper to say, for instance, that if completed fertility declines by one-sixth, the birth rate would also decline by one-sixth. This is specially so because fertility rates differ by age, and they are highest in India between ages 20-35. Again, the proportion of married women in different ages is also not the same, it goes on increasing with age. Therefore, even when age-specific fertility rates are the same in two populations, it is not necessary that the birth rates should also be the same, unless the proportion of the currently married females in different ages and the total size of the population are also the same.

According to the 1961 Census, the average marriage age of women in India is 15.6 years. This, however, should not be taken to mean that there are no marriages before this age. As a matter of fact, about 20 per cent women in 1961 were married before age 16. Therefore, even when average marriage age of women in India rises to 19, there will be some marriages before that age. (If there are no female marriages before the age of 19, the average marriage age

would be around 21.3 years). It is because of this that it has been suggested by me that when the average marriage age of females rises to 19, no female should give birth to a child before age 20.[8]

If female marriage age rises to 19 and no child is born to a woman before the age of 20, the first impact would be the elimination of motherhood between ages 15-20 (assuming that no woman bears a child before age 15). Taking the 1961 distribution of currently married females for India and applying the age-specific fertility rates of Punjab found by Mr S. P. Jain in 1961 (we could use any other rates) it would mean a reduction of 3.05 million births or a decline in the birth rate from 42 to 35. *This, however, is not the only gain in birth rate as a consequence of an increase in marriage age.*

It has been pointed out earlier that when female marriage age rises to 19 years or above, completed maternity declines. This means that a lower age-specific fertility rate becomes operative. Again, when marriage age rises to 19, the age distribution of married females would change, as those who are not married between ages 0 and 19 will marry later. It is not proper, therefore, to take one and the same schedule of age-specific currently married females and assume that since marriage age has risen to 19, no female would get married till that age, and, therefore, use the proportions of currently married females after age 20 for finding out the new birth rate[9]. By so doing, we would be leaving out of calculation those females up to the age of 19 who are married. It should be clear that those girls who have not been married up to the age of 19 because of a rise in marriage age would marry after that age. They would simply not go out of the marriage stream. The conclusion, therefore, is that for finding out the effect on the birth rate of a rise in the female marriage age after 19, we should keep neither the age schedule of currently married females nor the age schedule of fertility rates the same.

Size of Decline

With this background, it is easy to calculate the effect of an increase in the female age at marriage on birth rate in India. The first problem is that of obtaining an age schedule of currently married women when average age at marriage of women is 19. Since there is no all-India experience, Mr Raja Rao took the 1931-41 Kerala experience (as female age at marriage in that year was 19.2) and Mr Goyal the all-India experience assuming a certain decline in the incidence of marriages in earlier years. I had taken the age distribution of the six Delhi villages. The differences in our results are due to different age schedules of currently married females adopted for the purpose of calculations. As regards age-specific fertility rates, all of us took the Delhi rates. Mr Goyal also used the Kerala and Punjab rates and found that the decline is of the same order, namely, 30 per cent.

Having selected the age schedule of currently married females when marriage age is 19 and the respective fertility schedule, one can find out the birth rate for the "synthetic" or the "real" cohort, or for the "actual" or the "stable" population. In all these there would be slight differences in the results. When age-specific fertility rates are applied to the age schedule of currently married females found in the six Delhi villages, a decline of 50 per cent in the birth rate is obtained if female marriage age has risen to 19. However, when the age schedule of currently married females for India is used, a decline of 40 per cent is obtained. If, however, we apply these rates to the *stable* Indian population, the birth rate declines by 35.4 per cent, and the mean length of a generation comes to 29 years. It can thus be said with considerable certainty that the decline in birth rate would be of an order of 35 to 50 per cent if female age at marriage in India rises to 19.

Such a decline will be brought about if marriage age rises to 19 immediately. If, however, it is assumed that it will take 30 years or so to bring about this change, the percentage decline at the end of various five-yearly periods would be as follows:

TABLE 2: Percentage decline by the end of every five-year period

Period	Percentage decline in birth rate
1961-66	21.1
1967-71	26.2
1972-76	30.2
1987-91	29.2

This is because of changing age-specific fertility rates which become operative at various points of time.

In conclusion, it can be said, taking into consideration the possibility of alternative assumptions, that when female marriage age rises to 19 and no woman has a child before the age of 20, the birth rate in India would decline anywhere between 35 to 50 per cent. These are the two limits—the lower and the higher—and in the absence of all-India age-specific fertility rates it is difficult to give one firm figure.

1 *The Mysore Population Study*. New York: Department of Social Affairs of the United Nations, 1961. p.119.

2 Majumdar, D.N. *Social Contours of an Industrial City*. Bombay: Asia Publishing House, 1960, p. 161.

3 Mukerjee, S.B. *Studies on Fertility Rates in Calcutta*. Calcutta: Bookland Private Ltd. p. 18.

4 Balkrishna, R. *Report on the Economic Survey of Madras City, 1954-57*. New Delhi. Planning Commission, Research Programmes Committee, 1961. p. 236.

5 Sinha, J.N. *Differential Fertility and Mortality in an Urban Community of U.P.* (India). Ph.D. thesis, Lucknow University, 1952-53 (unpublished). p. 111.

6 Agarwala, S.N. *A Demographic Study of Six Urbanising Villages*. Delhi: Institute of Economic Growth, 1964. pp. IX1-IX.-IV (mimeographed).

7 Jain, S.P. *Certain Statistics on Fertility of Indian Woman to Show the Effect of Age at Marriage*. New Delhi: Office of the Registrar General of India, 1964. p.-3 (mimeographed)

8 Age 19 should be taken to mean 19 years completed.

9 Mr Goyal has employed this procedure.

SUGARCANE SHIELD

Maharashtra won the running silver shield in the sugarcane crop competition for southern region for 1963-64. The silver shield for the northern region was awarded to Madhya Pradesh.

In the southern region, Maharashtra farmers bagged all the three prizes for the one-year sugarcane crop, the first two prizes for the short duration crop and all the three prizes for the Adsali crop.

In the northern region, Madhya Pradesh farmers won the first two prizes for the one-year crop. The first two prizes for the short duration crop and the third prize for the one-year crop went to Uttar Pradesh farmers.

The highest yield per hectare was 387.89 tonnes in the southern region and 213.78 tonnes in the northern region.

Why Does U.P. Limp In Farm Production ?—II

TOO LITTLE USE OF FERTILISER

—THAKUR PHOOL SINGH—

In the first of the articles published in the July 19 issue the author had discussed the neglect of the new irrigation potential in the State and the diversion of the best lands from food crops to cash crops.

JUST as people require water and food to live and grow, plants too need water and food. But plants, unlike animals, have the ability to draw food from the earth, air and sunlight. When, however, the soil becomes deficient in life-sustaining foods, the plants can only exist; they cannot flourish. The way to make them flourish is to apply manures and fertilisers.

Manures and fertilisers make a greater contribution to the increase in yield per acre than even irrigation, just as we get more strength from the food we take than from the water we drink. Experiments carried out for four years (1955-59) at the State Soil Conservation Farm at Rahmankhera in Uttar Pradesh go to show that the contribution of manures and fertilisers is at least 50 per cent more than the contribution made by irrigation.

In all developed countries, higher agricultural yields have been obtained through use of fertilisers. The developing countries, too, have begun doing this—but only in respect of cash crops as the annual report for 1963 of the U.N. Food and Agricultural Organisation shows. It is well known that most of the fertilisers and manures available in our country are used for cash crops. The reasons for this are many. Producers of cash crops have easier access to credit, their production is more easily marketed, the returns are quicker and larger, and therefore they are keener to adopt modern methods, such as use of fertilisers. But greater attention to cash crops affects food cultivation. Some countries correct the situation by controlling the distribution of fertilisers. From 1956 onwards, the Philippines has restricted fertiliser subsidy to fertilisers applied to paddy lands in order to divert them from sugarcane fields.

Manures and fertilisers cover a wide range from cowdung, compost, green manure, oilcakes, press mud etc. to chemical fertilisers of numerous kinds. Each has an importance of its own. It is difficult to get reliable data about the quantity of cow-dung and compost available and used in the country. The farmers generally are advised to use organic manures and chemical manures in equal quantities. In practice, however, so far as the common run of cultivators go, they use as much of cow-dung as they can spare. Green manuring is not followed in U.P. One comes across huge growth of *Ipomea Cornea*, (commonly known as Hakim or Baihaya) along the roads and field boundaries, but it is seldom used as manure. There are many weeds which could be put to use but are not being used.

Ambitious production plans for chemical fertilisers based on estimates of needs have come unstuck for a variety of reasons. Where there should have been a fertiliser famine, there is huge carry-over of stocks from year to year. Consumption is not only far below the original expectations, but also below the present availability. The figures for U.P. are given in Table I below.

At least one alibi for low agricultural production cannot thus be pleaded. There are several reasons for this low offtake of fertilisers. The high cost of fertilisers is one. According to an F.A.O. report published in 1961-62, the farmer's price of a tonne (in terms of plant nutrients) of ammonium sulphate was Rs 1,882 in India as against Rs 693 (subsidised to the extent of Rs 547) in U.K. There is 25 per cent subsidy for superphosphate in U.P., but that is also not being used.

Apart from price, salesmanship plays an important part on the consumption of an article. The use of fertilisers will increase if farmers are better instructed in its advantages and judicious use. Easy availability of the right kind of fertiliser will also increase utilisation. In U.P., the Government has the sole monopoly of the sale of fertilisers and it does so through co-operatives, including cane co-operatives, and through the Agricultural Supply Organisation, which came into existence in April 1963.

These agencies, far from trying to educate the grower in the use of fertilisers, generally link its distribution with the supply of seed or credit. The farmer needs credit and seed very badly. It, therefore, often happens that he accepts the fertilisers also as a part of the deal and sells it in the market at cheaper rate. This is why fertiliser is available in the market at a rate cheaper than what the grower has to pay to the above-mentioned agencies.

I. Consumption Pattern

	Target	*Availability*	*Utilisation*
2nd Plan	225,000 tons	N.A.	143,000 tons
1961-62	311,000 „	270,635 tons	101,871 „
1962-63	463,750 „	353,073 „	131,822 „
1963-64	N.A. „	651,640 „	272,832 „

It is also true that the right kind of fertiliser is sometimes not available at the depots of the agencies. Storing capacity is inadequate to keep the suggested buffer stocks. The financial position of the agency, delays in placing indents and failure to consider the actual requirements of growers are also responsible for the right kind of fertiliser not being available. The central agency it elf is sometimes to blame: it supplies stocks without considering specific demands, for example C A N (Calcium Amonium Nitrate) where urea is indented.

As alredy pointed out, distribution of fertilisers is made by the Agriculture Department, the Co-operative Department and the Cane Development Department through the Agricultural Supply Organisation and the co-operatives, including cane co-operatives. The Agriculture Department and the Co-operative Department charge a rate of interest of 9 per cent a year, while the Cane Development Department charges 6½ per cent. The interest is charged on a six-monthly basis. Even though during the six months of a crop season the supply of fertilisers is made in any one month, the interest is charged for the full season of six months. The result is that the actual rate of interest charged to purchasers works out much higher than the apparent rate mentioned above. For example, the grower has to pay within two months six months' interest at the rate of 6½ per cent per annum on the fertilisers that he gets in the month of October, because the cane societies deduct the price of fertilisers from the price of the cane that he supplies to the factories in November and December.

All these defects follow from lack of competition. The person making supplies has no stake and the poor grower has no remedy for his ills.

The fertilisers are mainly nitrogenous and phosphatic. Table II alongside show the consumption of these fertilisers in different States in 1959-60 and 1961-62 in terms of nitrogen (N) and phosphoric acid (P_2O_5):

In 1962-63 it is estimated that the all-India consumption of nitrogen was 450,150 tonnes and that of phosphoric acid 102,000 tonnes.

The following conclusions can be

(*Continued on Page 28*)

II. Statewise Use of Nitrogen and Phosphoric Acid

State	Nitrogen (tonnes)		Phosphoric acid (tonnes)	
	1959-60	1961-62	1959-60	1961-62
1. Andhra Pradesh	27,834	77,230	14,025	17,956
2. Assam	914	279	128	115
3. Bihar	13,934	17,905	1,991	3,080
4. Gujarat	(a)	15,278	(a)	7,844
5. Jammu & Kashmir	903	1,046	1	16
6. Kerala	5,535	12,188	901	2,012
7. Madhya Pradesh	8,640	13,545	1,167	2,378
8. Madras	28,928	40,606	6,370	7,043
9. Maharashtra	37,236(b)	39,386	10,980 (b)	5,844
10. Mysore	10,411	23,345	3,008	4,591
11. Orissa	5,040	7,730	212	564
12. Punjab	5,126	17,449	181	1,055
13. Rajasthan	2,712	5,578	543	592
14. Uttar Pradesh	41,314	35,476	3,764	606
15. West Bengal	8,860	18,895	2,245	4,353
All States	197,387	325,936	45,516	58,049
All India (including Union Territories & Others)	230,816	369,764	50,111	62,934

(a)=included in Maharashtra (b)=for composite State of Bombay

III. Plant Food Consumption Per Acre of Cultivated Land, 1961-62

(Pounds)

State	N	P_2O_5	K_2O	Total
1. Andhra Pradesh	4.95	1.15	0.21	6.31
2. Assam	0.07	0.03	—	0.10
3. Bihar	1.55	0.27	0.04	1.86
4. Gujarat+Maharashtra	1.54	0.39	0.07	2.00
5. Jammu & Kashmir	1.02	0.02	—	1.04
6. Kerala	4.41	0.73	2.06	7.20
7. Madhya Pradesh	0.58	0.10	—	0.68
8. Madras	4.78	0.79	0.70	6.27
9. Maharashtra	a	a	a	a
10. Mysore	1.65	0.32	0.07	2.04
11. Orissa	0.95	0.07	0.01	1.03
12. Punjab	1.59	0.10	—	1.69
13. Rajasthan	0.33	0.03	—	0.36
14. Uttar Pradesh	1.40	0.02	0.01	1.43
15. West Bengal	2.52	0.58	0.43	3.53
All India (including Union Territories and Other)	1.97	0.36	0.17	2.50

a. shown with Gujarat above.

Note : Excludes fertilisers consumed by plantations, mixed fertiliser manufacturers and other users.

(Source : Production and Consumption of Fertilisers, Annual Review, 1962-63).

POWER : A Doubling in Fourth Plan

FOURTH PLAN IDEAS

THE Working Group of the Planning Commission has estimated an outlay of Rs 2,480 crore in the public sector and Rs 50 crore in the private sector for increasing the installed power generating capacity in the country to 24 million kW by the end of the Fourth Plan.

It is now expected that the installed capacity would reach 11.7 million kW by the end of the Third Plan. Benefits from continuing schemes would be 5.8 million kW, thus necessitating sanction for new schemes aggregating to 6.5 million kW. Pending finalisation of the Fourth Plan outlays, the Planning Commission has agreed to advance action on twelve new schemes of 2.04 million kW capacity.

The proposals were discussed at a recent meeting of the Planning Commission.

Of the total outlay, Rs 300 crore have been recommended by the Working Group for rural electrification. With this amount the Ministry of Irrigation and Power expects to electrify one lakh additional villages. About 43,000 villages will have been electrified by the end of the Third Plan, thus covering practically all villages and towns with a population exceeding 5,000 each and nearly 50 per cent i.e. 10,000 of those in the population group of 2,000—5,000. The outlays for various sectors in the Fourth Plan can be decided only after the size of the Fourth Plan is established. The Deputy Chairman, Planning Commission, was of the view that special attention should be given to the electrification of areas under the intensive agricultural development programme. A purely statistical approach to rural electrification based on the number of villages to be electrified was not desirable and electrification should be extended to all such areas where there was potential for development of lift irrigation and rural industries.

The total outlay includes Rs 50 crore which will be the spillover amount required for setting up the two atomic power stations at Tarapur (380 mW) and Rana Pratap Sagar (200 mW). Besides, the Atomic Energy Commission has proposed the construction of a 400 mW station near Madras and doubling the capacity at Rana Pratap Sagar.

REGIONAL APPROACH

As a matter of policy for formulating the power programme for the Fourth Plan, the Irrigation and Power Division of the Planning Commission has made a number of suggestions.

To make electricity as cheap as possible it is necessary to bring down the construction cost of power projects. One of the important steps to reduce the costs is to adopt the modern practices and the latest advances in technology and to examine to what extent the structure of the power supply industry needs to be reorganised.

The aim of the power programme should be to meet the power requirements of a State by harnessing the most economical resource in the region. But energy resources not being distributed evenly in all the States; some States like Gujarat and Punjab may have to depend on neighbouring States for their future power requirements. *A regional approach, regardless of boundaries, to the generation of power is therefore advisable.* This is also rendered necessary because of the anticipated production of a big quantity of middlings from the coal washeries in the Bengal-Bihar region. The middlings have little other use except in power generation. Large thermal power stations should be set up at pitheads or washeries and the power transmitted to adjacent States. Hydro-electric potential should be tapped for use of the region as a whole though the limited demand of the State concerned may not by itself justify it.

Thermal or atomic stations can be used more effectively and economically if they work in conjunction with hydro-electric stations—the former as base stations working at optimum efficiency and the latter for peaking purposes. Similarly, during monsoon, hydro-electric stations can be put to maximum use, thereby reducing the running hours of thermal units and, as a result, saving coal. *Such an integrated operation of power systems is expected to yield a saving of Rs 200 crore in the capital investment in the Fourth Plan and Rs 20 crore on maintenance every year.*

A beginning has already been made in the direction of regional integration by setting up five Regional Electricity Boards comprising representatives of the concerned State Electricity Boards and the Central Electricity Authority. Regional grids should be established with the ultimate aim of having an all-India grid.

It is considered desirable in the national interest that the Centre should assume direct responsibility for planning and setting up large power stations, both thermal and hydro-electric, particularly those which would benefit two or more States. The setting up of a Central Generating Board has been suggested to undertake such projects. The Centre should also take direct responsibility for laying extra high voltage lines for conveying bulk power over long distances. In many areas, 400-kV lines would now be necessary.

23 MILLION MORE WILL ASK FOR JOBS

FOURTH PLAN IDEAS

THE Planning Commission at its recent meeting recommended that the Fourth Plan should strive to create employment opportunities at least equivalent in number to the new entrants to the labour force (23 million).

The carry-over of the unemployment back-log from the Third Plan into the Fourth Plan may be roughly estimated at 12 million, as compared to 8 million at the beginning of the Third Plan. While no definite view of additional employment in the Fourth Plan can be taken the Fourth Plan as drawn up by the Working Groups may have an employment potential of 17.8 million in the non-agricultural sector and 4 to 5 million in the agricultural sector.

If the physical targets as suggested by the Working Groups are scaled down the employment objective of the Plan may be in danger. As unemployment of the order of 12 million will be difficult to sustain for a long time, the Plan effort in terms of employment may have to be even larger than 23 million, say 25 million.

An accurate picture of the employment situation cannot be had because data on unemployment are not comprehensive. A countrywide survey of unemployment at the end of the Third Plan is therefore to be conducted by the Ministry of Labour and Employment with the cooperation of State Statistical Bureaux and in consultation with the Central Statistical Organisation and other Central agencies.

The Rural Works Programme has greatly contributed to relieving unemployment during the Third Plan period. But such employment is seasonal. The programme should be so developed in the Fourth Plan that it should provide wholetime employment also. For this purpose, the programme may have to be integrated into the district development programme.

The programme of public works will also have to be enlarged. An extensive network of communications should be established so as to energise the rural areas and to break their isolation.

Plan Snippets

Government is taking special measures to ensure the raising of larger crops in the next Rabi season by increasing the acreage and adopting improved practices...The Industrial Finance Corporation has given financial assistance of Rs 196.78 crore to 334 industrial units during the past 16 years of its existence. In 1963-64, it gave Rs 38.27 crore to 90 concerns. The Corporation has decided to relax certain regulations for assistance to industries...Twenty-five medium irrigation projects and 11 hydro-electric projects have been completed during the Third Plan so far ; and 221 irrigation projects and 40 hydro-electric projects are under construction...Survey work on the entire length of the main Gandak canal up to the U.P.-Bihar border has been completed and earthwork on the main canal is in progress from miles 25 to 53...The National Instruments Factory at Avadi will manufacture, along with other instruments, dental instruments...The U.S. private capital investment in India increased to Rs 17 crore in 1963 from Rs 11.15 crore in 1962 and Rs 5.57 crore in 1961...The Union Government will set up a tractor factory in the Punjab and will import 1,000 tractors to meet Punjab's immediate demand.



The Planning Commission met on September 23, 24 and 25 to consider the Draft Memorandum on the Fourth Plan to be placed before the National Development Council, scheduled to meet on October 27 and 28.

Members of the Planning Commission met the Chairman on September 26 and had further discussion on the size of the Fourth Plan and the pattern of investment.

The Planning Commission held further meeting on September 27 and the broad outline of Fourth Plan came up for discussion before the Union Cabinet on September 28. It was felt that the growing needs for the important sectors had to be met though they had to be considered in the light of resources available. Work on the Memorandum to be submitted to the National Development Council is proceeding.

Mr Shriman Narayan, Member of the Planning Commission, has been appointed Ambassador to Nepal.

Mr Pitambar Pant, Chief of the Perspective Planning Division, left for Paris on September 27 to take part in a meeting organised by the Organisation for Economic Co-operation and Development.

Mr Abdulla Yaftali, Minister of Planning, Government of Afghanistan, accompanied by the President of the Afghan Bank, called on Mr B.R. Bhagat, Minister of Planning, on September 23.

Mr Orlando Letelier, Special Assistant to the President of Inter-American Development Bank, and Mr A. Maglaque, Economic Affairs Officer, International Trade Branch of the Economic Commission for Asia and the Far East (ECAFE) Secretariat, met Dr D.K. Ghosh, Director (Foreign Exchange), and Dr K.S. Gill, Director, Economic Division, on September 28.

Mr M. Butt, Joint Secretary, and Mr U.S. Rana, Director, Liaison, took part in an American Peace Corps Seminar held in Madras from October 8 to 10.

Mr R. P. Sachdev has resumed charge as Director, Co-ordination, from Mr R.M. Kantharajan.

QUOTATION BOX

In our country the Prime Minister, whoever he may be, always takes the second place to good men like Acharya Vinoba Bhave.

—The Prime Minister

Hammer for the one and sickle for the other.

—C.R. on the division among Communists

The Union Minister has written to me to say that no indiscriminate killing of frogs is taking place for export of legs, and frogs are collected at central places and then treated in a humane way. I have also received an assurance from the Seafood Canners and Freezers Association of India that the frogs are taken 'to butchering centres where they are killed by the heads being cut off which causes instantaneous death.'

—Mrs Rukmini Devi, Chairman, Animal Welfare Board

Mr Nehru's prestige should not be reduecd to 50 paise and 100 paise.

—Mr S.M. Banerjee, M.P., on the plan to mint Nehru coins

The Minister must make his speech listenable.

—Mr Anandan Nambiar, M.P.

Condoms should become as available and respectable (in Indian villages) as matches or *bidis*.

—Mrs. Taya Zinkin

Public men, especially in developing countries with not much money to throw about are always well advised to ask themselves "is your committee—like your journey—really necessary ?"

—Editoral in "The Statesman"

The Hindi creative artist lives penniless in a hostile, almost harsh, world. But as soon as he dies, he gets all he needed in life.

—A letter in a Delhi newspaper

Hurry up for the first child, welcome the second, wait for the third and stop the fourth.

—Advice of the Maharashtra Health Minister

Riding and field boots, several pairs, in good condition—Fit for use by I.P.S., I.A.S. and other probationers.

—A newspaper advertisement

And perhaps it is only in Delhi that a charming hostess could remark to an anxious guest: "Please don't be nervous. I have boiled the ice."

—Mrs. Amita Malik in "The Illustrated Weekly"

I agree with Mr Krishna Menon that the question is not whether you are a rightist or a leftist but whether you are for astrologers or for fertilisers.

—Dr. K. N. Raj

Apparently there are ways and ways in which people can live comfortably without income.

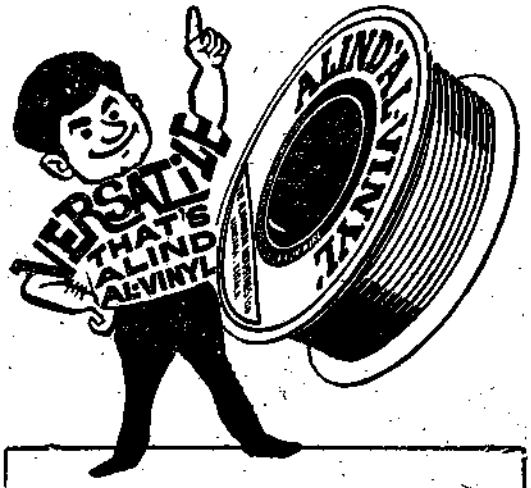
—Mr T. T. Krishnamachari

Why should not Ministers give up big houses? Why should the emphasis be only on small cars, as if the size of cars indicated simplicity?

—Mr B.H. Zaidi, M.P.

All Prime Ministers favour smaller Cabinets though in practice it's not so easy.

—The British Prime Minister



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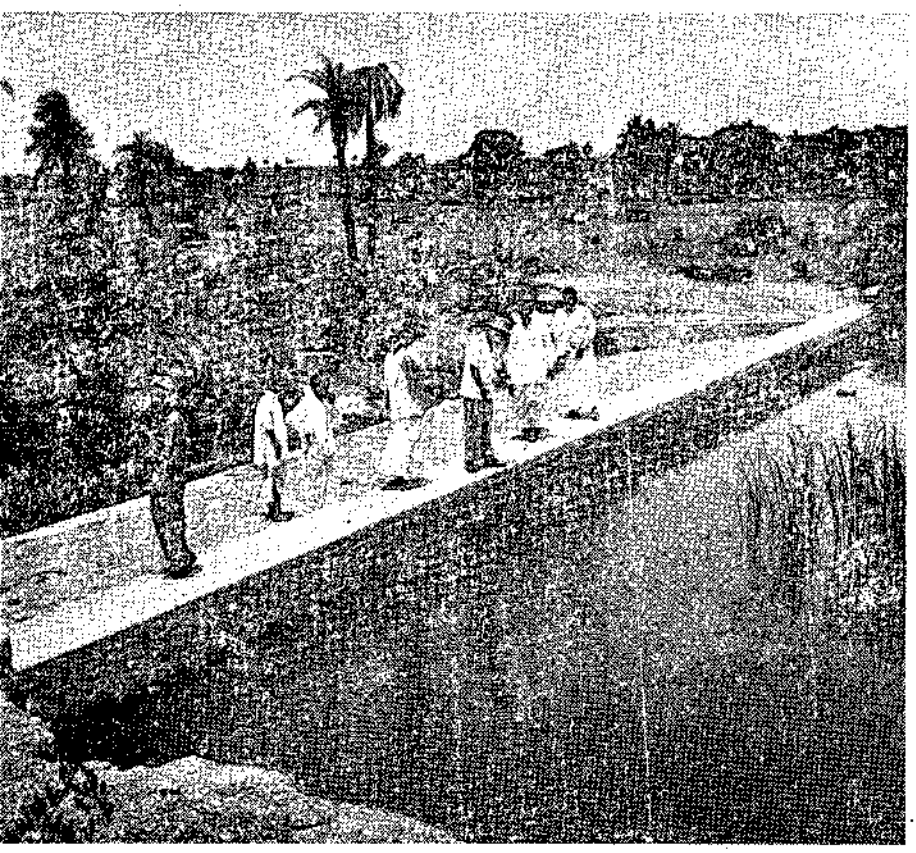
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BRIGHT SPOT IN BELLAR

Village Redeemed
Vision of a So

Chikkajogihalli has now a good road running over bridges and culverts.





IN the Bellary district of Mysore there is a village called Chikkajogihalli, which means 'village of the young mendicant'. Twelve years ago it was a dismal collection of hovels and wild shrub. Today it is an example of what a village should be in modern India.

The transformation is due to the vision of Mr. K Venkataswamy, a leading industrialist in Bangalore.

Mr Venkataswamy belongs to Chikkajogihalli. One day in 1953, thirty years after he had left the village, he revisited it and on that day he resolved that he should make it into a village of which everyone of its children would be proud.

Modernisation begins with the home. Mr Venkataswamy started by building a city-type house in Chikkajogihalli. An old well which had been in disuse was repaired and he installed a pump for the use of not himself alone but the whole village.

After a place to dwell and water to drink Mr Venkataswamy turned his attention to communications. The approach to the village was such that even a jeep couldn't make it. But now a good road 29 kilometres long was constructed with voluntary labour donated by Bharat Scouts and Guides. These volunteers came entirely from the villages that were to benefit by the road. A thousand men and women worked for three weeks. The result : the stony, bullock-cart track became a fair-weather motorable road. The Government came in to make it 'pucca'. And today it is part of a national highway.

The road done, a 'pravasi mandir' was built. Then followed a multipurpose co-operative society which serves 25 villages around. Within three years the society was recognised as a large-scale society ; besides issuing credit, it also distributes cement, iron and fertilisers.

This part of the State has always been a scarcity area. As Mr Venkataswamy put it, "Famine used to be a never-failing annual visitor." But it is no longer so. Rainfall continues to be below 50 cm, but several wells have been sunk since 1954, disused ones reclaimed and diesel pumps installed. There are at least 20 pumpsets in the village now.

With water came the wonder powders that make the earth grow more, and better seeds. Where nothing grew before except thorns, today paddy and sugarcane and chillies are grown. Coconut palms have been planted and a flourishing poultry farm has come up. For people of the Scheduled Tribes like Lambanies and Vaddars found in large numbers in the region a mat weaving co-operative has been started with capital of nearly Rs 30,000. All its directors are from tribal classes—and the society provides full-time work for 500 to 750 people for six months in a year and enables each worker to get about Rs 4 a



week. Another co-operative institution is the Neera Society which has absorbed the tappers rendered unemployed with the coming of Prohibition. The Society has acquired a sugar-making plant, and provides a living to 100 families who, otherwise, would have been tempted to take to illicit distillation. The Government has been prompt in giving technical and financial help to all these institutions.

Chikkajogihalli has also grown into the market-town for the surrounding area. A weekly fair is held every Monday, and the turnover is as high as Rs. 10,000. The village is also proud now to have a post office as also telegraph and telephone facilities.

The village has had an active panchyat since 1961. A 12-bed hospital has been built which serves seventy neighbouring villages. Its two doctors treat more than 130 outpatients daily. Mr. Venkataswamy has also renovated two temples.

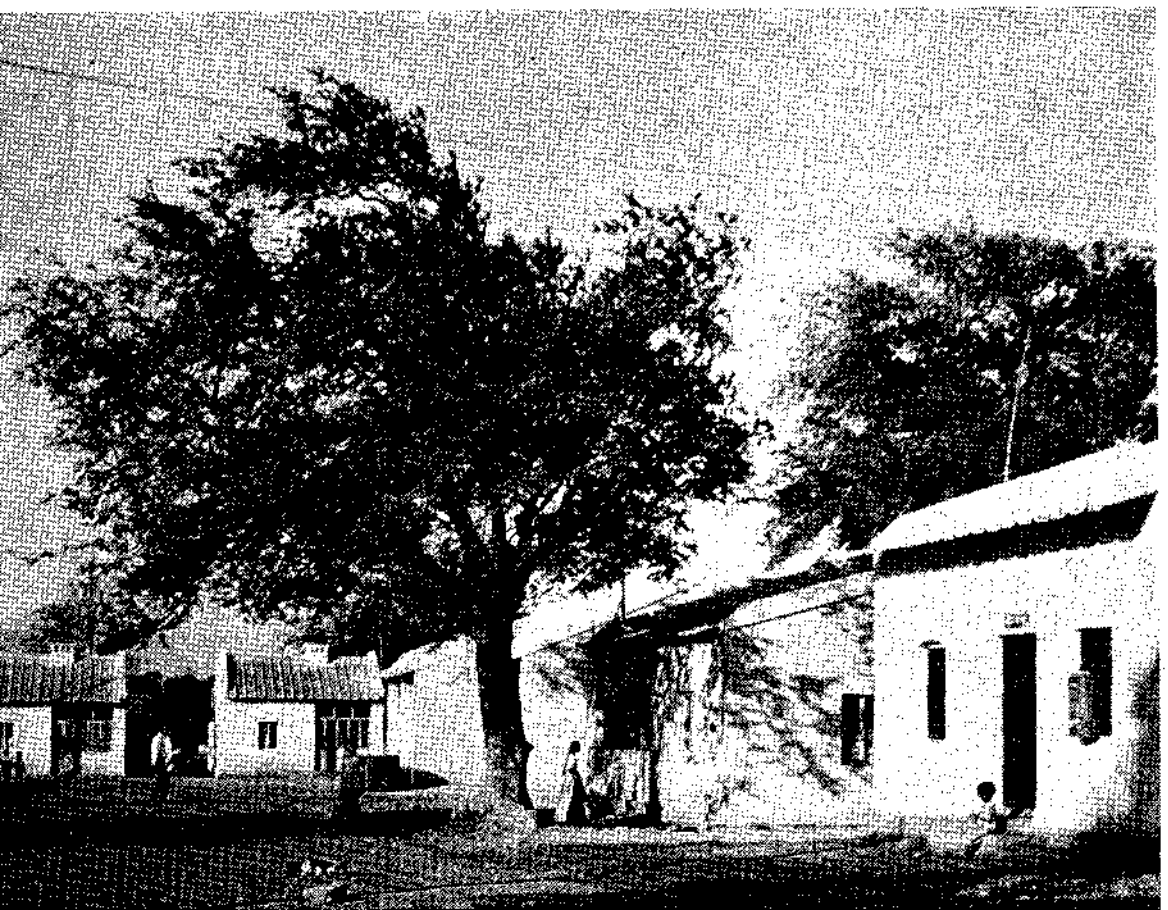
Education has grown with remarkable tempo. The village now has a nursery school with 100 children, a primary school and a middle school with 250 children and a high school with 100 students. A hostel has been started for backward class children in Mr. Venkataswamy's paternal house. With Rs 30,000 given by the Social Welfare Department a hostel building is being constructed. The State House Building Corporation has sanctioned Rs 92,000 for building 30 houses for the houseless. Some 63 more houses have been built under the subvention schemes for Scheduled Castes and Tribes.



Above: A coconut grove comes up on land that was a rocky stretch.

Left: Where not even dry crops could grow, irrigated crops like paddy and sugarcane are raised, thanks to harnessing of wells.

Now, after ten years of striving and achievement, Mr. Venkataswamy says, "It is no small satisfaction for me that my village is one which the founding fathers of new India would approve of."



More than a hundred houses have come up where thatched hovels once scarred the landscape. The village has a large service co-operative society, a high school, a 12-bed hospital, a post office, a weekly fair, a mat weaving society, and a neera society and is guided by an active panchayat.

Do you save what you mean to save? Who does?

TO BE HONEST I DON'T EITHER! It's like this: when I can easily get to my money I am tempted to spend it. And most often I do.

But if I deposit a part of my income as life insurance premium, it stays unspent until I really need it. What's more, even if I should not live long enough, I know my family will be able to live in comfort.

I think Life Insurance is the best way to save—the money stays saved.



There is no substitute for

LIFE INSURANCE

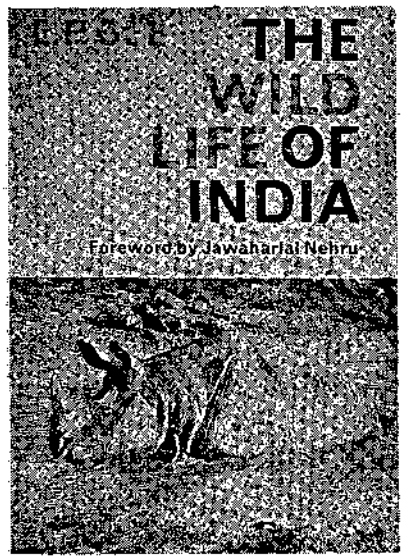
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Gee After Jim

JIM Corbett, whose name is legend, said in the 'forties that the tiger would be extinct in India within a couple of decades. The prophecy, luckily, has not come true. There are supposed to be 4,000 tigers still in the country today, compared to 40,000 some fifty years ago. We also have some 280 lions, 440 rhino and 7,000 elephants left.

They might vanish from India at the rate at which we are encroaching on forests and officials and villagers indulge in their love of unauthorised sport, but for the fact that ideas of conserving wild life are also spreading.

"Shoot with the camera, not with the gun" is the admonition all over the world. In a country with a



tradition of non-violence we should heed it the more.

Already many species of wild life have been wiped out from our country. The Wild Life Board has sought special protection for thirteen kinds of rare fauna which are in danger of extermination: the Indian lion, the snow leopard, the clouded leopard, the cheetah, the rhinoceros, the Indian wild ass (the only wild ass left in the world), the Kashmir stag, the musk deer, the brow-antlered deer, the pigmy hog, the great Indian bustard, the pinkheaded duck and the white-winged wood duck. So vast is our country that some animal species are still being discovered and identified—for example, the golden monkey named *Presbytis geei*, after Mr E.P. Gee the naturalist.

Mr Gee's book is one of the good things that have happened to the cause of wild life between last year's Wild Life Week and this year's (which has just concluded). It is a beautiful book, a book that ought to be read by everyone who claims to love India. It has 109 lovely pictures from all parts of the country and a lucid text, precise in observation, light in its flow, with little of that undergrowth that clogs jungle books.

Our favourite anecdote from the book : "When Kaziranga was opened to visitors in the year 1938, I was one of the first to go and see it... Rhino were then unused to seeing human visitors, and often their reaction was to charge those intruding into their haunts....I remember writing my remark in the visitors' book, 'Twice charged by rhino, and the elephants each time bolted for some distance'....A few months later some planter friends of mine visited the sanctuary, by which time the rhino of that vicinity had become more accustomed to visitors..They wrote in the same remarks column, "Rather disappointing. Charged only by the Forest Department."

The book has a foreword by Mr Nehru in which he wonders what right we, who are so uncivilised ourselves, have to call these beautiful animals, deer or tigers, wild.

How we wish a low-priced children's edition of the book can be brought out with all the pictures, intact and the text shortened.

Mama Passes

TWO veteran playwrights have died, Sambanda Mudaliar of Tamil Nad at the age of 93 and Mama Warerkar of Maharashtra at 81.

Between them Mama was better known in the rest of the country, for he was active in literary society and in politics. So much did the nickname 'Mama' stick to him that few remembered his real name was Bhargavaram. He himself was fond of saying that Bhargavaram was an impostor seeking to wrest Mama's popularity.

Bhargavaram was irrepressibly chatty and a man of acid, cynical wit who looked at things as he wanted them to appear. But to Mama the author, writing was a passion and a faith. Fifty years ago, when the profession was even more precarious than today, he quit his job in Posts and Telegraphs to become a wholetime author. His struggle for existence was hard and only ten years ago, before he was nominated to the Rajya Sabha, he had to write crime and mystery books to make a living.

In his eventful literary career he provoked controversies and often incurred unpopularity. But he was the only author in Maharashtra whose sensitive mind touched every problem in political and social life since the beginning of the twentieth century. He wrote dozens of novels, scores of plays and hundreds of articles and stories. He produced films and published periodicals. He introduced several new trends in the theatre and journalism ; Ibsenian technique is his pre-eminent gift to Marathi drama. He was also connected with broadcasting in India from its very first day in Bombay 35 years ago.

But Mama's greatest contribution is in the field of inter-regional communication of ideas. He had an all-India outlook and made friends with literary men from the different states. He was as conversant with Bengali literatre and theatre as with Marathi, and translated into Marathi the complete works of Sharatchandra Chattopadhyaya and Bankim and some Tagore.



IGNORAMAN

Wants to Know

Will the unjeeped BDOs do 'padayatra' or seek transfer?

Books

Resources for Planning

Public Finance in Underdeveloped Countries by R.N. Tripathy. World Press, Calcutta. 288 Pages. Rs. 15.

Narindar Singh

"If we had some butter we could have some bread, and butter if we had some bread." This sums up, I believe, the problem, as traditionaly posed, of resources for the development of an underdeveloped country. The obvious point to make is that the fiscal problem, *as traditionally posed,* ignores the vital fact that in the process of 'mobilising' *some* butter and *some* bread, more of the same are, and have been, created. Besides, processes are set in motion that, though quantitatively inexpressible, are, qualitatively no less significant than crude ratios of capital accumulation themselves.

In some mysterious fashion, which the economists have not yet been able fully to unravel, people get drawn into the process of development, giving it a new content and momentum. India's main difficulty, for example, has *not* been in regard to the *nominal* rate of saving itself. Rather, it has been the failure of the mass of the people to participate in the process of development such as it has been. If apathy and indifference were the greatest enemies of the country in Ranade's time, they continue to be so even today.

Nothing else explains our dismal performance on many fronts. To mention only the most obvious and deplorable fact, our agricultural output remains more or less stagnant, despite considerable increase in the availability of inputs of all types. Such a clear distortion of the simple cause and effect sequence must leave many an armchair economist perplexed and shaken, if not beaten. There must be something more to the process of development than mere nominal saving rations could indicate. "The central problem in the theory of economic growth," according to Professor Lewis, "is to understand the process by which a community is converted from being a 5 per cent saver to a 12 per cent saver—*with all the changes in attitudes, in institutions and techniques which accompany this conversion.*" (Emphasis added). In effect, therefore, there are many problems, not one. Yet from our experience it would appear that the second group of conditions is perhaps more difficult to satisfy than raising the saving ratio. If therefore, (to parody Orwell) there are many central problems that confront us, some, it seems, are more central than the others! Professor Lewis himself comes to saying very nearly this when he points out that there is no country so poor that it could not save 12 per cent of its national income *if it wanted to*; for, poverty has never prevented many nations from launching wars, *or from wasting their substance in other ways.*

This, I submit, is the crux of the problem that we face rather than a shortage of capital *in the usual sense.* Which of course is not to say that we have an abundance of it. Yet the point is that virtually the only opportunity available to an underdeveloped country, which is by definition short of capital, is superior organisation. For, then alone will two and two make more than four, while in the conditions now existing, they invariably make less than three if not two. But, superior organisation means not only avoiding delays and inefficiency of all sorts and thus reducing the cost of what we do, but to do only what we must. How far can *this* be said of much of the public and private expenditure in the country today? We are 'wasting our substance' in more ways than one: buildings go up on fabulous scales to swell expenditure and use up real resources that could have been used far more productively, while all that we can afford is functional, utility construction. Posh bungalows are being constructed to house senior military officers and this inordinately pushes up the defence bill, which it would be unpatriotic to question. And, yet, when the time comes for 'pruning' the Plan, which often does, one essential project or the other gets lopped off. How far do our practices measure up against the precept laid down by Arthur Smithies that the fiscal policy is a "policy under which the government uses its expenditure and revenue programmes to produce desirable effects and avoid undesirable effects on national income, production, and employment?"

Primarily, then, the problem is one of economic and social reorganisation for better order of priorities. We as a nation have to learn to instinctively oppose waste and extravagance. We have to learn to participate in the process of development. "Our plan implementation succeeded," said Mr. Asoka Mehta recently, "where it was a question of technical achievement such as power production, but it broke down the moment it became a human problem and the people's co-operation was required."

It is this human factor in development that has largely been ignored. And, it is this factor that accounts for at least as much as material capital does in the process of development. As Kuznets has shown in the fourth of his *Six Lectures,* the differences in the rates of capital formation in the rich and poor countries fail to explain all the differences in the respective living standards enjoyed therein. With a 5 per cent rate of capital formation and a capital output ratio of 2.5:1 and a fairly slow rate of population growth, which then prevailed, the still underdeveloped countries should have more than doubled their per capita income over the last hundred years or so. But nothing of the kind seems to have happened. Which only shows that some other factors must

also have been at work to neutralise the role of the observed saving ratio.

Economic development therefore consists not only in raising these ratios, but in correcting the other deficiencies also. But somehow, attention has been devoted to nominal rates of 'capital formation' to the almost complete neglect of the other factors. Perhaps, they are not so easily measurable or even identifiable and, economics being by heaven ordained to be an exact science, cannot afford to take much notice of them.

Such are the considerations that make me wary about books on the role of public finance in underdeveloped countries. Whatever the level of theoretical coherence achieved by them, they are almost exclusively devoted to making formalistic proposals. Dr. Tripathy's treatise is no exception to this general rule. From "the point of view of economic analysis," he says, "the most important macro-variables determining the process of economic growth appear to be: (a) the proportion of a community's income devoted to saving and capital formation, i.e., the behaviour of the coefficient of investment; and (b) the rate of growth of population *vis-a-vis* the rate of growth of output (p.3)." Thus, only if the country attains "a rate of growth of output which exceeds the rate of growth of population by a significant margin", will it "begin to improve its standards of living." The mathematics involved is unexceptionable, and yet, as the Kuznets illustration would show, the mathematics is not the whole story. The saving ratio should have resulted in a rate of growth of national output significantly above the rate of population growth. But it did not. Why? This, I believe should have been a more fruitful field of enquiry, which, unfortunately, has been completely left out by the author.

All that he does is merely to reiterate the points too often made in the literature: vicious circles, the demonstration effect, and all that. These questions having already been beaten to a pulp, there is hardly anything new or enlightening that he could say on them too. He seems to have been left with no choice, therefore, but to assemble quotations by the score. In fact, there is a heavy cargo of inverted commas literally on every page, though it is *not* the case here that the remarks confined within the same are mutually contradictory. But they hardly get one anywhere. On the role of fiscal policy in a developing economy all that he has to say is that (a) it must accelerate the rate of public investment; (b) mobilise resources for the public sector; (c) maintain as much stability as possible and (d) redistribute the growing national output. The first two appear to me to be one and the same thing and the other two are nothing but pious sentiments. But how are they going to be put through?

Public sector, of course, comes to the rescue. For, in no other way can fiscal policy perform "its role as a positive, dynamic instrument of economic development". But this dynamism is to be more or less confined to the provision of social overheads which are too unattractive for the private sector. The argument by now is too familiar for me to take it up here at any length. But what the author seems to be stressing here is that virtually the only justification for the public sector to exist in an underdeveloped country is the service it may render to the private sector.

However, even within this limited perspective, fiscal dilemma is inescapable. The public sector, on the eve of its initiation, when it cannot count on reinvestment of its older earnings, has to draw resources from the private sector. But the taxes meant for the purpose may act as a distinctive to the latter. At least that has been the textbook argument reproduced faithfully by the author. In a dynamic setting this may not be so. For, such taxes help ultimately to create facilities meant precisely for the growth of the private sector. Such taxes, in any case, have not inhibited the further growth of the private sector in this country. Perhaps that has been due to the extensive evasion of taxes going on at the same time. The high marginal rates of taxes, which the author considers a necessary evil in the Indian setting, act more as an incentive to conceal one's income than as a disincentive to 'work and save'. But the author imagines somewhat naively that they help to maximise the resources available to the public sector. That is a conclusion which would need some material to support it.

JUTE FACTS

Study of Jute and Mesta in India. Committee on Natural Resources, Planning Commission. 59 pages.

THE Planning Commission study group in its survey of jute and mesta has assembled all the essential data about the major commercial crop of Bengal. The analysis of production trends over a decade or more shows that the consequences of partition of Bengal do not count really as compared with the rise of the jute mills in Pakistan. The small peasant who happens to be a jute-grower is dependent on steady export of jute manufactures but the challenge of substitute packing materials cannot be dismissed.

The study converges on the results of the Plans for the jute grower who requires help to raise the yield. The competing claims of rice cultivation make it necessary to ensure regular export of Orissa rice to Bengal. This is a point of great interest at present—far more important than the comforting mixture of Bimlipatam jute (called Mesta) with real ute. It may be noted that mesta has gained ground in West Bengal as also in Bihar.

The study does not give attention to the effects of constant speculative trading in Calcutta. The raw jute and fibres markets afford opportunities for making quick profits and the efforts at planned development should give attention to the reduction of the gambling element in the trade. Small supplies from Bihar, Orissa and U.P. augment the jute production in Bengal. But it is well to recognise that East Pakistan has many advantages as a producer and the effort to buy better grade of jute should be kept up so that trade with East Pakistan does not languish. This of course is a political issue but it must be said that export trade requirements still call for imports of raw jute from East Pakistan and even the planners cannot aim at total self-sufficiency, because rice is more vital than jute by current reckoning for Bengal.

Misprints mar the text but the statistics are illuminating for those who clutch at the arguments for regulation—of the trade, not the acreage under jute as in the past!

M.K.R.

A NONAGENARIAN LOOKS AT EDUCATION

Our Villages Are an Encyclopaedia for Students to Study

N.G. CHAPEKAR

Yojana considers Mr Chapekar to be the eldest of its family of contributors. He called this essay 'rambling thoughts on education'.

NOT being a material thing, education is not easily defined. But whether defined or undefined, education is tied up with the purpose of our existence. We are not born merely to die. We come into the world with an assignment of duties. We are born with a *rina* (indebtedness, although it is too inadequate a word), with liabilities. This doctrine of birth with *rina* is a peculiar feature of the Indian attitude to life.

According to this view, man is born to discharge his duties ; it is only when he does his duty that he is entitled to the discharged receipt, to *moksha*. The *rinas* are mainly three—duty to God, duty to the ancestors and duty to society.

Divine power has the first claim upon us. Next to divinity come the ancestors. But for them where would I have been ? I enjoy all the comforts of life. I can fly to America or run to Delhi within an incredibly short time. All this is due to the achievements of my forerunners. I have to acknowledge their debt. Last comes the present, living generation. From birth to death, we all are helped directly or indirectly, perceptibly or imperceptibly, consciously or unconsciously, by people around us. Taking service from society, it is incumbent upon us to render service to it in return.

If these fundamentals were impressed on the minds of our youth from childhood, they would turn out to be useful citizens of the world. Belief in the supreme being supplies us with the ethical basis of life. Realisation of what we owe to our forefathers will make us humble. Knowledge that we could not live in this world without the help of others will induce in our youth the sense of equality, fairplay, civic sense, cordiality and respect.

Thus service to the nation and to all mankind is, or ought to be, the mainspring of man's action. In order to render this service, we have to equip ourselves morally, intellectually and emotionally. This brings us to the practical side of education. While discussing intellectual preparation, we have to bear in mind that no one can be all-knowing. No one is all-wise, and he must not be. Capacities and capabilities differ with individuals. However learned a man may be, his ignorance will be greater. His knowledge may be as high as a hill, but what he does not know will be like the Himalayas. I may be proficient in a few subjects, but there are numerous other subjects of which I do not know even the rudiments. From this it will be realised that what matters is not the amount of information pumped into the head of the learner but the extent to which his thinking capacity is sharpened and his mind developed both to acquire the capacity to comprehend and to contain what is comprehended.

The Little World

The system of education in our country is wholly vitiated by the assumption that the schools and colleges are meant for teaching. On the contrary they ought to exist to enable the student to learn. The teacher's task is to aid the students on their own to learn. The initiative should rest with the students and not with the teachers. It is unfortunate that at present stress is laid on teaching, instead of on learning, on text-books instead of discourse, and on getting things by rote instead of by independent thinking.

Stimulating the intellect of our boys and girls is the prime function of education. How is this to be brought about? I may make a suggestion, possibly a novel one: that a year's course of the study of their own village should be prescribed for our young people. Just as the world is one large co-operative society, the village is an encyclopaedia of knowledge and experience. We have in the village all the subjects to learn—subjects that confront and confound the State Ministers in the Sachivalaya: sociology, economics, agriculture, forestry, history, education, religion, trade, public health, etc.

All Education Is Basic

Let the youth be employed in census-taking of the men, women and children in the village. Let them find out the total acreage of the land under crop cultivation, and the total yield of grain and other crops. They will be able to see whether the gross output of paddy is enough for, more than, or short of, the total consumption of the village. While their teacher is expounding the intricacies of crop production, they will naturally have to discuss matters relating to manure and rainfall. They will not fail to get an insight into the administrative set-up also of their village life. For their attention will be directed to the working of the panchayat when they are considering the question of village sanitation. Boys who do this sort of study will make better ministers than the ones we have.

This, it may be said, is analogous to basic education. I venture to say that no education is worth the name which is not basic. Learning merely a craft is not education. To know a fact is not education. The knowledge that Poona is 120 miles from Bombay is not education. I must know all the circumstances which are

involved in this statement. What is a mile? How is distance measured? If mile is an English word what are our words for the distance? What were the original measurements? I shall feel enlightened and interested if I were told that the foot, the hand and the finger were the original measures and that these are still used to measure the length of a thing. We still say that our house is a few paces from our neighbour's house.

Here I may narrate an incident which, I trust, will be found interesting and also illustrative of the inherent defects in our educational system. It happened in 1891. The B.A. results of Bombay University were just out. I was on my way to Bombay to arrange for my law terms. At the railway station I met my professor from the Wilson College. He was on a visit to the dispensary that had been opened by the Scottish Mission at Badalpur. He did not know that I belonged to the place. He told me that he had noticed I had passed my examination. But what had struck him was that my name had been misspelt in the papers and given 'Chaphekar' instead of 'Chapekar'. Then he asked me why there were so many Patils in my village, and put a few other questions, all of which nonplussed me. This foreigner comes to my village and gathers so much information within a few hours! This was most amazing, particularly when we had not too high an opinion of him as a teacher. We had three Patils for Badalpur where there should have been only one. The fact, however, was that three closely situated villages had been grouped into one at some stage. It would be apparent to the student who studies the village first that two Patils are superfluous and a burden to Government. If no officer feels concerned about this wasteful state of things, it is because of our defective education.

The trouble with our present education is that it does not stick. It is not assimilated. It is like foreign matter in the body, expelled at the time of examinations. The consequence is that pupils have an interest in education only so far as it enables them to get a job somewhere. A degree is just a job ticket, not a badge of enlightenment. Nobody learns for the sake of knowledge. No wonder that the present system produces inadequate citizens.

LETTERS

Loans for Students

It is heartening to learn (Planning Newsletter *Yojana*, August 30) that more provision has been recommended in the next Plan for scholarships and that loans rather than outright grants to students have been suggested. It is also gratifying to know that a statutory organisation is proposed to be set up to administer scholarships and loans.

In some of the States in USA there are statutory bodies which guarantee loans to students granted by various banks in the state. Government contributions and public donations made to these bodies are held as cover for such guarantees. The banks grant the loans and recover them in easy instalments from the students when they complete the course and get employed. The handling and recovery of the loans is thus entrusted to efficient and experienced banks, ensuring quicker disbursement and better recovery.

The arrangement between the Canara Bank Jubilee Education Fund (Book Banks, *Yojana* August 30) and the Canara Bank in the matter of handling the loan scholarships is more or less on similar lines. Here, instead of the statutory body a private society guarantees the loans made by the bank and to back up the guarantee, a sum of Rs 1 lakh has been set apart. Against this sum the Bank has granted a limit of Rs 5 lakh for granting loans.

If the proposed statutory organisation enters into an arrangement with the scheduled banks, loans to students could be handled more efficiently and a large organisation does not have to be built up for the purpose. The money set apart may be diverted through the banks on a nominal charge or even without charge. The banks will have the advantage of the service of their branches to handle these loans, earning the goodwill of young and brilliant students. In America, various banks have also their own schemes of financing students.

It is up to the proposed statutory organisation to see how best it could secure the co-operation of the banks in this task. The banks, on their part, can also think of financing students on their own

Bangalore S. R. PRABHU

USING MANPOWER RESOURCES

"UNEMPLOYMENT and the Educational System" (*Yojana* August 2) depicts a gloomy picture of the educated unemployed in our country. As the wanted columns of daily papers show, everyone likes to recruit experienced and trained personnel. One fails to understand how a graduate fresh from college can have any experience unless he is given a chance to work in any office. A matriculate who joins as a clerk and puts in four years' service is usually preferred to a new graduate. In the circumstances educated unemployment will go on increasing unless the educational pattern is made job-oriented.

What a developing country needs are technical and vocational training institutions in large numbers. Technical training is more important these days than a mere degree in arts. The emphasis in planning should be to train personnel for small and medium scale industries.

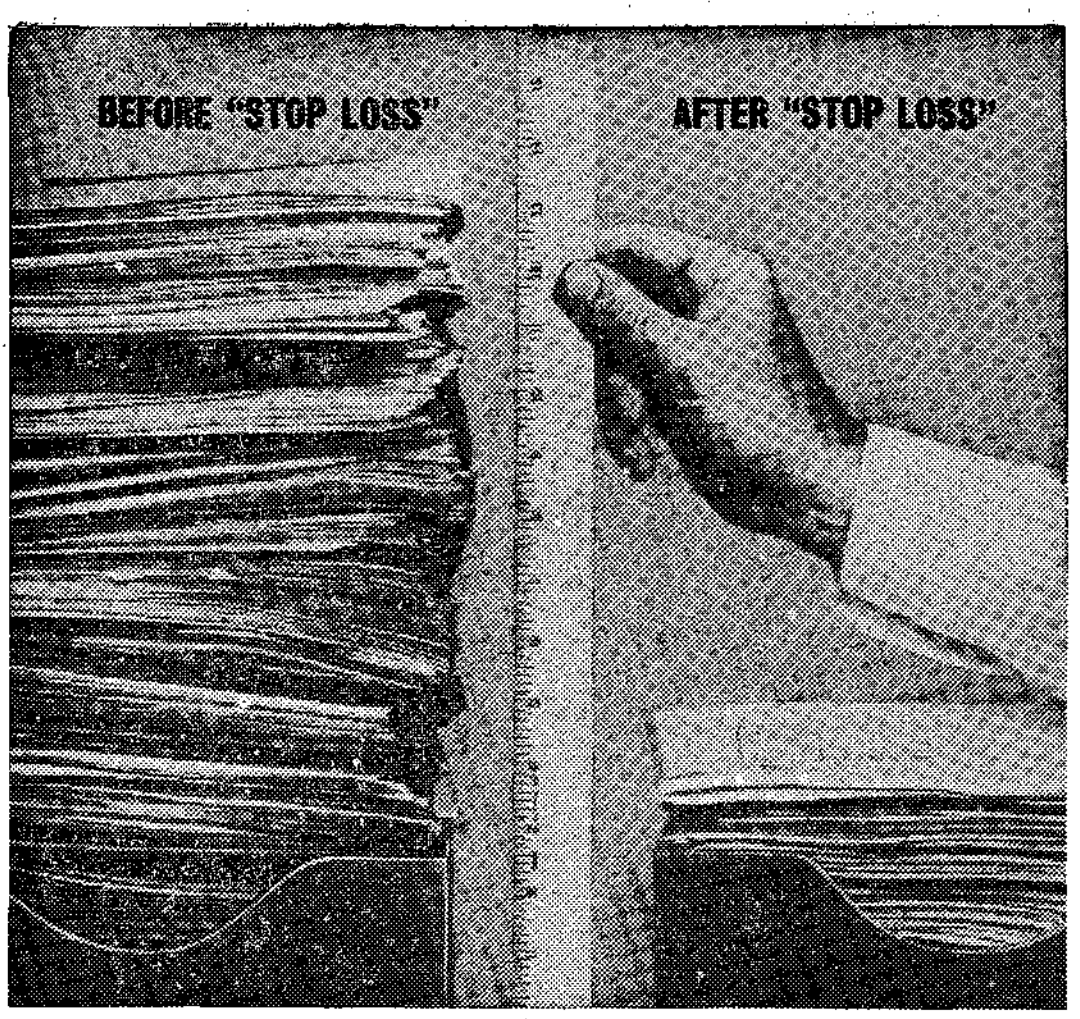
We are fortunate in having human resources in abundance. Because of lack of human resources the Western countries lay more emphasis on mechanisation. In our country we should make use of the manpower resources before embarking on heavy mechanisation. If we do so the population problem will cease to be the menace that it is today.

Waltair A. G. PRASAD

Collector's Item:

Seen on an ambulance in Delhi, in red letters :

Centralised Casualty Service
Govt. of India

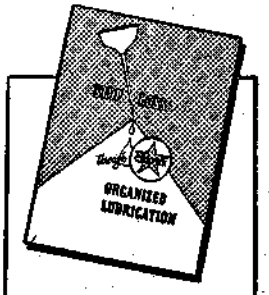


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FISH FROM CITY LAKE

SUCCESS STORY

SOME 140 fishermen of Nizam Sagar near Hyderabad reorganised themselves into a co-operative early in 1963 and the result was that in six months they sold fish valued at Rs 40,000. Within a year, the outturn of the co-operative has risen to over a lakh of rupees.

The co-operative in fact was not a new one. It was already there for years, but it was almost dead. Fishing was not being done on a systematic basis; the old-fashioned methods were unremunerative, and marketing was neglected.

The Nizam Sagar itself had brought calamity on the hundreds of fishermen that lived on its bounty. This man-made lake, spread over an area of 50 square miles, is a rich source of fish. It can yield 3,000 to 4,000 tons every year. But in the course of time the lake developed salinity and the fish yield decreased.

In these circumstances, the fishermen found it difficult to carry on the trade. Many left the lake and settled elsewhere. At this juncture the Government came to their rescue. It helped the fishermen to reorganise their inactive co-operative society. Subsidies and loans were given to them to put their business in order.

The best Government help came in the field of improved marketing techniques. Preservation and storage of the perishable commodity had long been a big problem for the fishermen. A cold storage has now been built at Nizam Sagar which can store two tons of fish at 30°F and freeze two tons of fish up to the temperature of 60°F below 0.

The storage has greatly boosted the fishing trade. The co-operative society makes the best use of the storage before it transports the fish to Hyderabad and surrounding areas in vehicles chartered by the Government.

With the help of the storage the co-operative society has been making such a lucrative business that it has recently decided to take over the storage from the Government on a rental, and also to run its own transport service and to make its own marketing arrangements at Hyderabad.

The fishermen of Nizam Sagar are now a prosperous community. Those who had given up the trade have now returned and resettled. Formerly a fisherman, hardly earning Rs 20 a month, carried a heavy burden of debt ; now he is free from the liability. The population of fishermen on the Nizam Sagar has grown to 500 families, all well equipped with improved methods of fishing.

T. Mohan Kumar



Camp at Palagara

THE Planning Forum of Rajah R.S. R.K. Ranga Rao College, Bobbili, in the Srikakulam district of Andhra Pradesh has taken up many activities since its formation last year. It has arranged several film shows in villages to popularise small savings and promote Plan-consciousness. It has held a number of discussions on the Plan and distributed Plan literature among all the students. It also undertook an economic survey of Bobbili town.

In December last year the Forum held a camp at Palagara village coinciding with the first anniversary of the Youth League of the village. Led by Mr G. Subbi Reddy, Principal of the college, students and teachers worked on a short road connecting Palagara with the village of Balijipeta. The Shramdan of the collegians prompted the villagers to come forward and help to complete the road within four hours. In the afternoon the Forum members sprayed houses with D.D.T. and also distributed Plan pamphlets to the literate householders. At a rally held in the evening, members of the village Youth League presented short plays.

Aspects of Food

INAUGURATING the Planning Forum of Shri Chinai College of Commerce and Economics, Bombay, on August 6, Mr G.M. Laud, Editor of *The Financial Express*, Bombay, traced the various steps involved in Planning and exhorted the Forum members to know "the various tools of planning, and how to sharpen the tools when necessary."

Referring to the food situation in the country he observed that the problem confronting the country had three aspects: (1) the immediate problem of tiding over the difficulty of reaching supplies for the consumer during the next few weeks without prices being pushed up further, (2) the short-term problem of ensuring a balance between demand and supply in 1964-65 at prices fair to both the producer and the consumer, and (3) the long-term strategy of making the country self-sufficient in food with remunerative prices for the producer and fair prices to the consumer.

Mr Laud was in favour of introduction of rationing and did not think criticisms against rationing were tenable in the present circumstances.

Mr D.R. Samant, Principal of the college, outlined the objectives of the Planning Forum and the activities proposed to be taken up during the year.

Power from Rihand power house will soon be supplied to certain railway sectors in Uttar Pradesh...A cotton textile mill with 24,000 spindles and 600 looms will be set up in Kenya (Africa) as a joint venture between India and Kenya...A board is to be set up to prepare a master plan to achieve the Fourth Plan target of Rs 20 crore in respect of export of marine products.

Monopolies in Industry

R. N. GUPTA

THE Federation of Indian Chambers of Commerce and Industry in a memorandum to the Monopolies Commission has said that the Five Year Plans have secured a "better distribution of income" in India, that the net output of industry amounts only to 11 per cent of the national income and therefore is too insignificant a category to be taken into account, that true monopoly cannot be established in our present conditions because we are in the process of development, and that there are too many laws regulating industries to let any single individual or group be able to establish a monopoly.

The Monopolies Commission was appointed to enquire into the "extent and effect of the concentration of economic power in private hands and the prevalence of monopolistic and restrictive practices in important sectors of economic activity." The Federation's effort is to side-track attention from the fact that a few finance-capitalists have concentrated economic power in their hands. It has tried to prove that there cannot be any restrictive practices in regard to production because demand has been outstripping supply during the past decade.

It would be interesting to consider these views in the light of what the Mahalanobis Committee has said in relation to the distribution of of income and wealth as a result of planning. The Committee pointed out that by using facilities provided by the Government, a small group of financial operators had been gaining control of the greatest part of the machinery of production in the private sector. The top ten per cent of the households in the country enjoys 23 to 28 per cent of the national income, while the bottom 20 per cent had only 7 to 8 per cent of it. The condition of agricultural labour had very much worsened. The contractors' incomes had registered the highest increase. While the number of joint stock companies in India had increased, a small number of companies accounted for the largest portion of their paid-up capital. A mere 0.5 to 1.4 per cent of shareholders in joint stock companies held from 31.5 to 56.5 per cent of the total number of shares of all joint companies, 1.6 per cent of the total number of companies claimed 53 per cent of the total paid-up shares of all companies in India. Twenty leading companies had an interest of one kind or other in 983 companies with a paid-up capital of Rs. 352 crore in 1958. Big industrial houses controlled chains of newspapers with a circulation of 67.5 per cent for all dailies. Four leading business houses cornered 17.91 per cent of the capital in the private sector in 1951 and 22.34 per cent in 1958. Further, in 1958, two top business houses had one-fifth of the gross capital stock of all non-government public companies.

Monopoly, as a contemporary journal has put it, does not mean in our situation "capacity to restrict sales or reduce the number of competitors. It means capacity to grab the maximum possible facilities, to control banking and to try to corrupt public opinion to the advantage of vested interests through ownership of the Press". It does not require a Monopolies Commission to establish that monopolies are growing and economic power is getting concentrated in fewer and fewer hands. What this Commission is expected to do is to recommend positive steps by which the concentration of economic power (much more than wealth) in a few hands can be prevented. For this concentration negates the concept of democracy, and makes a mockery of the concept of socialism by which we swear.

THE COOPERATIVE SECTOR

It is not for any dogmatic or doctrinaire considerations that our leaders and planners advocate the strengthening of a co-operative sector in the economy. They recognise that while the private sector leads to concentration of wealth the public sector is also fraught with the danger of authoritarianism, inefficiency, denial of freedom and initiative to the small men and women who constitute the vast majority of population in this country. Co-operatives would be the shield of the poor and resourceless people. They guarantee economic growth with the maintenance of the individual's dignity, freedom and initiative.

It would be interesting to study the distribution of capital, wealth and power in the co-operative sector in contrast with the private sector.

In 1961-62, there were 225,232 primary agricultural credit societies in India with a paid-up capital of Rs. 147.64 crore owned by two crore seventeen lakh farming families. In contrast, in the same year, there were about 30,000 limited companies in the private sector with a paid-up capital of about Rs. 20,000 crore. About 25 per cent of the share capital of these companies, as shown earlier, was owned by four leading business houses.

It is for this reason that the co-operative system in which dividends are controlled, the shareholding are widespread and the management is democratic (one man one vote) is advocated as an essential antidote to the growth of monopolies.

OCTOBER 2 EVENTS

The Education Commission was inaugurated on October 2, Mahatma Gandhi's birthday. Also on the same day, Panchayati Raj was formally introduced in West Bengal, and an Air India air service between India and the United Kingdom via Moscow was started.

HMT's FOURTH BEGINS PRODUCTION



The fourth machine tools plant of the Hindustan Machine Tools Limited at Kalamassery in Kerala began production on October 2.

Built at a cost of Rs 7.75 crore out of its own profits by HMT, the plant will produce tools worth Rs 5 crore every year in the inital stage. The production will be doubled after expansion at a later stage. The plant employs 3,000 workers.

New Antibiotic from Pimpri

Chlortetracycline hydrochloride, a new product of Hindustan Antibiotics, Pimpri, has been put on market.

The Union Minister of Petroleum and Chemicals, who released the drugs, also said that the prices of medicines produced in both the public and private sectors would be brought down.

Hindustan Antibiotics has a proposal to double the capacity of its streptomycin plant which has been working at the rated capacity of 40 tonnes a year of dihydrostreptomycin sulphate and streptomycin sulphate. The streptomycin plant was set up at a cost of Rs 2.75 crore entirely from the profits.

Hindustan Antibiotics has raised its financial resources to Rs 8 crore from Rs 2.5 crore by ploughing back its profits. A dividend of 10 per cent has been declared this year.

PROFITS

The Fertiliser Corporation of India made a gross profit of Rs 9.28 crore (and a net profit of Rs 3.85 crore) in 1963-1964.

The Sindri unit produced 746,596 tonnes and the Nangal unit 688,791 tonnes in the year. The ammonia plant at Trombay is expected to begin production next month.

The internal resources raised by the Corporation since the start of Sindri factory add up to Rs 47.97 crore.

The National Projects Construction Corporation made a net profit of Rs 39.08 lakh in 1963-64 and declared a dividend of 6 per cent. The total turnover was Rs 5.1 crore.

The Corporation has taken up projects costing Rs 32 crore.

NEW ORDNANCE FACTORY

The first of the series of new ordnance factories planned after the Emergency has gone into production.

Set up within eight months at Varangaon in Maharashtra at a cost of Rs 20 crore, the factory produces 7.62 mm ammunition for Ishapore rifles and other arms.

The Ordnance Cable Factory at Chandigarh has been producing 40 miles of field cables daily, saving Rs 2 lakh per month in foreign exchange. It began with 17 miles of cables a day only a year ago.

Government is planning to set up a new heavy water plant.

NEHRU UNIVERSITY

An agricultural university, named after Jawaharlal Nehru, was inaugurated at Jabalpur in Madhya Pradesh on October 2. The university has been designed on the pattern of the land grant colleges in the U.S.A. in which teaching, research and extension services are co-ordinated.

The existing agriculture college at Jabalpur will form the nucleus of the new campus. The six other agricultural colleges and the two colleges of veterinary science and animal husbandry will be the constituent colleges.

4.4 Million Tons More of U. S. Food for India

The United States will supply four million tons of wheat, 300,000 tons of rice and 75,000 tons of soya bean oil (together costing Rs 190 crore) under the U.S. Food for Peace programme. An agreement was signed in Delhi on September 30.

Another agreement was also signed the same day providing for loaning to India the bulk of the rupees resulting from the sale of these commodities for economic development projects.

A third agreement provides for a loan of Rs 16.6 crore accruing under an earlier P.L. 480 sales agreement of 1962.

These agreements bring the total value of commodities given by U.S. to India since August 1956 to Rs 1,372.9 crore.

Soon Ready: Tiruchi Plant & Trombay Factory

The high pressure boiler plant near Tiruchirapalli is expected to go into production in January next. Up to the end of August 1964, a sum of Rs 9.65 crore had been spent on this project.

The fertiliser factory at Trombay will begin trial operations next month and its urea plant will follow up in December. Up to the end of July last, Rs 27.93 crore had been spent on the project.

The Integral Coach Factory at Perambur will undertake the manufacture of motor coaches of 25 KV AC from 1965. Its prototype of a two-coach unit of metre-guage diesel rail car will be completed shortly.

PAPER FROM SWEDEN

Under an agreement signed recently, Sweden will give India Rs 3.24 crore of which Rs 1.08 crore will be grants in kind and Rs 2.16 crore as development credit. The grants will come mainly in the form of 8,000 tons of textbook paper for primary education.



"Uneasy lies the head that wears a crown"

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Calcutta-1

ENGINEERING EXPORT PROMOTION COUNCIL

THE FORTNIGHT'S PICK
of Articles Sent by Readers

URBANISATION

Pull for Cities ?

OR PUSH FROM VILLAGES?

A. K. Nanda

THE pace of urbanisation in India is often said to be more than what is justified by her rising scale of economic activity and the consequent expansion of cities. Indeed, the rate of urbanisation cannot be judged by itself, irrespective of the volume of economic activity carried out in the country. But it will be dangerous to stretch this point too far. Because, one significant feature of urbanisation in less developed countries is that *the population from over-populated rural areas flows over to cities not because of 'pull' by reason of greater economic activity in cities but because of 'push' from villages where the economic activity, overwhelmingly agricultural, has reached saturation point.*

This apart, there may be other reasons for any large-scale movement of population from rural areas to towns and cities. During 1941-5 the percentage of urban population in India rose highest of all, even though there was not much of expansion of economic activity in a planned order. It was primarily a consequence of social disorder which was set in motion by World War II. Also the joint family system, which was at one time the feature of the social system in India, was fast disintegrating and, with the agricultural aristocracy yielding place to a new kind of aristocracy, a revolution of rising expectations was in the making whose impact was felt very widely.

It has been observed that the rate of urbanisation in less developed countries is much more than in developed areas, where the countryside presents a picture of well-fed people in diverse occupations who have most of the civic amenities that are available in cities. Over-urbanisation is a major economic problem of the less developed countries in that they do not have an adequate base to support their urban population. The development of dual economy, that is urban and rural, has been suggested as a possible answer. That this is a right answer no one disputes.

But how is this development of dual economy going to take place? Opinions are not unanimous. The fact that a much smaller proportion of the labour force in the less developed countries is engaged in non-agricultural and especially mechanised industrial occupations seems to offer enough reason to suggest that their proportion should gradually be increased by setting up modern industries in cities. There are others who think that a continuous drive should be made to raise the levels of living of the rural population so as to decelerate the large internal migratory flows of population from rural to urban areas. Their reason is: without the technical know-how and skilled manpower the modern industries will not be of much help to us, and hence, in the urgency to provide employment and adequate social services to the increasing number of urban population, not so much for their economic importance as political, the government may some time be compelled to spend more in such directions only at the cost of decreased investment in other productive facilities.

It is often bandied about that adverse economic conditions are the greatest single cause of migration to cities. How far this is true is difficult to say at once though it is likely that people, possibly in a large number, move to cities in search of employment. In the absence of accurate information and knowledge about the motivations of the migrants who swell the cities and become the objects of public concern it is difficult to formulate sound and enlightened policies.

Three broad patterns of urban growth common to developing countries are discernible. The most common is perhaps the shuttle pattern in which family establishments in rural and urban areas constantly move back and forth. The movement is highly seasonal, following the agricultural cycle, and composed largely of able-bodied males.

The second pattern relates to the movement of isolated individuals moving more or less permanently into psychologically and socially unfamiliar urban settings. A city life is impersonal and anonymous, while a village life is more personal, more compact, more easy and uninhibited. This pattern of urban growth has often been found to be disruptive, as it produces a fundamental cleavage between the two separate worlds of the modernised cities and traditional village people. Psychologically, this disruption is still more as the rapid transition from the compact and intimate world of the village to the impersonal, anonymous world of the city creates a sense of deep personal insecurities. *A sense of rootlessness is associated with this pattern which provides a seed-bed for all manner of anomic movements.*

The third pattern of urban migration is based upon communal groupings in which people of a common ethnic, religious or regional background tend to cling together in the urban setting, and committed to mutual support, they often appear to present a united front in opposition to the rest of the society. This pattern can be identified with huge refugee influx in India from East and West Pakistan.

While all of these patterns of urban concentration can be said to be present in India, the extent to which each of these contributes to this end is not known. *That the rate of urbanisation is much higher than the rate of industrialisation is self-evident.* The relation between urbanisation and economic development seems to settle down comfortably to the fact that to speed up the rate of economic development, urbanisation has to be curbed, and the best way of doing it is to raise the levels of living of the rural population by an ambitious rural industries programme.

TRACTORS IN OUR FARMING

(*From Page 3*)

tractors and other ancillary equipment and will make them available to the cultivator on rental basis. They would take care of maintenance and training of operatives. They could further be asked to assume responsibility for seeing that the members either replaced their bullocks by cows and she-buffaloes or released the feed available to the co-operative which could take up maintenance of milch cattle through other persons.

The tractor co-operatives would thus in course of time become the nuclei of general service co-operatives concerned with such additional functions as the collection and marketing of saleable agricultural products like milk, vegetables, and fruits. They might also acquire milk-processing plants. It would be advisable to organise these societies first in the vicinity of the big townships so that the extra milk produced could be easily marketed.

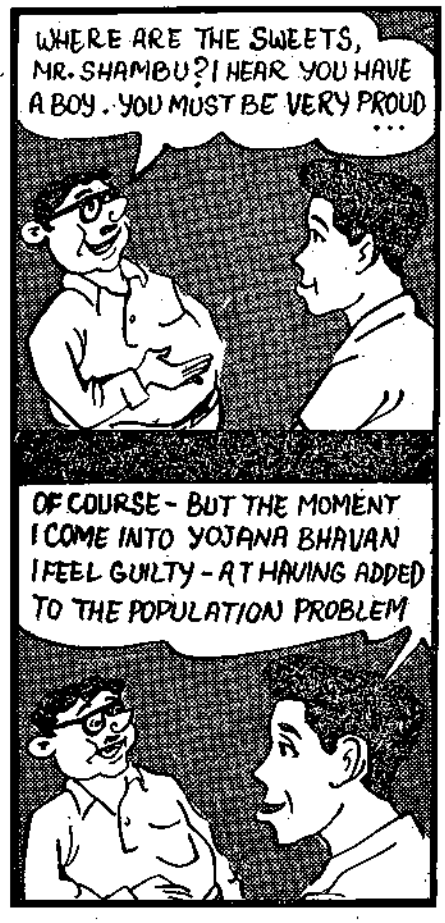
It has been shown above that introduction of tractors and connected mechanical equipment in agriculture is not likely to benefit the economy unless it is accompanied by such institutional arrangements as (a) will make their benefits available to the cultivators in general in a way that no vested interests are created in the rural economy, and (b) see that the food and fodder released from the bullock economy are available for developing milch economy in the villages.

If these two requirements are met, mechanical cultivation would change the village economy for the better and make a big contribution to a solution of the food problem of the country. If, however, this transition cannot be directed along the right lines it will only lead to locking up of scarce capital resources and creation of new vested interests.

1 See Survey of Wai Taluka by D. R. Gadgil, Gokhale Institute of Politics & Economics, Poona, 1940. p. 46.

2. See "The transition from a bullock to a tractor economy in India—some indirect effects and benefits" by P.N. Mathur and K.W. Kapp. Weltwirt-Schaftliches Archiv, 1961, pp. 333-349.

SHAMBU by Malinda Topa



Why Does U.P. Limp in Food Production?

(*From Page 10*)

drawn from the table:

1. The consumption of nitrogen is more than phosphoric acid.

2. U.P. occupies the fourth place in 1961-62 in India in respect of consumption of nitrogen, Andhra Pradesh, Madras and Maharashtra occupying the first three places.

3. U.P.'s consumption of nitrogen during 1961-62 is less than half that of Andhra Pradesh

4. U.P.'s consumption of nitrogen has been decreasing over the last three years.

5. In the matter of phosphoric acid, U.P. occupies the 11th place. Its consumption of phosphoric acid is hardly 3 per cent of that of Andhra Pradesh.

6. U.P.'s consumption of P_2O_5 also has been decreasing over the past three years.

It would be more appropriate to compare the plant food consumption *per acre* of cultivated area in different States. This may be seen in Table III (on page 10)

The conclusions that flow from this table are that U.P. occupies the ninth place among the States in the use of fertilisers and that U.P.'s consumption is 20 per cent that of Kerala.

It would be interesting to note that the consumption of plant food per acre in Japan is about 230 lb. This shows how negligible is the effort of our nation as a whole, and of U.P. in particular, in this direction.

Nor do the figures for green manuring in U.P. offer any consolation. In 1960-61, some 35,00,000 acres were green manured in Madras, 34,60,000 acres in Andhra Pradesh, 30,00,000 acres in Orissa and 11,38,000 acres in U.P. It should be kept in mind that cultivated area in Madras is less than 30 per cent of that of U.P. and that of Andhra Pradesh a little more than 50 per cent of U.P. In spite of this, both Madras and Andhra Pradesh have more than thrice as much area under green manure as in U.P. Apart from this, the use of green manure has remained stationary in U.P. while it is going up by leaps and bounds in the two southern States.

It is well-known that oil-cakes are one of the best organic manures. But they simply do not find a mention in the Plan and no targets have been fixed for them. Oil-cakes are costly, and the desirability of reducing their price through subsidy or otherwise has not even been considered so far.

It is clear that the poor performance of U.P. in food production is due, in addition to paucity of irrigation use, to the low use of fertilisers and green manure.

WE YOU ASK US TELL YOU

Questions from readers on planning and development will be answered on this page. It might be noted that the purpose of this service is to provide information. But we won't be able to entertain trade queries.

SMALL BANKS

R. A. KHAN, Lucknow

1. What is government's policy about small and non-scheduled banks?
2. Is there any move to amalgamate the non-scheduled banks into one?

ANSWERS : 1. The Reserve Bank of India is fostering the growth of economically sound and sizeable units to cater better for the banking needs of the people. Voluntary amalgamation of smaller banks to form viable units is encouraged.

2. There is a general move, preferably on voluntary basis, to merge non-viable units into financially sound and well-managed regional units.

Free Trade Zone

O. P. JAIN, New Delhi

The report on Kandla port published in *Yojana* of September 13 mentions the creation of a free trade zone at Kandla. What is a free trade zone and when will such a zone be established at Kandla ?

ANSWER : A free trade zone owes its origin to the free cities, like Trieste and Carthage, that existed on the Mediterranean coast. These free cities later developed into free ports where goods were allowed unrestricted entry without having to pay tolls or other levies.

A free trade zone is a segregated area in or adjacent to a port into which goods may be imported from abroad without being subjected to customs duty. Within the zone, such goods may be stored, exhibited, worked on, mixed with other foreign or domestic merchandise or used in manufacturing operations. The goods become subject to customs duties only when sent out of the zone to other parts of the country, but are exempt from duties if exported out of the country.

In such a zone manufacturers and traders have several advantages. Apart from exemption of duties on imports there are no restrictions on the quantity imported. Commodities can be imported even for re-exports with the same facilities. Thus delays and merchandise costs are reduced.

There are nearly a hundred free ports and trade zones in 35 countries of the world. In India Kandla is the only one and it is intended primarily for export promotion. Preference will be given to the manufacture and import of such commodities as are primarily meant for export, and not for home consumption.

The decision to establish a free trade zone at Kandla was taken last year. The zone is 9 kilometres from Kandla port and 5 kilometres from the new township of Gandhidham. The development work such as construction of roads and provision of water and power has already begun. Applications for setting up industries have been invited. Allotment of plots, on an initial lease of 30 years, was to begin this month. Two hundred industrial units and warehouses have been provided for in the zone.

Foreign Exchange

T. SURYANARAYANA RAO, Hyderabad

1. How many foreign exchange banks are there in India? Please give their names.
2. How does the Reserve Bank of India exercise control over them ?
3. Do the foreign exchange banks help in our export promotion programme ?

ANSWERS : 1. Under the Foreign Exchange Regulation Act, the Reserve Bank has granted licences to a number of commercial banks to deal in foreign exchange and they are known as authorised dealers. These include Indian banks as well as foreign banks. There are 14 foreign banks in India which are authorised to deal in foreign exchange. They are : American Express Co. Inc., Bank of Tokyo, British Bank of the Middle East, Chartered Bank, Comptoir National D' Es Compte de Paris (French Bank), Eastern Bank, First National City Bank (New York), Habib Bank, National & Grindlays Bank, Hong Kong & Shanghai Banking Corporation, Mercantile Bank, Mitsui Bank, National Bank of Pakistan, and Nederlandsche Handel-Maatschappij NV (Netherlands Trading Society).

2. The Reserve Bank of India is empowered by the Indian Banking Companies Act to inspect, make enquiry about or determine the adequacy of capital, elegibility of licences, opening of branches, amalgamation, suspension of business, compromise arrangement with creditors etc. of banks. Besides, foreign banks are required by the Act to maintain within India the resources raised and invested in this country. These banks are also required to maintain assets in India not less than 75 per cent of demand and time liabilities. Another regulatory measure relates to maintenance of a certain percentage of cash and liquid assets with the Reserve Bank of India.

3. Yes. Foreign exchange banks assist our export promotion programmes in many ways, such as discounting of foreign bills of exchange, grant of advances to exporters, provision of references to importers abroad, etc.

★The Bokaro Steel Limited, a new company set up to build the Bokaro steel plant, has bought from the Soviet Union a multi-bucket excavator and several cranes for preliminary construction work at the site of the Bokaro plant.

★A coal grinding mill, with a capacity of 16 tons of coal dust an hour, which will be installed at the Korba thermal power station in Madhya Pradesh, has been manufactured in the Soviet Union and will soon be shipped to India.

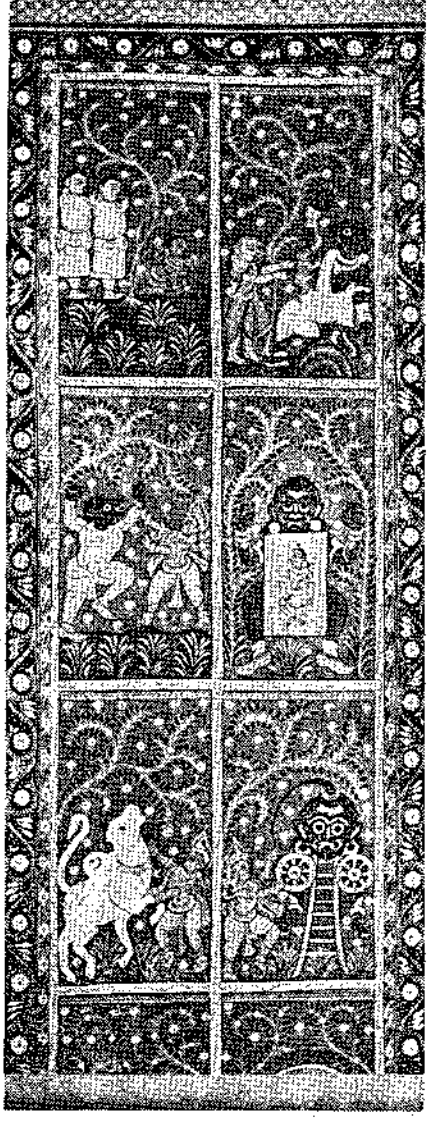
★The fifth consignment of high pressure centrifugal pumps is on way to India from the Soviet Union.

★Two hundred Indian farm machinery specialists have completed 3-month training course in the Soviet Union.

PRIDE OF PLACE 105

Reg. No D-876

Patas of Orissa



THE *pata* or scroll painting is one of the old forms of Orissan art associated with the Temple of Lord Jagannath. Their makers are called *patuas* or *chitrakaras*, and they live in and around Puri. The *patas* mainly depict episodes from the life of Jagannath, Balaram and Subhadra as also mythological scenes from the life of Krishna. The art is hereditary and there still are a large number of *patuas*. Pilgrims who visit the temple at Puri take back *patas* as mementos.



Though Orissan *patas* resemble more or less the old folk paintings of Bengal and the painted earthen dish (*sara*), they have little to do with the *patas* of Kalighat (nineteenth century) since reinterpreted in his inimitable style by Jamini Roy. Unlike old icon paintings of Orissa, "Kalighat painting originated in the early years of the nineteenth century and it was a product of the special conditions then obtaining in Calcutta." (W.G. Archer)

The icon paintings relating to the cult of Jagannath arose in the eleventh century when the foundation of the temple was laid by Chodganga Deva. The *patuas* took a piece of cloth according to the required size of a *pata* and first covered it with a paste of white powder and *kathua*, an indigenous gum, for making a suitable ground. After it was dry, the piece was rubbed with a stone. The base, thus rendered smooth, was coated with a layer of red lacquer on which were drawn the figures in bold, black lines. "The astonishing skill", says a well-known critic, "with which a harmonious colour combination is introduced by Orissan icon-painters against the background of rich red, has perhaps no parallel in any other phase of Indian painting."

The *patua* today follows the same technique though he uses water colour in place of basic indigenous colours used by his predecessors. The *patas* are in great demand, particularly at the time of the Car Festival.

There are about 30 families of *patuas* in Puri engaged in *pata* painting and wood and stone carving, besides others in Cuttack and Bhubaneswar.

To popularise further the Orissan *patas* and other crafts among the countrymen and particularly the tourists the State Government has appointed a Special Officer of Arts and Crafts, who supervises the production of materials going into *patas* and helps in marketing them.

The photographs were taken at the Crafts Museum, All India Handicrafts Board.

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EIGHTH YEAR

21

OCTOBER 25 1964

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SPECIAL REPORT ON KIRIBURU

YOJANA

Vol. VIII No. 21 Fortnightly Journal Published on behalf of the Planning Commission Kartika 3, 1886

SHAPE OF FOURTH PLAN

In the coming week the National Development Council, the highest policy-making body on planning, will meet to decide the targets, priorities and size of the Fourth Plan. The results of the intensive studies and discussions within the Planning Commission as reviewed by the Union Cabinet will be before the N.D.C. in the form of a memorandum.

The size and strategy of the coming Plan have been the subject of prolonged and animated debate. The proponents as well as the critics of the various schools—barring those who are conscientious objectors to planning itself—are all agreed on some points: that the Fourth Plan has to be much larger than the Third; that development is now more urgent; that agriculture should receive much more attention ; and that execution is more important than mere formulation of projects.

To build for plenty and to build for economic strength—this will remain the goal of the Fourth Plan. As for its total size, in terms of money, the requirements are expressed as a range between Rs. 21,500 crore and Rs. 22,500 crore rather than as a firm figure. In our fast-changing conditions five years are too long a period to allow rigid forecasts to be made. The dynamism of development itself would enlarge the resource potential. The range thus represents the element of flexibility governing the Fourth Plan. It also represents the determination of planners and Government to review programmes and projects and reapportion individual priorities in the light of emerging circumstances.

It is important not to attach too much importance to the mere size of the Plan. Not the money but the task to be achieved is what matters. There must be more production—primarily in food grains and the everyday goods. Likewise there must be more employment. Only then will the people feel convinced that development is a desirable, beneficent reality. Meanwhile the steady work of reinforcing the economy through heavy industry must go on. Agriculture or industry, what is required at this stage of development is the designing of fool-proof methods of execution. At all levels there is need for a greater will and sense of purpose. Each of the departments of the Union Government and the various State Governments must regard the Fourth Plan tasks as commitments, and not as ultimate targets. More forethought, more systematic studies, constant and fearless review of work will lead to better performance. Visible dedication and achievement on the part of the administration will in turn create that enthusiastic response from the people that planning needs in greater measure.

ABOUT THIS ISSUE

When electricity was taken from the Cauvery power-house to Kolar Gold Fields in the early years of the century it was hailed as the longest power transmission line in the world at the time. A couple of years earlier, in a laboratory in Hyderabad, Ronald Ross had discovered how malaria spreads. Not long before that Sir Arthur Cotton had examined the skill of the engineers of the Chola empire in the South who had built large dams on sand-bed, and this know-how was quickly adopted by the West.

Within our generation India has made two signal contributions to the world's experience : the use of non-violence as a political weapon to attain freedom, and the endeavour to achieve economic development without blood and regimentation.

What are the Indian ideas and achievements in technology ? How much progress have we already made in the direction of achieving technological self-sufficiency which is one of the major aims of the planning perspective ? The articles in this issue provide some indication. They outline the achievements in construction and fabrication in important fields of industry, and the beginnings made in the creative part of technology, namely design engineering. Hindustan Steel is equipping itself to build whole steel mills ; at Ranchi the Heavy Engineering complex is in a position to manufacture major equipment needed by the iron and steel industry ; in atomic energy, although we will not make the bomb, we are a developed nation already; in aviation we design and build our own aircraft, even such advanced aircraft as jets; the Fertiliser Corporation has built up the skills to design and build complex fertiliser plants; in electricals the capacity to put up giant factories and to make heavy machines is being acquired ; in machine tools we have already proved our skills to make instruments of excellent performance; in metallurgy, the National Laboratory at Jamshedpur has done outstanding work in evolving alloys from indigenous materials.

This Number, however, is not an exhaustive account of all we have been able to achieve. Owing to difficulties in the production schedule, it has important gaps. We have not been able to include articles on the pioneering work done by our Railways and our electronics and communications industries. The achievements in civil engineering, and the discovery of new drugs have also gone without adequate mention.

If the over-all achievement of India still appears meagre in comparison with that of advanced countries, we have to bear in mind a truth about technology. This truth, as Prof Gunnar Myrdal has put it, is that technology progresses in direct proportion to the sum of knowledge already gained. Therefore, the more we build, the faster we shall grow. And although we shall never spurn the hand of friends, we shall not always be at the receiving end.

THE CREATIVE ELEMENT I

PROGRESS

T. N. SINGH ON RESEARCH AND DEVELOPMENT OF DESIGN TALENT

With Minister for Heavy Engineering

Yojana : Could you name offhand some technological innovations in our country—things we have made for the first time or processes we have found on our own?

T.N. Singh : It is useful, right at the beginning, to make a distinction between two different meanings of innovation. When something is discovered or done for the first time in the world, it is innovation. Innovation also consists of making within our country something which has already been attempted elsewhere. An Indian achievement of the first kind is the recent discovery and manufacture of the antibiotic Hymacin at Pimpri. The National Chemical Laboratory of Poona has evolved a completely new process for producing vitamin C. These are two random instances. As for the second kind of innovation, examples are strewn all over the country. Our recent record has been very heartening in the development of processes and fabrication of equipment.



Yojana : Such as ?

T.N. Singh : Take any major project. Take Hindustan Steel, the Heavy Electricals, the Heavy Engineering Corporation, the Fertiliser Corporation, the Hindustan Machine Tools. Each has something special to show which is truly Indian. And I mustn't forget our Atomic Energy Establishment or our Railways (since Suri transmission is fresh in our minds) or the designing work done by Hindustan Aircraft and other Defence establishments. You see, every major project is tailor-made, custom-built. It is not as though you can take something ready-made and put it up at a new place. The principles may be the same ; but the details vary infinitely, and a great deal of knowledge and inventive ability is required. Designs, equipment and even the civil construction have to be thought out *de novo*. There is, first of all, the overall design. I want you to appreciate that in its higher aspects, especially where mammoth projects are concerned, design engineering is a highly creative function, calling for great professional ability and a dash of vision. Even in this we have made a commendable beginning. The five or six public sector corporations I mentioned have built up considerable designing talent. Some private sector organisations have also done so. There is Dastur & Co. which has done pioneering work.

After the grand design comes the stage of executing the units. Each individual unit involves, in turn, several detailed designs. hundreds of them, sometimes thousands, for the equipment and processes. After that comes the stage of actual fabrication and construction. As I said, even the civil works have to suit a given set of conditions—the terrain, the climate, the process involved, the people who handle it.

Yojana : You referred to the creative element in a design organisation. Could you eleborate the point ?

T.N. Singh : What I meant by that is that the design engineer is somewhat like a composer. I remember Browning's line about a musician : that he imagined the whole and then executed the parts. The designer has that creative element. Construction engineers interpret the idea. If you go round the country and visit the major projects you will find everywhere scores and hundreds of young engineers in the design organisations. A few of them—maybe two or three per cent—are sure to blossom into outstanding industrial designers and consultants.

Yojana : Would you say this gift is something one has to be born with and cannot be gained through experience ?

T.N. Singh : Oh, no. Not that way. You have heard the saying "Many are called but few are chosen." It is only a handful who can be eminent in any given field. The rest would be competent and reliable executives and production men. As a matter of fact, this design talent cannot be a hot-house plant. It can develop only when there is close link between research and industry proper. You will recall that in the earlier stages of the Industrial Revolution in Europe it was the craftsmen who threw up the innovators and inventors and not so much the universities. Even later the distinction between pure and applied research was very much thinner than is generally made out to be. Some of the greatest fundamental discoveries were made in the course of applied research. Similarly, findings of pure research have led to the biggest advances in technology.

Yojana : Do you think we have developed such close relationship between our research centres and industry ?

T.N. Singh : I wish I could say yes. This is one of the big lacunae in our country, despite all our efforts at planned advance. Industry, whether in the private sector or the public sector, isn't always very enthusiastic about the work of the national laboratories. There is,

TECHNOLOGICAL

however, one good development. Some of the industries themselves are sponsoring research in a systematic way. I would mention the Institute of Fertiliser Technology put up by our Fertiliser Corporation. HMT has an Institute of its own in Bangalore to do major work in designing, technological improvement and training. Research which is part of the industry itself has special scope in the chemicals field. I am hopeful that the Petroleum Institute will be a big aid to the imminent break-through in petro-chemicals.

Yojana : You said that the industries are lukewarm about our research laboratories. We have several organisations like the Council of Scientific and Industrial Research, the Directorate-General of Technical Development, the National Research Development Corporation, the different councils for industries and the Planning Commission itself. What are they all doing about this problem of liaison and co-ordination ?

T.N. Singh : This is very complex question. To evolve a process and even to prove its scientific feasibility is one thing ; to convince a hard-headed industrialist of its economic benefits and technical advantages is another. Even detailed pilot studies aren't enough. The laboratories cannot command the resources to carry out commercial-scale experiments. That is why I said that the industries should be far more closely associated with research. Only then can we have the requisite testing in the field, the opportunity for trial and error, the scope for altering design while trying it out. Not until the acceptability of a process is established would industry be interested. Take, for instance, the new process for making vitamin C to which I referred in the beginning. The National Chemical Laboratory swore by it, but the industry wouldn't be convinced, and two valuable years were wasted.

Borrowed Know-How Won't Do

Yojana: Is it that industries feel that instead of all the labour and the risks involved in building up indigenous know-how, it is easier to go in for well-tried and well-established processes? There is also the question of finance being tied up with technology. Through foreign collaboration arrangements companies get not only know-how but also capital. Further, a good trade name solves problems of marketing.

T. N. Singh : That is a point well taken. The temptation is always there to buy something ready-made rather than help to build up something over a period of time. But what is to be remembered is that the advanced nations themselves do not remain stationary in the matter of technology. The more advanced a country, the greater the acceleration in the pace of progress. They go ahead, and we stay behind unless we develop our own skills. We cannot always live on borrowed technology. We must take a leaf out of Japan's book. We all know that Japan borrowed technology from the West. But only for a time. Having borrowed it, it built its own know-how. There is the familiar adage about the Japanese importing a machine only once. Afterwards they make it their own, and now they are pioneers in several directions such as electricals and electronics.

Yojana: We have several agencies to co-ordinate industry and research; but are they themselves co-ordinated? Isn't there an element of overlap between their functions?

T. N. Singh: There might be, but the task to be done is so immense that they do not cover our full requirements. Take the Research Development Corporation. It is doing some good work, but it cannot possibly cover the whole field from steel and chemicals to the consumer goods. We require more specialisation. The industries concerned must themselves play a part. Take our Heavy Engineering Corporation of Ranchi. It is now closely allied with the expansion of the steel industry. It has fashioned a pig iron casting plant. You cannot imagine the amount of labour the designing of this plant has involved. Each individual machine and part of plant involves thousands of designs. Similarly HMT is making special purpose machine tools—which means that no two will be alike, and hundreds of drawings would be needed for each.

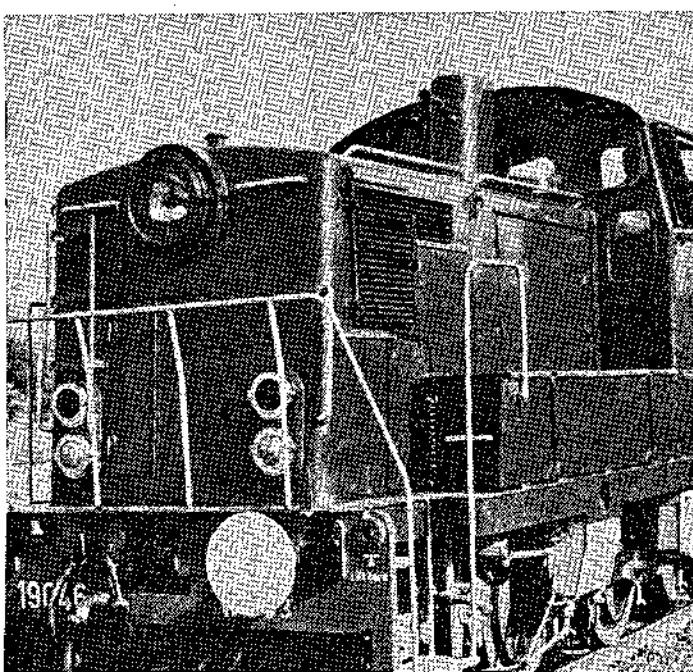
Fourth Plan Approach

Yojana: In the light of the experience gained, is there any attempt to promote, in the Fourth Plan, more of project-oriented research and closer link between industry and science?

T. N. Singh: Certainly, there is. One of the ideas is to have more institutes as part of the bigger industrial and engineering complexes. Secondly, our national laboratories will be given more specific problems to work upon. Thirdly, on the question of proving the commercial feasibility of discoveries, the public sector

(*Continued on Page 29*)

A locomotive incorporating the new transmission technique evolved by Mr. M. M. Suri, then of the Indian Railways





By
M. S. RAO
Chairman, Hindustan Steel Ltd.

HSL and the Revolution in Steel Industry

In terms both of the rate and the pattern of industrial growth, the past decade in the economic history of India will go on record as being unique. Criticisms notwithstanding, a good bit of credit for this must naturally go to the public sector because it was assigned the key role in the development of basic and heavy industries. From the very nature of their products, their size and sophisticated complexity in operation due to the installation of the latest techniques in manufacturing steel, the three public sector steel plants which came into being during this period have played an important role in the process of economic development of the country.

In the initial stages it is not possible to innovate. Dependence on foreign sources for machines and know-how is inescapable. Care has to be taken, however, that in this process, the latest available in the world may be acquired so that movement forward, keeping in line with advances in technology elsewhere, may be possible. The issue concerned have to be looked at from two angles: (a) acquisition of assets and (b) acquisition and building up of know-how. The former is relatively easier than the latter and yet for future development it is of crucial significance.

So far as the question of assets is concerned, it is a matter of satisfaction that the three public sector steel plants under Hindustan Steel acquired the latest available machines and techniques in steel manufacturing. For example, Hindustan Steel was the first in Asia to decide to have an L.D. plant and this also at a time when the L.D. process had just been developed in Austria. The Continuous and Semi-Continuous Hot Strip Mills have been in existence in USA for several decades but they were installed in such advanced countries as the United Kingdom and Germany only recently. These are complex sophisticated mills and require a high order of development in the manufacture of steel. Hindustan Steel has incorporated them in one of its plants, namely, Rourkela. Similarly we have, with the help of our collaborators in Great Britain, Germany and Russia, incorporated the latest techniques in our plants even though they have been developed and introduced in these countries only recently. It will be apparent from the above that in so far as physical assets are concerned we have got almost the best that any advanced country can boast of.

In the process of manufacturing steel, a number of innovations have been developed in foreign countries. Hindustan Steel is aware of them and it has been possible, even during the limited span of our existence, to introduce quite a number of these innovations in our steel plants. They include studies for injecting liquid as well as gaseous fuel in blast furnaces, the use of beneficiated or agglomerated ore, humidity control of the bla t, oxygen enrichment of the blast, high top pressure operation and high blast temperature in blast furnaces with a view to achieving increased productivity and reduced fuel rates. Some of these studies have been put into practice. Examples are the installation of an ore beneficiation plant at Barsua to feed the beneficiated iron ore to the Rourkela Steel Plant, establishment of sintering plants at Bhilai, Rourkela and Durgapur to utilise the smalls arising from these plants, arrangements made at Durgapur blast furnaces to inject fuel oil as well as coke

oven gas, incorporating the necessary equipment for humidity control, oxygen enrichment and higher temperature for the blast and the high top pressure operation in the blast furnaces coming under the current expansions of the Hindustan Steel. An important feature in the introduction of these techniques is that it has been done to suit Indian conditions.

In the field of steel melting also, many new ideas, such as oxygen lancing in open hearth furnace, installation of 500-ton open hearth furnaces with provision for oxygen lancing and flame enrichment, continuous casting of steel, vacuum degassing and O-G process, have either already been incorporated in the existing units or are under consideration as to how best they could be used in the process of our expansion.

Modern trends in rolling technology, such as the use, of 5-strand cold rolling mill, continuous annealing line, twin stand temper mill, continuous hot dip galvanising line, continuous electrolytic tinning line and a high capacity four-strand wire rod mill, are under study, and attempts are being made to introduce them as far as possible in the expansion programme in hand at Rourkela and Bhilai.

The Industrial Revolution which is taking place with the help of rapidly advancing sicence and technology all over the world at the moment is such that it is not possible to keep pace with it unless planned efforts are made in a big way inside the country itself to develop know-how. There are various aspects of this question and it is not proposed in this small article to refer to all of them. The achievement of physical and financial target is only one aspect of development. The other relates to the question of know-how and the building up of a core of engineers and technicians who not only may man important posts in running the modern steel mills but, in due course, may also prepare designs, project reports and introduce innovations. These issues are concerned with the achievement of the goal of technological self-sufficiency in a much deeper sense than is the case with filling up the gaps by mere acquisition of machines and know-how from the outside at the initial stages of development.

The management of Hindustan Steel took steps from the very beginning in both these directions. In so far as the question of manning is concerned, it was stipulated from the very start that our engineers would be trained by our collaborators sufficiently quickly so that they could replace foreign technicians. Sufficient progress has been made in this respect and at the moment the number of foreign technicians in the three steel plants has declined considerably and to a very large extent Indian engineers have come up and shown their abilities.

The Design Bureau

In so far as the second and the more basic question of building up a core of engineers who could prepare plan projects and innovate is concerned, the importance of this was realised as early as 1955 when the Indian Steel Mission to the USSR under Mr S.S. Khera made recommendations in this respect in their report in August-September 1955. The matter was taken up at the level of the Government and later on the management of HSL pursued it earnestly resulting in the formation of the Central Engineering and Design Bureau in 1959. At the outset this organisation under the overall charge of Central Headquarters consisted only of 13 engineers and now it has gone up to 250. The CEDB was organised with the following objectives:

(a) to collect all the drawings of the three plants under construction and make a detailed study of these in this office and at site with a view to understanding the principles and practices that have been used.

(b) at the earliest date all planning, designing, manufacture, construction, erection, commissioning and operation should be done in our country and by us hundred per cent.

It was hoped by the Government and HSL, as is apparent from the correspondence on this issue between the two, that this organisation would prepare the project reports not only in respect of expansion to be undertaken by HSL but also those of new projects like the Bokaro Steel Project. The building up of an organisation is necessarily a matter of gradual evolution. Much depends upon the availability of the right calibre of men and they are scarce even now. Natural limitations were there.

Although the high ambition of this Bureau for being able to prepare project reports for green field sites has not yet materialised, it is a matter of satisfaction that against heavy odds in manning, this Bureau, even during the six years of its existence, has been able to takec harge of expansions in Rourkela and Durgapur. M/s. Indian Gemeinsehaft Krupp-Demag, who were consultants for the one million stage construction of the Rourkela steel plant, have been ably replaced by the CEDB for the 1.8 million tonne expansion of Rourkela Steel Plant which is already under way. Similarly, at Durgapur, this orga i-sation has replaced M/s. International Construction Company for the expansion of the steel plant from 1 million tonnes to 1.6 million tonnes. The work of CEDB has been commended by such internationally reputed engineering and designing organisations as M/s International Construction Company and M/s Gipromez of U.S.S.R.

The CEDB is now engaged in planning the expansion of Rourkela and Durgapur plants from 1.8 million to 3 million tonnes and 1.6 million tonnes to 2.5 million tonnes respectively for the Fourth Plan. The engineers of this Bureau have worked in close consultation and co-operation with foreign technicians inside and outside the country, have collected in their library a lot of useful material in the process of the construction and building up of the steel plants, and have acquired confidence in their ability. The experience gained by them is of very great value, and potentialitis are immense. If the organisation develops along the lines projected for it and it is possible to increase and enrich its staff, it will be possible in the not very distant future to achieve the goal of technological self-sufficiency in this field of activity. In the sphere of know-how, contributions made by HSL steel plants, even though humble at the moment, are significant for the future.

CSIR PROMOTES COUNTRY'S SCIENTIFIC ABILITY

National Laboratories Reduce Dependence

By

Dr. S. HUSAIN ZAHEER

Director-General, Council of Scientific and Industrial Research.

THE industrial development of India has progressed at a rapid pace since Independence. Through its Five Year Plans India has made a systematic attempt to harness its vast mineral and agricultural resources for the benefit of its people. For a developing country it is essential that it resorts to planning to ensure effective utilisation of its limited technological and scientific manpower and resources for optimum achievement in the field of development and economic progress. Planning is also essential to find a solution to provide subsistence even at a low level to the vast population in the country which is also increasing at a rapid rate. The First Five Year Plan and the subsequent Plans have the raising of the standard of living of the people as their basic objective. Technological self-sufficiency must be looked upon as a means to enable the country to stand on its own feet and harness the resources of the country with indigenous talent for the attainment of these objectives.

Technological self-sufficiency should not be interpreted as insulation of the country from any links with the science and technology in other countries. Even in the case of advanced countries inter-flow of technical and scientific knowledge plays a significant role. In the case of less developed countries it is important that the means of communication of technical know-how from the more advanced countries should be quick and effective. The know-how from more advanced countries has also the advantage that it is communicated directly to the point of its application and does not have to pass through the various stages of development, which indigenous know-how must necessarily go through.

However, even for the application of know-how from abroad it is essential that the country should have an efficient system of communication in the form of qualified and meritorious scientists, well-equipped scientific institutions, technological and scientific libraries and documentation and dissemination services. Technological developments connected with the nature of the indigenous raw materials, minerals and agricultural resources and the quality and genius of her people are the prime responsibility of indigenous research which no foreign know-how can replace.

While making the maximum use of the know-how and technical knowledge of the more advanced countries, it is important that the developing countries gradually build up their own know-how so as not to be completely dependent on know-how from abroad. As the country grows and as its scientific and technical potential develops, it will generate its own know-how and will be in a better position to exchange it. The level of interflow with advanced countries will progressively become more even.

The Council of Scientific and Industrial Research set up in 1942 was established with the purpose of undertaking, promoting and co-ordinating scientific and technological research. During the last 17 years since Independence it has built up 27 laboratories and institutions dealing with research in various disciplines of science and different fields of industry. It has also set up documentation services, instrumentation organisations, dissemination services and built up an efficient system of communication and research in the country which is bound to play an increasingly important role in the industrial development of the country.

The scientific achievements by way of inventions and discoveries by the Council even now make an impressieve list but more significant is the contribution made by the laboratories of the CSIR to the industrial development of the country in terms of supplying data on raw materials and adaptation of processes to indigenous conditions. Some examples are cited below and the importance of each is described:

Electronic Components:

Electronics plays a vital role in automation and instrumentation in industry. Television, radio, radar, tape recorders, computors and automatic process control devices, X-ray equipment, electronic microscopes, etc. are all based on electronics. In any electronic equipment, there are basically six types of components : valves or transistors, resistors, capacitors, inductors or transformers, wires and cables and transducers such as loud speakers.

The present investment in the electronics industry in India is about Rs. 100 million and it is estimated to have a turnover of Rs. 200 million. A committee appointed by the Government of India has proposed a 40 per cent increase in the turnover every year so that the investment in ten years will be of the order of Rs. 1,600 million having a turnover of about Rs. 3,000 million.

Research at the National Physical Laboratory (NPL), New Delhi,

has resulted in the development of processes for the manufacture of mica and ceramic capacitors, ferrites and ceramic rods. These processes have been passed on to industry.

Silver Mica Capacitors:

Silver mica capacitors, based on the NPL process, are being manufactured under a licence by the Indian Telephone Industries, Bangalore (ITI), and Manilal Mohanlal & Co., Bombay. The firms were licensed in 1959, and their current annual production is to the tune of about 4 million capacitors and mica films. ITI is producing them for its own needs and uses the capacitor films in its carrier equipment, while Manilal Mohanlal & Co. has been licensed to increase its capacity to 30 million silver mica capacitors with a view to export. At present the country is exporting raw mica which fetches only a nominal price; silver mica films will bring a much higher price in the international market, especially in America, which is the largest importer of raw mica from India.

Ceramic Capacitors:

Ceramic capacitors have been licensed to Bharat Electronics Ltd., Bangalore, on an 'exclusive' basis. Its current annual production is about 2.3 million pieces, while the present estimated demand by both the radio and the fluorescent lamp industries is about 7.8 million pieces per annum. The company has been licensed to increase its annual production to 30 million ceramic capacitors. The total value of the capacitors at the present market rate, after achieveing full production, will be Rs. 12 million per annum, saving foreign exchange to that extent.

Ferrites and Ceramic Rods:

Ferrites are ceramic materials which exhibit the properties of ferromagnetism and are used as antenna rods, coil core and I.F. transformers. There are two categories of ferrites: 'soft ferrites', which can be produced to have permeabilities over a very wide range and can be used as a magnetic core for inductances particularly at the higher frequencies, and the 'hard ferrites', which are very similar to permanent magnets and can be utilised as substitutes for metallic magnets. The processes developed for the manufacture of ferrites utilise purely indigenous materials and, therefore, the industry employing these processes is independent of imports.

A survey of the possible requirements of different types of ferrites was made in 1963 among some of the large manufacturers of the radio receivers in Bombay and Calcutta and it was estimated that the present requirements of imported ferrites for the receiver industry alone are worth Rs. 1.5—2 million. The telecommunication industry also uses about Rs. 1 million worth of ferrites in their equipment.

Ceramic rods are special type of high frequency ceramics which are used in the manufacture of carbon resistances.

The pilot plant at NPL has been producing both soft ferrites, required by the radio receiver manufacturers, and ceramic rods, used for carbon resistor production. The plant was planned to produce about Rs. 0.8 million worth of ferrites. They are being supplied both to industry and to a research group in the Atomic Energy Commission manufacturing precision resistance for nuclear instruments. Recently, based on NPL know-how, Morris Electronics Pvt. Ltd., Poona, and Semi Conductors Ltd., Bombay, have been licensed to produce soft ferrites. The ceramic rods have been licensed to Morris Electronics Pvt. Ltd. and Microceramics Ltd., Hyderabad.

Signal Generators:

Radio frequency signal generators are widely used by the radio industry for the testing and aligning of receivers; they are also used by Defence and by some research laboratories. The Central Electronics Engineering Research Institute (CEERI), Pilani, has developed a signal generator which covers the frequency range of 30 kc/s to 30 mc/s (in eight bands) and has good frequency stability, the drift during a ten-minute period being less than 0.002 per cent. Output is available at the level of 1 volt or calibrated small values down to 2 microvolts. Facilities for internal as well as external modulation are provided.

The annual demand for standard R.F. signal generators has been estimated at 150 units for the next five years, involving an expenditure of Rs. 6 million if all the instruments were to be imported. The cost of the imported generator is Rs. 8,000 as compared to Rs. 5,000 of a similar Indian model. The Indian model utilises foreign components to the extent of about 12 per cent of its price.

TV Receivers:

Television has been recognised as an important medium for audio-visual education and entertainment, and it is currently receiving serious attention from the government as well as industry. Although at present the import of television receivers is restricted because of high foreign exchange cost, the contemplated use of television service would mean a demand of several thousand receivers every year.

The TV prototype receiver designed and developed by the CEERI gives careful attention to the design of the circuit, choice of components, layout, manner of wiring, ease of alignment and maintenance. Printed circuits have been used in the various sub-assemblies to improve the economics of manufacture. The TV set will have imported components up to 20 per cent of its value and is expected to cost much less than the imported receivers.

In the foreseeable future only one-channel systems are likely to operate in most of the television areas, and it would be possible to step up indigenous manufacture of single channel receivers for speedy distribution to various institutions and individuals. The knowledge gained in the field of television is also being utilised for development of industrial circuit television.

Equipment Testing:

Flameproof electrical equipment includes motors, switchgears, transformers and lighting fittings. All these kinds of equipment are used to guard against hazards of explosion which may occur in mines, in the petroleum industry (including petrol pumping stations), fertiliser factories, coke oven plants and the gas industry, including town gas supply. These industries require flameproof motors of different types. Although no precise estimate of demand is available, the annual

requirement of the petrol pumping stations alone is estimated at about 6,000 flameproof motors. According to one estimate 2,400 flameproof motors per annum are required in the mines, of which 30 per cent are expected to be about 60 kw. The equipment can be used only after obtaining the necessary certificate regarding their flamproofness.

In the absence of testing facilities, all equipment was imported from UK, tested at the Buxton Laboratory of the Ministry of Mines and Fuel. With the establishment of these facilities, the Central Mining Research Station (CMRS), Dhanbad, has been officially recognised as the testing authority for the purpose. Over 50 items of equipment have already been tested for their flameproofness from India and foreign countries, viz. USSR, Hungary, Poland, Belgium, Rumania, Britain, Japan, Germany, Italy and USA. Motors up to 100 h.p. have been tested.

The testing facilities have given an impetus to the establishment of indigenous industry for the manufacture of flameproof equipment, resulting in a saving of about Rs. 5 million worth of foreign exchange. CMRS has been giving advice and guidance to indigenous manufacturers to ensure proper standards.

Cation Exchangers

A copolymer of styrene and divinylbenzene in bead form is prepared by the suspension polymerisation technique. The beads are later sulphonated to yield a high capacity cation exchanger in the form of spherical particles.

Industry has taken up these processes; two of the resins based on CNSL and melamine are already under production by Tulsi Industries, Poona. Polystyrene based resin has been taken by Tulsi Industries and the Industrial Agricultural Engineering Co. Pvt. Ltd., Bombay, and the concerns are likely to go into production shortly. The selling prices of the CNSL and melamine exchange resins are respectively Rs. 80 and Rs. 175 per cubic foot.

With the rapid pace of industrialisation in the country the demand for ion-exchange resins will grow considerably in processes of purification, separation, concentration and recovery. They are being widely used for water treatment, and can be used for increasing the recovery of sugar from cane juice. Recently NCL produced polystyrene based cation exchanger which has been successfully employed by the Defence for making desalting kits. The project finds an important outlet for cashewnut shell liquid, a by-product of the Indian cashew kernel industry.

Optical Glass

Optical glass is a special type of glass, completely homogeneous, used for lenses and prisms in optical instruments, such as microscopes, telescopes, binoculars, cameras, range finders, etc. The vital role of optical glass was realised during the Second World War, when the supplies of optical glass from UK, the principal source for Indian requirements, were interrupted.

Since great secrecy is maintained regarding the technology of optical glass, the work had to be started from scratch. Raw materials were examined, equipment designed and fabricated, and the entire production technology worked out. The success of manufacture of optical glass lies in the scientific mastery of the details of the entire range of operations and their rigorous control. In view of the fact that the Central Glass and Ceramic Research Institute (CGCRI) Calcutta, was able independently to establish the technology of production on a pilot plant scale, the Government of India and the Planning Commission decided to entrust the work of commercial production of optical glass to the Institute. The optical glass manufactured by CGCRI was highly commended by both the National Physical Laboratory and Defence.

Because of its highly specialised uses and comparatively limited consumption, optical glass has never been an item of mass production. The annual world production is in the range of 2,000—3,000 tons as compared to the total annual production of about 20 million tons of ordinary glass. Consumption of optical glass in India had generally been 2-3 tons; it has now increased somewhat. The plant at CGCRI has a capacity exceeding the present requirement of the country and is now meeting all the requirements of most of the varieties of optical glass

Upgrading of Coals

Indian coals are in general high in ash or mineral matter. With the introduction of mechanised mining and progressive working of inferior seams, the ash content of the raw coals has gone up and stands at nearly 24 per cent. It makes the coals unsuitable for metallurgical purposes. To meet the requirements of the specified qualities of coal by different industries, including iron and steel and railways, the raw coals have to be upgraded to bring down the ash to acceptable limits.

In Indian coals the foreign matter is very finely disseminated. The Central Fuel Research Institute, (CFRI), Jealgora, has solved this problem of upgrading the mixed 'difficult' coals, produced from a large number of small mines, by developing a special procedure for coal washing. The Institute also campaigned for the establishment of large coal beneficiation plants for the cleaning of coals, particularly coking coals, for the manufacture of metallurgical coke, resulting in the installation of central washeries of large capacities (300-800 tons/hour).

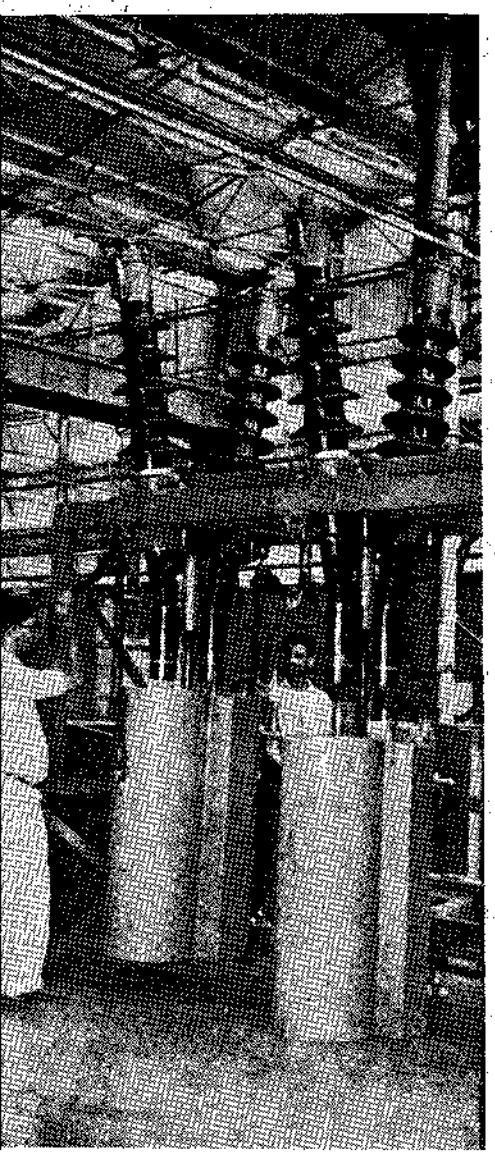
The CFRI acts as technical consultant to the public sector projects for the planning of all coal washeries, and is responsible for designing, preparation of specifications of equipment, scrutiny of tenders and advising the authorities on the suitability of the plants and equipment. The Institute has technically helped Hindustan Steel Ltd., the National Coal Development Corporation, the Durgapur Projects Ltd. and the Indian Railways in designing the coal beneficiation plants.

It is estimated that at the end of the Third Five Year Plan the total value of coal beneficiation plants designed, based on data supplied by the CFRI, will be of the order of Rs. 600 million. Even if a minimum consultancy charge of 3 per cent is levied on the total value of these projects, the money equivalent of CFRI's contribution on such projects alone would amount to Rs. 18 million, most of which would have been spent in foreign exchange.

(*Continued on Page 43*)

Big Push in Power

FOUR YEARS' PROGRESS OF HEAVY ELECTRICALS



nk being lowered by lifting gear during assembly

By

K. B. MATHUR

Chairman,

Heavy Electricals Ltd.

INDIA entered the field of heavy electrical manufacture barely four years ago. It was a modest beginning, but historic in significance as it set in motion a cycle of development in a highly technical field. November 6, 1960, when Prime Minister Nehru inaugurated the Bhopal unit of Heavy Electricals (India) Limited, is a landmark on this road to progress. Since then, massive development has been projected. A number of other units are coming up, part of the work has been completed and the remaining is in the course of implementation. The production capacities which will materialise when these units come into fruition are:

BHOPAL : (already in production since November, 1960)—Collaboration with Messrs. Associated Electrical Industries, U.K.

(i)	Hydro turbines and generators	0.5 mil. kW
(ii)	Steam turbines and generators	0.6 „ „
(iii)	Power transformers	3.0 „ „
(iv)	Industrial motors, large electric machines and synchronous condensers	240,000 kW
(v)	Capacitors	108,000 kVAr
(vi)	Traction motors and associated control equipment	800 Nos.
(vii)	Switchgear:	
	11 kV indoor type	1,500 Nos.
	11 kV outdoor type	400 Nos.
	33 kV oil circuit breakers	300 Nos.
	66 kV oil circuit breakers	100 Nos.
(viii)	Control panels	500 Nos.
(ix)	Control gears	400 Nos.

RANIPUR : (under construction, scheduled for production in third quarter of 1965)—Soviet collaboration.

(i)	Hydro turbines and generators	1.2 mil.kW
(ii)	Steam turbines & turbo alternators	1.5 „ „
(iii)	Large and medium size motors	0.52 „ „
(iv)	Associated control equipment	

HYDERABAD : (under construction) scheduled for production in second quarter of 1965—Czechoslovak collaboration.

Steam turbines and turbo alternators including the associated control equipment 0.8 mil.kW

TIRUCHI : (under construction) scheduled for production in first quarter of 1965—Czechoslovak collaboration.

High pressure boilers, 3,000 tons of steam/hour or equivalent 750,000 kW.

***

THE Bhopal unit, which has been under production, at present turns out high voltage switchgears, power transformers, capacitors, traction motors, thermac welders, control gear and control panels of a variety. Other lines of manufacture, for which this unit is being equipped, will be taken up as the respective areas get ready for production.

The Hydro-Turbine Section is now almost ready and a start has been made with the manufacture of nose-cones for the Obra power-house in Uttar Pradesh, which have since been supplied. The draft tubes and the spiral castings for the 33-MW hydro unit required for this power-house are now under fabrication.

Part of the Heavy Rotating Plant Section, which has been constructed, is now being equipped; and, within a month, industrial motor manufacture will be taken up. By the end

of March 1965, the entire Section is likely to be in commission, when the manufacture of thermal and hydro generators will be started—for which preparatory work started in the beginning of this year.

It is to be appreciated that considerable collection and analysis of data precedes the design work of heavy rotating equipment, which is time-consuming and fairly complicated. While we are rapidly building up a self-contained design organisation, it will be some time before our engineers acquire the requisite proficiency and experience in this line of work; meanwhile, we have to rely largely upon the assistance of our consultants.

The Thermal Turbine Section, which was sanctioned only last year, is now under construction and should be ready by March 1966. Here again preparatory action is in progress. Once this has been done, the Bhopal factory will have been equipped as a composite unit for the manufacture of heavy electrical equipment.

The most noteworthy achievement so far has been the design and manufacture, by our own engineers, of a number of large-sized power transformers, and, in particular, the one supplied to the Talcher thermal power station with a capacity of 75,000 kVA—which, by all standards, is a very large unit. The skill in the technology of manufacture which has been acquired in the sphere of transformers is indeed commendable, as it involves a high degree of skill and precision.

Private sector industries are also turning out similar equipment in India—but in lower ranges. And they are largely dependent on import of porcelain bushings, radiator banks, tap changers, current and potential transformers and a variety of rolled paper components, e.g., cross jet pots for switchgear and insulated paper cylinders for transformers which the Bhopal factory manufactures in its own shops.

Switchgear has hundreds of small components which require careful machining to close tolerances. Our young technicians have picked up the art fairly quickly, and will gradually attain the level of productivity of experts. Some experts felt that the top dome of the 33 kV switchgear consisting of a large aluminium casting will take us two to three years to produce in our own foundry. Our men, however, have picked up the skill after a few trials—and, now, one unit is turned out every second day.

Switchgear also involves fabrication work of a fairly complicated character, which, again, has been mastered. The output in this shpere has been continuously improving; and some of our workers have reached a stage of proficiency comparable to that of the experts elsewhere.

In the field of traction equipment, we have already produced 60 sets for the 1,500 volt D.C. electrical multiple units for the Bombay region. Commutator manufacture and preparation of insulated coils of close tolerances for these D.C. motors require a high degree of precision work, which, for the first time, has been undertaken by our young engineers. Its skill has been acquired, but speed in execution is a question of time.

While these modest achievements do not look spectacular, experts who visit Bhopal have all praise.

A vigorous drive has also been instituted to develop ancillary industries. A variety of semi-finished components is now indigenously available; notable being the magnet frames for traction motors, about which there was some doubt whether we would be able to develop their output so quickly.

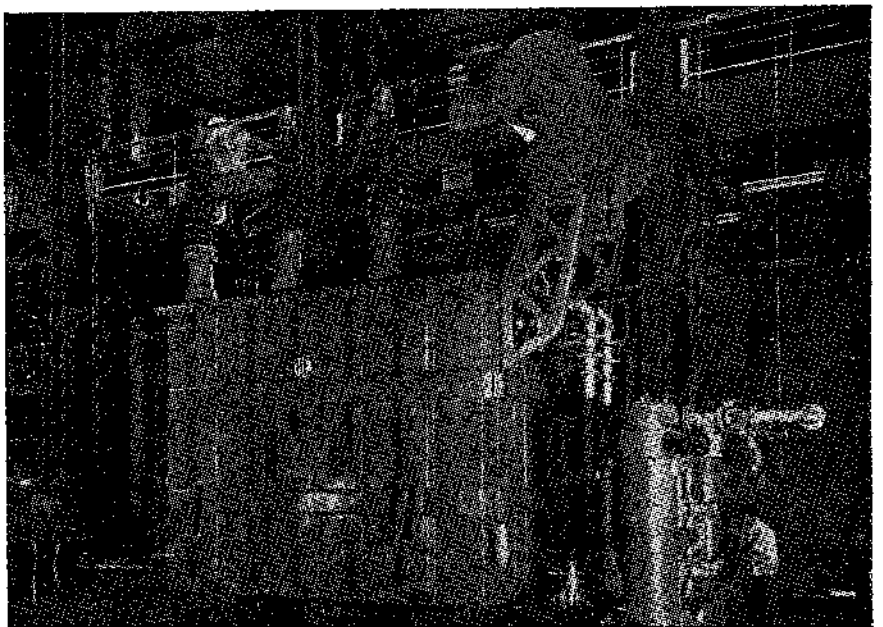
Public interest naturally centres on financial returns, the nation having made a large investment of its funds. Of the 25-crore project, only half is in production and the remainder is in the course of execution. The output of this half of the project has reached 50 per cent level and is progressively moving up. Since teething troubles have already been overcome we may hope that future development will proceed more speedily. Initial losses are, however, staggering and are apt to unnerve those uninitiated in this industry. It is, however, to be appreciated that this was all anticipated in the Project Report. It is recognised the world over that the optimum level of production in a heavy electrical plant can only be reached in six to seven years and this drill seems inescapable, recognising that we have started from scratch and technical acumen is having to be built up among novices from the school stage. While every endeavour is being made to shorten this period of trial there is limited scope for manoeuvre, as the human hand and mind which are involved take their own time. In this predicament, patience and perseverance are our best guides.

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In regard to the other units, it is anticipated that the High Pressure Boiler Plant at Tiruchi will be ready for commissioning early next year. Preparatory work for starting manufacture is in hand, Here again, a study of the quality of coal, water,

(*Continued on Page 57*)

A giant transformer (75,000 KVA) made by Heavy Electricals Bhopal, the largest ever made in India



WE HAVE REACHED

TAKE-OFF STAGE IN AIRCRAFT INDUSTRY

ALL-INDIAN JETS NOW MADE

CONTRIBUTED

THE question is often asked as to whether a country like India with its financial limitations, and more particularly in its present stage of development where understandably the accent is on quick yielding projects to advance the standard of living, should embark on establishing an indigenous aircraft industry.

The tremendous progress that aviation has made in the past two decades, the emergence of India as an independent, non-aligned country, the various political and economic forces that confront us, all point to the need for developing within the country the basic framework which in the years to come can house a full-fledged aircraft industry. The aircraft industry is as much based on creative thinking within the framework of scientific principles as on engineering skills and techniques.

Apart from the fact that it would be uneconomical and unwise to depend solely on aircraft purchased abroad or on securing designs for aircraft from other countries, the industry provides Indian scientists and technicians the opportunity that they so much desire to do creative work.

Development of an aircraft design is in itself a long process. The work involved in adapting components and equipment for tropical conditions is enormous. It is here that opportunity is provided for giving full play to the spirit of innovation. One of the essential factors governing design and development of aircraft is the existence of wind tunnel facilities and flight-testing facilities—the first to help the designer and the second to help the prototype engineer. These facilities are available only in some of the most advanced countries. But realising the vital role played by these facilities, steps have been taken to provide them in this country.

Viewed against the background of underdevelopment the emergence of Hindustan Aeronautics Ltd., as an aircraft manufacturing complex, within twenty-four years of the inception of the aircraft industry in the country at Hindustan Aircrafts Limited, Bangalore, must be considered a milestone. It could be said that within the limitations that our country faced, the first flight of the HJT-16, a truly all-Indian jet trainer, proves that there is an innate capacity in our countrymen to meet the challenge of aviation.

Design Work

THE emphasis being on self-reliance, a Design and Development Branch under the control of Dr V. M. Ghatage was established in Bangalore. The intention of the Government, to have the Prentice aircraft replaced by a trainer aircraft designed and developed in the country, was realised by HAL in the all-metal Hindustan trainer HT-2, the first all-metal trainer produced in the world. Except for the instruments and power plant all other items in this aircraft were produced in the country.

The Government of India, having subscribed to the idea that the Indian Air Force pilots should have training from the start in jet aircraft instead of piston engine trainers as hitherto, HAL was entrusted with the design and development of a jet trainer aircraft. The first prototype designated HJT-16 has just flown. It is the first jet aircraft to be developed without the assistance of any advanced nation. It is the intention to power the production aircraft with jet engine designed and developed in the country. The development of such an engine is in an advanced stage.

Since there was no supersonic aircraft to replace the Gnat fighter, HAL undertook the design and development of one. A team headed by Professor Kurt W. Tank has designed the HF-24 aircraft christened Marut. We are the fifth nation engaged in the design and development of a supersonic aircraft. Tooling for quantity production of this aircraft in several versions for different specialists roles is in hand.

To meet the requirements of civilian flying clubs, HAL has produced the Pushpak aircraft which is fabric-covered and is of an economical category. This aircraft is in current production and supply. The section producing Pushpak aircraft—which is anticipated to be powered by an indigenously designed engine—is entrusted also with the production of Krishak aircraft (air observation post version).

Unlike as in other industries it is difficult to measure progress in the aircraft industry purely in terms of the number of aircraft produced with respect to investment. It is one of the most complicated industries, and far more of planning, research and innovation go into it than in other industries. It would be difficult to realise the innumerable innovations that have been made and the new processes that have been devised in aircraft produced in the country today.

Progress of HAL

SELF-RELIANCE is a relative term in the aircraft industry, more particularly in developing nations. The inherent limitations of our industrial base, still in formation, and paucity of technical resources impose

a certain degree of dependence on outside help during the initial period. But, propelled by a powerful desire to close the time gap, HAL can be said to have achieved in a comparatively short span, progress of which the nation can be justly proud.

India is relatively a new entrant in aviation, yet it is today firmly placed on the world map with its entry into the field of supersonic aircraft.

From a mere overhaul base established to meet the demands of the second World War it has grown into an institution fully equipped in every aspect of aircraft production—from design to manufacture.

In these twenty-four years, HAL has progressed from the assembly manufacture of Harlow PC5 trainers to the manufacture of a hundred per cent indigenously designed jet trainer the HJT-16. The pattern of production in other countries is that the aircraft company designs an airframe according to required specifications, while the power plant or engine, the hydraulic system, the electrical system, the landing gear and the weapon system are manufactured and supplied by other companies.

In our country the aircraft industry has to develop into a composite establishment to manufacture all its requirements. Consequently, apart from airframe manufacturing facilities, production of engines has also been taken up by HAL.

HAL's domestic demand for light alloys, magnesium castings, and other precision castings and forgings, is rising steadily and will rise further in the coming years. Therefore, a foundry and forge have been established and are being expanded. The Government of India has also entered into a licence agreement with High Duty Alloys Ltd., of U.K., for technical know-how. Necessary work in connection with the execution of the agreement has been taken in hand. HAL has its own flight testing group. HAL's plans for the next logical step for making the aircraft industry self-sufficient is the establishment of facilities for quantity production of accessories. The scheme is under active consideration. HAL has the requisite knowledge, production techniques and also the supply of skilled personnel to establish such a factory.

The investment, both in resources and manpower, in the aircraft industry in this country, while appears colossal compared to that of other countries, is in reality a very small fraction of the outlay in other countries. Yet, judged from the results and the experience gained, we can look forward confidently to an era of progress.

QUOTATION BOX

If India is to be truly secular in future, *avatarhood* must be taken out from its leaders; the only criterion for leadership must then be whether or not a person can devolve executive instructions on all levels, without interim appeals to kinship, godliness and Mother India.

—Agehananda Bharati

At the convocation of the Mysore Hindi Prachar Sabha all the speakers including its president Mr H. Ramakrishna Rao, Mr M. C. Chagla and the Chief Minister of Mysore spoke in English.

—Mr P. Kodanda Rao

My assessment is that the Chinese have lost faith in the Indians. They think that the Indians have double-crossed them.

—President Ayub Khan

What is the sign of prosperity? Should we seek it in some tall, magnificent buildings or in the luxurious life led by a few families who control all the wealth, while the masses continue to live in abject poverty and misery?

—Miss Fatima Jinnah

A casual impression he had gathered was that Indians today were better dressed, particularly in the countryside, than they used to be.

—Mr Pierre-Paul Schweitzer, of the International Monetary Fund

There are many misconceptions about Shastri's ability to drive home a point in English. It has yet to be realised that few Indian politicians can match his quiet competence in the handling of a foreign idiom.

—The Editor of "The Illustrated Weekly"

Some years ago a very senior teacher of an Indian university told me in accents of despair: "Do you know it is not the standard of the students that is going down but the standard of the examiners?"

—A writer in "The Indian Express"

The Foreign Service has so far felt no democratic impact. Much of the energies of our ambassadors are spent in securing personal privileges, jostling for position and pulling strings.

—Mr C. S. Venkatachar

SHAMBU **Malinda Topa**



PLAN SNIPPETS

* A high-level bridge across the Betwa river near Jhansi has been opened to traffic. Built at a cost of Rs 31.34 lakh, the bridge facilitates traffic between U.P. and Madhya Pradesh.

* Up to the end of August this year, co-operative sugar factories produced 5.98 lakh tons of sugar out of the total production of 25.12 lakh tons. Forty-eight co-operative factories were working this season.

* A Bombay firm has secured an order for supplying Indian shoes and slippers valued at Rs 5.33 lakh and hand-knitting machines valued at Rs 5.71 lakh to the U.S.A. The Punjab Export Corporation is to supply to U.S.A. bed covers valued at Rs 4.66 lakh.

* The Employees' State Insurance Scheme has been extended to 2.1 lakh factory workers of Ahmedabad, thus covering 29 lakh workers all over the country.

* An Indian Chamber of Commerce has been established in Argentina.

* The Union Government has set up a committee of experts to draw a plan for the control of floods in the delta areas in the Godavari, Krishna and Guntur districts of Andhra Pradesh.

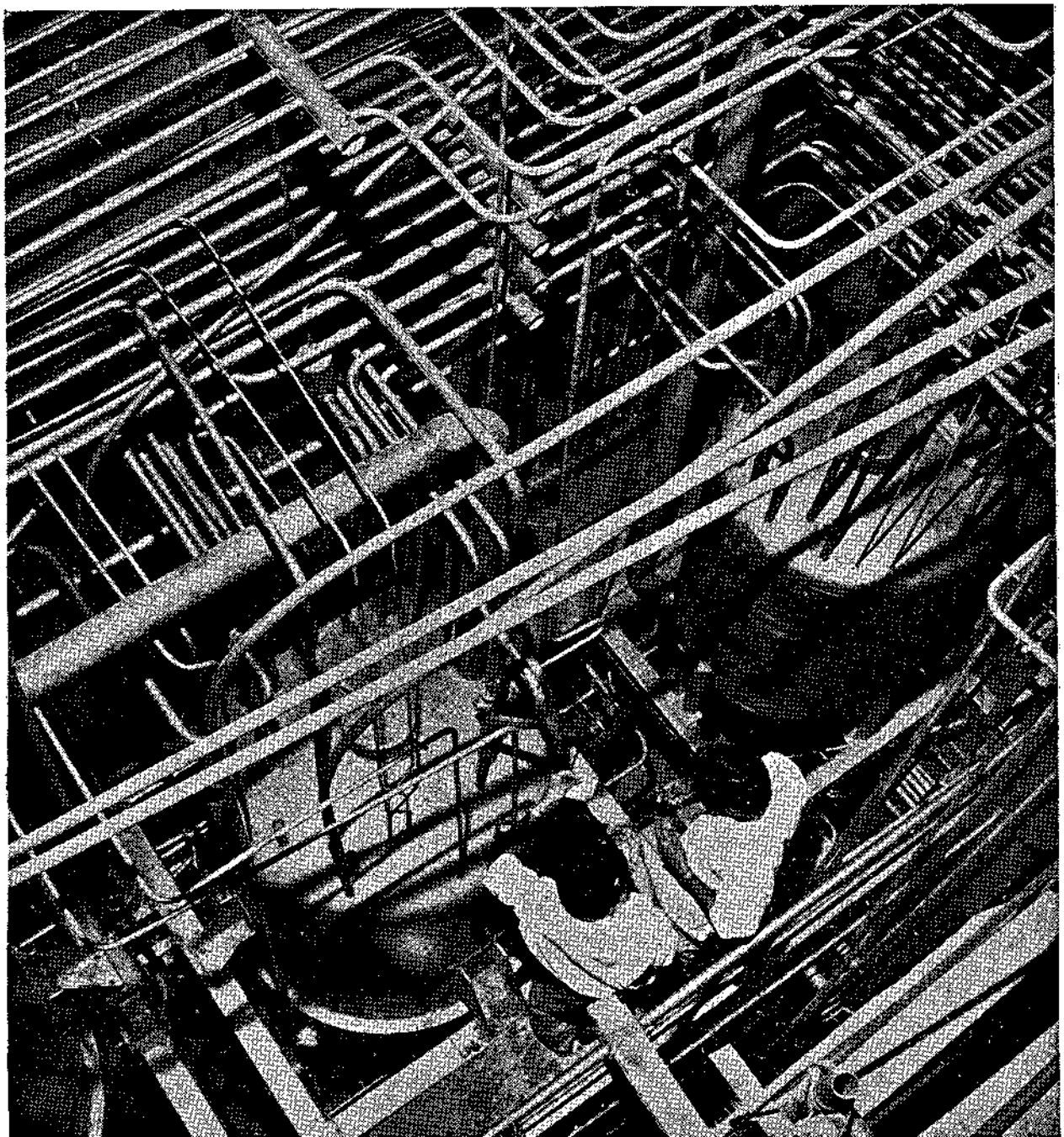
* The Dandakaranya Project Administration has finalised a programme of work for the season from October 1964 to September 1965.

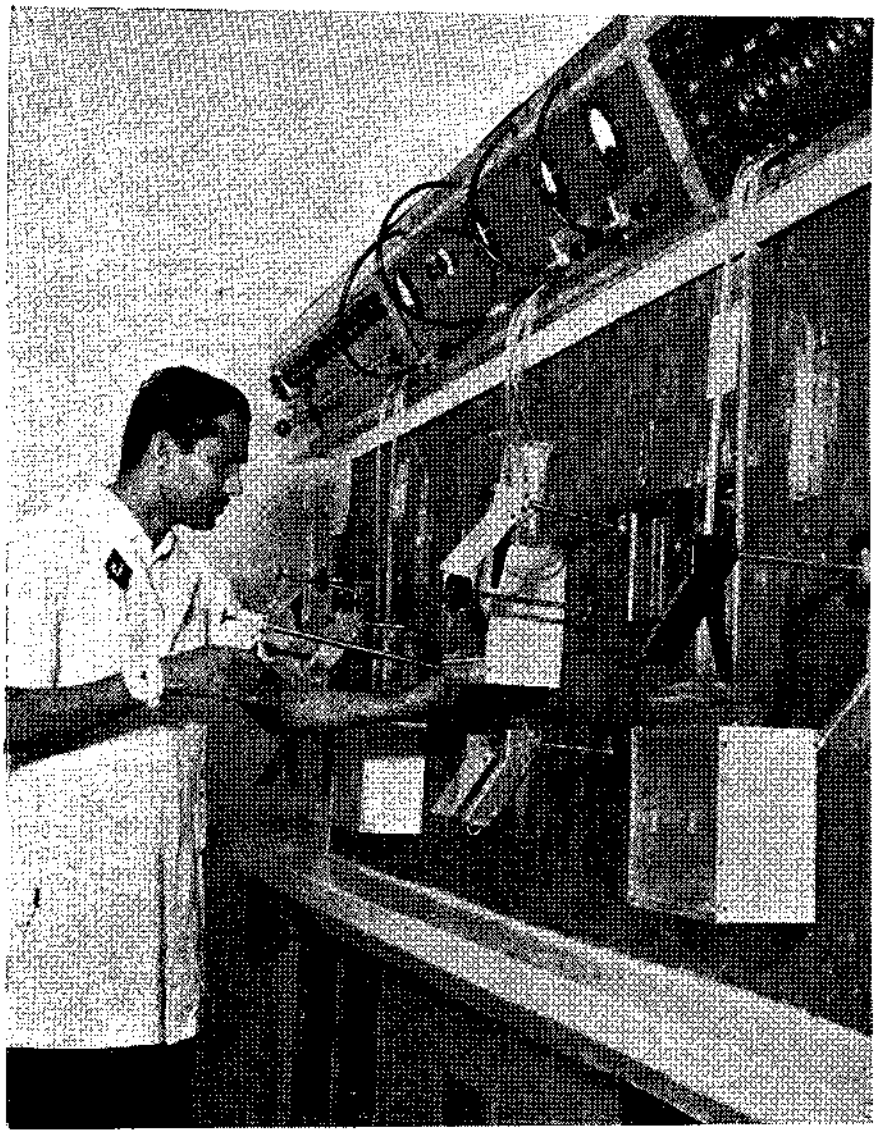
THE ATOM IN INDIA

One Industry in Which We Are a Developed Nation: Our Scientists & Engineers Do Notable Work in Finding and Building

A maze of pipes and tubes in a cell of the Plutonium Plant at Trombay

ARTICLE OVERLEAF





At the Radioisotope Production Plant at Trombay

By

S.N. GUPTA

Editor, Nuclear India

SOME of the most outstanding achievements in independent India have been in the field of peaceful uses of atomic energy. It is worth noting that almost all this progress has been made during a brief period of ten years as the Department of Atomic Energy was set up only in August 1954. It was in March 1955 that the Atomic Energy Commission decided to build at Trombay a reactor of the pool type using enriched uranium fuel elements. Though basically similar reactors were available on sale, the Commission considered that valuable experience would be gained if Indian scientists and engineers were made entirely responsible for the designing, erection and commissioning of India's first reactor. It may be interesting to note here that at the time this decision was taken only two countries in Europe, besides Fance, the UK and the USSR, had designed and built their own research reactors.

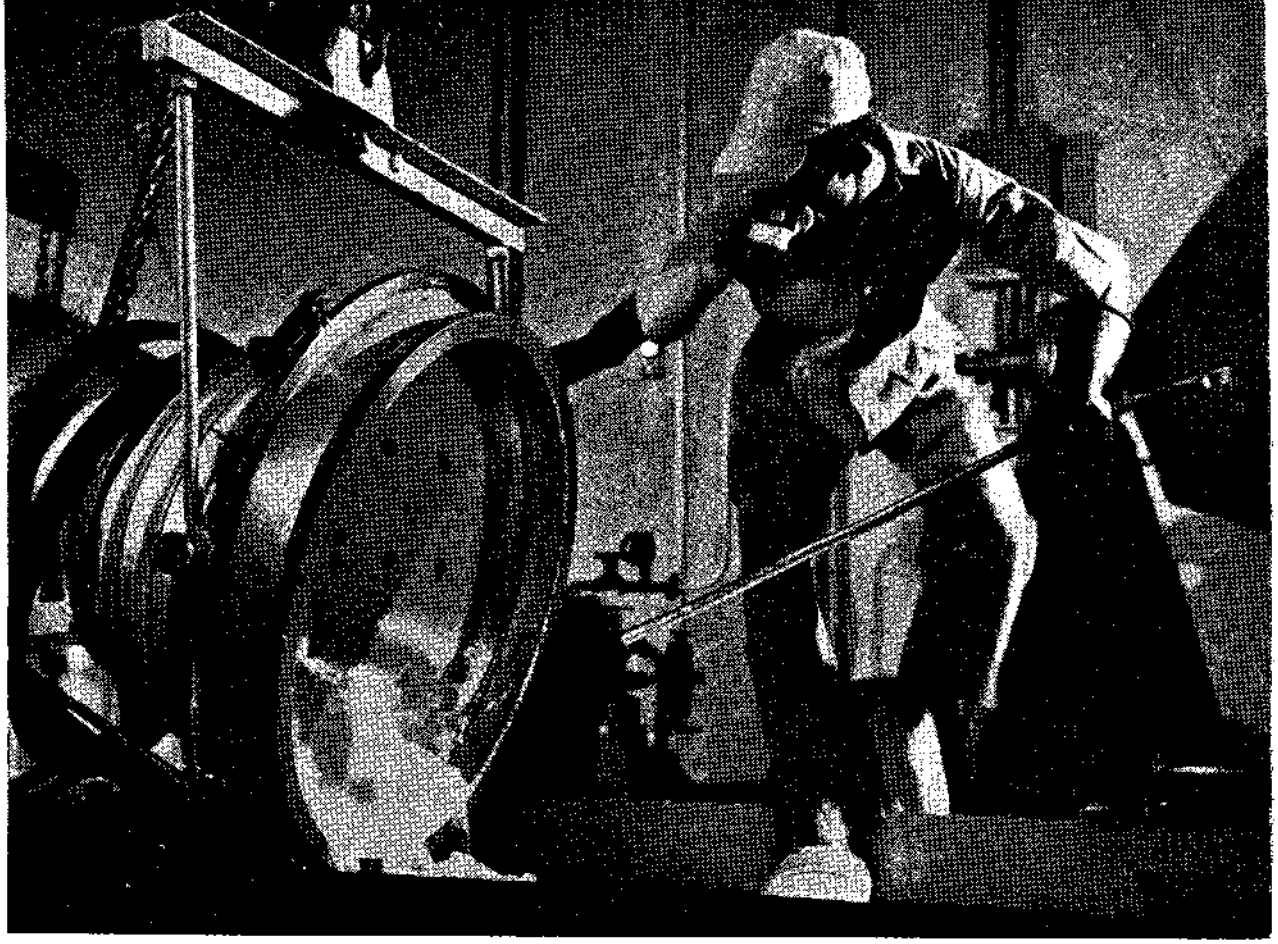
THE reactor at Trombay, on which about 50 scientists and engineers were working, was completed within one year and it became critical for the first time on August 4, 1956. This reactor, named Apsara, was the first one to become critical not only in India, but also in Asia.

India's second reactor, the Canada-India Reactor (CIR), was built in collaboration with Canada. Although Canada was responsible for designing and commissioning this 40-MW reactor, the group actually working on the project consisted of both Canadian and Indian personnel. The largest number of Canadian staff on this project at any time did not exceed 30 as against the total engineering and skilled artisan force of 1,200.

Under the agreement with Canada it was stipulated "that the fuel elements for the initial fuel charge and the continuing requirements of the reactor will be supplied from Canada save to the extent that India provides them from sources within India".

Though India, contrary to expectations of some, had fabricated fuel elements before the completion of CIR, some scepticism was expressed about using fuel rods fabricated at Trombay for the initial loading of the reactor. It was, therefore, decided to send two fuel rods from Trombay's first batch to Chalk River in Canada for use in the NRX reactor there. The Canadian authorities were not only satisfied with their performance but also expressed the view that Trombay's fuel rods were among the very best. The Canadian design provides for an elongation of 8.6″ in each fuel rod. One of the two rods from Trombay increased in length by only 0.1″ after an irradiation of 1,840 megawatt days per tonne and the other by 0.6″ after an irradiation of 1,620 megawatt days per tonne.

CIR reached first criticality on July 10, 1960, and half the first fuel charge of 190 rods was fabricated at Trombay and the other half provided by Canada. Today the reactor is fuelled entirely with fuel rods fabricated at Trombay.



An ingot of nuclear pure uranium being cast at the Uranium Metal Plant at Trombay.

One of the notable achievements of Indian scientists and engineers was to operate this reactor and to bring it up to the designed power level of 40 MW. Although the reactor achieved first criticality on July 10, 1960, it was brought to full power operation by Indian scientists and engineers only on October 16, 1963. This was not an easy task because the reactor had had a series of 'teething troubles' which had to be rectified. This also demonstrated that it is not enough to get a reactor or other facilities from outside unless the country possessed trained personnel to operate them.

INDIA'S third reactor, Zerlina, is a zero energy reactor and was designed, engineered and built entirely by Indian scientists and engineers. This reactor, which has proved to be a very valuable experimental facility, became critical for the first time on January 14, 1961.

ATOMIC FUEL

WITH a view to achieving self-sufficiency in the nuclear field, it was decided as early as May 1956 to set up a plant for producing reactor



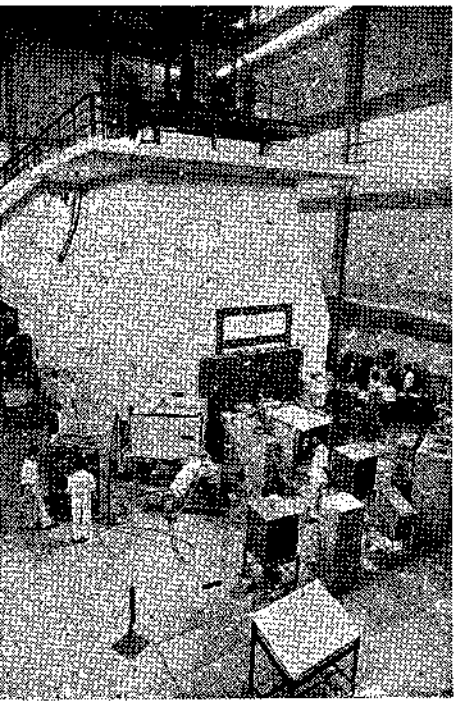
Girls at work on the Electronics Assembly line at Trombay

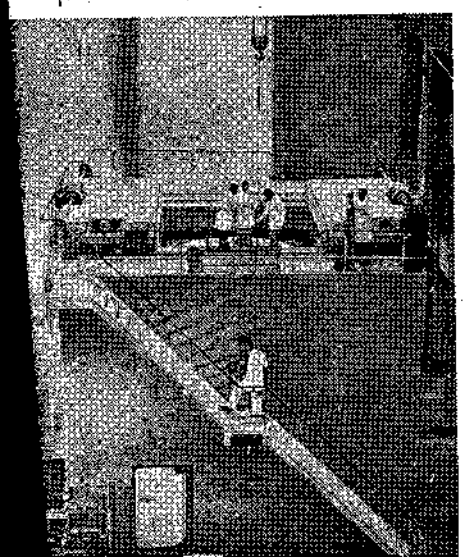
grade uranium metal, as well as a fuel element fabrication facility. The Uranium Metal Plant was commissioned by the middle of December 1958; and the first nuclear pure ingot of uranium metal was produced on January 30, 1959, from uranium fluoride obtained from the Thorium Plant at Trombay. The latter had been built in 1955 for processing thorium cake obtained from the monazite sands in Kerala.

The Uranium Plant was intended to be a pilot plant designed to provide first-hand experience in the production of nuclear grade uranium metal. It had practically no 'teething troubles'. Its initially designed capacity was 30 tonnes of uranium metal per annum, sufficient for providing the uranium for CIR and Zerlina. However, reactor technology has progressed to such an extent that the same plant, with minor additions, can produce enough uranium for feeding the Rajasthan and

Kalpakkam nuclear power stations with a total capacity of 800 MW.

Fabrication of fuel elements for reactors is a highly skilled and complex job. Indeed this is one of the trickiest aspects of building a reactor. This is borne out by the fact that in the world today there are only about half a dozen countries making their own fuel elements. On the basis of development work carried out at Trombay, the preliminary flow sheet for the plant was finalised in November 1957; and it was completed in less than twenty months after this, *e gineered and built entirely by Indian metallurgists and engineers.* The first prototype fuel element for CIR was produced on June 15, 1959, and the first lot of ten fuel elements was ready on February 15, 1960 about five months before CIR became critical. It is of interest to note that Indian fuel elements have some of the finest grained uranium metal in the world, some five to six times finer than the grain in most other fuel elements.





Above: Reactor Apsara with various experimental assemblies in the foreground Below: Reactor Zerlina—which was designed, engineered, and built entirely by our scientists and technicians (On Apsara we had Canadian collaboration.)

India has long been known to have the largest deposits of thorium in the world in its monazite sands of Kerala, but the efforts of the Atomic Minerals Division of the Department have led to the discovery of even larger deposits on the borders of Bengal and Bihar. It has also led to the discovery of substantial deposits of uranium in Bihar. One of these deposits is being developed industrially, and a uranium mine is being opened in this area. A uranium mill to produce uranium concentrates from this ore, by treating a thousand tonnes of ore per day, is also being set up near the mine at Jaduguda in Bihar. This mill again has been designed by Indian scientists and engineers, and is being erected by them.

PLUTONIUM PLANT

TROMBAY scientists and engineers have also successfully designed, built and commissioned a Fuel Element Reprocessing Plant (Plutonium Plant) for processing irradiated uranium rods to extract plutonium and other fissionable materials. Plutonium is an extremely valuable fissile material and atomic fuel for future reactors. It is of great importance to the long-term power programme of the country as plutonium reactors can be used to breed uranium 233, also a fissile material, from thorium. India having the largest reserves of thorium in the world, her long-term atomic power programme is based on its use in future reactors.

In addition to India, only four other countries in the world have operating fuel element processing plants at present, namely France, the U.K., the U.S.A. and the U.S.S.R., while Norway has a small pilot plant.

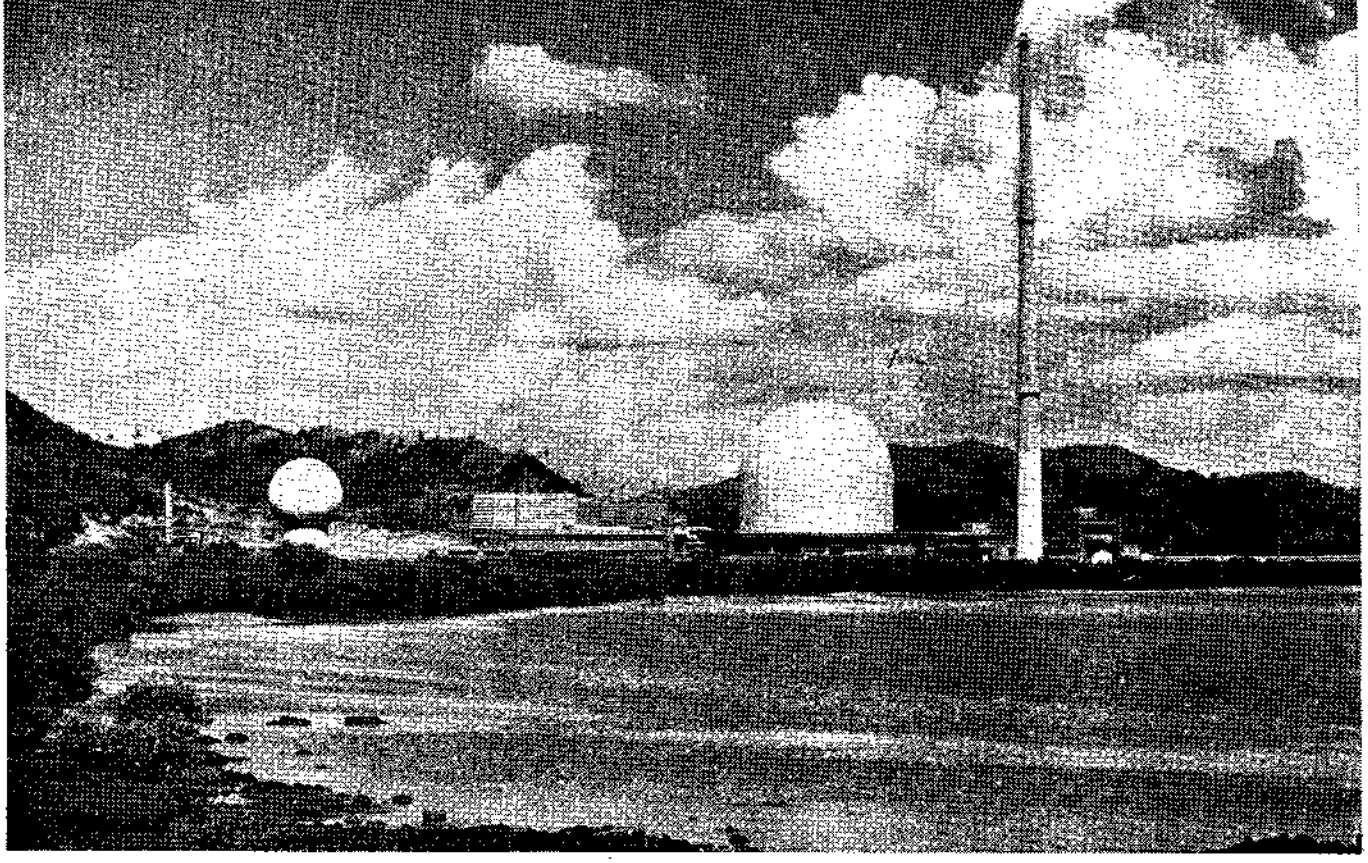
INSTRUMENTATION & EQUIPMENT

As atomic radiations cannot be perceived by the senses, electronic instruments and radiation detectors are needed not only to detect the dangerous levels of radiation but also to carry out research in various fields. A small electronics group was formed in 1955 to design, fabricate and install reactor control in trumentation as well as produce other instruments required for the reactors at Trombay. After completing this task in 1960, this group was expanded and diversified in order fruitfully to utilise the experience gained in this field. Today the Establishment produces most of the electronic instruments needed not only for its own work but also by other institutions employing radioisotopes and radiation sources.

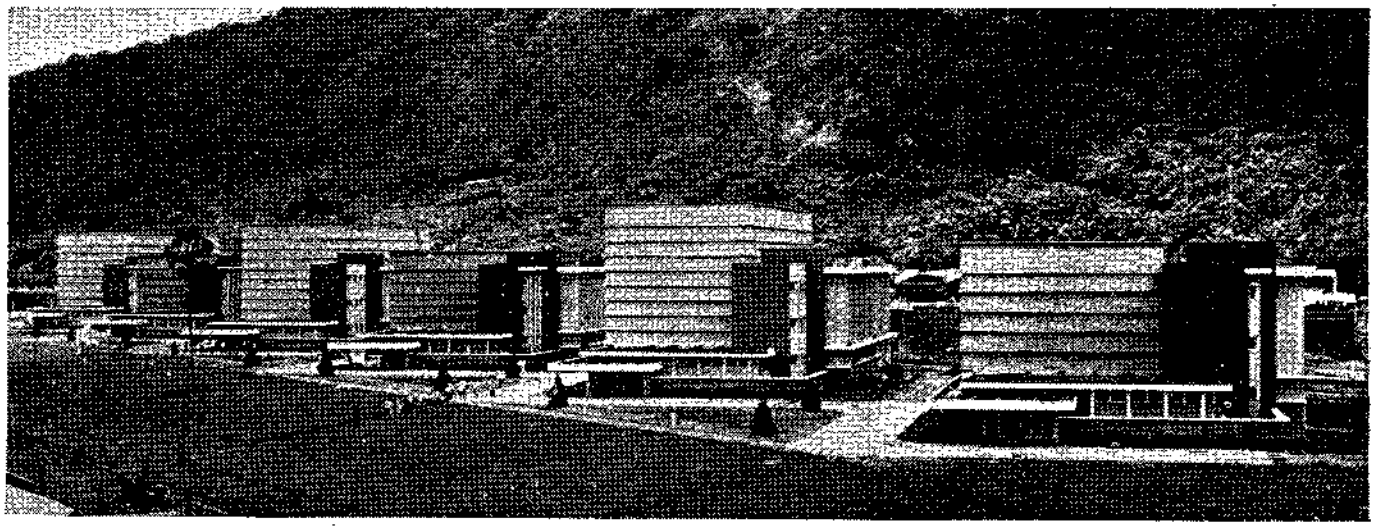
High vacuum equipment constitutes one of the essential requirements for nuclear work. The Tr mbay Establishment has developed and fabricated a number of high vacuum instruments, thereby saving a considerable amount of foreign exchange. Techniques developed here have also been employed for uses other than in the field of atomic energy. For instance, at the time of the Chinese invasion in October 1962 there was a sudden increase in the demand for blood plasma. The only two existing plants in the country for freeze-drying this life-saver were not adequate to meet the demand. The Trombay Establishment designed and fabricated a plant for this purpose, capable of freeze-drying 600 bottles or 180 litres of plasma per month. This was the first unit of its kind to be built in India and it has been installed at the Haffkine Institute in Bombay. Trombay is now developing mobile freeze-dryer units.

RADIOISOTOPES

Radioisotopes and radiation sources are perhaps the most versatile



Above: A view of the Canada-India Reactor at Trombay. Below: The six engineering halls of the Atomic Energy Establishment.



tools of the Atomic Age. One of the tasks of the Department of Atomic Energy has been to make these tools available to workers in agriculture, biology, industry, medicine and research all over the country. The production of radioisotopes and labelled compounds at Trombay has steadily increased over the years and today more than 250 different types of radioactive products including many special preparations are readily available for users. Radioisotopes have also been exported to Ceylon, France, Pakistan, South Korea and Thailand.

A number of experiments have been carried out, using the radiotracer technique, in the field of hydrology for the measurement of movement of silt on river and sea beds and of water flow in rivers. Particular mention may be made here of the experiments conducted successfully in studying silt movement in various harbours. The results of these studies have saved the port authorities concerned considerable amounts of money in dredging operations. The experience and knowledge gained in this field have been placed at the disposal of the International Atomic Energy Agency for the benefit of other countries.

In the field of life sciences, fundamental aspects of biological actions

(*Continued on Page 59*)

FOR HEAVY INDUSTRIES, OUR OWN BIG MACHINES

By

A. K. GHOSH

Special Officer, Heavy Engineering Corporation, Ranchi

OIL, coal and steel may be said to be the industrial gold of a country. Our industrial growth depends to a large extent on the easy availability of these basic raw materials. Oil prospecting and drilling have to be done, coal is to be mined and steel is to be made in abundance to help industry to grow. For this growth to be self-sustaining, we have ourselves to produce the oil drilling rigs, coal mining machinery and the steel plant equipment.

This is exactly where the Heavy Engineering Corporation comes in. With its four principal units, three at Ranchi and one at Durgapur, HEC is establishing a huge industrial complex in collaboration with Prommashexport of the Soviet Union and Technoexport of Czechoslovakia to produce items of heavy machinery and equipment required principally for the oil, coal and steel industry. This equipment is a basic need for which we had so far been completely dependent on imports.

The striking feature of the HEC complex is, perhaps, not so much its size, gigantic though it is in keeping with modern tendencies and necessitated by ever increasing pressure on industry to produce more at lower cost, but its conception and orientation as an integrated complex to deliver to the nation a million-ton steel plant every alternate year and simultaneously to produce all the necessary equipment to help raise as much coal every year as is required, and enough capital goods by way of heavy machine tools for expansion of existing machining facilities and establishment of new units.

HEC has already brought the country to a new stage of its technological development. Out of its three units at Ranchi, namely the Foundry Forge Plant (FFP), the Heavy Machine Building Plant (HMBP) and the Heavy Machine Tools Plant (HMTP), the first two have already gone into pilot production.

The Foundry Forge

The FFP, which will have an ultimate capacity as shown in the table below, can now undertake grey iron and non-ferrous castings weighing upto 3 tons and 300 kg. a piece respectively. In another two years' time, it would be ready to undertake all the types of work as mentioned below:

	Capacity in tons per annum	Maximum piece weight of casting and forgings
Grey iron and other alloyed castings	46,600	100 tons
Steel castings	88,382	90 ,,
Non-ferrons castings	700	1000 kg.
Steel forgings	32,954	80 tons
Rough machining	64,015	100 ,,
Roll making (C.I. chilled and forged rolls)	21,310	30 ,,

The capacities mentioned above perhaps do not convey much to the layman or give him an idea of the facilities that are necessary to handle work of such magnitude, or of the technology behind it all. To elucidate only briefly, it may suffice to mention here that there are going to be plants within the FF Plant only to cater for the auxiliary service of producer gas, oxygen and acetylene. Some of the underground furnaces of this Plant are going to be as high as a seven-storey house and some chimneys taller than the Qutb Minar.

Besides serving as a metallurgical base primarily to its other two units at Ranchi as well as to other heavy industries of the country for their requirements of such heavy castings and forgings—the capacity for which does not exist in the country yet—the FFP will also be opening up, within a year's time from now, a new vista of industrial progress by making 'rolls' for the steel mills for the first time in India. These are at present produced only in a few highly industrialised countries of the world.

The Heavy Machine Plant

The major equipment for a steel plant would be made in the HMBP. The coke oven and by-product equipment shop of this plant has already gone into pilot production with the fabrication of steel structurals, a pig casting machine for the Durgapur steel plant, and E.O.T. cranes for the Hardwar plant of the Heavy Electricals Ltd. Very soon, the HMBP would also be undertaking to make the sixth blast furnace complex of the Bhilai steel plant. In addition, it is also planning for the delivery of a complex iron and by-product making plant for the Orissa Development Corporation to be established at Talcher. The complex is to consist of a pig iron plant, coke oven and by-product plant as well as their auxiliary plants. All these are proposed to be manufactured and delivered by the end of 1968. These indicate the huge potentialities of this gigantic Plant.

The items proposed to be manufactured in this Plant and the approximate figure of output at full production in tons per annum are given below:

	Output in tons
Coke oven and by-product equipment	7,700
Blast furnace equipment	5,500
Steel making equipment	7,000
Crushing and grinding equipment	3,150
Crane equipment	6,570
Rolling mill equipment	34,500
Spare parts for metallurgical equipment	1,080
Heavy mining equipment	820
Excavators	4,950
Press forging equipment	1,360
Heavy oil drilling rigs	5,500
Miscellaneous heavy machine parts and assemblies	1,810
Total	80,000

It would be seen from the foregoing that most of the major items required for the setting up of a steel plant would be taken up for manufacture in the HMBP. In addition, it would also be manufacturing heavy oil drilling rigs for the oil industry and other equipment.

Heavy Machine Tools

For the development of the machine building industry as such, and for meeting the requirements of heavy and extra heavy machine tools for the steel and other heavy engineering industries, for example, shipbuilding, heavy electrical, structural, earth-moving and materials-handling, chemical and fertiliser, loco and marine diesel engine industries, the Corporation is developing the Heavy Machine Tools Plant at Ranchi.

The average weight of the machine tools to be produced by this Plant would range from 25 to 30 tons a piece, while the maximum weight of an individual machine will be approximately 180 tons. The manufacture of machine tools of such large dimensions and capacities has not hitherto been attempted even in some of the more advanced countries. This Plant is expected to start pilot production of heavy radial drills, heavy centre and roll-turning lathes and planing machines from early 1966 and will gradually introduce new items in its manufacturing programme. Among these will be horizontal borers, edge planers, vertical borers and roll grinders in the second, third and fourth phases of its production programme. The planned capacity for this Plant, when in full production, will be:

	Peak Production per Annum Nos.	Weight in tons
Centre lathes	70	3,455
Radial drilling machines	36	412
Double-column planing machines	38	1,410
Horizontal borers	53	1,069
Vertical boring and turning mills	31	1,029
Plano-milling machines	20	1,000
Precision cylindrical and roll grinding machines	30	429
Spares and accessories	—	1,176
Total :	278	10,000

Coal Mining Machinery

The fourth unit of the Corporation, namely the Coal Mining Machinery Plant, has been established at Durgapur on account of its proximity not only to the steel plants but also to the coal mines. Raising of coal is being done in our country mostly with outdated machinery and with a bias towards manual labour. Coal mining and coal raising have become much more modernised in the world today with the availability of a large number of mining machinery for the manufacture of which an organised attempt has not so far been made in our country. The CMMP will go a long way to fill up this gap. In addition, it will also be undertaking the manufacture of light oil drilling rigs for exploration. The Plant has already begun production and a number of multi-stage mine pumps and conveyors are coming out of its assembly lines.

Large-Scale Work at Ranchi on Designing and Fabrication

Being away from the Ranchi complex of the HEC, the CMMP has its own iron and steel foundry, forge shop, oxygen plant and other servicing shops to make it self-contained. When in full production, its capacity will be:

	Quantity	Weight in tons/year
Coal cutters	600 pcs.	1,704
Loaders	250 ,,	1,371
Conveyors	1,800 ,,	22,487
Trolley and battery type electric mine locomotives	150 ,,	300
Haulages	400 ,,	3,804
Main axial fans	100 ,,	1,154
Electric winders	25 ,,	1,157
Booster fans	250 ,,	50
Centrifugal pumps	500 ,,	998
Sand pumps	300 ,,	550
Automatic cage keps for use in vertical shafts and safety detaching hooks, clips etc	—	2,000
Light drill rigs for exploration drilling	25 ,,	28
Spare parts	—	8,323

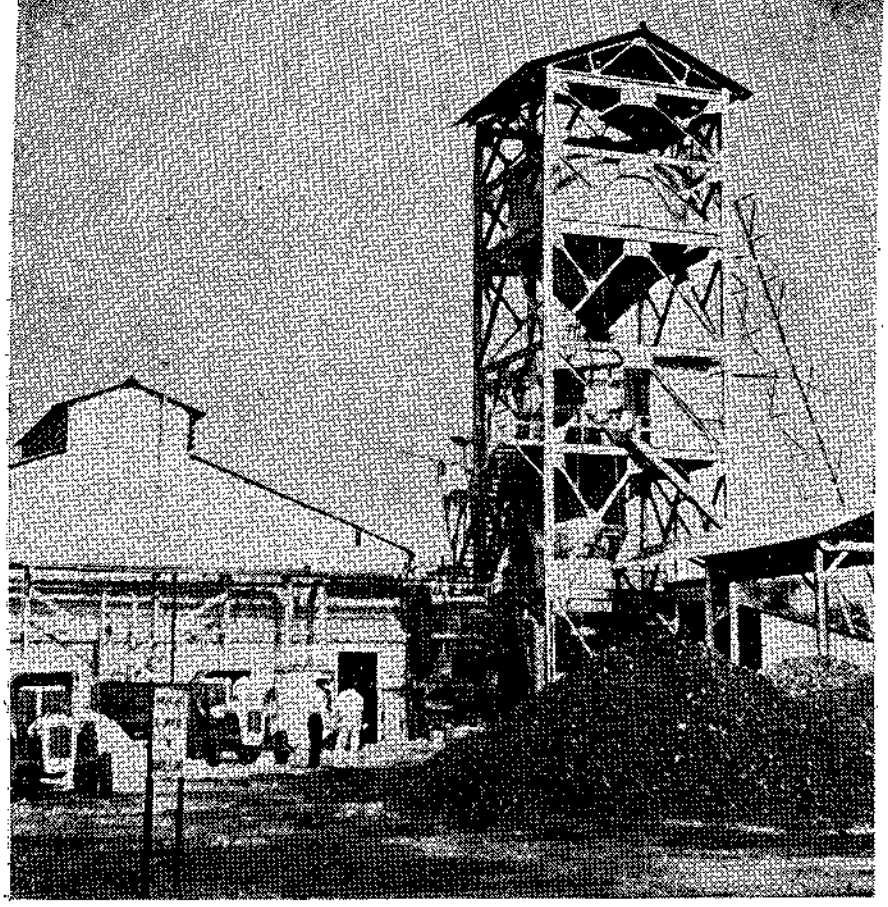
Design Organisation

It would be apparent from the foregoing that for the optimum utilisation of the productive capacity of the individual units of the HEC, facilities have to be developed in the country for the integrated designs of industrial plants or projects.

Apart from the individual Product Design Bureau attached to each of the HEC units, the establishment of a Cental Construction Design Organisation is also being taken up. The knowledge and experience acquired during the establishment of its own complexes at Ranchi and Durgapur will be ultilised in full for this. For the establishment of the Foundry Forge and the Heavy Machine Tools Plants, detailed designs for the civil, structural, electrical, mechanical and public health engineering works are all being undertaken by the Cental Design Organisation of the Corporation and it is also now possible for them to prepare complete designs and drawings for the establishment of similar engineering complexes. As a matter of fact, a beginning has already been made. As mentioned earlier, a complete pig casting machine for the Durgapur Steel Plant is already being designed in this Organisation and is being manufactured in the HMBP. The designing works connected with the delivery of a complete pig iron, coke oven and by-product plant to the Orissa Development Corporation which would require the preparation of as many as 8,000 design drawings, is also under the active consideration of the Corporation. The establishment of such designing skills would take us a long way towards our cherished goal of technological self-sufficiency.

Training Institute

As a part of an integrated scheme, the Corporation has also established a Central Training Institute to ensure a regular flow of engineering personnel and craftsmen, so essential to man such large and complex plants. The Training Institute has complete workshop facilities to train some 1,000 trade apprentices and 300 engineering graduates at a time. Arrangements for specialised overseas training in the USSR or Czechoslovakia have also been made. In course of time, the Institute would also be able to provide training facilities to other industries as part of an all-India programme. Trained craftsmen have already been seconded to all the HEC projects from this Institute and many more are undergoing the necessary training.



A view of the stagging generator pilot plant departmentally designed, engineered and installed by the Planning and Development Division of the Fertiliser Corporation of India.

Big Gains in

Corporation Builds up Self-Reliance

Creditable Achievement of Planning & Development Division

Contributed

SUBSTANTIAL progress has been made in fertiliser technology in India in recent years as a result of the pioneering and sustained efforts of the Planning and Development Division of Fertiliser Corporation of India. These efforts have been directed towards developing new products and processes and planning, designing, engineering and installing new fertiliser plants based on technical know-how acquired on its own. Having thus developed adequate technical know-how and experience, the Division is now in a position to undertake the planning, designing, engineering and construction of two major fertiliser plants every year.

Notable among the achievements of the Division have been :

The complete designing of the nitric acid and calcium ammonium nitrate plants at Rourkela effecting a saving of Rs. 1 crore in foreign exchange;

Designing of the ammonium sulphate plant for Namrup effecting a saving of Rs. 40 lakh;

Planning, designing and engineering of complete 100,000 tonnes of nitrogen capacity plant now under implementation at Korba based on coal;

Designing and engineering of CO conversion catalyst plant effecting a saving of Rs. 30 lakh in foreign exchange;

Designing and engineering of ammonium bicarbonate plant;

Regeneration of CO conversion catalyst imported from abroad effecting a saving of Rs. 25 lakh in foreign exchange;

Production of 4,200 cft. of CO conversion catalyst effecting a saving of Rs. 15 lakh in foreign exchange;

Production of ammonium bicarbonate effecting a saving of Rs. 15 lakh a year in foreign exchange;

Production of ammonium sulphate from coke-oven ammonia liquor;

Utilisation of indigenous timbers for cooling towers; and Production of desulphurisation oxide and cation exchange resin effecting a saving of Rs. 7.5 lakh a year in foreign exchange.

Fertiliser Technology

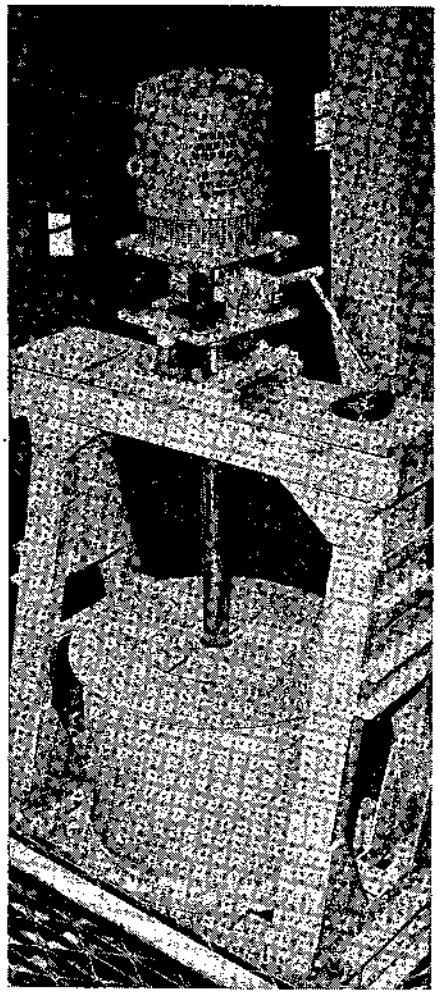
Besides, complete technical know-how in respect of planning, designing and engineering have been established for medium pressure nitric acid plants, ammonia vaporisation plants, calcium ammonium nitrate, double salt and ammonium nitrate plants, ammonium sulphate plants based on direct neutralisation process and ammonium sulphate plants based on gypsum process.

The Division is engaged in extensive and intensive project planning work. As regards extensive planning, it has been engaged in assessment of fertiliser requirements at the end of the Third and Fourth Plan periods, possible locations of fertiliser plants based on the availability of raw materials, utilities, etc., and generation of fabrication facilities based on standard designs of plant and equipment. In matters of intensive planning of specific projects, it has done numerous feasibility and techno-economic surveys and project reports and estimates for new fertiliser projects for the Third and Fourth Five Year Plans, including those at **Trombay, Namrup, Gorakhpur, Korba, Barauni, Durgapur, Rihand, Udaipur, Khetri, Madras** and expansion of **Sindri and Nangal.**

POOLING OF KNOW-HOW

THE Planning and Development Division, with the Central Institute of Fertiliser Technology as its adjunct, is an integrated technological organisation which has been set up under the Fertiliser Corporation of India to pool technical talent and know-how available within the Corporation to achieve in the shortest possible time the fullest measure of technological self-sufficiency in the fertiliser industry. Under this Division, a well-knit team has been built up and put under a unified technical direction to cover the interrelated aspects of technological investigation, process development, project planning, process design, engineering design, etc.

The Division started as a technological branch at Sindri in 1951. This department soon justified its existence and the confidence reposed in it by the management by developing an indigenous catalyst for water gas shift conversion at a fraction of the cost of imported catalyst. Besides developmental work, the department was given every scope to participate in the planning of the coke ovens at Sindri and the utilisation of the coke oven gas therefrom.



Some equipment of the ammonium bicarbonate production plant being put up by the P and D Division based on pilot studies. The intention is to meet the country's total requirement of the material and avoid imports.

Later, in 1955, Sindri successfully undertook construction of an expansion to the gypsum-based ammonium sulphate plant to increase its output by about 300 tons a day. With the gradual development of the interlinked functions of planning, development, design, engineering and procurement in 1959, Sindri put up a successful bid for building the 850-tons per day nitric acid plant and 2000 tons nitro-limestone plant at Rourkela.

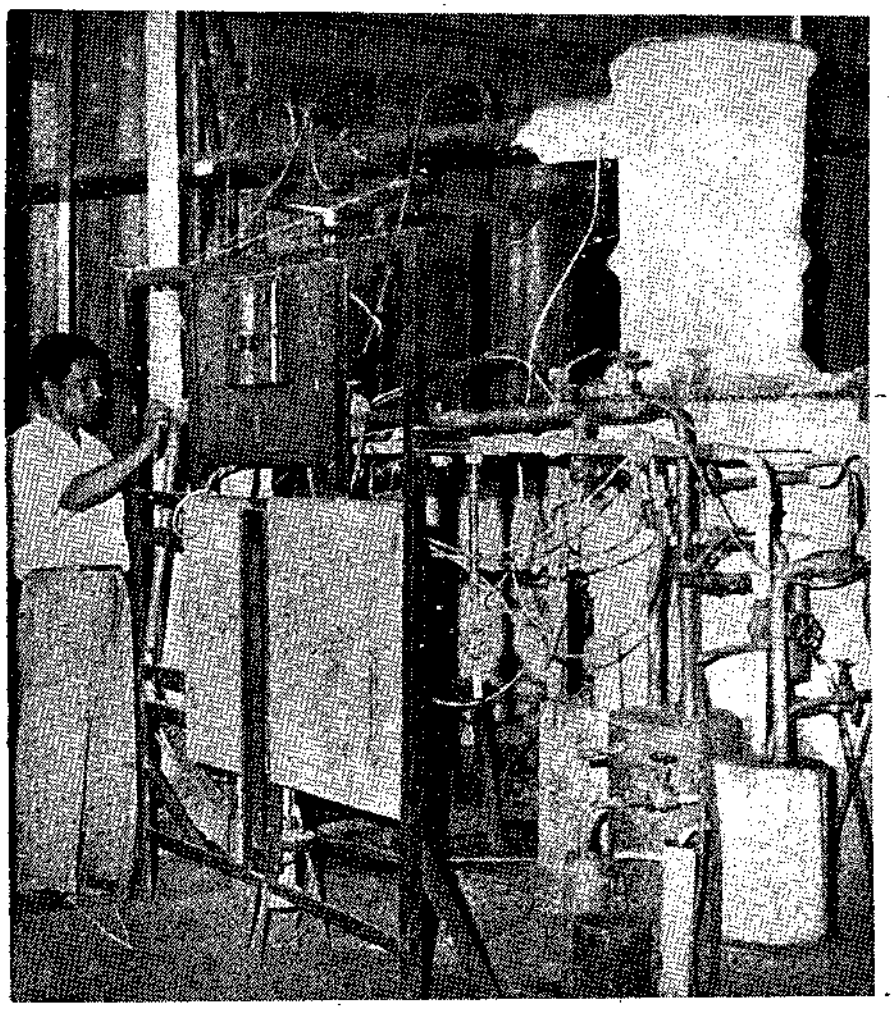
It might be relevant to note here that both in the sulphate expansion at Sindri and the fertiliser plant at Rourkela, the plants were constructed and commissioned in a good time-schedule, the former ahead of the connected unit put up by foreign contractors to receive and process the sulphate further. Both the jobs secured a higher usage of indigenous components than in previous plants of that type in India. *In Rourkela, the total saving in the approved estimates effected by this Division was about Rs. 2.5 crore.*

While Sindri was developing itself in these directions Nangal also came into existence and was engaged on project planning activities for the Trombay and Namrup fertiliser projects. At the same time, on a decision taken by the Government in 1955, a Central Institute of Fertiliser Technology came up in Sindri utilising Russain assistance under UN auspices.

INTEGRATED ORGANISATION

The Fertiliser Corporation itself was formed in 1961 by the amalgamation of Sindri and Nangal. The Corporation set up a Planning and Development Division and vested in it all the functions performed by the departments which had previously been located separately at Sindri and Nangal. The headquarters of the Division were established at Sindri and the main corps of technologists and engineers are now housed in the Central Institute of Fertiliser Technology campus at Sindri.

The Government took a decision in early 1963 that the Fertiliser Corporation should equip the Planning and Development Division in all respects so that it can undertake the entire work involved in building two major plants a year and that the plant to be immediately implemented under this directive would be the Korba fertiliser plant in Madhya Pradesh with a capacity of 100,000 tons of nitrogen per annum as urea,



A pilot plant for a fluidised bed reactor for preparation of active carbon from indigenous raw material

starting with coal as the principal raw material.

Thus, the Planning and Development Division of the Corporation today is a comprehensive, multi-functional organisation. The various functional departments of the Planning and Development Division, which are interdependent, are briefly described below:

Practical Technology Department: The responsibility of this Department is to carry out studies and investigations in fertiliser technology and evolve data and know-how so that plants and equipment can be completely designed, engineered and commissioned with indigenous talent. Investigations are carried out on the improvement of the existing processes and products as also in the field of development of new techniques and processes. The services of the Department are requisitioned by the design and engineering units when the job on hand is not based on established processes or require additional data which are to be obtained by actual investigations. It has a number of specialist sections, comprising various facets of fertiliser technology, such as gas technology, coal carbonisation, gas purification, acids and salts technology, with sub-sections for nitrogenous phosphatic and potassic fertilisers, high package analysis fertilisers, organic fertilisers, micro nutrients, fertiliser trials covering soil agronomy, micro-biology, etc., high pressure science and technology, catalysis, water and effluent treatment, storage, handling and keeping qualities of fertilisers, physico-chemical techniques such as x-ray, electron microscopy, spectroscopy, polarography, chromatography, analytical control standardisation, corrosion and material testing etc.

Project Planning and Process Design Department: This Department is organised in two sections, one for project planning and the other for process and technological design. The planning section which is responsible for overall planning for the fertiliser industry has a number of specialist groups such as planning cell for overall planning, groups for process study, statistics and costing etc. The intensive planning group consists of engineers for each sanctioned project whose functions are: site investigations, site selection, collection of associated data on soils, water, transportation etc., exploration of raw materials and utilities; working out details on processes and products; preparation of techno-economic surveys and/or detailed project reports including project estimates, financial and productivity returns, time scheduling of projects; co-ordination amongst various design and engineering groups; and follow up on progress of procurment. There is a contract group for drafting of contracts and preparation of tender documents etc. A documentation group serves as a pool of knowledge for dissemination through technical publications, abstracts and documental archives.

The major function of the other group in the Planning and Design Department, namely the design group, is chemical engineering plant design. It has specialist groups for carrying out process designs on gasification of solid fuels such as coals and lignite, gasification of liquid and gaseous fuels including catalytic reformation, and associated equipment for by products etc. There are also groups for gas processing and conversion; for gas purification; for high pressure technological design with further specialist subgroups; for acid fertiliser and salts plant design, for acids, for nitrogenous fertilisers, for phosphatic and nitro phosphate fertiliser etc.; for auxiliary plants and services such as water treatment, effluent disposal, raw materials and product handling, storage, bagging; yard piping, installation and instrument layout; other auxiliary plants such as cooling towers, steam generation etc.

Project Planning and Technological Design Department: It covers the following design aspects: (1) development, selection and reasons of the technological scheme; (2) detailed engineering flow diagrams of the production; (3) material and energy balances; (4) development of scheme of operation control including automation, chemical control and analytical methods in combination with practical technology and instrument equipment; (5) material of construction in co-ordination with practical technology department; (6) plant equipment layout; (7) piping layout in co-ordination with engineering departments; (8) distribution systems for power, water, steam etc. in co-ordination with specialist groups in engineering departments; (9) selection in consultation with the engineering departments for plant and equipment from vendors as well as for fabrication; (10) auxiliary plant requirements; (11) techno-economic calculations including cost of production; (12) plant modelling and working out complete plant layout designs; and (13) final development of project and participation in the start-up.

ENGINEERING DEPARTMENTS

The engineering departments are organised in two groups at present. As the work load increases, as it is bound to when the departmental design, engineering etc. of two plants a year gain momentum, each branch of engineering will have enough work for it to be established as a separate department in its own right. At present, the two engineering departments are: (a) Mechnical, Civil, Structural and Public Health Engineering Department, (b) Elec-

(Continued on Page 41)

TISCO THE PIONEER

training ground of steel technologists

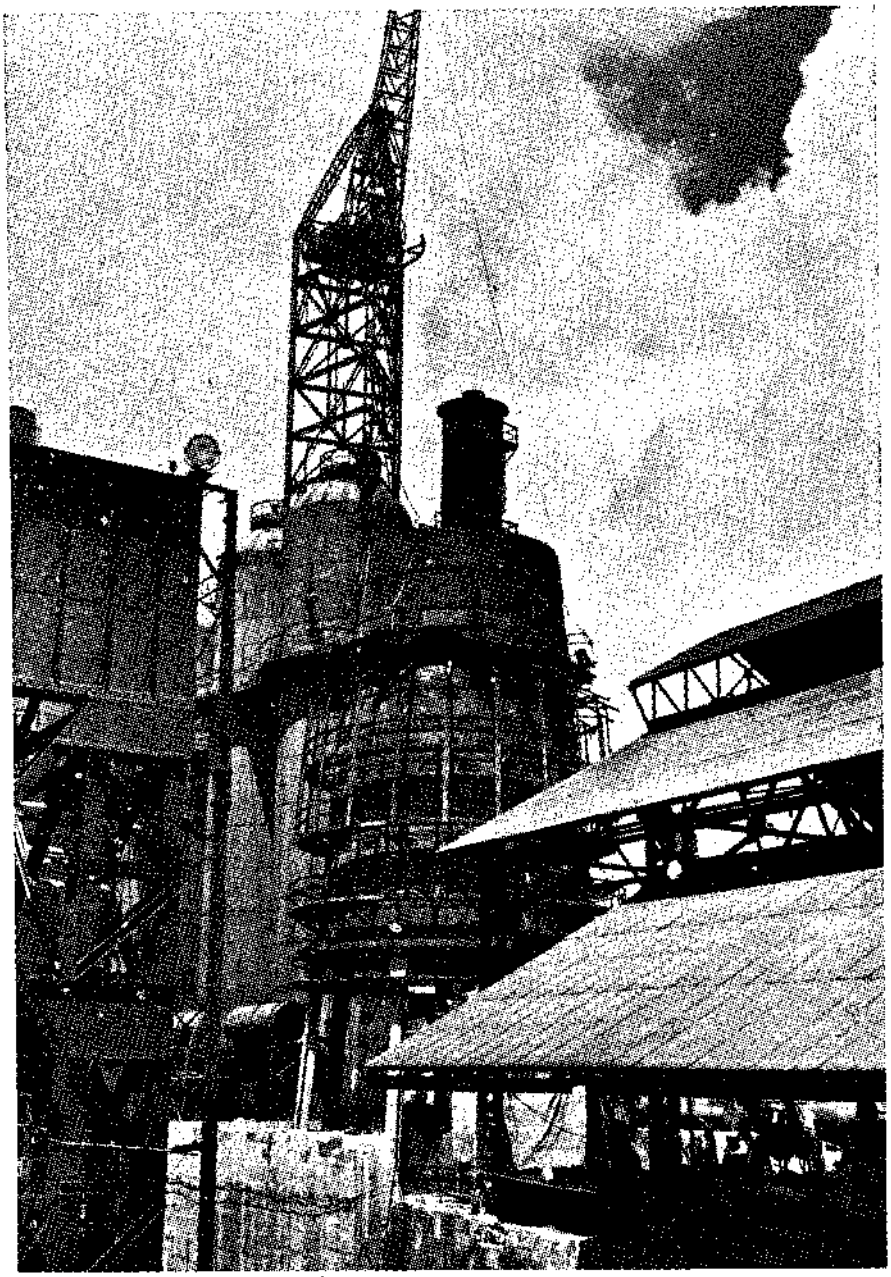
Evolution of Special Structurals

By

S. VISWANATHAN

Director of Scientific Studies, Tata Iron and Steel, and

P. H. TATA



New furnace being built in place of an old blast furnace at TISCO

TODAY we live in an industrial age—an era marked by rapid technological developments and progress all over the world. Self-sufficiency in technology implies the adequacy of means to achieve desired ends. What these ends are for India have been clearly defined in our Constitution, namely to provide every Indian with a standard of living consistent with the country's ideals and objectives.

The Tata Iron and Steel Company, pioneers in the steel industry of India, have made valuable contributions towards the country's technological development for several decades and some of them are summarised below.

The importance of properly trained personnel at various levels—top executives, senior and junior supervisors down to the operatives and technicians—need hardly be emphasised. This factor assumes a greater significance in a country like ours where not only the know-how but the technical personnel required has to be imported initially.

The imperative need for properly planned recruitment and training was realised by Tata Steel as far back as in 1921 when a separate department was established for this purpose. In doing so, the company was following the advice of the illustrious founder, Jamsetji Tata, who foresaw, that it was not possible to run a steel works without building up a solid core of Indian steel technicians. Elaborate schemes were drawn up for the training of various categories of personnel—graduate engineers, artisan trainees for various skills, operatives, etc. and these were revised from time to time to suit the changing requirements of a modern steel plant, and in the context of improvements in technical education in the country.

Numerous part-time courses and training schemes have also been evolved to offer an opportunity of development to these employees who do not have the benefit of higher education; such schemes open up promotion chances to those posts for which normally the company would otherwise have to go outside for recruitment. This incidentally benefits the nation by conserving the limited resources of technical personnel. The schemes evolved by the company for recruitment and training of personnel of various categories have not only paid rich dividends but also helped the cause of self-sufficiency. This will be borne out by the fact that *at present Tata Steel does not call upon the services of foreign technicians for running the complex of an integrated iron and steel plant covering regular operation, research and development of new techniques, engineering and design for major construction jobs; all these are being done by Indian engineers and technicians.*

Tata Steel has helped the country by training various categories of personnel for

other undertakings as well. Special mention may be made of the assistance to Hindustan Steel Limited. It gave valuable assistance to Hindustan Steel by providing training to nearly 2,000 personnel, comprising senior supervisors, graduate engineers and operatives. Men who received such training have been of great help to public sector steel units in running their plants. Even now the training of some engineers for the Alloy Steel Plant and operatives for the Heavy Engineering Corporation is being imparted by Tata Steel. Moreover, by sparing the services of its experienced personnel of various categories to take up employment with Hindustan Steel, Tisco helped Hindustan Steel to keep down their dependence on foreign engineers to the minimum. Besides this, the services of experts from Tisco have always been made available to Hindustan Steel.

In our country, industry and the academic world have lived at some considerable distance from each other to the great disadvantage of both. To bridge this gulf, Tata Steel introduced a scheme to establish a closer link between the industry and the universities so that teachers may have a proper appreciation of the actual conditions obtaining in industries and impart to their teaching the necessary 'industrial bias'. Industries in their turn can, through this association, look forward to useful contributions from the universities as in the technically advanced Western countries. The company has been inviting two or three staff members of engineering faculties from different institutions to spend about six weeks at Jamshedpur where they undergo a specified programme of training suited to their particular branch of speciality, discuss various problems on the shop floor with senior supervisors and finally deliver talks on their subjects to officers and staff of the Steel Company. This promotes a very valuable exchange of ideas.

Oil Injection Method

With rapid developments taking place in iron and steel technology, adoption of new techniques to keep pace with such developments and introduction of new products are essential to make any worthwhile claim regarding technological self-sufficiency. A few examples are cited below to show how the Steel Company has been aware of this need and has successfully implemented new techniques and introduced new products developed by its own metallurgists and engineers.

A recent innovation in coke oven practice is the spraying of oil on coal to be charged into the oven in order to increase the bulk density of the charge and derive the consequent benefits by increased throughput. Trials were conducted to establish the feasibility of this technique under local conditions and equipment was designed for adopting this method. For nearly three years this technique is being successfully adopted by Tisco and it has been found that by addition of about 0.5 per cent of oil to the coal, the bulk density of the charge increases by 5 per cent.

The injection of auxiliary fuels into the blast furnace has almost become a standard practice in the operation of modern blast furnaces in order to achieve the twin benefits of increased production and reduced coke rate. The advantages of such a system under Indian conditions, where both conservation of metallurgical coal and increased production of pig iron are of prime importance, was first realised by Tisco and elaborate trials of the two systems available were conducted in two different furnaces. While the operational results were encouraging, the system has been modified to suit local conditions for use on other furnaces.

At present oil injection is adopted in all the blast furnaces and ultimately all the furnaces will use the locally developed system. An average injection rate of 30 kg. of oil per tonne of iron has resulted in the replacement of 3 kg. of coke for every 1 kg. of oil, and an increase in production of about 5 per cent. It may be added that steps have already been taken for trying out the enrichment of the blast in one of the blast furnaces to assess the merits of the use of oxygen with fuel injection.

Another development in steel technology is the extensive use of oxygen through roof lances and burners in the open hearth furnaces in order to increase the productivity. By installing a tonnage oxygen plant for supply of oxygen and using this method of introducing oxygen for process requirements, the resultant benefit of increased output has been obtained.

New Product

An important factor contributing to technological self-sufficiency is constant research in order to improve the existing techniques, introduce new products and methods and then standardise them. For this purpose the Steel Company established a separate Research Department staffed with qualified metallurgists and chemists. While the achievements of this department over the years are numerous, none can perhaps equal in importance *the development of the processes to manufacture locally bullet-proof armour plates and other steels for armament purposes during the Second World War. Even today the Steel Company is called upon by the Defence Ministry to manufacture special steels which is undertaken by improvised methods of production and heat treatment.*

Other notable contributions by Tisco were the development of special structural steels like TISCROM and TISCOR. During the years immediately preceding the Second World War, low alloy high tensile structural steels were developed and they came into wide application in the Western countries. Till that time the indigenous steel industry was content with manufacturing ordinary plain carbon steels. The impetus to embark on the manufacture of alloy structural steels in India presented itself when the project of the Howrah Bridge at Calcutta was being considered. The Tata Iron and Steel Company developed a special steel under the name of 'TISCROM' specifically to meet the requirements of this bridge. Several difficulties were encountered which were subsequently overcome and the Howrah Bridge stands today as a landmark of the first step taken for production of alloy steels on a large scale in this country.

Yet another significant contribution has been made by the development of the technique for manufacture of high silicon electrical steel sheets of acceptable quality. Since 1947 about 140,000 tons of dynamo grade sheets and 6,000 tons of transformer grade sheets have been manufactured although the manufacture of transformer grade sheets has been discontinued, in order to meet the greater demand for dynamo grade sheets. Tisco is the only producer of this product in the country at present.

Major Construction

Iron and steel making is essentially a high temperature technology. Successful operation depends very much on the development and use of proper refractories. Considerable work has been done by Tisco engineers in evolving methods to utilise locally available raw materials for manufacturing various steel plant refractories and also improve on the practice in order to obtain a longer refractory life.

The use of semi-silica bricks in place of mica schist for increasing the life of the lining of acid Bessemer converters is an example. After elaborate research, a method was evolved to use even certain grades of non-refractory chrome ores in the manufacture of super-basic refractories. Complete details for the manufacturing process of these refractories were worked out and a plant has been installed and operated successfully. Tisco has also taken the initiative in establishing a separate unit for the manufacture of practically all categories of steel plant refractories.

For any country that is embarking on an ambitious plan of industrialisation, it is essential to have indigenous engineering standards tailored to suit its own needs. The Indian Standards Institution was formed at an opportune time, filling an immediate need. The Steel Company made available to the Indian Standards Institution its own engineers and scientists who could draw from their experience in formulating these standards and ensure that the minimum quality required by the consumer was maintained.

Considerable work has been done by Tisco Engineering Division in the field of design of equipment and the planning and execution of major construction jobs for which foreign aid had to be sought in the past. An occasion arose about a decade ago when one of the big blast furnaces in Tisco was blown out and while relining, its capacity had to be increased from 800 to 1,000 tons, which meant a complete new design. The entire design and fabrication as well as the erection of the furnace with all auxiliaries was accomplished satisfactorily and that too without affecting the production of the other blast furnaces. *The entire job was done by a team of Tisco engineers.*

Planning and execution of major construction jobs such as replacement of mill equipment without seriously affecting regular operations deserves special mention. In the past the normal practice was to shut down the mill for three to four months for dismantling of old equipment and installation of new units. After detailed studies and proper planning, Tisco engineers devised a method of supporting the existing equipment on temporary structures to permit laying of new foundations and erection of permanent supports without interrupting mill production.

The steel that has flowed out of Jamshedpur for over 50 years has helped India to take her first steps on the road to industrialisation. And Tata Steel will continue to play an important role by contributing towards the achievement of economic and technological self-sufficiency in the country.

TECHNICAL DEVELOPMENT

Contribution of Directorate-General Outlined

By

S. S. KUMAR

Director-General, Technical Development

THE Directorate-General of Technical Development, previously known as 'Development Wing,' came into existence in 1951 in the wake of the reorganisation of the Ministry of Industry and Supply, Commerce, Works, Mines and Power. The creation of this organisation was intended to fulfil the long felt need of a technical body of specialists who would be able to act as advisers and consultants to the Government in assessing country's needs in the industrial sphere and in assisting the securing of a well-balanced and co-ordinated pattern of industrial growth.

The field of activity of the Directorate-General is wide and varied and with the increased tempo of industrialisation in the country during the last few years, it has expanded considerably. The organisation at present comprises of 33 Technical Directorates—20 for engineering industries and 13 for chemical industries—each responsible for the development of a group of allied industries. With the exception of a few industries like iron and steel, textile, sugar and vanaspati, it is entrusted with the task of formulating and executing the development plans for all other industries.

FUNCTION

The primary function of the Directorate-General is to assist the economic Ministries in the planning and development of industries aimed at securing a balanced pattern of industrialisation of the country with a view to :

(a) securing increased production of those articles and commodities the present production of which is insufficient to meet the country's demand;

(b) diversifying the production activities to meet the country's requirements in various sectors;

(c) ensuring improvement in the quality of products and the maximum economy in their cost of production;

(d) arranging for supply of technical know-how, and foreign collaboration, where necessary, taking advantage of the facilities offered by the Colombo Plan, T.C.M. etc.

SCRUTINY & APPROVAL

THE growth of the industries in the private sector is regulated by the Industries (Development and Regulation) Act, 1951. The Act which confers the necessary powers to secure integrated development in respect of industries listed in the First Schedule of the Industrial Policy Resolution requires that every scheme for the establishment of new industrial undertaking or for effecting substantial expansion or manufacture of a new article by the existing ones has to be got approved by the Government.

The Government have by a notification exempted from the licensing provisions of the Act all industrial undertakings which have fixed assets of less than Rs. 25 lakh in value. The units having fixed assets between Rs. 5 lakh and Rs. 25 lakh are, however, required to get their production programmes approved by the Directorate-General of Technical Development before they are taken on the list of this organisation for assistance in matters relating to import of capital goods, allocation of imported or controlled raw materials etc.

The applications received for licences under the Industries (Development and Regulation) Act or for registration from the units having fixed assets between Rs. 5 lakh and Rs. 25 lakh are examined in the Technical Directorates taking into consideration not only the technical feasibility of the scheme but also certain other factors such as the economic size of the project, future demand in relation to Plan targets, availability of suitable raw materials, appropriate location, choice of manufacturing process and the importance of the items in the light of the priorities fixed in the Plan. The schemes involving foreign collaboration are scrutinised to ensure that the terms and conditions of foreign agreement are not contracted disadvantageously and the country's foreign exchange holdings are not unduly dissipated.

The detailed examination of the schemes makes it possible for the Directorate-General of Technical Development to advise the entrepreneurs in a number of ways such as choice of location of the undertaking, diversification of the range of production, choice of manufacturing process etc.

WATCH & HELP

AFTER the approval of the schemes by the economic Ministries and after the grant of licence to the parties, the Directorate-General of Technical Development is also required to keep a watch on the progress of implementation of the schemes and also in compliance with the terms and conditions laid down for the scheme. This task of watching the progress of implementation is of continuous character and even involves periodic appraisal by occasional inspection and discussions with the entrepreneurs until such time as the project is commissioned

for production. The undertakings are required to submit half-yearly returns showing the progress in the implementation of their schemes. These returns are carefully scrutinised and the position reviewing the different stages of implementation is reported to the concerned Ministries, the Planning Commission and the State Directors of Industries.

In case of genuine difficulties experienced by entrepreneurs in implementing their sanctioned schemes, necessary assistance is given. But in cases where no progress has been made or where insufficient progress has been made despite all possible assistance, necessary action for the revocation of such schemes is initiated by the concerned Ministry on the advice of the Directorate-General of Technical Development.

After the schemes have gone into production, the responsibility devolves on the Directorate-General of Technical Development to provide operational assistance to the industries in the procurement of imported or indigenous raw materials, spares and components, fuel, electric power, transport facilities etc. All the units borne on the list of Directorate-General of Technical Development, which require imported raw materials or components, submit their import applications to this organisation. These are scrutinised from the standpoint of indigenous availability of various stores proposed to be imported, essentiality of the items with reference to production etc., and recommendations thereon are forwarded to the Chief Controller of Imports and Exports and other licensing authorities for issue of import licences.

Likewise in the allocation of indigenous raw materials which may be controlled or in short supply such as steel, cement, non-ferrous metals etc., requests of the units are received in this organisation and the recommendations thereon are made to the economic Ministries after a careful examination of the need for allocation, quantity to be allowed etc.

ADVICE ON KNOW-HOW

UNDER different foreign aid programmes, technical experts are also secured from foreign countries for advising the Indian industry on the adoption of improved techniques aimed at securing economy in the cost of production achieving higher productivity etc. This has resulted in considerable technological improvements in a number of fileds like glass, asbestos, cement products, coated abrasives, jute and tea processing machinery, tooling practices, foundry practices, razor blades, bonded abrasives, graphite electrodes, paints and varnishes, porcelain and pottery, grinding wheels, plastic moulds, caliberated wrought iron chains, recovery and use of cotton-seed linters, recovery of caustic soda in paper manufacture, machine tools, fountain-pens and pencils. The industries are also assisted in arranging technical training of their personnel in foreign countries in those specialised fields for which facilities do not exist in India.

In complex fields where indigenous technical know-how is insufficient, technical collaboration with well-known foreign firms is arranged to bring in necessary know-how. By this method it has been possible to establish production facilities in the country in a number of vital sectors of industry such as sophisticated machine-tools, industrial machinery, precision instruments, refractories, transport equipment, heavy chemicals and fertilisers, insulators, plastic raw materials, synthetic rubber, man-made fibres, and synthetic dyes and drugs. Under the terms of collaboration Indian personnel are trained in the respective lines to enable them to take independent charge of the projects in due course.

Wherever it is considered impracticable to start production straight off with 100 per cent indigenous components and parts, because of the complex nature of the product, the Directorate-General of Techincal Development encourages and assists the industry to take up its manufacture in phases aiming at progressive reduction in import content. Through such phased production programmes considerable success has been made in reducing import-content in the manufacture of cement mill machinery, tractors, bicycles, sewing machines, typewriters, radio receivers and a multitude of other products. In case of automobiles it is expected that most of the vehicles would achieve an indigenous content of 90 per cent by the end of 1964.

APPLIED RESEARCH

VERY extensive applied research on industrial technology and techniques is conducted in the National Laboratories. The Directorate-General of Technical Development keeps in close touch with such developments and helps in eventual commercial exploitation of the processes developed by the National Laboratories. A few of the processes of the Council of Scientific and Industrial Research adopted by the industry for commercial exploitation are for the manufacture of Nier wires/strips, ceramic capacitors, boron-free enamels, silver mica capacitors, benzyl chloride, pine oil, salicylanimide, ether, hexachlorethane, enzymes (diastatic), mica insulating bricks, potassium chloride from salt bitterns, infant food, cuprous oxide, ion exchange resins etc. The Directorate-General of Technical Development, being more aware of the industry's needs, brings to the notice of the National Laboratories those problems that need to be tackled in a fundamental manner through applied research.

The organisation also makes available technical advice to the extent possible within its framework to entrepreneurs in the formulation of their production programmes which could fit in the overall industrial plan of the country. Numerous enquiries calling for such information as : present production, licensed capacity, consumption and future demand, scope for further development in specific industry, economic size of unit and capital requirements are received and attended to in this organisation. The information that is provided considerably helps entrepreneurs in formulating their ideas on production programmes and in drawing up schemes for manufacture.

Questions of exports are also constantly assessed and suitable measures are taken. This also involves due contribution in the preparation of draft standard specifications with a view to improving the quality of indigenous production.

REVIEW OF NEEDS

As already stated, it is an important function of the Directorate-General and its corps of specialised technical officers to undertake continuous review of the growth of production facilities and production in various lines of manufacture in relation to the growing needs of the economy and to study, from time to time, the industrial gaps and defici-

(Continued on Page 54)

How Research is Helping

DESIGN OF WATER & POWER PROJECTS

By C. V. GOLE

Director, Central Water & Power Research Station, Poona

WITH the achievement of Independence the need for a systematic development of the country began to take concrete form and a host of problems connected with construction of dams, hydro-electric power systems, flood control, development of ports and harbours and other projects called for experimental investigations.

The design of some of the new dam projects had initially to be entrusted to foreign agencies. This involved not only expenditure of foreign exchange but considerable delay in finalisation of designs. Indian engineers, several of them trained under international aid programmes, soon took over. The design of the Hirakud Dam was first undertaken by a U.S. firm, the International Engineering Company, Denver, and the relevant hydraulic model tests were undertaken by the Colorado A and M College, USA. Some major changes in the design were, however, made by the Central Water and Power Commission, and further tests were undertaken by the Poona Research Station.

Other major projects such as Bhakra, Chambal, Kosi, Koyna, Rihand and those of the Damodar Valley have come up mainly owing to the skill of Indian design, research and construction engineers.

The Photoelastic Laboratory established at the Central Water and Power Research Station in 1949 has been tackling complicated structural problems of reinforcement around galleries in dams, sluice-ways and the like which had previously to be referred to foreign laboratories such as those of the U.S. Bureau of Reclamation. Some design procedures have also been evolved by our Photoelastic Laboratory.

In the absence of facilities for solution of problems relating to navigation and development of ports and harbours in India about a decade ago, even minor problems had to be referred to foreign consultants such as Neyrpic Laboratory, France. For the first time in India, the required facilities were introduced in the Poona Research Station. Almost all the problems have since been handled in the Research Station, resulting in considerable saving of foreign exchange. Theoretical and experimental study of disturbances inside harbours of regular shape has been done and new methods of solving these problems found. Some of the important problems investigated concern the harbours of Madras, Bombay, Kandla and Cochin. Investigations have been carried out also for development of all-weather facilities at Mangalore, Karwar, Porbandar, Tuticorin and Paradeep. The problem of coastal erosion is being studied with particular reference to the Kerala coast.

Radioisotopes have been successfully used in the field for tracking the movement of sediment in running waters. Use of isotopes in subsoil investigation and soil compaction control has also immense possibilities and experiments are being taken up.

A unique Indian device for passing floods from storage reservoirs is the volute siphon, having a coefficient of discharge 0.8 with priming depth 2 to 3 inches. The Hirebhsagar Dam in Mysore was the first in the world to be equipped with these siphons. Field investigations and hydraulic model experiments for practical improvement in the design of these siphons, with particular reference to vibrations in the Dam caused by full throttle operation of the siphons, have been recently completed.

Hydraulic research requires many precision instruments for accurate observations in models, which are not readily available in India and need considerable foreign exchange for procurement from abroad. Instruments like the miniature current meter for recording low velocities, wave height recorder for harbour model studies, and bed profile recorder for tracing bed configuration in models have been developed in the Poona Research Station at much cheaper cost. A snake type wave generator and prototype wave height recorder have also been developed. Automatic tide generator, pressure pick-up for fast varying water pressure and remote control for manoeuvring of ship models in hydraulic model experiments for navigation channels and dock entrances are under development.

A well-equipped experimental tank for testing ship models, the first of of its kind in India, was established in 1955 for helping the ship-building industry. The industry was till then dependent on foreign laboratories such as the National Physical Laboratory, U.K. The tank, which is 500 feet long and 12 feet wide is proposed to be extended by 250 feet and to a width of 36 feet, to facilitate high speed testing so essential for the Navy.

A Cavitation Research Laboratory is being established with the aid of the U.N. Special Fund to meet the urgent need for cavitation-free designs of hydraulic structures and machines in India. An Earthquake Engineering Research Laboratory for conducting investigations to enable safeguards to be incorporated in the design of the dams proposed in the seismic zone of India, a Rock Mechanics Laboratory for *in situ* tests and relevant studies for tunnels, underground power-houses and dam foundations, and a Model Engineering Laboratory for evolution of economical shapes of dams etc. have been established in keeping with such developments abroad.

Although hydraulic models offer a handy tool for finalising the designs for achieving economy in construction, coupled with safety of structures they have their limitations. Interpretations of model results has to be done carefully. Attempts are being made to confirm and improve their reliability by observing the performance of the prototypes when constructed and comparing with model results. The hydraulic models have not only saved millions of rupees but have also made the structures more safe.

WHAT DRIVES AN INNOVATOR?

Example of Lakshmanrao and the New Tools He Gave to Farmers

By S. L. KIRLOSKAR

In assessing the contribution the Kirloskars have made to the technological progress of the country, it would be useful to know how the pioneers started working in the field some seventy-odd years ago.

We have progressed now to a point where we make a wide variety of farm implements : ploughs, pumps, sugarcane crushers, decorticators, diesel engines, electric motors and many more items. In some fields, like ploughs, pumps or diesel engines, we take pride in being the largest manufacturers in the country.

However, it took us many long years to grow. Not only because we lacked the men and machines which we now have, but also and largely because the social ethos in the country was anything but conducive to industry.

In these circumstances one could venture into an industrial field if one had the required knowledge of the field, plus plenty of grit and courage of one's convictions.

The first of the companies in the Kirloskar group was started over 75 years ago under conditions which were discouraging to such a venture. The society did not know much about industries, and the British who were then ruling India did not want Indian industries to grow and compete with British manufacturers.

The man who started the first factory was my father, the late Mr. Lakshmanrao Kirloskar. Early in his childhood he showed his fondness for machines, and when he grew up it became his passion. This was unusual in the society of his times, because ambitious young men then usually took to professions like law or medicine.

The Only Incentive

Lakshmanrao studied draftsmanship and got a job as a teacher on forty rupees a month. Disagreement with his superiors led to his resignation. He then started on a job manufacturing petty requirements of medical practitioners, and some very small items like shirt buttons.

Small things would not however satisfy his burning ambition, and he started looking for a new field of manufacture. Hand chaff-cutters were his first product—back in 1901. When he started selling them to farmers, his sharp business eye saw immense potentialities for the manufacture of farm implements.

But the Indian farmer was not ready for his product. Lakshmanrao made India's first iron plough, but no farmer would buy it. His first six ploughs remained unsold for over two years. But he was not discouraged. To sell them, he sent men to farmers to convince them that the new plough would bring them more yield per acre. It took a lot of convincing until an enterprising farmer bought all the six ploughs. That farmer's experience convinced other farmers, and within five years the factory had sold two hundred ploughs.

This is how the Kirloskar factory started manufacturing agricultural implements.

We discovered that in order to manufacture farm implements and sell them in large numbers we had to convince the farmers of (i) the utility of the product and (ii) the economy it would bring in.

Our experience has been that a farmer is convinced only through own experience. His needs have to be studied, his wants properly satisfied. The product must reduce not only his labour, but also his costs. I say this because we have planned our products on these principles, and I think my experience has proved that they are very sound principles.

Even Before the Plans

I have often been asked whether the rapid growth of our group during the past twenty years has not materially been due to State planning. The question intrigues me. Our major industrial base was laid many years before the official Plan was laid, most of our units became going concerns before the Second Plan began stimulating the economy—if it did. For instance the growth of our engineering exports owes a great deal more to foresight of the people who were actively associated with the enterprise than to State aid, which came much later.

To revert to the story.

We developed our ploughs first, and when the farmers were convinced that the ploughs brought them better crops we went to their other urgent needs : sugarcane crusher, the decorticator and the pump. The utility and reliability of these products won them large customers from farmers. The farmer accepted the pump because, like the plough, it saved his labour and brought down the cost. For centuries animals drew water for the Indian farmer as we all know. The process was slow, laborious and in the end expensive. The beast worked all day, usually starved, and tired, and with them the farmer also starved and tired, and yet the land was left hot, tired and thirsty. The animals could not draw up enough water for the farmer's thirsty land. The pump could.

As the mechanical drawer of water greatly improved the farmer's crops he became our steadfast customer. We now manufacture these products in thousands. It also opened up for us several other lines of manufacture. To work the pumps we make diesel engines and electric motors, and to run other workshops we make machine tools.

Since the early' fifties, our efforts began to grow beyond the needs of the primary producers alone. For instance, we manufacture now 16″ × 16″ axial flow pumps and pumps of specialised use in sugar and chemical industries. In 1958 we started production of the 24″ pump having a discharge of 18,000 gallons a minute. This is the largest pump of its kind in the country today.

Products to Suit Our Needs

There are some products which we adapted and improved to suit the requirements of the Indian farmers. Iron ploughs were used for a considerable time. We adapted the plough to our requirements and we now make several varieties of them to suit different types of soil.

The decorticator is basically an Indian invention. We improved on it so much that we became the largest manufacturers of the machine. Farmers producing groundnuts found this machine a boon.

The power operated sugarcane mill is one more adaptation in which we put a lot of effort to make it suitable to our requirements.

But I think our contribution can be judged more by the change it brought in the agricultural field. Before the introduction of power operated machines which we manufacture, only the traditional implements were in use which required no engineering knowledge to make, and were not the time-and-cost-saving-machines which we make.

Nor is this all. Our two recent undertakings, which were started in 1958 and 1962 respectively, have branched out in the direction of pneumatic appliances and machines like compressors, drills and refrigeration units, and of heavy diesel engines in the range of 80 to 800 brake horse power, usable in many directions as prime movers.

When we developed from simple implements to sophisticated products, the need arose to obtain collaboration from the established foreign enterprises. We have now over 50 collaboration agreements in operation with various companies from different countries. Collaboration, we have found, is a continuous dialogue between us and the foreigners, which conduces to the growth of both. Our aim has always been to telescope our progress in our field into a shorter time-span than would be possible if we were to try to develop entirely under our own steam. Collaboration has also thrown up numerous other benefits which we would have missed, or would have obtained after very long, in its absence.

Here, let me point out that we started collaborating with foreign companies even before the First Five Year Plan was born. Our desire to improve our products and benefit from the industrially advanced countries prompted us to take this step.

Have we contributed to the economic growth of the country in the engineering field? Yes, I must say very emphatically, though perhaps immodestly—but truthfully. Are we where we are today because of development planning? My answer is that we have done rather well, and that what we have achieved so far is largely in spite of the Plans rather than because of them. To say otherwise is to play down the enormous contribution made to our group by the pioneers and by the present management which has experienced many more frustrating moments since 1956 than before.

The Creative Element

(*Continued from Page 3*)

industries will play a more positive role. It is right that in a developing country like ours where the State assumes so much of responsibility for growth, the initiative in utilisation of research must also come from the State.

Yojana: What about the private sector?

T.N. Singh: I must in fairness say that our industrialists also show a considerable amount of interest in industrial research. They have done excellent work in consumer industries. In textiles, ATIRA and CITRA have a fine record. The cement industry has also been active in designing and fabricating equipment.

Yojana: So far we have been talking only about the major industries. What about the small industries? There is this talk about development of 'intermediate' technology. But, wouldn't the development of a new, 'intermediate' technology cause a strain on our limited resources?

T. N. Singh: One shouldn't regard technological know-how as a fixed, unalternable quantity. It grows all the time. Unfortunately, in our country, the major portion of attention has gone to the urban industries. We have to concentrate more and more on non-urban industries. Our entire training programme for craftsmen, and our diploma courses, must aim at attracting the children of farmers and rural craftsmen and retaining them in the so-called non-sophisticated industries. Our technologists need not all come from the middle classes. We shall then be saddled with a new division between town and country. It is because we must reduce this distance between town and country that 'intermediate' technology becomes a 'must.'

Yojana: What are the prospects of our progress towards technological self-sufficiency?

T.N. Singh: Very good indeed. It is one of the declared aims of our Five Year Plans to attain this self-sufficiency. And from what I have seen in the steel plants, and at Ranchi, Bhopal and the machine tool projects, I am all admiration for the young men there. I believe some of the youngest foremen in major industrial projects anywhere in the world are to be found in our country. Similarly, even in design organisations we have some outstanding young men. They are going to get greater and greater opportunities in the next few years to prove their skill and to serve the nation.

MORE

By

DR. B. R. NIJHAWAN

Director, National Metallurgical Laboratory, Jamshedpur



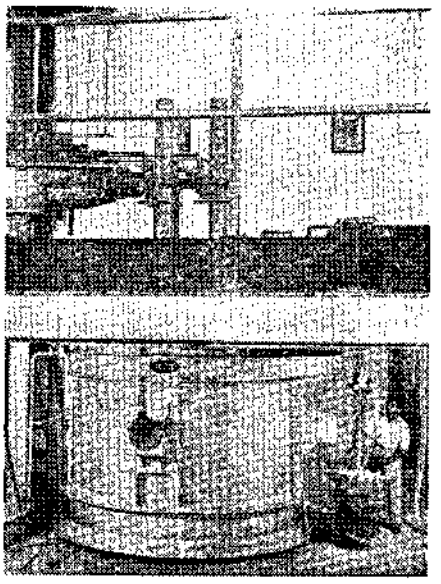
The basic side-blown converter of half-ton capacity, designed and fabricated at NML

THE use in industry of more metals in diverse forms is largely the result of systematic scientific research designed to meet the technologist's new demands. In India, this demand has multiplied during our successive Five Year Plans requiring effective utilisation of the indigenous resources of metals and minerals. With the changing pattern of industrialisation, covering a wider spectrum, the expanding metallurgical industry faces new and challenging fields.

The National Metallurgical Laboratory has wholly dedicated itself to the growth of indigenous metallurgical and mineral industries against the background of systematic research in basic fields of study. The importance and indispensability of research are now recognised by the country's metallurgical industries and the NML is playing a vital role in achieving self-sufficiency in the metallurgical and allied industries.

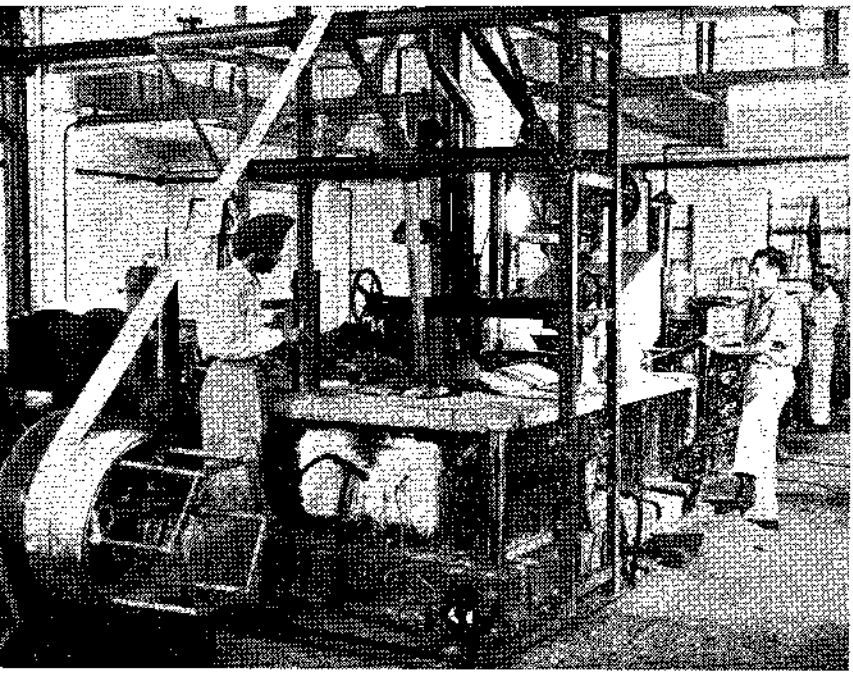
The following outline will briefly describe some of the useful work carried out in this direction.

No country in the world is self-sufficient in respect of all its metal and mineral requirements, and India is no exception to this general rule. The import of vital metals like nickel involves a heavy amount of foreign exchange apart from the risk of being cut off from the supply in the case of political exigencies. The effect of such shortages has been mitigated by the National Metallurgical Laboratory by developing substitute alloys made by optimum combination of indigenous metals adopting specialised techniques. Take, for instance, nickel, the metal in short supply, which is an essential raw material for producing stainless steel. Research and development at the National Metallurgical Laboratory have resulted in a new method for making stainless steels without nickel, using chromium, manganese, nitrogen and copper which are available in the country.



The pilot submerged arc smelting furnace for production of ferro-alloys installed at NML

FROM METALS



New Alloys Developed by NML:

24 New Processes & Techniques

The new steels can replace the famed 18:8 chromium-nickel steel in certain specific applications. These nickel-free stainless steels can be used for utensils in Indian households, including tumblers, *thalis, katoris,* spoons, pots, pressure cookers, cooking ranges, restaurant ware etc. For wash-basins and similar other fittings on the Indian railway coaches, these steels will prove equally useful. They may also be used for hospital ware, dairy equipment, decorative and architectural parts, steel furniture, high strength structural members, etc., and for applications requiring metals with low magnetic permeability.

Nickel-free alloy compositions have also been developed for substituting copper-nickel alloy, now used for coinage production in the country. Coins stamped out of these new compositions have been found to be satisfactory. Another development in this direction is the production of nickel and cobalt-free electrical resistance alloys which have been found to possess properties similar to imported conventional types of heating elements used for domestic and industrial heating purposes.

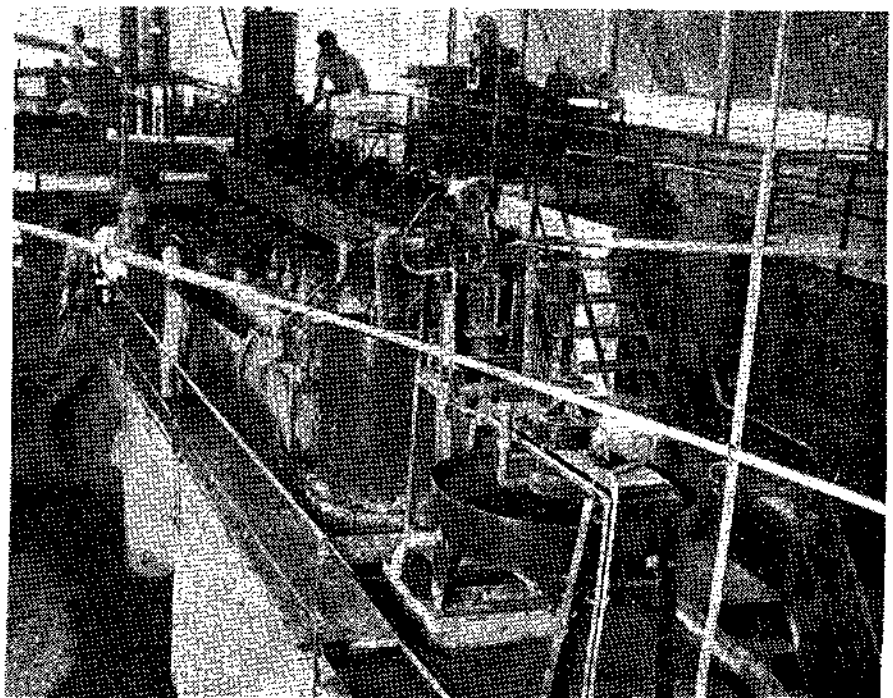
To minimise the use of zinc, another metal largely imported, a technique has been developed to give a coating of aluminium on mild steel, the aluminised steel has proved to be better than galvanised material. These products can be used in telegraph hardware, automobile parts, corrugated sheets and for other products which have to withstand corrosion to a large degree.

The technique developed has been leased out for commercial scale production.

A common sight in the manganese mining localities is the unending series of mountain-size dumps of rejected ores. These are a legacy of the past when rich ore deposits were mined for export. While the high-grade manganese ore went out of the country, the low-grade ore and fines went into the making of these dumps.

With the pressing need for making the most of available resources, a way

Left : Pilot plant for hot-dip aluminising of steel strips, designed and fabricated by NML. Below: Units of mineral beneficiation plant installed at NML



has been found for utilising these and other low-grade ores. The National Metallurgical Laboratory made a countrywide study on the amenability of low-grade manganese ores to beneficiation. Ore samples from Andhra, Bombay, Madhya Pradesh, Mysore, Orissa and Rajasthan were investigated. The findings are that majority of these ores can be upgraded to 48 per cent and above manganese content and can be utilised for ferro-manganese production.

The complexity of these investigations can be well appreciated when it is realised that no two ores are alike and that each has to be tested separately to determine its beneficiation characteristics for upgrading it to the required specifications. Industrial pilot plant tests for manganese ore beneficiation have been carried out. The NML also advised a number of State Governments and commercial enterprises in putting up large-size plants.

In the mining of iron ores for smelting purpose, the utilisation of the ore fines becomes complicated because of the climatic conditions in India. The matter was simple when hand-mining was done, as selective mining yielded lump-sized iron ore material. With the introduction of heavily mechanised mining, owing to the expansion of the iron and steel industry, separation of ore fines by the manual method cannot be attempted or accomplished. It has been the experience of the steel plants that under the tropical conditions in India, the screening and handling system becomes completely blinded and choked because of the muddy condition of ore from rain. It is thus of paramount importance to separate the fines from the lumpy iron ore materials both in fair and rainy weather and to utilise the iron ore fines thus separated to the maximum national advantage. The high alumina content of the ore also affects the smelting operation in blast furnace.

The problems of improving the quality of ores despatched from the mines and also of ensuring regular supplies of properly blended and sized ores to steel plants for the production of quality sinter were successfully tackled at NML. Based on the investigations conducted at NML, the steel plants in public and private sectors are putting up ore beneficiation and sintering plants. Mr. J.R.D. Tata, chairman of the board of directors, Tata Industries Ltd., stated in this connection: "I wish to record our appreciation of the assistance we have received from the National Metallurgical Laboratory at Jamshedpur, whose investigations, undertaken at our request, have formed, to some extent, the basis of our ore beneficiation programme."

For limestone to be used as a metallurgical flux, the maximum availability of the base (CaO) is essential and for that purpose the silica content of the limestone should be low so that its CaO content is not used up in fluxing its own silica in the steel-making furnace. The percentage of silica in limestone for use in open-hearth steel-making should therefore be very low—preferably of the order of 1-2 per cent.

The quality of Indian limestone used in steelmaking in respect of silica content is deteriorating and with these poor grades of limestone, production in the steel plants is adversely affected. It is, therefore, very essential to beneficiate the limestone so as to reduce its silica content. Comprehensive work on upgrading of limestone for steelmaking was successfully undertaken on pilot plant scale. The use of limestone in steelmaking has a promising potentiality as shown by full-scale steel plant trials conducted in the country's steel plants.

Smelting of Iron in Low-Shaft Furnace

The distribution of suitable mineral deposits imposes limitations on the ultimate pattern of heavy industry throughout the country. This will be apparent from the fact that the distribution of basic raw materials like iron ore and particularly metallurgical coal are confined to selected areas in the north-eastern region and this has led to the concentration of iron and steel industry in this region.

In keeping with the policy of the Government to promote a regional distribution of basic industries, alternative methods of iron production utilising non-coking fuel for reduction purposes are being investigated by the National Metallurgical Laboratory in its 15 tons-a-day low-shaft furnace pilot plant. Smelting trials conducted so far at the National Metallurgical Laboratory have shown that foundry grade pig iron can be successfully produced using low-shaft furnace smelting technique.

On behalf of the State Governments of Andhra Pradesh, Punjab, Maharashtra and Rajasthan, pilot plant investigations have been completed at the pilot low-shaft furnace, determining the suitabilities of the regional raw materials for the production of foundry grades of pig iron. On the basis of investigation project reports prepared by the NML based on these comprehensive pilot plant trials, establishment of industrial plants for the production of foundry grades of pig iron is now well on its way in suitable location.

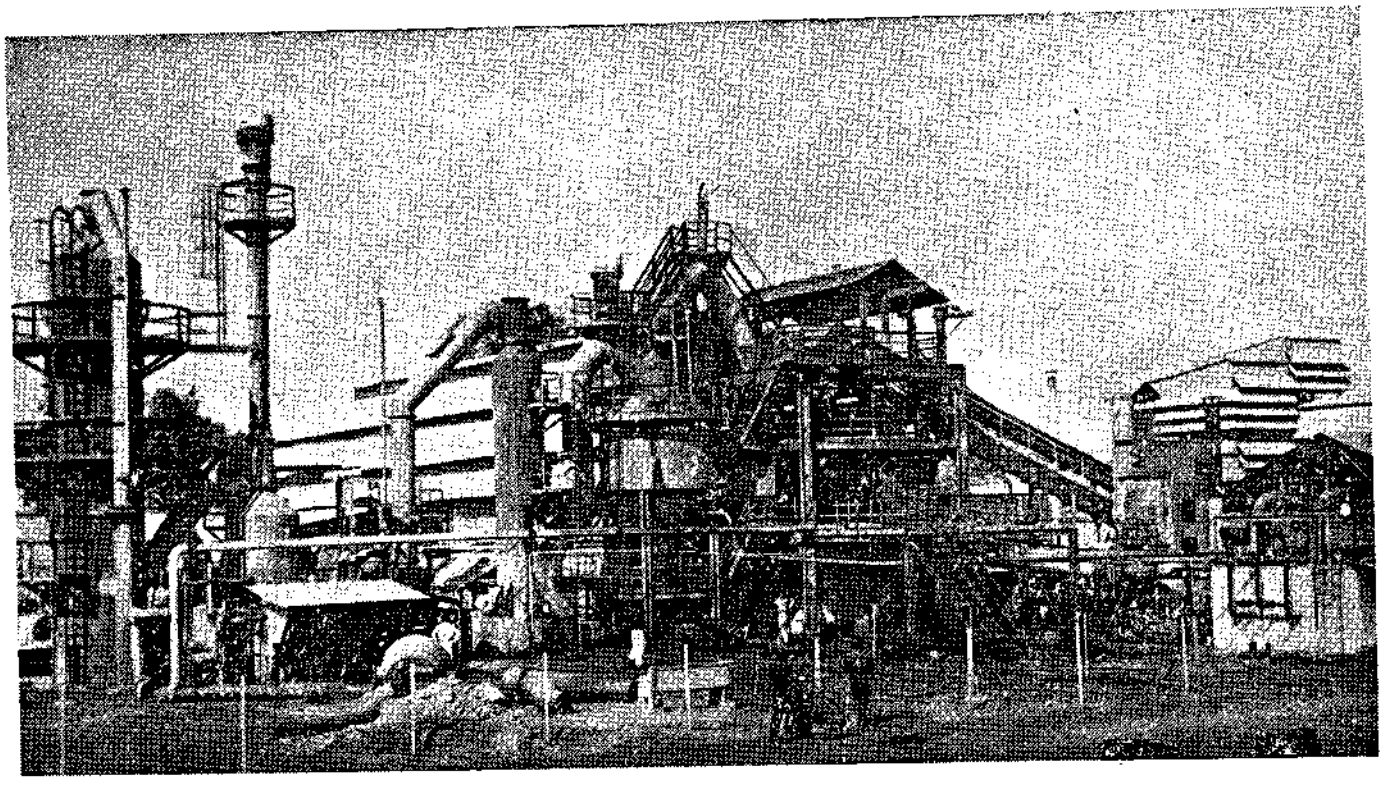
Ferro-Alloys

With the establishment of alloy, tool and special steel plants, there will be a great demand for different types of ferro-alloys. In India, at present, there is no commercial-scale production of ferro-alloys excepting ferro-manganese and ferro-silicon. The Laboratory has developed manufacturing techniques of important ferro-alloys, such as low-carbon ferro-chrome, carbon-free ferro-chrome, ferro-vanadium, ferro-titanium, ferro-tungsten and nitrided ferro-alloys from indigenous materials which have been produced on tonnage scale and supplied to ordnance factories to meet their requirements.

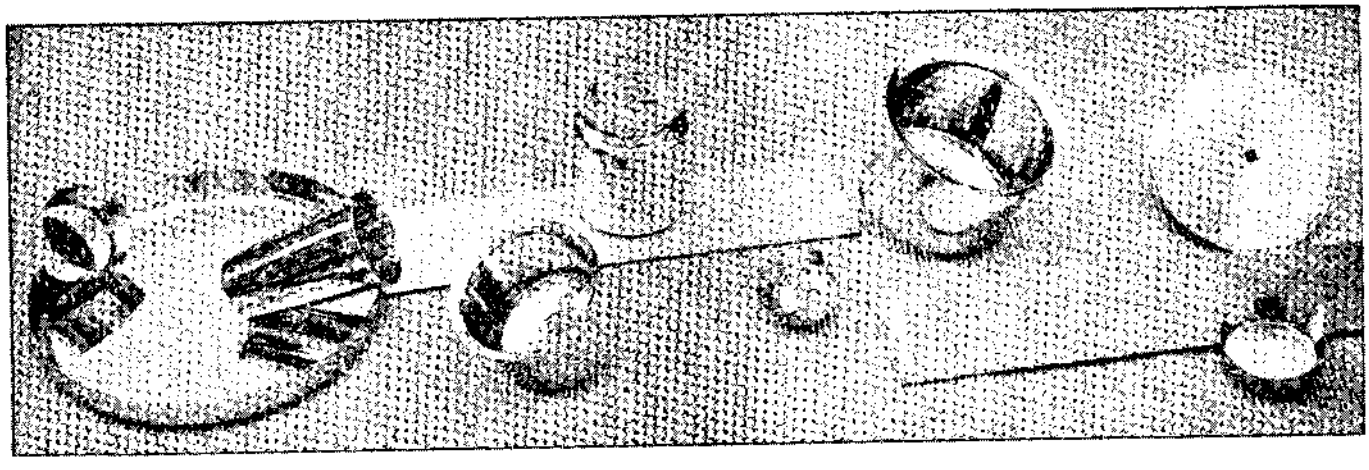
Non-Ferrous Metals

Magnesium, which is indispensable in the production of light alloys for aircraft and used in metallic form for strategic military requirement, has been produced successfully for the first time in India on laboratory scale in the National Metallurgical Laboratory. The present requirement of this metal is met by imports. The National Metallurgical Laboratory has put up a pilot plant to produce magnesium metal as well as magnesium powder to meet the requirement of the ordnance factories.

The Laboratory has also developed the technique of production of electrolytic manganese metal and manganese dioxide from low-grade manganese ore containing as low as 15 per cent manganese. Electrolytic manganese metal is of vital importance for producing special steels such as stainless steels, high-speed



15-tons-a-day low-shaft furnace installed at NML. Below: Utensils fabricated out of nickel-free stainless steel developed at the Laboratory



and tool steels, and other ferrous and non-ferrous alloys, to be made in the near future in the country. This metal and its dioxide is well on its way for production on commercial scale based on the NML developed process.

Foundry Moulding Materials

To meet the needs of the fast-growing foundry industry, a long-term project is in progress on the assessment of moulding characteristics of various Indian foundry sands and bonding materials. A large number of foundry sands and bonding clays have been investigated and the data obtained have been made available to foundries in the country. In the past, no organised attempt was made to collect data for the foundry sands in use. Methods have been developed to improve certain difficult sands by processes such as washing and grading to yield material suitable for use as moulding sands. Advice has been given to foundries on melting procedures, types of furnaces and fluxes to be used, and methods of obviating gas absorption.

To help the small foundries, the National Metallurgical Laboratory has established regional foundry stations at Batala, Howrah and Madras.

Corrosion of Metals and Alloys

The National Metallurgical Laboratory is also fully alive to the need of metallurgical researches on corrosion of metals and alloys and has already done extensive work in the causes and effects of corrosion

phenomenon. It is assisting metallurgical industries in defining their corrosion problems, suggesting remedial measures etc. Long-range research work on the corrosion of metals and alloys under various atmospheric conditions is under way and interesting results have been obtained in certain cases. The National Metallurgical Laboratory has set up a corrosion research station on the sea coast at Digha in West Bengal to study the various aspects of corrosion in marine atmosphere.

Refractories

With the steel ingot production reaching a higher level as formulated under successive Five Year Plans, there will be a corresponding rise in the demand for refractories which form the back-bone of iron and steel as well as metallurgical glass, and ceramic, cement and kiln brick industries.

Refractories are used as lining materials for industrial furnaces and other high-temperature operations. It has been estimated that a one-million-ton steel plant requires about 150,000 tons of refractories during its installation and about 80,000 tons for annual replacement. The chief feature of the development work at the NML is the production of new types of basic and special refractories from the abundantly occurring but little utilised minerals.

The Laboratory has already developed techniques of manufacture of a number of special and basic refractories which are now on commercial production.

For small-scale melting of brass, special alloy steels, non-ferrous alloys and precious metals, India imports carbon and clay bonded graphite crucibles. Techniques for preparing carbon and clay bonded graphite crucibles from indigenous raw materials have been developed at NML. A number of firms have been given licences for manufacturing carbon and clay bonded graphite crucibles by this process.

Pilot Plants

The urgency and importance of pilot plant investigations have been fully established and increasing emphasis is being laid on pilot plant investigations of the processes developed at the NML. The fields thus enlarged relate to :

1. Low-shaft furnace pilot plant.
2. Pilot plant for the production of ferro-alloys in submerged arc electric smelting furnace from indigenous ores.
3. Pilot plant for beneficiation of low-grade ores and minerals.
4. Pilot plant for thermal beneficiation of low-grade manganese and chrome ores.
5. Pilot plant for hot-dip aluminising of steel wires and strips.
6. Pilot plant for the production of vanadium pentoxide from vanadiferous magnetite ores.
7. Pilot plant for the production of special and basic refractories from indigenous raw materials.
8. Pilot plant for the production of electrolytic manganese metal and manganese dioxide.
9. Steel-making by pneumatic method and oxygen injection in side-blown basic converter and L.D. converter.
10. Iron production in vertical shaft furnace by fuel injection.
11. Pilot plant for production of magnesium metal and magnesium powder.
12. Pilot plant for the production of synthetic cryolite.

Fundamental Problems

Although emphasis has been laid on operational and applied research projects, the Laboratory has pursued with equal vigour fundamental projects which have resulted in the advancement of knowledge in the field of study besides training a corps of research workers. The fundamental problems under investigation relate to isothermal transformation studies on Indian plain carbon and alloy steels, solubility of nitrogen in plain carbon and alloy steels, carbon activity in iron and its alloys, studies on age-hardening, interaction between solute and solvent atoms in the liquid state, study on temper brittleness, phase studies on electro-deposited copper-tin alloys, studies on phase transformation in alloys by X-ray diffraction technique, morphology of phosphorus in Indian manganese ores, studies on the properties of rare earths, and so on.

Processes Ready for Exploitation

As a result of intensive research and pilot plant work done at the National Metallurgical Laboratory, 24 new techniques and processes were made ready for commerical exploitation. It is gratifying that out of these 24 processes, 21 have already been leased out on royalty and premia basis to industries for commercial-scale production.

Technical Aid to Industries

As metallurgical industries are becoming increasingly conscious of the application of research results numerous technical problems are being referred to this Laboratory in an ever increasing measure, and they are being effectively handled to increase productivity consistent with the quality of products. The National Metallurgical Laboratory is acting as a nucleus for many of the long-range and short-term projects connected with the development of metal and mineral industries, and is being consulted by the National Mineral Development Corporation, the Railway Design and Standards Organisation, Hindustan Steel and other establishments in both public and private sectors. Long-range fundamental work has also been done in making the best use of foundry raw materials and in evolving national standards.

The Laboratory has a specific role to play in promoting basic and fundamental research in metallurgical subjects and more so in undertaking applied research and pilot plant industrial scale trials for the development of mineral, ferrous and non-ferrous metal industries in the country. As such, the research and development themes at NML are aligned to the industrial growth in mineral and metal fields projected during the successive Five Year Plans; these requirements place a high premium on ingenuity in metallurgical research and development so that it is accepted as an asset to the industrial potential of the country.

The progress in these fields at the National Metallurgical Laboratory has been significant, steady and rewarding. Apart from the fact just pointed out that 21 out of the 24 new techniques and processes developed at NML have already been leased out to industries, commendable reviews of its work have been appearing from time to time in the international technical press.

10,000 Qualified Personnel Needed by 1970

Role of Consultant Engineering in Industrial Growth

By

K. B. RAO

Managing Director, National Industrial Development Corporation

INDUSTRIALISATION has come a long way from the days when the initial idea of establishing a manufacturing facility was translated into an operating plant through a series of trials and errors. The entire process of evolution of new industrial facility must—if it has to be economical and technically satisfactory and forecast results which are obtainable—go through a series of well-defined stages of planning, projecting and engineering. These generally commence with a detailed investigation of market potentiality followed by a technical feasibility and economic viability appraisal through detailed designing and engineering of the entire complex to the actual construction of the plant and start of production.

Each one of the subsequent steps in this series of projecting activities is dependent on the conclusions and results arrived at in a preceding stage of the study. It is, therefore, of fundamental importance that the basic activities, namely marketability and techno-economic criteria, be determined with as high a degree of accuracy as may be possible under a given set of conditions surrounding a specific project.

Economic appraisals in any projecting activity imply forecasts and these inevitably involve risks as regards their accuracy. While some of the variables and unknown projecting factors can be estimated with a fair measure of accuracy, there is always the hazard that on account of miscalculations during the planning stage of a project, the whole success of the project may be vitiated. Certain allowances in the form of contingency etc. are always allowed in cost estimates, but it must be borne in mind that the estimates contained in a techno-economic feasibility study relate not only to costs but also to market conditions, technological innovations, selection of equipment and many other variables. It is therefore vital that any project decision should be based on rational analysis of the available data and premises.

Studies of Potential

THE first step in the launching of a new project generally involves investigation of the market potential and investigations into the various aspects of general outline of the products planned to be manufactured and the process of manufacture to be adopted, the requirements of plant and machinery, land, buildings utilities and services, transportation and labour, raw materials, site studies, estimates of capital investment required etc. which lead to a techno-economic assessment of the scheme. Such studies give broad indications of the technical and economic features of the proposed economic activity and include estimates of costs of production and profiles of financial returns.

With the scheme formally decided upon on the basis of techno-economic studies, the next step is the preparation of detailed designs and the engineering of the proposed project. At this stage, complete designs of the project including plant layout, design of buildings, complete details of production and auxiliary equipment, personnel organisation requirements etc. are developed to an extent to a degree of detail adequate for actual construction to be taken in hand. At this stage the cost of construction and economics of production are also more accurately predicted.

Role of Consultants

THE fundamental role of consultant engineering in the establishment of new industrial facilities relates to the various steps enunciated above although on a continuing basis such services also cover technical assistance in actual establishment of production, investigations into the means of improving production, quality, reducing cost of production etc. This article limits itself to discussing the role of consultant engineering in the initial establishment of a new industrial facility.

Generally speaking, a consultant engineering organisation is called on wherever specialised, independent engineering judgement and broad experience are essential. The size of the project is no criterion; for example, the owners of a small-scale factory or a complex integrated chemical plant will be equally concerned with the selection, installation and operation of production equipment and material handling systems in the most economical manner. In both it is risky to rely on the engineering services offered by competing manufacturers of equipment whose opinions may be sincere but naturally include an element of self-interest. The unbiased judgement of a consulting engineer with no product

allegiance and with a thorough knowledge of all types of equipment can ensure the best and most economical results.

In the overall cost of a major project the expenditure on consultant engineering services is proportionately small. The objective engineering counsel and planning, which a consultant engineering organisation offers, ensures that the overall cost of a project is the minimum commensurate with the highest quality. As distinct from a plant operation engineer or product designer, a consulting engineer is trained to think in terms of an entire project rather than a specific function.

Consultant engineering can, generally speaking, be broadly classified as :

i. General consultant engineering;
ii. Process consultant engineering.

General consultant engineering, usually undertaken by the main consultant, concerns itself with plant layouts, building designs, equipment and plant requirements, utilities and service designs, manpower and other resources requirements, and economic forecasts, etc. To the extent necessary, it draws upon others for process know-how involved in the particular endeavour. In many cases, such as general engineering plants, the general consultant engineering service is itself adequately equipped to provide such knowledge as well.

The activity of process consultant engineering covers process know-how or specialised knowledge and experience relating to actual production technology. This is more clearly defined in the case of process industries such as chemicals, oil, fertilisers etc.

While it is true that there is yet a paucity of process know-how and knowledge of production technology within the country and that the transition from academic and operational levels of process know-how to the actual plant design levels is relatively long and complex, the technical knowledge and experience involved in general consultant engineering is largely available and can be developed fairly rapidly to satisfy the demand in this particular field.

UNFORTUNATELY, one of the inhibiting factors which has been acting against the widespread use of general engineering consultants has been the lack of appreciation of the distinction between general engineering consultancy and process consultancy. It is most desirable to make entrepreneurs and managements aware of this distinction so that dependence on foreign resources in the field of general consultant engineering may be reduced to a minimum, if not completely eliminated, as quickly as possible.

Although occasionally, contract engineering, viz. actual construction and supply of equipment etc., is also undertaken by consulting engineers, such a practice is generally an exception and is frowned upon. The value of a consultant lies largely in his ability to give unbiased advice free from administrative or contractual influences. It would, therefore, be desirable to ensure that the set-up of consulting engineering services in the country is by and large completely independent of such administrative or contractual influences.

A consultant engineering organisation should not be so placed where its judgement is likely to be influenced by administrative considerations as may happen if such an organisation is part of a plant management or linked with a Government department or organisation in a manner that would in any way deter its freedom to express its view or give its opinion based on technical considerations. It should also not be connected in any way with any contractual facilities such as equipment manufacturers or building contractors etc., whose claims may tend to influence the judgement of a consultant.

Growth Requirements

THE importance of consultant engineering in the context of planned industrial development in India is being increasingly recognised and some broad assessments have been made of the magnitude of such services required in the future. For example, the magnitude of investment in organised industries during the Fourth Plan period is estimated to be of the order of Rs 5,600 crore. This investment will cover both new facilities and substantial expansions of existing facilities. In every case the consultant engineer has a basic and vital role to play. Even on a conservative basis, the cost of such consultant engineering services during the Fourth Plan period would aggregate to a little over Rs 200 crore of which nearly 60 per cent would be towards general consultant engineering services, the balance being for specialist process consultancy.

Having regard to the present-day wage levels for technical personnel, the total equivalent of the monetary value of consultant engineering services referred to above would be over 10,000 technical personnel for general consultant engineering services alone by 1970.

In so far as process engineering is concerned it would be neither physically possible nor technically feasible to achieve complete self-sufficiency within a short span of five years. However, a planned beginning in this direction is also called for.

Even the most liberal estimates do not place the present total number of technical personnel engaged in consultant engineering services in the country at over 3,000 men. The gap which needs to be filled within the next few years is, therefore, a large one and can be successfully bridged only if the importance and urgency of the problem are appreciated and a well planned and co-ordinated approach evolved.

This is, perhaps, one of those fields of technical activity where the knowledge and experience of those otherwise considered physically old for field activities can be made use of to a great advantage.

Work of NIDC

Recognising the need for providing a fillip for early achievement of self-sufficiency and the development of these activities on a rational and ethical basis, Government established the Technological Consultancy Bureau as a division of the National Industrial Development Corporation in 1960. It aims at providing general consultancy services for a wide variety of industrial development activities although during its initial stages its activities are being restricted to certain public sector projects only. The firm intention, however, is that as soon as the Bureau has fully established itself, it should be in a position to render similar services to the

private sector as well.

During the short span of its existence the Bureau already has a number of divisions including those of Industrial Planning, Civil, Structural, Mechanical, Electrical, Industrial, Chemical and Metallurgical Engineering and of Architecture and Town Planning.

As a means of augmenting its resources, particularly with regard to specialised knowledge, it has taken steps for the participation of technical institutions and research laboratories in the country in its work. It is also forming panels of specialist engineers of wide experience and engineering organisations both in the country and abroad whose services could be drawn upon from time to time for specific works as and when occasion arises.

The Bureau has already undertaken important assignments ranging from investigations relating to demand potentials, techno-economic feasibility studies of major projects to detailed project designing and engineering of large industrial undertakings. The experience which these works have already provided to its young engineers has not only given them the competence to undertake such work with increasing speed and efficiency but has also provided the nucleus for an accelerated growth of such technical know-how in the country. It goes to the credit of the organisation that in spite of its very short period of existence it has proved the value of such consultant engineering services and the merit of developing such an activity on a rationally planned basis. It is Government's intention to expand its facilities to the maximum extent possible commensurate with efficiency of work so that it could provide an example and yardstick for the evolution of similar organisations in the country.

India has embarked on a massive programme of industrialisation with a view to attaining a self-sufficient and self-generating economy. This calls for the development within the country not merely of the tangible material resources necessary for the implementation of these programmes but also the building up of a fund of technical know-how and engineering data related to specific conditions obtaining in India. The only way in which this can be achieved is through the growth of the consultant engineering tradition in India in various spheres of industrial activity. The building up of the requisite engineering data necessary for efficient consultancy is a slow process. This is a circumstance which imparts a special urgency to the need for the development of consultant engineering bodies indigenously. With the emergence of the Technological Consultancy Bureau of the National Industrial Development Corporation, a significant step has been taken in this direction.

ENGINEERING SERVICE

Under an agreement, India and U.S.A. will jointly establish an engineering company in India to provide technical and engineering services for the development of petroleum, petro-chemical and other industrial projects in India.

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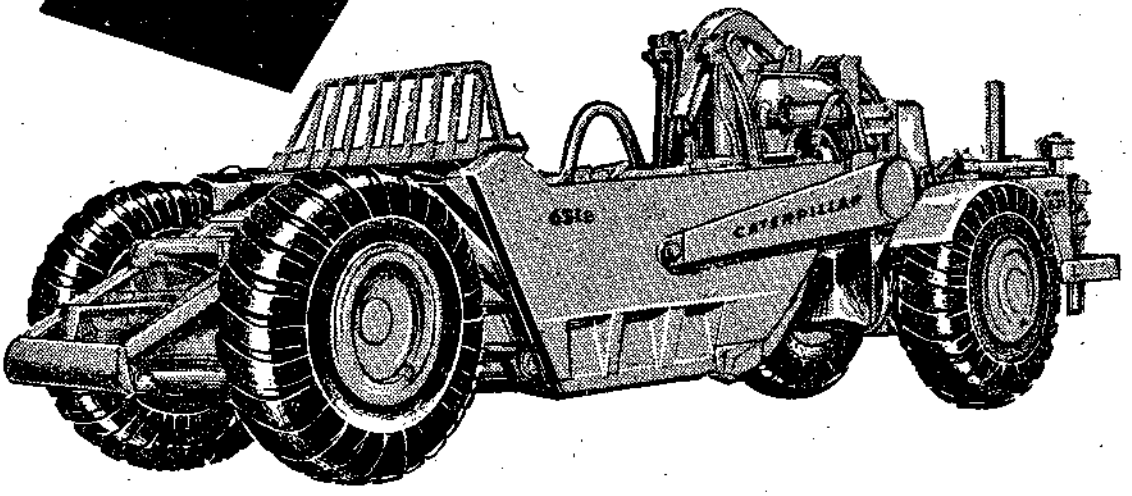
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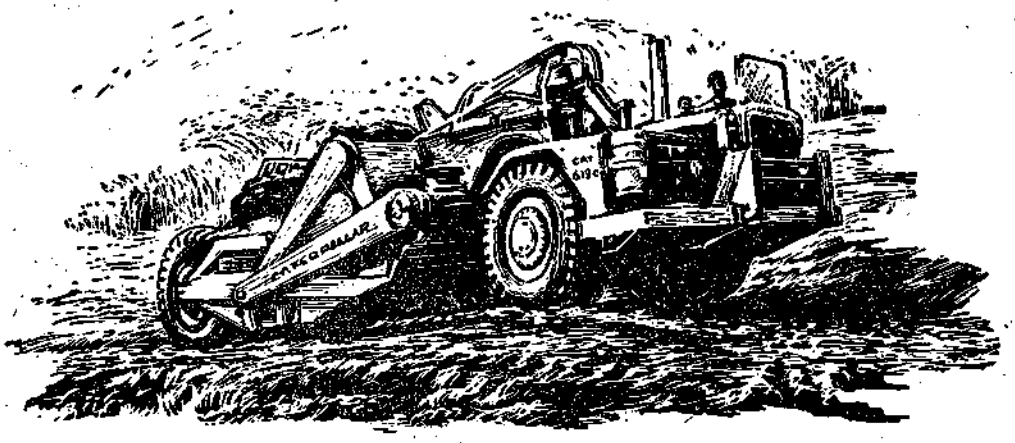
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IS ON THE JOB WHEREVER THERE'S MATERIAL ON THE MOVE

From Milk to Steel

Indo-German Venture Shows How Collaboration Works

CONTRIBUTED

TECHNOLOGICAL innovation is one of the more important determinants of industrial progress. It enables tasks to be accomplished which previously were thought difficult or impossible. Where the task is already being performed, it enables industry to obtain a quantitatively or qualitatively superior result with the same expenditure of time, materials or effort. The end result of technological innovation is progress.

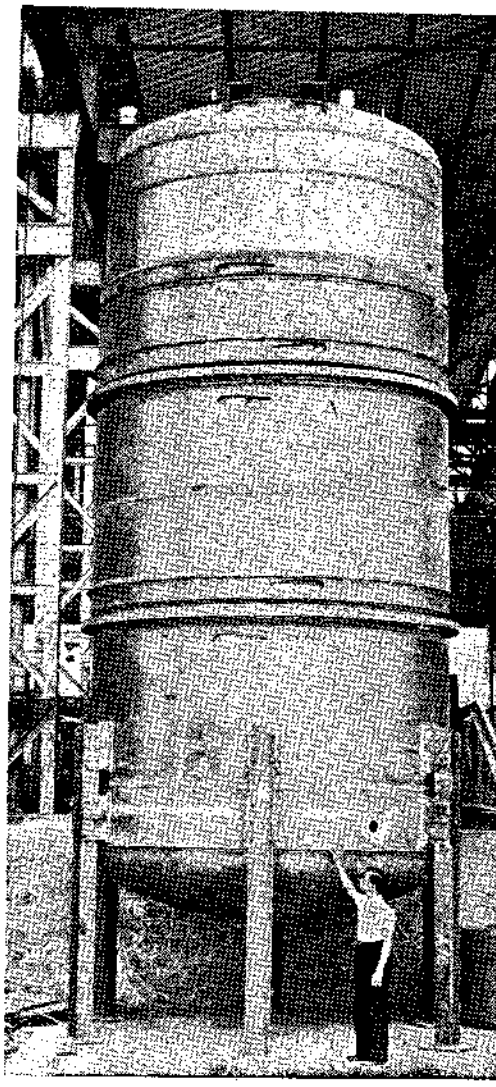
In an endeavour to step up the rate of technological innovation and thus hasten and strengthen India's industrial development, Larsen & Toubro Limited has extended its manufacturing programme and wrought several collaborations with leading foreign industrial organisations. The company brings engineering know-how, technical skills and plant and equipment, incorporating the latest developments to the steel, cement, oil, chemical, pharmaceutical, fertiliser, mining, pulp and paper, and dairy industries.

Manufacturing output at the company's works at Pawai, Bombay, has more than trebled in the last three years. It comprises a wide range of items, such as milk storage tanks, road milk tankers, can washers, batch pasteurisers, plate heat exchangers, cheese making machinery and accessories for refrigeration plant for the dairy industry; switchgear and electrical equipment such as control and relay panels, switchboards, switch-fuse units and motor starters; petrol pumps, Minikek grinding mills; diamond core drills, diamond bits and drilling accessories; cooling towers; unit operation equipment such as pressure vessels, heat exchangers, evaporators, distillation stills and reaction kettles for the chemical, pharmaceutical and food processing industries and distilleries; gas scrubbers; sheep'sfoot tamping rollers; belt conveyors and material handling equipment; cast iron and steel lubricated taper plug valves; flour milling and feed milling plant; pressure die-casting dies; crown corks; and aluminium capsules.

In the company's manufacturing organisation every effort is made to bring out a qualitatively superior product, equal to the best produced anywhere in the world. The company's investment in equipment, research, planning, design and quality control has paid it rich dividends in the form of orders from the export market. Several of the company's products are exported, a notable example being the export of motor starters to Europe.

Larsen & Toubro Limited is the Indian partner in the largest single Indo-German enterprise participated in by German private capital in India. This enterprise is Utkal Machinery Limited at Kansbahal, Orissa, and the three German partners are Gutehoffnungshuette Sterkrade Aktiengesellschaft which contributes its long experience and know-how in the steel, oil and mining industries; Heinrich Koppers, its engineering experience in the construction of coking plants and gas works; and J.M. Voith, its know-how as the world's leading builder of machines for the paper and pulp industries. Utkal Machinery Limited can make a variety of plant and equipment for heavy industry. At present it is working on fabrication work for some projects of national importance such as the major part of the structures and plate work needed for the fourth blast furnace of the Rourkela steel works.

Besides plant and equipment, industry requires various other engineering services before production can be commenced. The company offers all these services under one roof. The amassing of varied engineering talent in one organisation enables industry to set up manufacturing units with economy, skill and speed. The company offers a complete "turnkey" job, by co-ordinating the design and construction of civil works; local manufacture of stainless steel, copper, aluminium and mild steel vessels, columns and towers, heat exchangers, structural steel supports, staging, pipe supports and hangers etc.; erection of plant, equipment, piping and instrumentation; and planning and erection of electrical installation.



Stainless steel fermentor

The company also undertakes large mechanical construction and erection works, two recent assignments being the erection of the three blast furnaces, pig casting machine and rolling mill buildings for the Rourkela steel works and the mechanical construction and erection of the first public sector oil refinery at Noonmati, Gauhati. Instrumentation of the entire refinery and power-house was done by Larsen & Toubro,

(*Continued on Page 42*)

FERTILISERS

(*Continued from Page 22*)

trical and Instrumentation Engineering Department. In future, separate departments for each branch—mechanical, civil, structural, public health, electrical, instrumentation—will have to be instituted.

The Mechanical Engineering Wing assists the practical technology groups in process and technological development and to engineer process plant designs for the planning and design groups for large-scale plants. The engineering and drawing office staff are allocated project-wise for close-knit and speedy working. The detailed engineering of plants and equipment for which designs are prepared by the design wing of the Planning and Design Department are carried out and translated into blueprints. Bills of materials are drawn up and enquiries sent out by the procurement engineering wing. Specifications, requisitions and tenders are vetted by all the concerned wings before final recommendations are submitted. The mechanical engineering group has also an inspection and testing section.

The civil, structural and public health engineering sections are organised for preparation of drawings showing arrangements of structures, detailed design of structures, trusses, pipe bridges, conveyor gantries etc. on the civil and structural sides and water supply schemes for process water, boiler feed water, sanitary water, arrangements for cooling towers and schemes for effluent and sewage disposal on the public health side. It is also proposed to take up under the purview of these groups a township for the new projects. These groups are also provided with their own drawing and design office.

The Electrical and Instrumentation Engineering Department is responsible for the design, engineering and procurement of electrical and instrument items for projects. Specialist groups have been instituted in the electrical division for substations and distribution plant layout, generation, estimating and records. Similarly, in the instruments group, following specialist sections have been instituted; electronic instruments, pneumatic and other instruments, piping and layout and estimates and records.

For turn-key jobs, specifications for electrical equipment and instruments are prepared for tender enquiries and the tenders are analysed and recommendations made. Where plants are designed, engineered and procured, the necessary design and engineering is carried out in close collaboration and co-ordination with the other departments.

The engineering departments assist the Practical Technology Department in all its requirements for engineering and maintenance not only for developmental work but also for pilot and semi-production plants. Precision workshops have been set up under the engineering departments for fabrication of equipment and repairs and maintenance of installed equipment for the Practical Technology Department's needs.

Techno-Commercial Procurement Department : This self-contained department acts as the centre of commercial intelligence and provides all information to the various specialist groups regarding availability and prices of off-shelf equipment as well as scope for fabrication facilities in the country. Commercial aspects such as foreign exchange release, grant of import licence, co-ordination on release of controlled commodities, clearance, customs, despatch at ports, shipping and rail transportation formalities, drawing up and standardisation of contracts etc. are attended to by this group.

Close team-work has been established among the various departments from the very beginning. As a result, the Planning and Development Division has gained valuable knowledge and experience, and Government has associated the groups actively on various organs and bodies connected with the fertiliser industry; it is represented on the Planning Group on Fertilisers as well as the Working Group set up on fabrication of chemical plants and equipment.

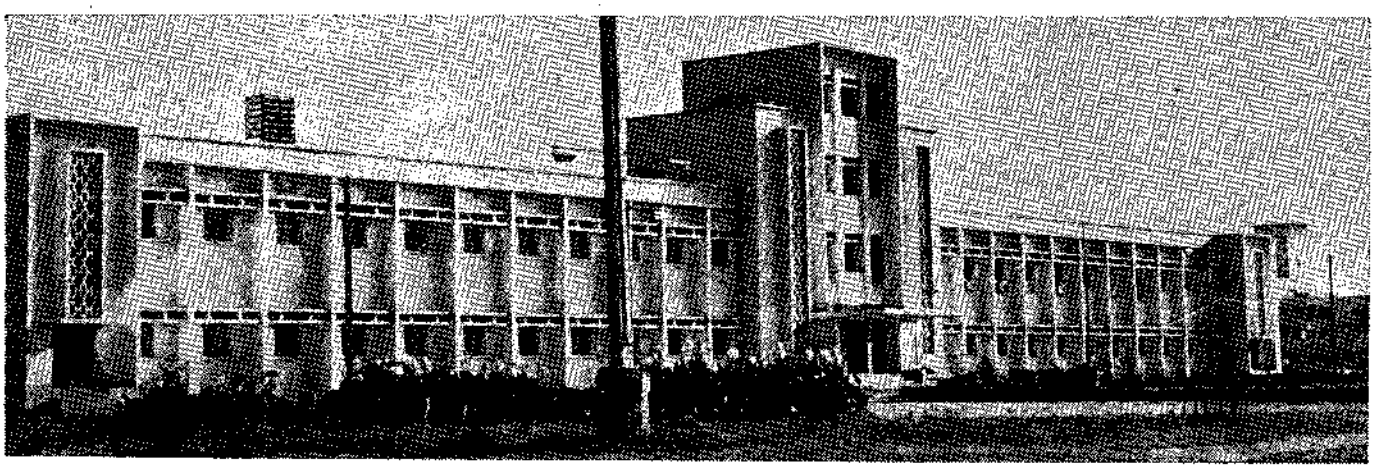
Close relations have also been established with other institutions such as the Indian Agricultural Research Institute, the Indian Council of Agricultural Research, the specialist sections of the Planning Commission, the Ministry of Food and Agriculture and other departments.

ACHIEVEMENTS

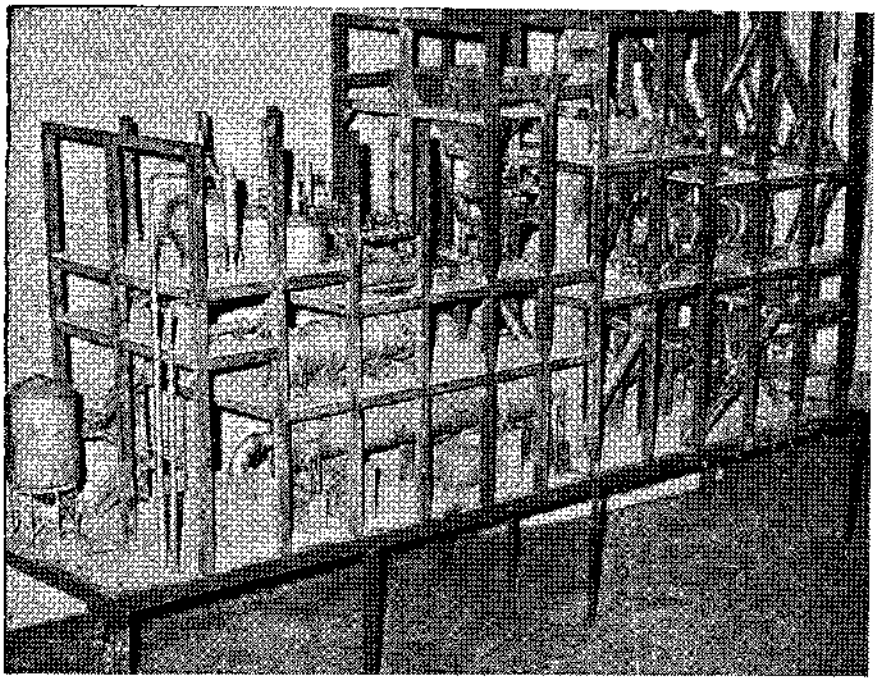
The processes and products developed by the Division have been listed at the outset. A number of patents have been taken in India and abroad. The Division has also prepared many techno-economic surveys and project reports for the Corporation as well as the Government. Technologists of the Division have published a number of technical papers in various journals.

As stated earlier, the Division has now been organised to handle two projects a year and it has been taking advance action on Korba and Durgapur projects. For the projects now under construction such as Namrup and Gorakhpur, certain plant sections are being departmentally designed, engineered and procured by the Division such as ammonium sulphate plant in Namrup and the auxiliary plants for material handling, cooling towers, water treatment etc. in Gorakhpur.

This work has also prompted many firms in India to take up more and more work by way of design and fabrication. For example, for the



The building of the Central Institute of Fertiliser Technology at Sindri which forms part of the Planning and Development Division of the Fertiliser Corporation. The Institute area is being extended to put up the design, engineering and procurement wings.



A model of the 200-ton-a-day nitrolimestone plant designed by the P and D Division for the Rourkela fertiliser plant

ammonium sulphate expansion taken up in Sindri, a number of stainless steel vessels and towers have been fabricated in the country for the first time. Another item of special interest was the collaboration between the design engineering sections in the Corporation and private manufacturers in developing and manufacturing nickel-chromium alloy pumps for corrosive ammonium sulphate liquor. The result of this collaboration was the evolution of a comparatively trouble-free pump design with easily replaceable parts and convenient for expiditious assembling and dismantling for the purpose of maintenance, cleaning etc.

Similarly, for the Rourkela project, our endeavours to have maximum indigenous fabrication led the few firms already in the field to manufacture stainless steel equipment to the fullest extent. Some other firms who did not have previous experience in this particular line have also been helped to develop. In the case of mild steel, for example, some equipment for working at 20 atmospheres were fabricated by firms who had no previous experience in the line. It can be claimed that the tonnage of stainless steel fabricated for the Rourkela project during a period of 12-18 months was certainly much more than the tonnage of similar fabrication in any corresponding period before.

Standardisation of sizes and specifications of equipment is crucial for industrial fabrication. With this end in view, the Planning and Development Division has prepared and submitted to the Government several documents on specifications based on standard capacity plants of the fertiliser manufacturing units of the future.

TOWARDS SELF-RELIANCE

Industrial construction involves: (a) civil and structural engineering for machine foundations, plant buildings and structures, (b) mechanical erection of plant and equipment, and utilities including inter-plant hook-ups, and (c) town planning and architecture both for townships associated with each specific project, and factory buildings and offices.

The experience and resources within the country in these directions are good enough to make any foreign assistance unnecessary and it can be stated that the country is fairly self-sufficient in these requirements. In our conditions, with our concept of mixed economy, civil engineering can be either carried out departmentally or entrusted to experienced firms, whichever is more advantageous. The same considerations would apply to the fields relating to town-planing, architecture and mechanical erection of plant and equipment.

India's efforts are directed towards establishment of heavy and other industries to meet the full requirements of the country from indigenous production. In this effort, besides the fertiliser industry, many other industries such as the pharmaceutical industry, the steel industry, the machine building industry, and the coal development industry, are being established on a large scale. The experience of Planning and Development Division of the Fertiliser Corporation would suggest that each group of major industries should also have similar multi-functional organisations for the achievement of technological self-sufficiency in their respective fields.

From Milk to Steel

(*Continued from Page 40*)

and it marked the first time that such specialised work was entrusted to an Indian contractor. The company is now engaged in instrumentation work for the Barauni Refineries. It has been awarded the contract for the mechanical and electrical erection and instrumentation of the 200-M.W. thermal power station extension at Korba, Madhya Pradesh. The company also specialises in the erection of medium-sized chemical and pharmaceutical plants and several such plants have been completed.

The company's wholly owned subsidiary, Engineering Construction Corporation Limited (ECC), has designed and constructed several industrial buildings and structures in conventional reinforced concrete as well as precast and prestressed concrete—cement factories, docks, chemical and fertiliser plants, a water treatment plant, and the longest building to be constructed in South-East Asia, the 54000-metre-long Modular Laboratory for the Atomic Energy Commission at Trombay. The organisation of construction work on factory lines was evolved by ECC for the construction of the Modular Laboratory. High grade concrete units were cast on platforms, transported by diesel locos and placed into position by special cranes designed for the purpose.

THE NATIONAL LABORATORIES

(*Continued from Page 8*)

Active carbons are needed in large quantities for bleaching of vegetable oils and in the refining and decolorisation of various chemical and pharmaceutical solutions. The Regional Research Laboratory, Hyderabad, undertook studies on methods of production of different types of active carbons using coal as the starting material.

The process developed by RRL, Hyderabad, consists of subjecting the non-coking coal available from Singareni Collieries (Andhra Pradesh) to low temperature carbonisation using the internally heated process. The semicoke thus obtained is steam activated, and an active surface in carbon is created both during the carbonisation process due to devolatilisation and contact with the heating gases as well as the subsequent reaction between steam and carbon. A pilot plant of 0.75 tonnes per day capacity was designed, fabricated and set up in 1962 and the active carbons are being marketed under the trade name 'Hykol' through Voltas Ltd., Bombay.

With increasing demand for different types of Hykols, a prototype plant of capacity 2 tonnes Hykol 'X' per day, financed by the National Research Development Corporation at a cost of Rs. 1.6 million, has been designed and set up at the Laboratory and will be going into production soon. The Hykols are being supplied at a price ranging from Rs. 800 to Rs 3,500 per tonne compared to the cost of Rs. 2,000 as to Rs. 7,000 per tonne for imported carbons.

Production of new types of active carbons has resulted in a saving of foreign exchange worth Rs. 0.5 million besides yielding valuable design and operational data for the setting up of commercial plants.

Magnesium:

India requires for its metallurgical industry and defence about 200 tons of magnesium. At present the National Metallurgical Laboratory (NML), Jamshedpur, has developed a pilot plant for 25 lbs. a day of magnesium. Designed on the data obtained from the pilot plant, the Central Design Engineering Unit of the CSIR and the National Metallurgical Laboratory are working for the installation of a semi-commercial unit of a capacity of 250 tons per annum which will meet the entire present requirements of the country. It may be stated that designs of this plant and its commercial installation by foreign consultants would have cost the country nearly a crore of rupees for a commercial plant.

Low-Shaft Furnace:

The 15 tonnes a day low-shaft furnace pilot plant was installed in National Metallurgical Laboratory with the object of conducting comprehensive investigations to assess the possibilities of making commercial grades of pig iron from substandard raw materials like soft iron ores, iron ore fines, beneficiated magnetite iron ore with various non-coking high ash coals, or carbonised lignite, plentiful supplies of which exist in India but are unsuitable for exploitation in the conventional blast furnace.

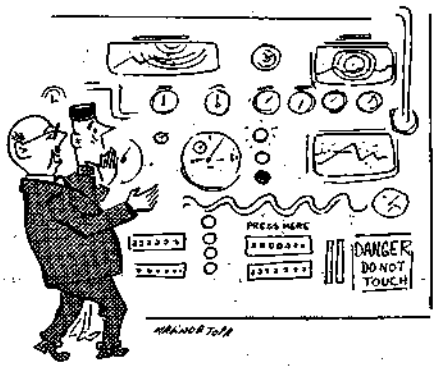
Based on extensive smelting trials with low temperature carbonised coke made from large varieties of non-coking coals, it has been established that iron making in low-shaft furnace with non-coking coals is technically feasible and commercially attractive in regions where coking coal is not available. Carbonised lignite briquettes can be employed for iron smelting. The low-shaft furnace produces liquid iron which can directly be used in foundry or for processing into steel.

A plant to produce 0.1 million tonnes of pig iron in Punjab with NML technical know-how will be on stream shortly.

The advantage of the process developed in the NML depends on the utilisation of non-coking coals, carbonised lignite briquettes and run-of-mine iron ore fines for the production of pig iron.

The establishment of regional iron and steel plants and consequent development of ancillary industries will not only lead to further employment, but also contribute towards attainment of iron production targets.

These are some of the examples in which the CSIR has helped industry in attaining a proper technological balance, raising the scientific and technological ability of the country and in making it less dependent on know-how from abroad.



This apparatus has no function. It's only to impress our clients.

MAKE TV SETS

I have read all the views on Television published in *Yojana* of August 16.

Television is needed in India. But as suggested by one in *Yojana*, it should be allowed to develop in the private sector on commercial lines. Necessary arrangements may be made to establish a factory to manufacture television broadcasting and receiving sets. It can also be developed on the lines of the Hindustan Machine Tools, Indian Telephone Industries, etc. For the benefit of the common man the receiver sets can be supplied on hire-purchase system to individuals, Gram Panchayats and other voluntary organisations.

A word of caution to our planners. They should see to it that the factory for the manufacture of TV sets is set up with modern equipment. Once we set up a factory with outdated machinery it will be difficult and expensive to convert it into a modern one. We started the Sharavati Project and now changes are being made every now and then.

Television should necessarily be a big project. Otherwise it will be useless.

Bangalore S. KAMALAKSHA

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(A Government of India Undertaking)

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BRIQUETTING & CARBONISATION PLANT

The following products will be produced in the Briquetting and Carbonisation Plant of the Corporation during the first quarter of 1965 :

1. RAW BRIQUETTING AND LECO (CARBONISED BRIQUETTES)	Useful for Industries, Domestic purposes, in Canteens, Hospitals and Hotels.
2. ORTHO CRESOL 3. META PARA CRESOLS 4. XYLENOLS 5. CARBOLIC ACID 6. POLYVALENT PHENOLS	Useful in many Chemical Industries.

Prospective customers are requested to send their firm demands to the—

SUPERINTENDENT

Briquetting and Carbonisation Plant, Neyveli Lignite Corporation Ltd., Neyveli-I,

South Arcot District — Madras State.

FROM LABORATORY TO FACTORY

NRDC Promotes Use of Research : Indian Processes Have Already Yielded Rs. 5 Crore

THE continued dependence on imported know-how is in the interest of neither national prestige nor national economy. The prospect of filling the growing gap between supply and demand of goods and materials by continuing manufacture activities on the basis of foreign collaboration is receding every day.

The setting up of National Research Development Corporation of India (NRDC) for development and utilisation of laboratory researches was proposed by the Council of Scientific and Industrial Research. The proposal was studied and discussed at an inter-Ministerial meeting at which Planning Commission was also present on November 14, 1952. The meeting unanimously agreed to setting up of NRDC. The Cabinet approved the proposal in April 1953 and NRDC was set up in December 1953 as a Government-owned organisation on the pattern of the National Research Development Corporation of the United Kingdom to exploit, in the public interest, for profit or otherwise, the researches carried out in various laboratories.

The unco-ordinated development of research and industry in our country has made the task of NRDC particularly difficult. In spite of these disabilities NRDC with its limited resources has been actively endeavouring to co ordinate research and industry and orient research programmes in more practical and utilitarian directions. It is also attempting to create a bias in national attitudes in favour of indigenous know-how and to make the industry research conscious and to develop receptivity, and the ability and will to adopt indigenous know-how.

As a result of these efforts the utilisation of researches by industry has been steadily increasing. The various inventions licensed by NRDC on which successful commercial production has been established are listed below:

By

Dr. A. N. KAPUR

Executive Director, National Research Development Corporation

Name of process	*Name of licensee*	*Value in Rs. of Production up to 31.3.64*
Central Food Technological Research Institute, Mysore		
1. Infant food	Kaira Distt. Co-operative Milk Producers' Union Ltd., Anand	2,76,73,570
2. Composite protein food	Unichem Laboratories, Bombay	2,09,512
3. Tonic wine	F.K. Research Products, Mysore	1,06,790
4. Ginger cocktail	F.K. Research Products,	19,435
5. Vacuum tester for canned food	Gardeners Corporation, New Delhi	7,450
		2,80,16,757
National Physical Laboratory, New Delhi		
1. Duplicating, printing & allied black inks	Mysore Lac & Paint Works, Mysore.	26,90,000
2. Silver mica capacitors	a) Indian Telephone Industries, Bangalore	13,64,877
	b) Manilal Mohanlal & Co., Bombay.	3,99,580
3. Ceramic capacitors	Bharat Electronics, Bangalore.	10,96,660
4. Carbon slabs & rods	a) Beni Ltd., Calcutta	6,53,695
	b) B. Himatsinghka	4,028
5. Indelible ink	Mysore Lac & Paint Works, Mysore.	5,09,150
6. Antirust solution	a) Mysore Lac & Paint Works, Mysore.	16,990
	b) Plastipeel Chemical Corp., Bombay.	1,850
		67,36,830
Central Glass & Ceramic Research Institute, Calcutta		
1. Mica insulating bricks	a) Bhupal Mining Works, Bhilwara	31,84,000
	b) Reliance Firebricks & Pottery Works, Cacutta.	2,70,923
2. Chemical porcelain	Bengal Porcelain Co. Ltd. Calcutta.	72,990
3. Vitreous enamels	Beni Ltd., Calcutta.	20,604
4. Boron free enamels	Ceramic Sales Corporation, Calcutta.	11,920
5. Copper enamels	Kalyani Industries, Calcutta.	1,085
		35,61,522
C.S.I.R. Schemes (at Shri Ram Institute for Industrial Research, New Delhi)		
1. Carboxymethyl cellulose	Sardesai Bros., Bilimora.	24,63,138
2. Shrifirset compounds	Sardesai Bros., Bilimora	11,44,110
3. Ethyl ether	Industrial Solvents & Chemicals, Bombay.	3,42,600
4. Thermocouple ammeters	Radio Lamp Works	22,073
5. Polyester resins	Rawji Amarsi, Bombay.	5,304
		39,97,225

Indian Railways

1. Bituminous emulsions	Shalimar Tar Products, Calcutta.	21,22,300
		21,22,300

Central Fuel Research Institute, Jealgora

1. Carbions	Bird & Co., Calcutta	13,85,809
2. Lissasorb	Newmac Industries, Bombay	4,22,385
		18,08,194

Indian Agricultural Research Institute, New Delhi

1. Pine oil	Prabhat General Agencies, Bombay	16,87,000
2. Hand hoe	a) Cossul & Co., Kanpur	1,359
	b) Pran Engineering Works, Bareilly.	212
		16,88,571

Shri Ram Institute for Industrial Research, Delhi

1. Plastipeel	Plastipeel Chemical Corp., Bombay	8,88,000
2. Salicylanilide & rot proofing compound	Hico Products (P) Ltd., Bombay.	25,073
3. Impact tear tester	Associated Instruments, Delhi.	16,163
4. SRI electronic Moisture meter	Motwane Mfg. Co., Bombay.	11,340
5. Cloth marking ink	Industrial Chemical Corp. Faridabad.	464
		9,41,040

Central Electrochemical Research Institute, Karaikudi

1. Electrolytic cuprous oxide	a) Technico Enterprises, Calcutta.	4,75,100
	b) Pigments & Chemical Industries, Calcutta	81,590
		5,56,690

National Chemical Laboratory, Poona

1. Cation exchange resins from CNSL	Tulsi Industries, Poona	3,92,400
2. Can sealing composition	Arya Chemical Works, Calcutta.	1,40,470
3. Rubber base contact adhesive	K. N. Chari & Co., Madras.	15,509
4. Anion exchange resins	Tulsi Industries, Poona.	872
5. Liquid rubber	K. N. Chari & Co., Madras.	244
		5,49,495

Regional Research Laboratory, Jammu

1. Diosgenin from dioscorea tubers	CIPLA, Bombay.	3,69,400
		3,69,400

Regional Research Laboratory, Hyderabad

1. Hykol 'O'	—	2,33,713
2. Benzyl chloride	S. H. Kelkar & Co., Bombay.	608
		2,34,321

Central Building Research Institute, Roorkee

1. Brick & block making machine	a) Supercraft Ltd., Calcutta	52,800
	b) J.K. Iron & Steel, Kanpur	42,000
	c) Prem Enamel & Metal Factory, Delhi.	13,500
2. Under reaming tool	M.S. Jain, Roorkee	52,410
3. New foaming agents for production of low density foamed concrete	Hindustan Housing Factory, New Delhi.	1,600
		1,62,310

Central Salt & Marine Chemicals Research Institute, Bhavnagar

1. Light basic magnesium carbonate	Selective Chemicals, Bhavnagar	32,693
		32,693

Central Leather Research Institute, Madras

1. Latex cement	a) Karanjirapally Small Scale Rubber Industries Co. Ltd.	14,033
	b) K.N. Chari & Co., Madras.	109
2. Enzyme depilants & bates	Leather Chemicals & Industries Ltd., Calcutta.	98
		14,240

Jadavpur University, Calcutta

1. Salicylic acid	Modi Desai Industries, Bombay	47,180
		47,180

Indian Institute of Sugarcane Research, Lucknow

1. Bullock drawn sugarcane planter	Pran Engineering Corp., Saharanpur	14,300
		14,300

Forest Research Institute, Debradun

1. Bamboo boards	Western India Plywood Balliapatam	16,386
		16,386

The total value of production up to March 31, 1964 is Rs 5.1 crore. *This has resulted in foreign exchange saving of Rs* 4.08 *crore.*

Besides, there have been numerous promising researches. These, however, could not be commercially exploited as in some cases the Government department responsible for industrial development granted foreign collaboration to entrepreneurs *even when indigenous know-how was available.* Sometimes the capacities sanctioned covered not only the immediate but also the potential demand in the country. The indigenous know-how was thereby blocked. In other cases the import of plant and machinery which was not indigenously available was not sanctioned and the licensces could not set up manufacture. It is not suggested that entrepreneurs should be forced to use indigenous know-how.

The utilisation of indigenous know-how would progress greatly if special help is provided to entrepreneuers who are willing to utilise indigenous know-how.

The main lacunae in development of indigenous researches are:

(a) The inventions are often too theoretical and impractical;

(b) There is a lack of adequate facilities for design and engineering know-how and scaling up of laboratory researches to commercial projects;

(c) Industry does not have sufficient will, receptivity and competence to adopt new ideas and innovations.

These will be overcome only if greater emphasis is placed on technological development than abstruse laboratory researches. Dr Frederick Seitz, President of National Academy of Sciences, U.S.A., testifying before the Science and Astronautics Committee of the U.S. House of Representatives, on October 15, 1963, stated that only a small fraction of the $ 15 billion federal support to research was devoted to scientific and basic research and the rest went to technological development. NRDC should, therefore, be adequately strengthened to give matching assistance to research laboratories.

THE TASK AHEAD

Though NRDC has a Survey and Information Section, a Technical Section, an Industrial Liaison Section, and a Chemical Engineering Section on the lines of NRDC of the United Kingdom, these sections are as yet one-man sections. Naturally NRDC is unable to discharge its responsibilities effectively. It is, therefore, suggested that NRDC should be expanded as recommended below:

1. *Liaison Section:* Adequate increase of liaison staff and representation of NRDC on all industrial development councils and governing bodies of research laboratories would enable it to bring about effective liaison and close collaboration between research and industry. It would then be in a position to assist the laboratories in originating research projects of merit which will be assured of good reception from the industry.

2. *Central Pilot Plant Unit*: NRDC should have a Central Pilot Plant Unit at which promising researches should be tried out in co-operation with technicians from industry and scientists from research institutes on pilot plant scale and the results demonstrated to the industry. In cases where industry is shy to undertake commercial development this unit should set up semi-commercial scale plants for commercial exploitation of indigenous know-how.

3. *Design and Engineering Cell:* NRDC should set up a Design and Engineering Cell. With its close association with research laboratories and industry, the Design and Engineering Cell of NRDC should be able to render very useful service to the country in developing indigenous know-how and exploit the genius of our inventive and imaginative minds to the benefit of the whole community.

4. *Central Workshop:* NRDC should set up a workshop for fabrication of plant and equipment so that it could assist the licensees in setting up their factories. This will help to overcome the biggest lacuna in translation of laboratory research. At the moment even when some items of laboratory research are promising it is difficult to implement it commercially owing to lack of manufacturing facilities for plant and equipment in the country and foreign exchange difficulties in importing equipment. The plant manufacturing unit under the NRDC should work in collaboration with engineering workshops in private and public sectors and fabricate plant and machinery for all entrepreneurs.

5. *Survey and Information Section*: Information regarding market demands, specifications and uses of products is a prerequisite for selection of right problems. Compilation of import data, survey of patents, and latest information on the industrial licences issued, installed capacity of various plants and Plan targets of various products would help greatly in evolving fruitful research programmes and in eliminating infructuous expenditure on research projects which are ultimately found to have no commercial scope.

6. *Patent Unit*: It is essential that before patents are taken their economic viability, commercial scope and technical feasibility should be examined. At present patents are being taken without going into these aspects with the result that more than 50 per cent of the patents have to be ultimately abandoned.

The Railway Board at our instance have issued a circular to all their research laboratories to explore the commercial scope of their inventions with the assistance of NRDC before applying for patents. The work for taking all Government patents should be assigned to NRDC and adequate facilities created.

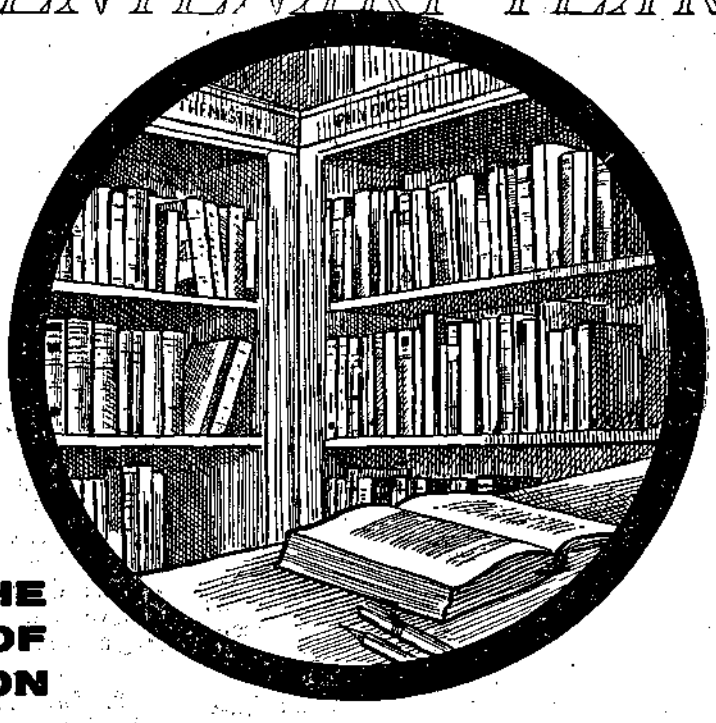
7. *Journal*: A journal containing technical and economic information relating to processes, products and market surveys and other technical and scientific information for dissemination to industry and research organisations should be brought out by the Corporation to give publicity to various processes available for licensing as well as products of various licensee firms.

8. *Foreign Exchange*: The Corporation should have a foreign exchange allocation of its own for importing plant and equipment and raw materials which are not indigenously available. Without this, most of the processes remain unutilised and also enormous delays are experienced in establishing commercial production. This is very necessary, since through normal channels it takes enormous time to get the licenses cleared.

CHALLENGING RESPONSIBILITY

It is hoped that these proposals for strengthening the NRDC would receive the attention of the authorities and research and industry will not be allowed to remain separately cloistered. The harnessing of science and technology is a challenging responsibility for a government dedicated to securing a better life for its people. Unless our national attitudes are oriented in favour of indigenous know-how and the programmes of research are more practical and utilitarian the expansion of research and industry would be more a hindrance than a help to the country. When granting industrial licences for the starting of new units or expansion of existing units, it should be ensured that there is provision for setting up adequate research facilities for improvement of the economics of production and quality of products. Every industrial unit must have on its staff at least one competent scientist who keeps himself abreast of the technical developments in the field of the activities of the firm. Only then will industry be in a position to make a proper assessment of the merits of indigenous know-how and utilise it.

BIRD'S CENTENARY YEAR



PAPER FOR THE EXTENSION OF EDUCATION

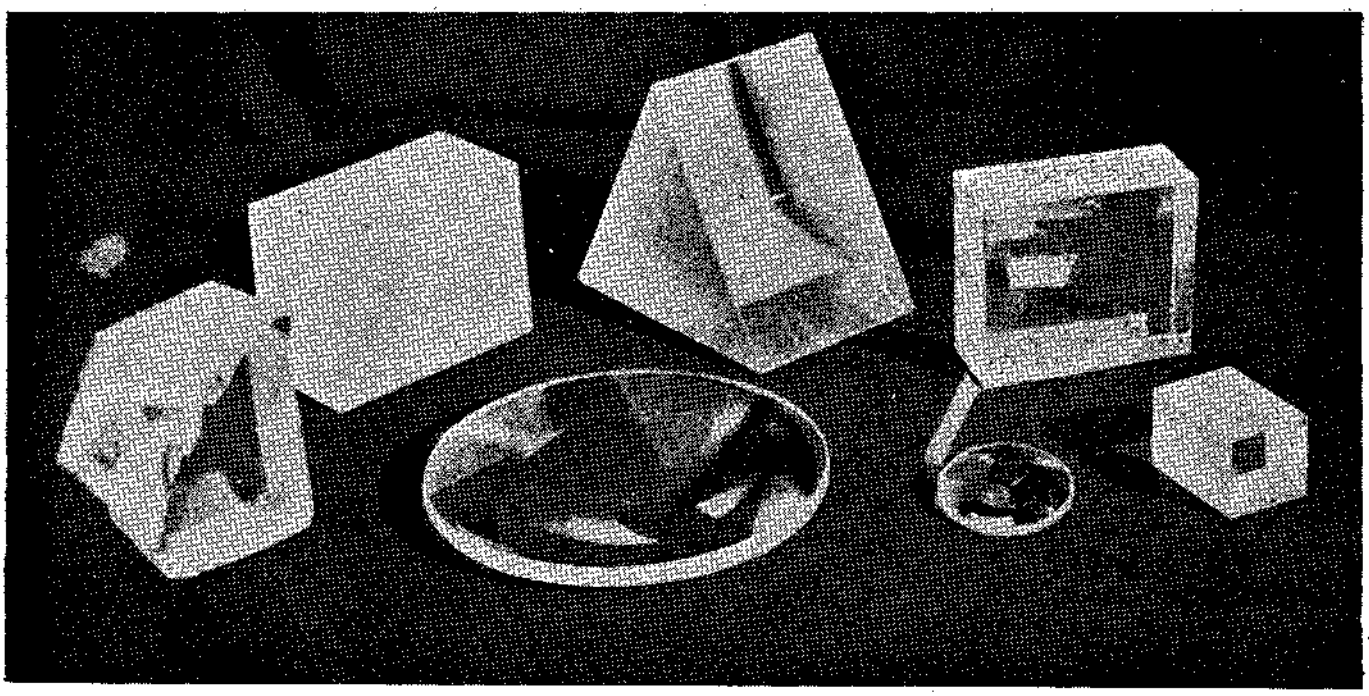
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B2/BRD-9A



Some samples of optical glass produced at the Central Glass and Ceramic Research Institute, Calcutta

Secrets of OPTICAL GLASS Found

India is one of few countries making it : Big saving in exchange

By

DR ATMA RAM

Director, Central Glass and Ceramic Research Institute, Calcutta

THE Central Glass and Ceramic Research Institute was established in August 1950. Its main function is to carry on research on subjects having a bearing on glass and ceramic sciences and technologies. Its work touches glass, pottery, refractories, vitreous enamelling and mica (the last having been added in 1960 at the request of the Ministry of Commerce and Industry, arising mostly out of Institute's work on the utilisation of mica wastes.) Teaching is not one of the functions of the Institute, but special practical training is imparted for short periods to persons sponsored by industry, universities and other organisations.

Besides helping the utilisation of the country's resources of related raw materials and the attainment of higher technological efficiency in the glass and ceramics industries, one of the objectives of the Institute is to make the country independent of imported know-how.

A few of the completed investigations illustrating the contributions of the Institute in these directions are mentioned below.

A special assignment given to the Institute by the Planning Commission in 1956 was to work out processes for the production of optical glass to make the country independent of imports for this vitally strategic material. Opitcal glass is produced in about half a dozen countries in the world and its manufacture is a carefully preserved secret. Ever since the outbreak of the Second World War in 1939, the Government of India had been anxious for its production in the country and negotiations had been in progress for a long time with almost all the foreign manufacturing firms, without success.

The Institute succeeded in establishing the details of manufacturing operations without association of any manufacturing firm. The entire equipment was designed and fabricated at the Institute, since the manufacturers do not, *for reasons of secrecy*, sell such equipment or supply the designs. The samples of optical glass produced in 1958 on a pilot scale were declared to be of an A-grade quality. A plant of a capacity of more than the requirements was fabricated and erected at the Institute and went into production in the later part of 1960.

All the major types of optical glass are now being produced in the plant and the demand which has considerably increased after emergency is being fully met. In addition to relieving the country of its continued dependence for a vital material, the production of optical glass should give impetus to the development of optical instruments industry in the country.

Survey, Evaluation and Beneficiation of Raw Materials

Authentic information on raw materials, such as occurrence, extent of deposits, quality, amenability to beneficiation, etc. is an essential prerequisite for locating new factories as also for an uninterrupted supply to the existing ones which have already undergone appreciable expansion. Based on the results of investigations, the Institute has published memoirs and monographs on the survey of indigenous resources of glass and ceramic raw materials, such as sands, quartz, felspar, clays, talcs, etc. The survey has established that raw materials for these industries are available in practically all the regions.

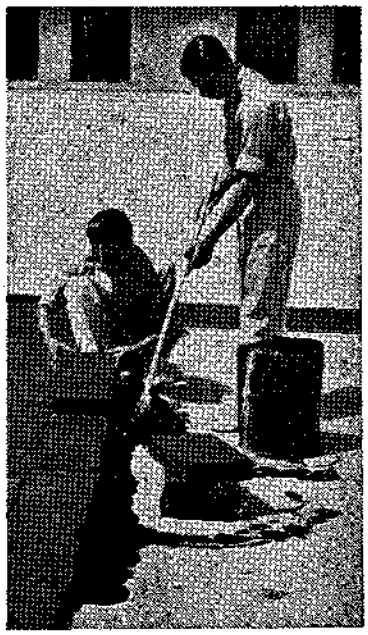
In addition to helping increased utilisation of the country's raw materials, and making them available in some cases from near deposits than hitherto, this work has *dispelled the erroneous impression regarding unsuitability of Indian raw materials. Actually, Indian quartzites have been found to be amongst the purest in the world*, and by using these, some of the finest varieties of optical glass can be, and are actually being, produced at the Institute.

Survey of magnesite, chrome ores, etc. is in progress.

Improvement in Quality

Glass containers—A wide variety of glass containers, such as ampoules, vials, bottles, jars and carboys constituting 40 to 50 per cent of the total production of glassware (about 250,000 tons in 1962) and valued at more than Rs. 8 crore are used in the chemical, pharmaceutical, fruit preservation, fermentation, soft drinks, dairy, cosmetics, ink and a host of other industries. Containers of inferior quality are detrimental to the interests of user trades and ultimately of the consumer. Complaints on the poor performance of local products (there were insistent demands for improving empty containers) were often received at the Institute and were investigated in detail over several years and as a result, compositions suitable for the manufacture of glass containers were worked out.

There are now very few complaints about the quality of indigenous



Placing foam glass on a roof for insulation

containers. The import of glass containers had been substantially reduced even before the present foreign exchange restrictions were imposed. Results have been freely given to industry and have been well utilised.

Saggars—Saggars are used in the pottery industry for keeping articles for firing in kilns and are used over and over again. Consequently, their life appreciably influences the cost of production of potteryware. The average life of saggars commonly used in Indian factories was reported to be about 6 to 8 firings as against 18 to 20 obtained in advanced countries. The Institute investigated the problem and some of the saggars made according to the Institute's findings, by using indigenous raw materials and without involving any radical change in the existing operations, stood even 30 firings under service trials in factories.

Better Train Lights

Plaster of Paris—Plaster of Paris made by calcining gypsum is an essential material extensively used in ceramic industries for making moulds for forming articles. The methods used in Indian factories were faulty. Further, the quality of Indian gypsum is not comparable to that obtained from Dandot (now in Pakistan) to which Indian factories were used. The Institute worked out in detail the conditions necessary for making good plasters and also designed kilns suitable for the purpose. The results have been given to industry.

Locomotive headlights: While examining the causes of some railway accidents occurring during nights, a view was expressed that some of these might be due to insufficient light on the railway track. The Indian Railway Board approached the Institute for examining the possibility of reducing the divergence of light from locomotive headlights so as to ensure better illumination of the track by providing a system of lenses. A fairly simple and inexpensive method which would not involve any change in the present assembly of fittings, otherwise necessary according to the Railway Board, has been worked out by designing a special bulb as the source of light. After extensive trials conducted in the workshops of the Eastern Railway at Jamalpur, its performance has been declared to be quite satisfactory.

Substitutes for Imports

In finding out substitutes for imported chemicals, without which some industries would come to a stop, the Institute has successfully worked out some substitutes. Mention may specially be made of those for two essential chemicals, viz. borax and selenium.

Borax—Borax is an essential flux for the vitreous enamelling industry of the country, the production of which is valued at Rs 2 crore and provides a variety of advertisement signs, hospital ware and utensils to poorer sections of the population. The industry consumes imported borax amounting to Rs 6 lakh per annum. After detailed investigations the Institute worked out enamel compositions free from borax by utilising indigenous raw materials. Extensive trials were conducted in factories and the process was covered under patent which has been assigned by the National Research Development Corporation of India to an Indian firm.

Apart from saving foreign exchange and assisting the utilisation of indigenous resources, the industry will now become independent of imports for supplies of an essential ingredient.

Selenium—The Institute's work on this material has demonstrated that,

contrary to the general belief, the great national laboratories can contribute to the well-being of cottage industry. One of the biggest cottage industries in the country is the glass bangle industry which is concentrated at Firozabad near Agra, providing employment and livelihood to some 70,000 people.

The total annual production of glass bangles in India is valued at Rs 3 to 4 crore and red bangles, which are particularly favoured, form nearly half the total production. In their making, selenium is the colourant, and it was entirely imported. At one time, owing to scarcity, the price of selenium rose from Rs 8 per pound prevalent in pre-war days to Rs 300, and the industry faced great hardship, in regard to both availability and price.

After extensive investigations in the laboratory and factory trials in the works, in which local artisans and equipment were employed, the Institute succeeded in producing most of the red bangles *without the use of selenium* and utilising indigenous material. In view of their importance to cottage industry, the Council of Scientific and Industrial Research gave the results free of charge to the entire glass bangle industry.

In addition to bangles, the Institute had also succeeded in producing selenium-free *red signal glasses,* extensively used on railways and in road and air traffic control. Their official adoption by the Indian Railways is under consideration.

Although undertaken as an industrial problem, this has led to some remarkable fundamental research on the origin of colour in red glass and the Institute's views have already been well accepted.

Chemical Porcelain—A wide variety of porcelain articles, technically known as chemical porcelain—such as crucibles, dishes, funnels and basins is used in scientific institutions and research laboratories and these used to be entirely imported. The Institute has successfully worked out processes for manufacturing from indigenous raw materials, chemical procelain, declared satisfactory by several chemical laboratories, comparable in quality with some of the best imported products. The process was assigned to an Indian firm and the products are already on the market.

Enamel-coated Resistors—A variety of enamel-coated resistors as also enamels used in electrical industries were entirely imported. Investigations were taken up at the Institute and enamel compositions and processes for enamelling resistors to meet the requirements of the specifications laid down for the purpose were worked out. The process was assigned by the National Research Development Corporation to an Indian firm who have been in production for several years.

Automobile Spark Plugs—Spark plugs used in automobiles were imported. Two firms in Bombay and Bangalore started making metallic parts and assembled plugs by importing ceramic parts with electrodes. While examining the case for protection to this industry, the Tariff Commission recommended that the ceramic component of spark plugs should also be made in the country.

Tests and performance trials conducted by the two factories indicated that the ceramic parts made at the Institute by using indigenous raw materials were satisfactory for the types of automobiles in the country.

A Material of Special Interest

Foam glass is an efficient thermal insulating material approaching cork in its performance, with the added advantage of being non-combustible, rigid and unaffected by the action of moisture and termites. It is extensively used in building, air-conditioning and cold storage industries, as well as for insulating hot and cold pipes, storage tanks, etc. The processes for its production are kept secret in the few countries where it is produced.

Cork is entirely imported. In 1955-56 imports of cork slabs were valued at about Rs 50 lakh. The Institute has successfully worked out complete processes for producing foam glass from Indian raw materials. The patent has been assigned to one firm which has erected a factory near Bombay and initial production trials are in progress.

Research on Mica

In the mining of mica, only about 15 per cent is saleable, and the rest is waste. The Institute has worked out two processes for utilising this waste—one for making *heat insulating materials* extensively used on industrial furnaces and these were being made from imported vermiculite, and the other for *wet grinding of mica.*

An entirely *new industry* has been established and two factories, one in Rajasthan and the other in Bihar, are already producing and supplying such heat insulating bricks to some of the steel plants, oil refineries, power plants, etc. One more plant is being established in Gudur, Andhra Pradesh.

The methods for wet grinding of mica which is used as a filler in rubber, wall paper industries and could replace aluminium in paints, are closely guarded secrets of some U.S. firms. The Institute has worked out complete processes for their manufacture.

Production of Special Glass and Ceramic Articles

While engaged in investigations on examining the possibility of manufacturing imported articles in the country, the Institute had worked out methods for producing several glass and ceramic articles, e.g. pyrometer sheaths, refractory tubes and plates, combustion boats, glass electrodes for pH meters, enamel stains, etc.

In order to render assistance in this regard, the Institute had been supplying these articles to a limited extent, but persistent requests for increased supplies from the industry, educational and technical institutions and research organisations induced the Council of Scientific and Industrial Research to create in 1960 a special production cell at the Institute financed by a loan from the Government of India. During the short period of its functioning, even with the small size of production, it has already paid off three return instalments together with interest.

Fundamental Research

Amongst the fields of fundamental research pursued at the Institute special mention may be made of: the origin of colour in coloured glasses, special titania glasses, thermal conductivity of low conductive materials, mineralogy of clays and introduction of polarographic technique in the analysis of silicates.

Art and Science of Design in Aluminium

By

W. W. ROBERTSON

Chief Technical Officer,
Indian Aluminium Company

THE technology of aluminium production is relatively complex. It involves a series of processes, each of which must be carefully controlled if the desired levels of product quality and operating efficiencies are to be achieved. In India today, customers who use aluminium for the manufacture of end products require quality standards comparable to what one would find in more developed countries. The attainment of technological self-sufficiency in the aluminium industry is a problem with several interesting aspects. The approach which has been followed by Indian Aluminium Company Ltd. is outlined below.

The Company was formed over a quarter of a century ago as a member of the Aluminium Limited Group (Montreal, Canada). In the early stages it was necessary to rely very strongly on the parent company for the basic process technology. All of the design work for the original plants was done outside the country ; most of the equipment had to be fabricated outside and imported. Foreign nationals selected the plant sites, supervised the erection and start-up of the plants and the early operation.

From the beginning it was the policy to place local technical personnel in positions of operating responsibility. Extensive use was made of the training facilities available in the parent companies' operation elsewhere in the world. Indian engineers were sent for on-the-job training to similar plants, mostly in Canada, to become familiar with the numerous aspects of aluminium technology. The first step toward technological self-sufficiency was concerned with building up a staff of trained technical personnel. The method was basically the "school of experience". Today with a total payroll of 4,800 there are only two non-national technical personnel.

As the Company grew, emphasis was placed on technical development work. In each plant a department was given the personnel and facilities to carry out experimental work in the laboratory as well as on plant scale equipment. Individuals were able to investigate their ideas giving them experience with research methods and increasing their field of knowledge.

When time came for the expansion of production facilities, the Company personnel were in a much better position to participate directly in the planning and execution of these projects. A specific example was when the alumina plant was expanded step-wise from 18,000 to 60,000 annual tonnes. Certain process changes were planned. In preparation for these a complex series of physical and chemical tests on local bauxite were carried out in the Company's laboratories at Muri (Bihar). These data served as the basic design information for the new process. Although the plant was designed by the technical consultants (Aluminium Laboratories) very close liaison was maintained with the Company engineers as the design progressed. Suggestions originating from them were accepted and incorporated in the final design which was unique and involved a process which increased the recovery of alumina from the indigenous bauxite.

NEW DEVICES

The contribution of the Company's engineers did not end at the design stage. The erection and installation of the new plant equipment was carried out under their supervision. More local materials were used than was previously the case. Following erection, the next major task was to put the larger capacity unit on stream. This was likewise handled entirely by local personnel. In all new plants there is a period after start-up when intensive work is required to overcome difficulties with new equipment and to determine optimum operating conditions. In this respect the contribution of the Company's engineers was particularly noteworthy. Within a relatively short time interval the start-up difficulties were overcome and design capacity attained. In each of these steps it should be emphasised that no attempt was made to accomplish these developments unilaterally. Rather, maximum use was made of the services of the principal consultants. A continual dialogue by correspondence was carried out with each side making useful contributions to a mutually agreeable plan of action.

Similarly in the smelter expansion which is now in progress in Alupuram (Kerala) the final design incorporated the ideas of both the consultants and local personnel. Part of the engineering work was done outside the country but a large portion of it was carried out locally and the erection is being completely supervised by Company engineers.

The same considerations apply to the expansion of the sheet rolling facilities. The new four high strip mill and ancillary equipment were brought into production successfully and attained satisfactory quality and quantity of output in a relatively short time. Systematic development work has led to the successful production of specialised products such as foil stock and container sheet which compare favourably in quality with that available elsewhere.

The process for the manufacture of pyrotechnic powder at Kalwa (Maharashtra) was largely developed by the plant personnel with the help of Company's technical consultants. This involved a modification in the method for manufacture of aluminium paste and design of the ancillary equipment needed for further processing. The plant was brought into production late in 1961 and is now meeting most of the pyro-technic powder demands of the fireworks industry, saving valuable foreign exchange.

Company engineers have worked closely with fabricators to familiarise them with the art and science of design in aluminium. In the transportation field, contributions have been made to facilitate indigenous design of bus bodies, road tankers, truck bodies, refrigerated fish vans and in various applications in railway rolling stock. Assistance has been given in several important applications required for the defence of the country. In all of these cases the emphasis has been to make full use of the natural advantages of aluminium metal. The association with a major international organisation has been of considerable help in expediting many of these applications. An important contribution has been to adapt procedures available outside and to evolve designs particularly suited to local conditions.

COUNTRY'S NEEDS

What of the future ? The need for a considerable expansion of the aluminium industry in the country is self-evident. It is logical for the existing producers to play a significant role in this expansion. The evolutionary process, which has been operative in the Company toward technological self-sufficiency, will continue. The experience that the Company's personnel have acquired in the design and operational aspects of the industry has given them increased confidence that they can play an even greater role in the future. It is important to stress that the motivation here is not selfish or chauvinistic. In certain areas work will be done by Company engineers because they are better qualified than others to do it. In other cases the most logical course of action will be to utilise the services of consultants either within the country or outside.

Technological self-sufficiency is not an end in itself. The interests of the nation will best be served by making efficient use of all sources of assistance potentially available. It would be unwise, in a developing country, not to take advantage of the opportunity to avoid the repetition of research work which has been done elsewhere. Rather, initial emphasis should be placed on becoming acquainted with the state of technology in a given field as rapidly as possible: subsequently efforts should be directed towards further development work specifically applicable to local conditions, needs and resources.

ACHIEVEMENTS IN OIL

Problem of Long-Distance Transportation of Waxy Crude Solved by Research

By

Dr. N. C. SEN GUPTA

Senior Fields Chemist, Oil India

DISCOVERY and development of oilfields cover a very wide spectrum of technological subjects for which specialists' services are available in and around the main oil belts of the world. Assam being far away from these oil belts and also because of India's foreign exchange difficulties, this technical know-how is not available to Oil India except in the form in which it is published in technical journals.

Foreign exchange difficulties also make it mandatory for the technicians of Oil India to find and use, wherever possible, local substitutes for standard equipment and chemicals which are essential for the development of oilfields. This article will show that in spite of these handicaps the progress of Oil India can be considered statisfactory. Not only has applied research kept pace with the operational progress of Oil India but there is at least one project, namely long-distance transmission of waxy crude through pipeline, in which the fundamental and applied research carried out by the technicians now working for Oil India can compare with any of the major discoveries in petroleum technology.

Although Oil India was inaugurated recently as a 50:50 partnership venture of the Government of India and the Burmah Oil Company, the nucleus of the Oil India staff, mostly Indian personnel who came from the Assam Oil Company, was associated with Nahorkatiya and Moran oilfields from the beginning.

Drilling

The first well of Oil India was completed as an oil producer within 469 days of its being spudded-in. Since it was the first well, a number of tests had to be carried out for oil and gas at several stages which was responsible for the very slow progress in this well. The second well was completed in 116 days of being spudded-in. At this stage, to improve the speed of drilling, a study was initiated on the relation between drilling rate on the one hand and weight on bit, speed of rotation and mud hydraulics on the other. The result of this study was a tremendous improvement in drilling rate. The fastest well drilled in this area so far took only 12 days and 4 hours to complete. Of this time, the actual on-bottom drilling time was less than three days.

Simultaneously with increasing weight on drilling bit, jetting action of bit nozzles etc., considerable progress was made in improving the quality of mud and cementing technique which it would take pages to describe. Simple mechanical devices to improve the efficiency, such as power tongs for running in isolation and oil strings, were also added from time to time. With increase in the speed of drilling, certain drilling troubles such as reaming and balling up of bits were also minimised or eliminated.

Deviation drilling, a valuable method for drilling oil from inaccessible areas, was first tried in Assam in 1962, and during the first half of 1963 three deviation wells were drilled. Since one of the fields is separated into two parts by a fairly wide river, deviation drilling is now being undertaken as a routine to tap oil from beds underneath the river.

Detection

Measurement of electrical properties *in situ* such as electrical resistivity, self-potential etc. of the formation drilled through, developed over the past two decades, has been successfully utilised in detecting oil and gas bearing sands. This information is supplemented by examination of drill cuttings which come up to the surface along with drilling mud. With the help of these it has been possible more or less to eliminate the costly and time-consuming procedures such as drill-stem testing or conventional coring.

Quantitative aspects of the subsurface electrical properties are also being pursued vigorously. It appears that for reasonably clean sands, water saturation obtained from electrical logs agrees reasonably well with the finds of the laboratory by either the restored state technique or the mercury injection method.

Colour Separation

Most of Oil India's completed wells have sufficient reservoir pressure to flow automatically. When the flow is controlled with a choke, the tubing pressure obtained in most cases is of the order of 1,200 psi. Also, the average gas/oil ratio of the field is very nearly 200 : 1 vol/vol. This gas is separated from the oil in several stages through gas/oil separators. The pressure of the first separator is controlled between 600 and 800 psi and that of the last separator is only 12 psi. This multistage separation results in :

(a) increasing the volume of crude and reducing that of gas,

(b) raising the *API* gravity of the crude, and

(c) improving the pumpability of the crude as discussed later.

Considerable theoretical work, laboratory investigations and pilot plant experiments were conducted by Oil India in order to find the optimum effect of multistage separation. It was proved that the cost involved in putting multistage units (five or six separators) would pay for itself by the increased volume of the crude in less than one year. The optimum pressures of the separators were also

fixed from theoretical considerations backed by field experiments. The overall effect was an increase of 3-4 per cent of oil by volume and an *API* gravity increase of about two units. The volume of gas was simultaneously reduced by about 20 per cent and its calorific value dropped by 100-150 Btu/1000 cft.

Even with multistage separation the gas coming out of low pressure separators contains appreciable amount of liquid hydrocarbons. Theoretical investigations to get a further recovery by compressing the low pressure gas and recycling it through high pressure separators has been done. Arrangements are in hand to carry out field experiments on this topic.

Reservoir Studies

Accurate reservoir information is being collected at Oil India's fields from the very early days. Bottom hole samples from all major pools have been analysed and elementary reservoir calculations have been done for one major pool to study the extent of water-drive and to predict the future performance of the pool. Similar work on other major pools will be undertaken soon.

Various schemes for secondary recovery and pressure maintenance are under preliminary discussion. A decision on these will be taken in a couple of years.

Crude Oil Transport

It was decided by the Government of India that of the crude produced at Oil India's fields about two million tons will be processed in the Barauni refinery and 3 to 4 million tons in the Gauhati refinery. The crude oil produced, however, contains a high percentage of paraffin wax and shows a pour point of 85-90°F. Presence of the wax in crude makes it very difficult to pump through a pipeline especially during winter months when the temperature goes well below 85°F even in a buried pipeline. At the Assam Oil Company's field which also produces waxy crude but where the refinery is situated within ten miles from the field, pumping of the crude to the refinery during winter months is done by heating the crude as well as the entire length of the pipe by steam. However, as the main consumers of the Oil India crude, namely the two public sector refineries, are situated far away from the oilfields, heating of the entire line for crude transport is not a practical proposition.

As a result of research carried out over a period of five to six years as well as in U.K. this problem of transporting the crude during winter months through long distance pipelines has been solved in a novel way. The process has been patented and the plant is called 'Crude Conditioning Plant'.

Physically the crude is first heated in the plant to about 200°F, i.e. at a temperature comparable to or somewhat higher than the bottom hole temperatures at some of the wells. This is followed by rapid cooling of the crude roughly at the rate of 1°F per minute to the minimum underground temperature corresponding to the depth of burial of the pipeline, namely 65° F.

Microscopically, in the process of conditioning, the first stage dissolves all wax nucleus into the crude at 200° F. The subsequent rapid cooling produces supersaturation of wax in the liquid resulting in the formation of wax crystals very much smaller in size compared to that obtained in the ordinary crude. This has been demonstrated by taking electron-microscopic photographs of conditioned and unconditioned crudes.

TECHNICAL DEVELOPMENT *from Page 26*

encies which need to be filled.

The knowledge acquired from these studies is made use of by the officers in giving general guidance to entrepreneurs seeking productive investment opportunities towards filling the gaps in industrial fields. These studies are either undertaken by the officers of this organisation on their own, or, in more complex fields, through the media of specialists and committees with which they are associated.

The Directorate-General of Technical Development also assists the Government by furnishing from time to time technical and other data prior to the establishment of various public sector projects regarding the scope and extent of production facilities to be covered by them. In certain cases this office is also called upon to assist in carrying on negotiations with foreign collaborators in preliminary stages. Examples of such projects in which this office undertook these preliminary responsibilities in the past are the ones related to the manufacture of coal mining equipment at Durgapur, the heavy machine building plant at Ranchi, the foundry forge plant at Ranchi and the Hindustan Machine Tools factory.

Some of the other important functions which the Directorate-General is called upon to perform are :

(i) Issue of licences for import of machine tools.

(ii) Guiding the work of the Development Councils formulated under the Industries (D & R) Act and performing the secretariat work of various Development Councils.

(iii) Issuing certificate of exemption from payment of customs duty on scientific instruments and appliances.

(iv) Work connected with the manufacture of defence stores in civilian sectors.

(v) Investigation and development of indigenous sources of supply of stores so far imported either wholly or partially from abroad.

(vi) Making recommendations regarding : (a) formulation of import and export policies ; (b) tariff protection ; (c) regulation of import and export duties and quotas.

Thus the Directorate-General of Technical Development has an important role in the industrial development of the country. Through the efforts of this organisation the complex of industrial structure is steadily growing and technical know-how is being developed in lines where it still lacks, while in many fields a stage of self-sufficiency in technology and technical know-how has almost been reached. The programmes in the Third and coming Plans would further add to the technological maturity of Indian industry.

Advance In Chemicals

Major ICI Projects Completed by Indians

CONTRIBUTED

AGRICULTURE dominated India's economy until about the beginning of the Second Plan when the Government acknowledged the need for an accelerated pace of industrial development to achieve the desired growth pattern. The period 1956-61 therefore marked the beginning of the industrial era in India.

Imperial Chemical Industries (India)'s interest at the time lay largely in the business of selling chemicals and its manufacturing activities consisted of a dyes and textile auxiliary unit at Sewri, Bombay, and the associated company, Alkali and Chemical Corporation of India's plant at Rishra, near Calcutta. In tune with the objectives of the Plan, I.C.I. (India) launched an expansion programme and capital investment in the associated companies increased by Rs. 8.2 crore. A further Rs. 13.1 crore have since been added in the Third Plan. Indian Explosives Ltd., Gomia, established with a 20 per cent Government of India participation, commenced production in 1958. A plant to make 3,500 tons per annum of polythene was set up at Rishra in 1959, and extended to 10,700 tons in 1964. Another plant to produce accelerators, anti-oxidents and retarders for the Rubber Industry started production in 1963. Atic Industries Ltd., Bulsar, was set up, in equal partnership with a West Coast business house, to make vat dyestuffs. The latest venture, Chemicals and Fibres of India Ltd., Bombay, has its first project, a polyester fibre plant, nearing completion in the trans-Thana industrial area outside Bombay.

These developments have been initiated and engineered by I.C.I. (India) in collaboration with the appropriate Divisions of I.C.I., U.K., who have provided know-how, basic design information and start-up assistance. Nevertheless, this progress would not have been possible without a major design and engineering effort by the company in India. Designs have had to be adapted to local conditions. Shortage of foreign exchange has constantly accentuated the need to increase the content of local design and procurement. Technical personnel have had to be trained in design, construction, start-up and management of highly specialised plants. Thus it has been and remains necessary to build up technical manpower resources for future expansion.

SPECIAL DEPARTMENT

A Technical Development Department, for carrying out appraisals, basic design and project co-ordination, and a Central Engineering Department to undertake engineering design, procurement and construction came into being in 1957. A Work Study unit was also established the same year. A combination of these has enabled the company to apply the most up-to-date techniques in project work.

In the initial stages, services of adequate number of trained and experienced specialists were obtained on loan from associated I.C.I. companies in the U.K. and Australia. As a result, well defined procedures have been established for economic handling of projects. Studies of market potential are carried out by end-user survey and verified by mathematical techniques. Optimum size of plant is chosen on commercial, technical and engineering considerations and its profitability determined on a discounted cash flow basis. The basic design of the plant even where it is an adaptation of units already in operation in U.K., is subjected to critical examination by a team of experts. Consideration is being given to the use, in design, of computers as practised by the associates in U.K. Scale models are built up and form the basis of construction and piping. The models are retained and brought up to date as plant extensions or modifications are carried out. Construction planning is carefully carried out using the "critical path scheduling" techniques.

At all stages of the project—design, construction and start-up—Work Study practitioners are associated and method study applied. Method study and work measurement are continued after the plants go into production and work reward or incentive schemes introduced wherever possible. All jobs are fully appraised on the basis of job content, environmental conditions and job responsibility. Process and plant development continues over the life of the plant aimed at maximising efficiency and minimising manufacturing costs.

The polyester fibre plant now nearing completion at Thana is an example of the fruits of this organised effort. Method study and critical examination in the design stages have resulted in economies not only in plant and equipment but also in the utilisation of land. The erection has been carried out at a rapid pace. With access to site obtained in the thick of monsoon, in August 1963, the plant will be completed and ready for production before the end of the year, exactly 16 months after the first soil was turned. Before the first piece of equipment was placed on the ground, the company decided to seek Government approval for a multifold expansion and product diversification.

Proper planning and application of modern techniques is also of considerable value to the large number of contractors executing these projects. Information has been made freely available to them and their co-operation obtained in successfully completing the projects according to design. The contractors will, no doubt, in turn, carry the knowledge with them and apply it wherever they go.

The organisation developed in India has made significant contribution in reduction of foreign

exchange requirements both for design and plant. These requirements vary with the type of plant and process. In case of new processes, being introduced in the country for the first time, and complex plants, the imported design and equipment may amount up to 50 per cent. Efforts by the company have resulted in savings in the foreign exchange component in all cases. In the rubber chemicals plant at Rishra, 88 per cent of the design was done in India and only 21 per cent of the equipment imported. In the extensions to the paints plant at Rishra, which include a new synthetic resin plant, the design, purchase and erection of equipment have been carried out entirely in India.

During all these years the company has followed a deliberate policy of exchange of technical personnel with its associates in the U.K., Australia and Canada. Specialists are brought in for short and medium-term assignments. The latest addition in this respect has been in craft training for which instructors have been obtained on loan from the U.K. The CAFI craft training instructor is in Bombay in advance of the start-up of the polyester fibre plant. Indian staff are sent regularly to U.K., Australia and Canada to obtain training and maintain contact with personnel in corresponding jobs in those countries. The training is imparted not only in technical and engineering aspects but also in research, technical service and commercial fields. A regular interchange of information keeps I.C.I. (India) and its staff in touch with current developments throughout the world.

The progress made in the last decade is a measure of the company's confidence in the industrial future of India and the capabilities of its Indian personnel. Industrial development in a controlled economy is necessarily dominated by Government licensing policies. The company has a number of applications pending with the Government for extensions and new products and the investment will increase multifold. It hopes to maintain the pride of place in the achievement of a self-reliant and self-generating economy and technological self-sufficiency.

Neyveli Fabricates Vital Equipment

WORKSHOP SAVES MONEY AND TIME

VAST reserves of lignite are available in Neyveli. Only a part of these are being exploited and the balance is waiting to be exploited for the benefit of the Southern region. This task, however, has its own problems because, for every tonne of lignite to be exposed, 8.56 tons of overburden has to be removed and disposed of.

Work on the project was inaugurated in May 1957. The first phase consisted of removing the overburden with the aid of conventional equipment and specialised mining equipment.

A second line of disposal system for removing the overburden was found necessary to obtain the required production to meet the demand of lignite. Two conveyors, one a stationary conveyor of a capacity of 2,850 tons of overburden per hour, 8.5 metres in lift and a length of 60 metres, and a second shiftable conveyor of the same capacity but with a length of 510 metres were rigged up by the Corporation for the purpose.

By

R.R. PILLAI

Deputy General Manager, Neyveli Lignite Project

Lignite production was entirely dependent on the possibility of fabricating these conveyors at minimum cost.

First Conveyor : The first conveyor was assembled completely out of surplus materials available at site at a total cost (labour only) of Rs. 2,000. The parts used were (1) one half of a tripper assembly, (2) spare lagged pulley 1,270 mm. dia × 1,500 mm., (3) take-up section of a 1,200′ mm. surplus conveyor (4) eight surplus standard sections, (5) two spare gear drives 78 KW 1 : 18 : 667 reduction with fluid coupling and brakes, (6) 130 metres 1,200 mm. 36 oz. cotton duck of 6 ply belting from spare stock. and (7) spare drive head control kiosk.

While matching these widely different parts into a workable conveyor a number of problems had to be solved, the most important being the drive belt tension and run back protections.

Drive Belt Tension : To restrict the tension rating within limits, without reducing the capacity of the conveyor the speed was increased from 4 m/sec. to 5 m/sec. by increasing the drive pulley diameter from 1,000 mm. to 1,270 mm., and the gear reduction ratio from 1 : 22 to 1 : 18 : 667.

Single pulley drive was chosen for simplicity and also owing to the restricted space available with an arc of contact of 180°. To ensure that the belt did not slip on the pulley it was lagged with rubber with double herring bone grooves on it thus increasing the coefficient of friction to 0.39 and reducing the slack side tension. With the above, the maximum tension in belt was brought down to 8,000 lbs. from 10,600 lbs.

Run-back Protection: Since incline conveyors have a tendency to run back when stopped with load, provision for incorporating a positive pawl and ratchet type of run-back protection was made in the drive pulley itself which was not made use of, as the three brakes provided were capable of developing 2,800 cm kg. braking torque were found adequate to overcome any tendency to run-back. An additional brake was also provided at the tail-end pulley as an added protection.

As cotton belt has a tendency to elongate during operation, loop take-

up was provided in two sections. The live storage take-up pulley was directly connected to the gravity type counterweight in the take-up tower.

Second Conveyor : The second conveyor required was fabricated in the Central Workshops at a total cost of just over Rs. 18,000. Though there were no special features in this conveyor the fabrication done in our workshops was so sound and sturdy that it has operated smoothly and has withstood a number of shiftings.

CENTRAL WORKSHOPS

Fabrication for Thermal Expansion Scheme : The shortage of electricity in South India created the necessity to put up a 250 MW thermal power station at Neyveli using lignite as fuel. Further expansion of the thermal power station was found necessary and arrangements were made for the procurement of equipment and fabricating the structurals for the building to house the th rmal plant.

The U.S.S.R. was prepared to supply only the steel sections for the structurals and the fabrication was arranged for the first time in the workshops attached to the Corporation.

The total tonnage of the structurals was about 1,000. The structures consist of columns, roof trusses and gantry girders for taking the 120-ton overhead crane. The fabrication of columns and girders consisted of built-up sections. The submerged arc welding machine was used for the built-up section of the columns and girders. The design of the structurals was such that no *riveting* was involved in the fabrication work.

All joints were arc-welded. To prevent distortion in the welded structurals, special type of jigs and fixures had to be made. The welding was done only after the various sections required for the structures were assembled carefully in the jig. Mostly electrodes supplied by the U.S.S.R.were used for welding. The Lincoln automatic submerged arc welding machine was used and w res and fluxes for wel ling were also supplied by the U.S.S.R.

The entire fabrication was completed within six months. The total labour involved in monetary terms came to Rs. 112,320.

Manufacture of Air and Gas Ducts for Fertiliser Factory: Boilers for the process steam plant had to be erected in the fertiliser factory, and the air and gas ducts were manufactured in our workshops as most of the firms in India were quoting high prices.

The total weight of the air and gas ducts for the two boilers in the fertiliser factory was 200 tonnes. This involved mainly sheet metal works and for this purpose the Central Workshops had facilities. The thickness of plates used varies from 4 to 5 mm. and they were welded by edge and fillet type of welding using 8 and 10 GMS electrodes. The press brake and guillotine shear installed in the workshops were fully utilised. This work was completed in about four months which helped the fertiliser factory to complete the boiler erection in time. The total labour cost per ton was only Rs. 160.

Reconditioning of Giant Excavator Bucket Teeth : Another important work the workshop is doing is the building up of the teeth for the bucket wheel excavator. There are four bucket wheel excavators out of which two are of 250 litre bucket capacity and the other two are of 700 litre capacity. These bucket wheel excavators are fitted with nearly 90 teeth. The teeth are fitted with tungsten carbide inserts. Originally the teeth were being imported from West Germany and, since the cost was high, we were forced to recondition the worn-out teeth locally at the Central Workshops with available resources.

The worn-out teeth are built up, and grooves for the T.C. inserts are cut in the milling and shaping machines. The area near and around the T.C. insert seating of the teeth is hard-faced, with highly wear-resistant hard-facing 'Verdur' electrodes. The T.C. inserts are placed in the grooves and braced in an oil-fired muffle furnace at a maximum temperature of about 1,200° to 1,250°C.

Experience has shown that the teeth reconditioned locally in the workshops of Neyveli Lignite Corporation are working up to 200 to 250 hours—almost the life of the new teeth imported from West Germany even in the excavation of hard strata in the Neyveli mine.

Heavy Electricals

(*From Page 10*)

ambient temperature, etc. precedes the actual design work. This is in progress.

The Hyderabad unit will be ready to make a modest beginning by the middle of next year. Preparatory action for starting production is in hand.

The Hardwar unit, which will come up in phases, is also likely to be partially ready by the end of next year to start production of industrial motors. Other phases will follow.

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To help future growth without much assistance from outside agencies, Heavy Electricals have built up a nucleus for industrial project and design work. The project report for a foundry forge plant has just been prepared and a number of other studies are in hand. A Structural Design Organisation, which has been developed, has made a substantial contribution in the design work of Hyderabad and Tiruchi plants. All the architectural design work of buildings has been implemented through their own engineers.

The building up of technical personnel for such an extensive venture has its own problems. Technical schools, for the training of technicians, are already functioning at each of these centres; and a large number of engineers are under training at the consultants' workshops in foreign countries.

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In the development of this industry, a substantial coverage to all our future requirements has been attempted. Once the entire set-up is geared to its tasks, it will be an industry of immense potential value. It will not only ensure self-sufficiency of electric power, upon which industrial growth depends, but will also have developed a range of technical and technological ability which could be turned to good purpose in any other line of manufacture, particularly the more sophisticated equipment. A dynamic industry of such magnitude and skill, accompanied by scientific and technological research, will be a star in the constellation of industries.

WORK OF ROORKEE INSTITUTE

NEW IDEAS AND MATERIALS FOR CONSTRUCTION

P.L.DE *Head of the Information and Survey Division, Central Building Research Institute, Roorkee*

THOUGH research in the field of physical sciences and to some extent agricultural and medical sciences started in India early in this century, no attention had been given until recently to research in the field of engineering. Research on the application of modern advances in building technology began barely a decade ago with the establishment of the Central Building Research Institute at Roorkee in 1950.

Planning and development of building research has since been included in the successive Five Year Plans. The Institute has made some significant contributions in utilising science towards achieving efficiency and economy in materials and building techniques and in providing better comfort and amenities to the occupiers. A few such innovations are described in this article.

BUILDING MATERIALS

Bricks and Tiles: Bricks and clay tiles are among the oldest building materials known to man and they will continue to be the principal building materials in India. However, the brick and tile industry in India continues to run on more or less primitive lines and there has been little impact on it of modern scientific development. Very recently, CBRI has suggested a number of innovations, based on laboratory research and field trials, which could be profitably utilised in improving the quality of bricks and tiles.

Certain types of heavy and sticky clays, for example the black cotton soil of Central India, produce bricks of very poor quality by the conventional methods. By utilising an improved process which mainly consists of blending the clay with 20 to 30 per cent powdered 'grog' (clay burnt at 500° -600° C) it has been possible to produce bricks of better quality. The process is now being adopted by the brick industries at Indore. Instead of clamp kilns, Bull's trench kiln has been successfully introduced and slag coal is being used as fuel. In order to avoid lime bursting half per cent sodium chloride is being added to the soil. The strength of the bricks produced by this process shows an improvement of more than 100 per cent. Water absorption is also reduced from about 25 to 18 per cent.

Some of the other processes developed at the Institute which have attracted the attention of the brick industry are production of acid resistant bricks, engineering bricks and coloured bricks from the alluvial soil of the Indo-Gangetic plain.

Cracking and warping of green tiles during drying is one of the major problems facing the tile industry in India. A process developed at the Institute, which consists of mixing the raw clay with a small amount of ammonium chloride, has been found to be effective in reducing the loss due to warping and cracking. Addition of only 0.6 to 0.7 per cent of this salt with the clay in some tile factories at Madras has shown promising results. If this improved process is adopted, the production of export quality tiles can be increased by about 20 per cent.

Industrial Wastes as New Building Materials: The rapid industrialisation of the country has caused the production of huge quantities of wastes, the disposal of which is a serious problem facing many industries. As a result of laboratory and field investigations the Institute has developed processes for the utilisation of some of these wastes as useful building materials.

Fly ash is one of such wastes produced in huge quantities from thermal power stations as a finely powdered residue resulting from the combustion of pulverised coal in boilers.

By replacing 20-25 per cent of cement, it can be safely used for the manufacture of pozzolanic cement either at the cement works or at the construction sites, where it can be added to the cement at the time of mixing. Various construction projects under P.W.D. and other organisations are now using fly ash cement particularly for mass concrete works. Another promising use of fly ash is the production of sintered light weight aggregate for concrete.

Blast furnace slag is another waste produced from steel plants, which when suitably treated, can be used as an admixture with cement or as light-weight aggregate. Molten slag, when chilled suddenly, produces granulated slag which is suitable for the manufacture of slag cement. The Institute's work on the use of Indian granulated slag in the manufacture of cement showed that it can be produced by separate or combined grinding of 65 parts of the portland cement clinker with 35 parts of the slag. Slag cement is now being produced from Tatas' slag, and factories for the production of such cement using slag from Bhilai and Durgapur steel plants are shortly going to be established.

Lime sludge produced as a waste from sugar factories employing the carbonation process can be utilised for the manufacture of building lime by a process developed at the Institute.

Other possible avenues of utilisation of wastes as building materials are the production of light-weight aggregate from silt deposited at water-works, building boards from coconut husk, heat insulating and sound absorbing slabs from mineral wool, expansion joint fillers from coconut pith and cashewnut shell liquid.

TECHNIQUES

Foundation: Expansive soils, such as black cotton soils, confront engineers with difficult foundation problems. Such soils swell and shrink alternately with seasonal variation of moisture and this in turn gives rise to vertical and lateral movements of the ground causing cracks in buildings. As a result of large-scale laboratory and field trials a method of design, generally called "under-reamed pile and beam foundation", has been developed and successfully adopted in a number of buildings on black cotton soil thereby completely eliminating the chances of cracking. In most places this form of foundation has been found to be about 25 per cent cheaper than the normal foundation taken down to about 2 metres.

Adoption of deep-pile foundation for multistorey buildings, bridges and other heavy structures is being increasingly resorted to. No rational method for the determination of the safe bearing capacity of piles is yet available. Results of a number of load and penetration tests carried out in India and data on similar tests carried out elsewhere has made it possible to develop a method for easy determination of the bearing capacity of piles which is now being adopted in many construction projects.

Walls: A new technique, known as "cavity wall" construction, has been successfully tried in several buildings built by the Institute. An eight-inch cavity wall consisting of two leaves of three-inch thickness with two-inch cavity in between and having galvanised iron wire ties at suitable intervals has been found to be strong and stable for single and double-storey houses. Besides having better thermal and sound insulation and resistance to water penetration, the cavity walls save about 30 per cent of brick and mortar consumption as compared to nine-inch solid walls. The cost of constructing these walls in 1:3 cement-sand mortar is about 10 per cent less than that of nine-inch solid brick wall in 1:6 mortar.

The conventional design of lintels for supporting the wall over door and window openings is uneconomical. An improved design of three-inch RCC lintel reinforced with three bars of 3/8 inch diameter has been found to be adequate. It is also economical to the extent of about 50 per cent as compared to conventional lintels.

Reinforced cement concrete frames for doors and windows have been used with success in place of costly timber. The problem of fixing wooden shutters has been solved by designing suitable aluminium pipe and helically wound wire fixtures.

Roof: The cost of the roof represents 25 to 30 per cent of the total cost of a building and unless it is reduced the ever-increasing demand for cheap houses cannot be met. A number of simple and economic techniques for roofing low-cost houses have been successfully tried. These include precast doubly carved tiles, cellular concrete units, precast doubly carved shell units. The comparative saving in cement and steel as compared to conventional four-inch thick RCC slab roof is shown in the table.

*Comparative economics of different types of Roofs**

Type of roof	*Cement lbs/sft*	*Steel lbs/sft*	*% Saving in Cement*	*% Saving steel*
4″ thick RCC slab	7.6	2.2	—	—
Precast doubly curved tiles (2′ 3″ × 2′ 3″)	5.8	1.2	24	46
Precast cellular concrete units (4′ × 2″)	4.4	0.47	42	74
Precast doubly curved shell units (4′ × 4″)	4.2	1.32	45	40

Besides the saving in scarce meterial and overall cost, these construction techniques also have the advantage of being precast and are conducive to speed.

The use of precast prestressed trusses in long-span roofs has proved to be economical. In these reinforced concrete trusses, the members are cast monolithically and only the tie carrying tension is post-tensioned by a single straight cable. A truss of 45 feet-span effects a saving in cost of about 26 per cent compared to a steel truss.

Shell roofs satisfy a wide range of functional and operational needs of factory buildings and are economical in the consumption of steel and cement. Research at the CBRI and the experimental structures built up in collaboration with CPWD, the Railways, port trusts, municipal corporations and other organisations have promoted the wider use of such roofs. Folded plates which are akin to shells in their structural action are also nearly as economical as cylindrical shells for roofing large spans. The roof of the Indo-Swiss Training Centre at Chandigarh was recently constructed with folded plates designed at CBRI.

While searching for new and economical techniques of construction the functional efficiency of building as affecting the users' comfort has not been ignored. New techniques for better thermal and acoustic insulation and illumination inside residential and industrial buildings have been tried with success. These have been propagated through the publication of research papers and popular digests and notes and by contact with the industry and construction agencies.

Wider adoption of these techniques in the building industry will go a long way in reducing the shortage of building materials and in increasing the productivity and efficiency of buildings.

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THE ATOM IN INDIA

From Page 17

of ionising radiations are being investigated. Work is also being done in the fields of induction of mutations in plants of economic importance such as rice and groundnut. Some of the mutations induced at the experimental field station at Trombay have resulted in new strains of rice with such favourable features as higher yields, finer grains, early flowering and whiter kernels. Experiments are also carried out for developing radiation methods for preservation of food. It has been found that treatment of fruits like mango, apple, banana, guava and sapota with low doses of gamma radiation appreciably extends their storage life at room temperatures. The technological aspects of radiation sterilisation and pasteurisation of canned mango slices and orange juice have been explored to some extent. Attention is also being given to the use of ioni ing radiations for the disinfestation of grain.

A Radiation Medicine Centre was set up in Bombay last year to promote the use of radioisotopes in the diagnosis and treatment of diseases. Good progress has already been made in investigations related to thyroid disorders including thyroid cancer, study of the problem of sporadic goitres and the establishment of methods for radioisotopic applications.

Labelled vitamins and fats have also been used to study tropical malaborption syndrome, and the knowledge thus gained has made a rational treatment of these diseases possible.

ATOMIC POWER

ONE of the objectives of India's atomic energy programme is the generation of electrical power upon which the industrialisation of the country depends. Nuclear power stations are being set up in Maharashtra, Rajasthan and Madras States which will be generating a total of 1.2 million kilowatts of electricity by the end of the Fourth Plan. It is now agreed that electricity from these stations will be slightly cheaper than electricity from thermal stations in these areas where coal would have to be brought by rail over long distances. The installation of an additional 1.8 million kilowatts of nuclear power during the Fifth Plan is now under consideration.

However, it would not have been possible to undertake a nuclear power programme of this order without first having developed the technology and trained personnel in nuclear sciences at Trombay.

Most of the industries in India since Independence have been set up, by and large, in collaboration with foreign technical know-how. It is, therefore, a matter of some pride that Indian scientists and engineers have set up at Trombay not only intricate atomic reactors, but also complex industrial-scale production plants without foreign assistance. While the country has been spending enormous sums of money for obtaining foreign know-how, exotic metals like uranium and thorium employing sophisticated processes are produced by Indian scientists and engineers to a standard of purity where the total impurities are measured in less than a few parts per million. Indeed it is true that while India is still generally a developing nation, in this newest and the most modern field of scientific endeavour she has already attained the status of a developed country.

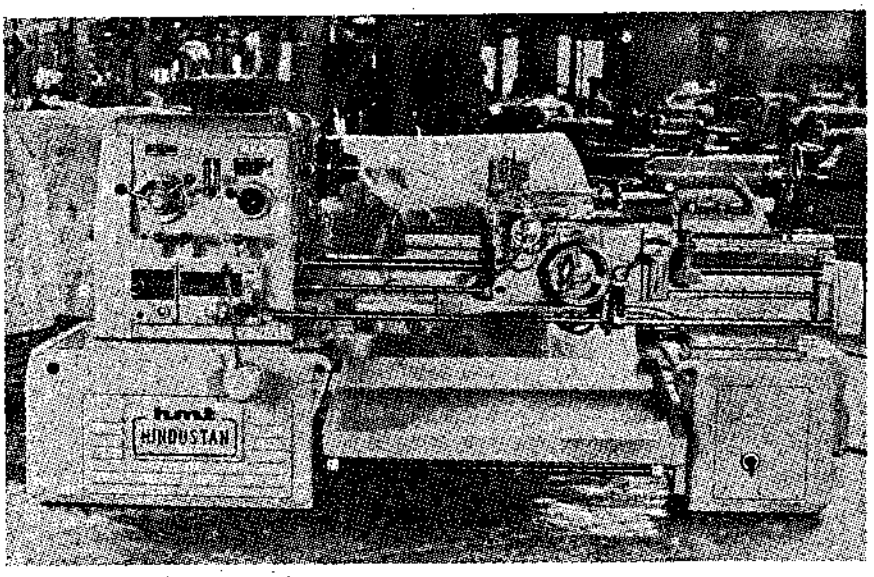


This flying glass is one of the accidental discoveries of our Institute.

HMT—Lesson in Self-Reliance

PLANT THAT PRODUCES MACHINES, DESIGNS, DESIGNERS

From One Factory to Five within 10 Years



Among machines wholly designed and made by HMT are a series of centre lathes like the one above

By

S. M. PATIL

Managing Director, Hindustan Machine Tools

THE progress of the Indian machine tool industry has been synonymous with the rapid expansion of the Hindustan Machine Tools Ltd.

The Indian machine tool industry, which grew up and became stable during the Second World War, suffered a near debacle afterwards. In 1950 indigenous production dropped to a mere Rs. 29 lakh against the wartime peak output of Rs. 112 lakh. On the other hand, imports of machine tools kept increasing, and in 1949 the imports amounted to about Rs. 420 lakh.

With independent India embarking upon a series of Five-Year Plans, it was soon realised that the prerequisite of all industrial development was a well-organised machine tool industry to produce the necessary capital equipment. It was against this background that in March 1949 the Government of India entered into technical collaboration agreement with Messrs. Oerlikon Machine Tool Works, Buehrle & Co., Switzerland, for setting up a machine tool factory in the country. The Hindustan Machine Tools Limited came into being in Bangalore. HMT's first factory was inaugurated in October 1955.

Production and Growth

In the background of initial reverses and teething troubles, the management of HMT decided to introduce multiple shift work in 1956 and for this purpose recruited and trained sufficient manpower. In order to achieve adequate autonomy in the day-to-day working of the factory, the financial partenrship of the Swiss company was terminated in the same year since such an arrangement had run into numerous working difficulties.

The Government of India took over the complete management of the factory and bought over from Oerlikons their share capital in the company. Owing to these and other far-sighted measures takenby the management, HMT soon turned the corner and through increased efficiency and output earned substantial profits in 1960-61, which not only enabled the company to declare a maiden dividend of 10 per cent during that year, but to plough back the surpluses to establish the second factory in Bangalore which was inaugurated on July 28, 1961. Described by the late Prime Minister as a 'gift to the nation', this factory was planned, built and commissioned *without any foreign technical assistance and with no financial aid from the Government of India.*

Quantitatively, HMT's production has been increasing year after year. In 1956-57, the Bangalore factory, HMT-I, produced 135 machines valued at Rs. 50 lakh only. Production during 1957-58 was stepped up to 402 machines valued at Rs. 155 lakh. The output increased to 552 machines valued at Rs. 200 lakh during 1958-59. In 1959-60 the output figure rose to 702 machines of value roughly Rs. 225 lakh. When the first factory in Bangalore reached its full capacity during 1960-61, its production reached a figure of 1,002 machines worth about Rs. 350 lakh.

During 1961-62, when the second factory started production, the output of the two factories reached 1,250 machines worth Rs. 445 lakh. When substantial production from the second factory had been achieved during 1962-63, the total output of both the units reached 1,615 machines valued roughly at Rs. 670 lakh. During the financial year 1963-64, both the HMT factories in Bangalore reached their full capacity and produced 2,000 machines valued roughly at Rs. 925 lakh.

Encouraged by the outstanding techno-economic progress achieved by the Company, HMT in 1961 offered to the Government to build three more machine tool factories during the Third Five-Year Plan, out of which one more unit could be financed by the company from its own resources. The Government accepted the proposal and the third HMT factory in the Punjab was set up in 1962-63 at Pinjore near Chandigarh on a site measuring 900 acres given by the Punjab Government. This factory was inaugurated in October 1963. The unit will achieve its rated capacity in 1965-66.

The fourth machine tool factory together with a self-contained township like the others in Bangalore and Pinjore has come up at Kalamassery near Ernakulam in Kerala. The land required for the factory and colony measuring 850 acres has been acquired by the State Government and gifted to the company. The total capital cost of Rs. 7.5 crore required for setting up this unit is *provided entirely from the internal resources of* HMT and no part of the capital cost will be borne by the Government. The factory was commissioned on October 2 this year.

Construction work on the fifth HMT factory in Hyderabad at a capital cost of Rs. 7.75 crore started in May 1964 on a site measuring 850 acres similarly given as gift by the Andhra Pradesh Government. The factory, like its predecessors, has been planned and is being built entirely by Indian personnel without any foreign technical collaboration and is scheduled to go into production towards the end of 1965.

When all the five HMT factories have gone into production, the total output is estimated to reach Rs. 25 crore per annum during 1967 having, by then, about 15,000 employees in all on the company's rolls.

Diversification of Products

Production in the Bangalore factory, which began in 1956 with the Oerlikons high speed high precision centre lathe, has been continuously diversified and stepped up to meet the varied needs of the customers. In 1957-58, the production lines were expanded to include the manufacture of milling machines and in 1958-59 a wide range of radial drills was added. General purpose lathes were introduced during 1959-60 and a new range of cylindrical and universal grinding machines were put through manufacture during the year 1960-61. A new concept in the manufacturing technology which had been in vogue in all the highly developed countries in the world through the use of special purpose and transfer line machines for mass production, mainly in the automobile industry, also influenced the machine tool market in our country. HMT had the pioneering privilege of entering into this rather sophisticated field and through the collaboration of a famous French firm commenced the manufacture of these high production machines in their second factory in Bangalore in 1962-63.

To meet the steeply rising demand for varieties of machine tools and metal working machinery in the country and to fill the capacity of the various HMT's new factories, the company thought it appropriate to diversify further its products. Accordingly, in 1963, HMT entered into licence agreement with a British firm for the manufacture of the gear shaping machines. It is planned to make these machines initially in Bangalore and shift them ultimately to HMT's fifth unit in Hyderabad.

Also in 1963, the company entered into design collaboration with a West German firm for the manufacture of all-electric heavy duty programme controlled milling machines. These machines are planned to be manufactured in HMT's third factory at Pinjore. Simultaneously, heavy duty surface grinders of East German design are to be made in the Bangalore factories. Negotiations for the licence manufacture of single spindle automatics, mainly required in the armament and ordnance factories, have been recently concluded with a French firm.

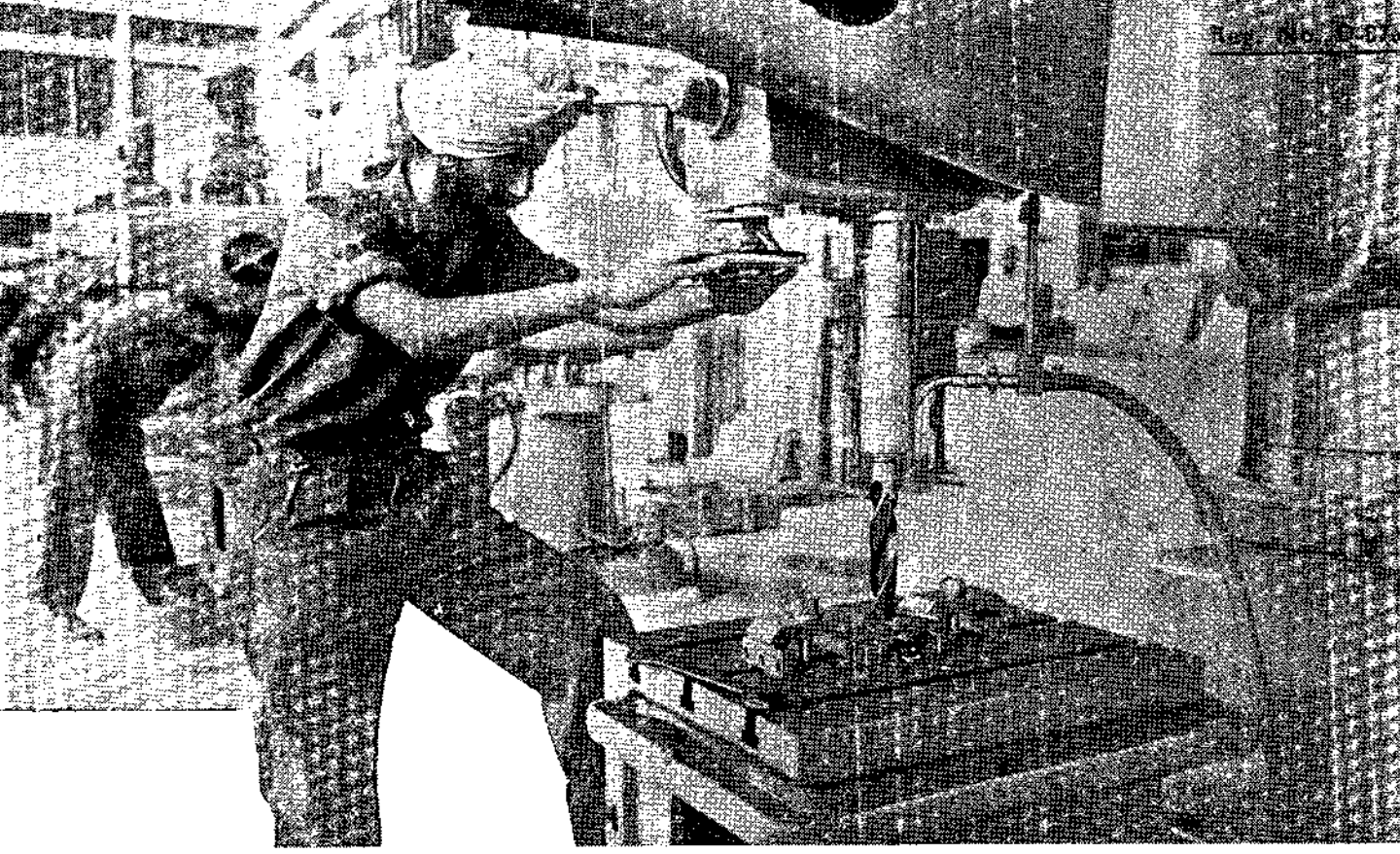
Although the rapid progress achieved by HMT has been greatly due to the far-sighted policy of buying up modern designs of machine tools from abroad under the scope of limited licence agreements with the foreign collaborating firms, the company realised from the very beginning that such a measure cannot be a permanent solution. No doubt it takes considerable time, resources and determined effort to evolve one's own designs, particularly in the matter of modern sophisticated machine tools, but attempts have to be made to develop indigenous designs as an ultimate solution.

HMT's Own Designs

If the Indian machine tool industry has to meet satisfactorily the growing demands for highly diversified and latest designs of machine tools from the machine-tool makers, it will have to concentrate on the creation of design talents in the country so as to meet this serious lacuna. National programmes of machine tool research are now being sponsored by the machine tool industries of all the Common Market countries of Europe. In U.S.S.R., Czechoslovakia, the German Democratic Republic and other East European countries, research in the machine tool field, as in others, is concentrated in the Government-operated agencies, whereas the West European and American programmes of research rely largely on contributions from the private industry.

In India the effort will have to be co-operative, with the Indian Machine Tool Manufacturers' Association following the lead given by the Government of India in establishing the Central Machine Tool Institute in Bangalore with technical assistance provided by the Government of Czechoslovakia. Although such nation-wide research in machine tool designs has to be taken up through Government aid and co-operative efforts, all this would be meaningless if the machine tool manufacturers individually have no programme of their own to evolve specific designs in their respective factories, and rely for only general guidance, standardisation and basic technology on research organisations of the above type.

With this conception, it has been HMT's continuous endeavour to develop a full-fledged Design and Development Department, which is now capable of producing its own designs. Latest models of heavy duty turret lathes and a family of centre lathes now on market are HMT's maiden designs. Besides, more than five different types of machine tools are either under design or in prototype manufacture which will soon be introduced in the market. The designing of special purpose machines, which calls for custom-built machines to meet indivi-



A worker at the Pinjore factory, HMT's third, which went into production in October 1963

WISE USE OF FUNDS AND SKILLS

dual customer's requirements, calls for tremendous efforts on the part of HMT since each machine is more or less a composite design by itself.

Specialisation

Although this diversification of HMT's programme of production has resulted in certain decided advantages in the initial stages, the fact of its being carried too far has already posed some serious technical problems inherent in any highly changing production programme. It is, therefore, intended to decentralise the various production lines and permit each factory to specialise and diversify in one or two main categories of machines to achieve greater operational efficiency and lowering of costs.

Future Plans

The demand for machine tools has been rapidly rising. The demand figures for the Fifth Plan have been worked out tentatively, and according to these estimates, machine tool requirements by 1970-71 are placed at Rs. 100 crore per annum. To meet at least 50 per cent of this steeply rising domestic demand and be able to export some portion of its production, HMT has again offered to the Government to establish five more factories during the Fifth Plan period at the rate of one factory a year and to find the capital expenditure for all these additional units from its own internal resources. The Government has provisionally approved this offer and the pre-planning work on the sixth unit has just been entrusted to the HMT's Project Department.

Watch Factory

From machine tools to wrist watches ? Yes. In view of the large concentration of skilled manpower in HMT, the Government entrusted the company with the pioneering task of establishing the first watch factory in the country and transferred to the company the licence agreement which they had entered with Messrs. Citizen Watch Co. of Japan for this purpose.

Construction of the watch factory on the site adjoining the machine tool factories in Jalahalli near Bangalore began during 1961 and was completed in October 1962. After erection of the plant and machinery, manufacture of watches with 54 per cent indigenous content commenced during April 1963. In 1963-64, over a lakh and twenty thousand watches in three varieties—stainless steel 'Janata' watches, gold-plated 'Citizen' watches, and gold-plated 'Sujata' watches for women—were produced. In the early part of this year the factory manufactured the radium dial watches known as 'Jawan' for the use of the fighting forces. The present rate of production is 600 watches per day with 60 per cent indigenous content.

The company, which earned only 1 per cent return in 1956-57, recorded a return of 37.5 per cent in 1963-64 on a share capital which increased from Rs. 3.9 crore to Rs. 8 crore in 1963-64 and earned a net profit of Rs. 3 crore.

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