NATIONAL PRODUCTIVITY COUNCIL JOURNAL

PRODUCTIVITY

Vol. IX No. 2
Monsoon 1968

NATIONAL PRODUCTIVITY COUNCIL

The National Productivity Council is an autonomous organisation registered as a Society. Representatives of Government, employers, workers and various other interests participate in its working. Established in 1958, the Council conducts its activities in collaboration with institutions and organisations interested in the Productivity Drive. Forty-seven Local Productivity Councils have been established all over the country and they work as the spearhead of the productivity movement.

The purpose of NPC is to stimulate productivity consciousness in the country and to provide services with a view to maximising the utilisation of available resources of men, machines, materials and power; to wage war against waste; to help secure for the people of the country a better and higher standard of living. To this end, NPC collects and disseminates information about techniques and procedures of productivity. In collaboration with Local Productivity Councils and various institutions and organisations it organises and conducts training programmes for various levels of management in the subjects of productivity. It has also organised an Advisory Service for industries to facilitate the introduction of productivity techniques.

Recognising that for a more intensive productivity effort, the training and other activities of NPC, designed to acquaint management with productivity techniques should be supported by demonstration of their validity and value in application, NPC has decided to offer a Productivity Survey and Implementation Service (PSIS) to industry. This Service is intended to assist industry adopt techniques of higher management and operational efficiency consistent with the economic and social aspirations of the community. PSIS is concerned with the investigation of management and operational practices and problems, measures of improvement and their implementation. NPC has also established a special Fuel Efficiency Service.

NPC publications include pamphlets, leaflets and Reports of Productivity Teams. NPC utilises audio-visual media of films, radio and exhibitions for propagating the concept and techniques of productivity. Through these media NPC seeks to carry the message of productivity and to create the appropriate climate for increasing national productivity. This Journal is an effort in the same direction.

PRODUCTIVITY

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MISCELLANEOUS

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PRODUCTIVITY

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NATIONAL PRODUCTIVITY COUNCIL JOURNAL

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Winter 1968

RODUCTIVITY ABROAD

"The Republic of my imagination lies on the extreme left of celestial space."—John Maynard Keynes

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"Even our electricities seem programmed" —Alan Brien in the *New Statesman*

IX, No. 2 MONSOON 1968 *Editor:* DH BUTANI

PRODUCTIVITY

ATIONAL PRODUCTIVITY COUNCIL JOURNAL

The Take Off

DUE TO RECESSION IN INDUSTRY, AND IN THE MINDS OF MEN, THE TALK OF TAKE-OFF—WHICH was the rage at the time of the Third Plan Draft—has ceased ; and for some years, we have had a Holiday in Planning on the ostensible ground that it was essential to take a step backward for a leap forward. With the guidelines of the New Fourth Plan becoming clearer, is it possible to inject into the economy an element of Take Off, now that sufficient slack has been caused by Recession ? Does Productivity furnish the leverage for the Take Off ; or do we rely on the mechanics of the National Income-Savings-Investment Formula ?

Did not Keynes say that if we all decided to save by foregoing our dinner—and if we did this day after day—the restaurants would close, sell off their things, throw off their people ; and that such savings could cause a cumulative disinvestment ? Thus the economic system contains no automatic mechanism by which financial savings are converted into productive assets; and if we want it on a massive scale, we need a Productive Investment Policy.

What is the essence of a Positive Investment Policy ? In a remarkable address to the Indian Parliament delivered at the special invitation of the late Prime Minister Jawaharlal Nehru, Professor Gunnar Myrdal[1] analysed the basic causes of low productivity in this country, and incidentally furnished us with the essentials of an investment policy appropriate to the Indian economy :

> "There is a danger that in our endeavour to procure the machines and the tools, and to build the factories and the dams and to find the money to finance it all, we become too materialistic and forget the human factor, the people, whose bodies and minds must be the chief depository of a developing nation's savings and investments.
>
> "It is far from my intention to make propaganda for Communism, but on this point, simple honesty compels me to stress that the Soviet Union never made this mistake. In the time of the harsh and cruel dictatorship of Stalin, and in spite of the exigencies of the long civil war and the Second World War, and in spite also of an outmoded materialistic theory of capital formation, which Marxism has inherited from the classical economists and defines capital as only material goods, and while they were pressing up capital formation

[1]An economist and writer of international repute, Dr. Gunnar Mydral was Cabinet Minister in Sweden and not long ago Executive Secretary of the United Nations Economic Commission for Europe

in that narrow materialistic sense to extraordinarily high levels, *the Russians, at the same time, also continually, made huge investments in human beings, what Marshall called 'personal capital'. The result is that the Soviet Union now stands with levels of education and health equal to, and in some respects superior to what is standard in the richer Western countries.*"

Even the hard-headed Business Economists of the United States—including the Harvard group—have come to this conclusion that the major causal factor in the take off of the Soviet economy is its tremendous investment in human capabilities.

Even the theoretical economists, struggling for the identification of the residual factor in the massive increases in the productivity of the US economy, have come to the conclusion that as large a proportion as 60 to 70 per cent. of the Growth Rate is traceable to this investment in the human factor; no wonder then that the major advances in productivity, even in the Anglo-Saxon countries have followed not the major innovations but the major advances in education and the welfare of the common man: reduction in working hours, improvement in working and housing conditions etc., etc.

This is not to underestimate the revolutionary implications of the transformation in the fuelling and the instruments of production; but it is of vital interest in the context of the Indian Economy as it operates at the moment that we emphasise this theory because, in terms of economic thinking, we seem to be still in the pre-Keynesian savings formula, under which wealth accumulated and men decayed.

The real fact is that the whole emphasis in capital formation has shifted from machines to men : "Both technological advance and improved skills and abilities are the product of personal development. Machines do not improve themselves...most technological advance is now the result not of the accident of inspiration or genius but of highly purposeful effort. Once we had to wait for the accidental appearance of Edisons and Wrights. *Now through education and organised effort in a laboratory or experimental shop, we get something approaching the same results from much more common clay.* So it comes to this : *we now get the larger part of our industrial growth not from more capital investment but from improvements in men. We get from men pretty much what we invest in them....*" (John Kenneth Galbraith, *The Liberal Hour*—Italics ours).

The fact of the matter is that we have in India literally a race between the hare and the hound. Since Independence our labour force has increased by 40 million but the registered factory employment has increased by only two to three million. Even considering all the possible increases in secondary and tertiary employment, we have on hand many millions of people whom we must put to work by all means at our disposal.

Even assuming that their marginal productivity would be less than the current rates of wages, there would still be a fairly large increase in the national income which would at least cover a large part of the total social cost involved in the very existence of unemployed resources.

Surely, in spite of recession there does exist a large volume of unsatisfied demand[2] both from Government as also from the richer sections of the community that could, with appropriate

[2]And demand can always be stimulated. In one of his most cynical attacks on current economic thinking, Keynes said : "Pyramid-building, earthquakes, even wars may serve to increase wealth, if the education of our statesmen on the principles of the classical economics stands in the way of anything better... If the Treasury were to fill old bottles with banknotes, bury them at suitable depths in disused coalmines which are then filled up to the surface with town rubbish, and leave it to private enterprise on well-tried principles of *laissez-faire* to dig the notes up again (the right to do so being obtained, of course, by tendering for leases of the note-bearing territory), there need be no more unemployment and, with the help of the repercussions, the real income of the community, and its capital wealth also, would probably become a good deal greater than it actually is. It would, indeed, be more sensible to build houses and the like; but if there are political and practical difficulties in the way of this, the above would be better than nothing."—*General Theory of Employment, Interest & Money*, 1960-Edition, pp. 129-131

organization, put unemployed people to work. Assuming a conservative estimate of 30 million unemployed, and assuming their marginal productivity to be less than the average per capita income—of unemployed engineers, it would be much more— we could generate an additional national income of Rs. 900 crores per year.

In fact this is the only approach to the maximisation of what we may call social productivity; it could very well mark the beginning of the take off of the economy. It is essential to develop this line of thinking, even in terms of productivity, even on the basis of the elementary formula of productivity being equivalent to output divided by input. While the unemployed add nothing to the numerator, they add substantially to the denominator, *for the total input of the social economy is the total social cost incurred in maintaining the entire population.*

This is felt even in the United States which could well afford the luxury of a marginal increase in the volume of unemployment. It was the late President Kennedy who, in a special article that would have been published in his name in this Journal but for his death, declared in an important Manpower Policy announcement : "...Unemployment is our Number One Economic Problem. It wastes the lives of men and women, depriving both them and the nation. Our continued underuse of human and physical capacity is costing us a sum of $30 to 40 billion of additional goods and services. This means a considerably lower standard of living than we would otherwise enjoy..."[3] Our econometricians could very well work out the cost to the Indian economy corresponding to the additional goods and services that we could produce with unemployed manpower.

The aggregate unemployed resources, considering the whole economy, are very substantial.

[3]Obituary of President Kennedy, published in the NPC Productivity Journal, Vol. IV No. 4, pages between the Contents and the Leading Article

OPERATIONS RESEARCH

Emerging from World War II as a *mystique*, the manner and the rate at which Operations Research has been applied to practically the whole range of industry, large segments of commerce, transport, service facilities, even the dark recesses of administration: all this indicates how productivity has got on into the current of social change, for Operations Research, despite its mystical aura, its mathematical mask, its intimacy with military logistics, is nothing else, in reality, but an integrated application of productivity techniques.

...The fact of the matter is that modern industry is in continuous need of a strategy on account of two concentric complexities: an inner complex system, called a factory or a firm, operating within a complex environment of government policies, markets, technologies. The factory or the firm, appearing to the external world as a single unified system, is in itself a complex world of money, men, materials and machines; and the techniques of Operations Research such as Linear Programming constitute a strategy by which managements steer their way to a rational, optimum productive use of resources. As elaborated by the Earl of Halsbury in his thesis from Plato to Linear Programme, *the techniques of Operations Research can be applied to "society as a whole and ask how its performance can be optimised."* This, of course, is LOOKING TOO FAR AHEAD. At present, it would pay dividends if we were to adopt Operations Research as The Strategy of Productivity.

—from PRODUCTIVITY
Vol. IV No. 2

We have during the last 20 years pumped in nearly Rs. 25 thousand crores, largely into machines, materials and facilities. Of these, the best estimate is that, on the average, hardly 30 per cent is utilised. In the under-utilisation of human resources, the position in fact is a lot more serious. *Nobody would suggest that considering the intellectual and physical resources of the Indian population we could be utilising anything more than 10 per cent.*, not of course in terms of employment and unemployment, but in terms of a broad estimate of total human capabilities. *It is this productivity potential that has explosive possibilities either way.*

Fifty years ago, Czarist Russia was described by Ogg in his *Governments of Europe* as "a babel of tongues and castes and creeds". Fifty years ago, the Czarist army collapsed on the German frontier. Twenty to thirty years thereafter, the same country beat back the mechanised hordes of Hitler, by massive manpower deployment. Now that super-power is running a close race to the moon. This surely is Take Off : and why can't we take off? In substance, *the Soviet Union pumped productivity into the people.*

There is really nothing that stands in our way, for there are only two main determinants of what we can achieve : our organising ability and our love of the public welfare. *Luckily, it is only in India that there is no basis for an ideological conflict, for the aggregate demand for all types of enterprise, both public and private, would exceed the aggregate supply for any foreseeable period of time.* We need to develop the country by all the methods that we possibly can use : socialistic, capitalistic and cooperative; for the areas, both physically and sectorally, are so large that practically all methods can be tried, even concurrently in many of the areas. In fact, *a productivity policy essentially means a rapid improvisation of all sorts of techniques, physical and social, to get the best out of the existing resources.*

And the time has become propitious for priming our engines for a take off. We have had a bumper harvest of nearly a hundred million tonnes this year ; and it is not a freak, for the increased yield has been obtained largely from areas of assured rainfall and through the increased use of fertilisers and cultivation of high-yielding varieties. In fact, there are *very substantial and significant evidences of a breakthrough in agriculture* "through the genetic destruction of the yield barriers in the major cereals and millets". *The earlier tall varieties of wheat, for example, had an upper limit of a yield of 30 to 40 quintals per hectare. This upper limit has been raised to 70 quintals per hectare.* This is no longer a part of theory but a part of the established fact in Indian agriculture : "*...In the immediate future, the prospects are* bright for developing wheat which can yield about 100 quintals per hectare... such varieties will have 3 to 4 times as many grains per ear as the variety now grown;" and there will be many more ears to the corn. These new varieties are actually on the assembly line : "*...We are now poised for a major yield explosion not only in wheat but also in rice, jowar, bajara and maize...*"[4] (italics ours)

Other evidences of the modernisation of Indian agriculture are also significant. Even experimentally some of these developments are of substantial value. In a massive experiment undertaken by four State Governments—Assam, Bihar, Orissa and Uttar Pradesh, as representing a wide variety of climatic and soil conditions, 12,500 acres of jute crop were sprayed from the air with a combination of fertilisers and insecticides.[5] The approximate height of the jute plant increased from 9 to 12 ft. and the yield of the crop by weight by 20 to 50 per cent. of fibre. Is this not a

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[4]From a contribution on FROM NATURAL TO "EXPLOITIVE' STAGE (See Appendix A), by Dr. MS Swaminathan, Director of what is popularly known as the Pusa Institute, New Delhi

[5]If necessary, we could divert planes from passenger travel to agricultural development. Probably this would not be necessary, for, as Sri Jatin Chakarvarty pointed out at the last meeting of the National Productivity Council, our aircraft producing capacity is seriously underutilised; and we surely can easily produce on a mass scale spraying aircraft machines.—**Editor**

've increase in productivity actually achieved? Are these methods and achievements not a of Take Off?

Agricultural implements are being manufactured on a mass scale; and all over the country ɔs are coming up. The latest, for example, is a workshop equipped with modern German) machinery set up at the Mandi Project. Quite a range of agricultural tools have actually manufactured at Mandi and distributed to farm families. One modern mould board plough, *Mandi plough*, has been developed at the workshop and is manufactured on a mass scale a foundry nearby. These tools have proved very useful and *the demand* for them is so great supply cannot keep pace with it.

And we are manufacturing not only big tractors but also the small tractors. The Japanese alking Tractor (of 5 HP) run on kerosene and usable on very small pieces of land, is today ɔle in the country at a cost of about Rs. 4,500. The farmer operates it, walking behind the machine, directing and controlling it. By fitting different kinds of wheels to it, the farmer use it for ploughing, cultivating, harrowing, puddling or weeding paddy fields, spraying or ɜting insecticides, harvesting, threshing, husking and lifting irrigation water. By attaching a trailer to it, he can use it for transporting farmyard manure, fertilizers, farm machines, farm and even his family members. *This is produced in India and available for use!*

And with regard to fertilizers, as with regard to steel, we have learnt the lesson, for every tonne of fertilizer produces 8 to 10 tonnes of foodgrains. Luckily, due to a conjuncture of circumstances, as part of the still-born Fourth Plan Draft of 1966, the only project that has survived intact is the fertilizer production aiming at a capacity, by the end of 1970-1971, of 3 million of nitrogenous fertilizer plus a million tonnes of phosphatic fertilizer; and no opportunity is being lost of using refinery and steel manufacture byproducts for producing as large a quantity of fertilizers as we can manage. *And the people have taken to fertilizers, for the aggregate demand ɔr fertilizers far exceeds the aggregate supply.*

The fact of the matter is that *an agricultural revolution of high productive possibilities is actually on in the Indian economy*; and there are reports from the campuses of the new agricultural universities, which now dot the entire map of India, that *the farmers are flocking into the campuses to learn new techniques, to ask questions about the new varieties, new agronomic practices, and the agricultural scientist, who wallowed in idle luxury on agricultural research stations in pre-partition India, is now on the proving rack.* In fact it is an area where the masses and the classes are coming together for a massive productive upsurge out of what has so far been both physically and in human terms, a sink of the Indian economy.

And if we can take the bull by the horns, we can swing ourselves into the take off : if we can manage to shake off the psychology of depression. Unfortunately, our intellectuals, in spite of being well-informed, are behind time in the appraisal of facts. There has been a recession in the Indian economy now for quite some time, yet it is only now that we have had an appreciation of it among the thinking and governing classes of the country. All the time it was taking place with a continuous decline in industrial output from a 10-12 per cent growth rate some three years back to only around one per cent towards the end of 1967.

Unfortunately, again while *the recession is actually receding*, we continue to suffer from a recession psychology : during the last six months, the growth rate of industrial output has increased from nearly nil to around 6 per cent, and we may close the year with an 8-10 per cent growth rate.

In fact, there are signs in critical areas that industry is picking up. The wagon manufacturing industry, rather hard-hit by recession, is now fully booked with orders ; and the heavy structurals

sector has received sufficient orders from Bokaro, Madras Fertilizers, etc., to keep it going at full capacity upto 1970-71. Cement Industry which was depressed is now looking up with export orders from Ceylon and Kuwait.

By the end of the year, the industrial economy may be growing at the pre-recession levels of production; and foodgrains output may, with an intelligent and determined employment of resources in areas of assured rainfall, go up by another 5 to 10 million tonnes, well over the 100 million tonnes mark. National income may increase by 5 to 6 per cent due to the working of autonomous economic forces alone.

And the Government appears determined, for it has actually budgeted that the Central Government disbursements during 1968-69 will exceed its budgetary receipts, on both capital and revenue accounts, by over Rs. 300 crores. Thus we shall continue to prime the pump and there is no reason why we should not prime it to the point of Take Off, at least till recessionary conditions wear off.

And the economy is very much stronger than it ever was, to stand the priming of the pump. Most of our defence equipment is now domestically manufactured. We were hardly an oil producing country in the pre-partition period. Now we produce 5 million tonnes of our own crude oil. We are prospecting off-shore oil, both at home and abroad. The Oil and Natural Gas Commission now earns substantially what it spends on oil exploration and production. The total earnings of the ONGC during the original Fourth Plan that was (1965-66 to 1970-71) will be Rs. 225 crores; and that will totally cover all its expenditure on exploration and production. What more evidence do we require that in a crucial area of the economy, where our foreign rulers declared us, not very long ago, as nearly defunct, we have become practically self-generating; and that is the definition of the Take Off in Modern Economics.

Not only in oil production, but in its refining, we are in a very advanced stage. By the end of this year, the ninth refinery in the country (at Madras)—the sixth in the public sector, will go on stream. The refinery will, for the first time in the country, manufacture sulphur, among other things, and quality lubricating oil base stocks in bulk. After the refinery goes on stream, the country would be in a position to stop import of lubricating oils, such as engine oils, gear oils, etc. And the Madras refinery will be the first refinery in India to use indigenous equipment to the extent of nearly 60 per cent. Plates for oil storage tanks and for crude oil pipe-line will be supplied by Rourkela Steel Plant. These are all signs that the economy is rapidly becoming self-generating.

From February this year, trial runs have actually started at Rourkela on the production of cold rolled steel; and by the end of the year, we shall be able to establish an annual output of 650,000 tons of cold rolled sheets, required for automobile expansion. In fact, the second stage of Rourkela is complete, boosting its ingot steel output from 1.0 to 1.8 million tons per year. Surely, the base of the economy is becoming stronger.

Even otherwise, over a long period, the economy has become substantially stronger. In 1943 the Bengal famine resulted in 3 million dead. In the Bihar famine which destroyed 60 per cent of the crop in two successive droughts, when food and drinking water was not available over a large part of the area, we did not allow people to die. We begged and borrowed and improvised, so men and women and children survived : in fact, surprisingly *a large part of the undernourished people of Bihar got a square meal only during the famine period.* The much-decried bureaucratic administration organised a remarkable system of relief; and the search for underground water has revealed large possibilities of underground water availability, which were not known before. As the (London) *Economist* rightly remarked: ". . . this question goes far beyond Bihar. *Indian*

agriculture may well be on the edge of a radical breakthrough to higher productivity and hence to some hope of ending the hungry half-life of the millions at the bottom of the social pyramid[6]..."

It is not only the agricultural practices that are being transformed : as many as 24 modern rice mills are being set up and the techniques they will be using will add nearly 2 million tonnes to the net output of rice available for consumption in the country[7]. A number of modern bakeries, producing fortified bread for the people in the metropolitan areas are actually getting on the production line.

It is not only in the traditional cereals, but in many other areas, efforts are under way to provide more nutritious food for the people. Poultry farming, to some extent, grapevine gardening have come up on a scale unheard of in the pre-partition period; and there are evident signs of marked quality improvement. Recently, from a German Foundation stock of eggs, chickens of high quality have been hatched and distributed. For cattle improvement a herd of 25 heifers and eight bulls of the German spotted highland breed is being used for improving the local breed. The value of this measure can be appreciated from the fact that the yield of the German cow is 3 to 5 thousand litres of milk per lactation against a yield of less than 3 hundred litres of the local breed of cows.[8]

And then there are the vast marine resources upon which we can draw to feed the people. According to expert estimates, *the Indian Ocean is capable of yielding 20 million tonnes of fish every year*. The invention of an apparatus like the highly-sensitive oceanic fish finder may enable *exploitation of the bulk of this supply in the course of the next few years*. This potential is about two-fifth of the entire world fish production at present and *it is ten times as much as what the Indian Ocean is made to yield currently*. In recent years, there has been a systematic attempt to explore and exploit fish resources – inland and oceanic. At present we obtain about a million tonnes of marine fish from this source. This is about half the total catch from the Indian Ocean. Even if this proportion is maintained as India's share, *the oceanic catch can be increased ten times*. Assuming that within the next ten years, the population of India would rise to 650 million, it would amount to roughly 15 Kgs. annual per capita supply. In a country where about half the population is not habituated to eat fish, the per capita availability for those who use fish may be 30 Kgs. which is a very respectable quantity and very substantial addition to the sources of protein food for a population where deficiency in protein remains acute.[9]

In fact, the real potential of the country has yet to be discovered. The techniques by which Israel has made *the desert bloom* from scant water resources are now available for application: our desert areas – virgin soil from ancient times – is many times the size of Israel. Similar

[6]Italics ours, from 'The Disaster That Never Was', (See Appendix B)

[7]"If the trends in the demands for new inputs are taken as a guide, Indian agriculture has shown a remarkable response to new ideas and industrial inputs. Modernisation of the rice milling industry can increase the out-turn of rice from 20 million tonnes of paddy by 1.5 million tonnes per year. Of this, 1 million tonnes can accrue from modernising the huller type sector of the industry. At present ex-mill prices this amounts to a *net gain of Rs. 105 crores* and a saving of over Rs. 55 crores because quantitatively this estimate of increased out-turn of rice is twice as much as the average annual imports of rice over several years. As the production of paddy increases, the quantity which will be processed by the mechanised milling industry is bound to increase." (N. K. Bhojwani, 'Productivity in Paddy', Calcutta Productivity Council Annual Newsletter, 1967). Presumably, the saving of Rs. 55 crores referred to above, is in terms of foreign exchange.

[8]This mentions *inter alia* the quality improvement sought to be brought about by identical methods in the principal raw materials of industry. "At a farm where the local breed of sheep is being improved with the help of German merino lambs, it was shown that while the wool obtained from the local sheep was coarse, the quality of that produced by the improved breed was very fine. Also, the quantity was enormously greater."

[9]'Agricultural Situation (October 1967)', published by the Ministry of Food & Agriculture, p. 743

experiments are also on in the Sahara; and there's no reason why we should not benefit from the scientific knowledge that is now the common heritage of mankind.

The real potential of the country, however, is its people;[10] and if we can avoid "the tragedy of unemployed resources", there is no limit to the development that can take place. *It is intelligence and character—not fiscal and monetary expedients—that set a limit to the productive deployment of resources.*

The traditional signs of Take Off are there : Breakthrough Research in Agriculture, a wide and sophisticated dispersion of industry, heavy machine manufacture, domestically-supported defence capabilities, a large reservoir of trained manpower, a critical intelligentsia, a mass of people willing to work and though soaked in ancient culture, yet sensitive to the urges of the future, a responsible government, a living constitution based on social democracy and with Productivity embodied in the Directive Principles of State Policy, not to mention the Thumba Rocket, the nuclear power stations and the like. This is modern India ; and *its Potential productivity is infinite !* ●●●

[10]The First Five Year Plan Report of the Planning Commission characterised the huge population of the country as its "Investment Potential"

Appendix A

From Natural To Exploitive Agriculture

MS Swaminathan

In the leading article — The Take off—there are references to the Revolution in Indian Agriculture, now on the cards. These are based on a learned contribution by Dr. MS Swaminathan.* As the matter is of vital public interest, extensive extracts are printed below for the benefit of the Readers of the Productivity Journal.

TWO FAVOURABLE FEATURES OF INDIA'S agricultural situation are :

(a) The availability of abundant sunlight and the prevalence of favourable temperature for crop growth throughout the year in most areas, thereby making multiple cropping feasible.

(b) The availability of large tapped and untapped water resources. **Recent scientific research has aimed at exploiting these advantages through the genetic destruction of the yield barriers in the major cereals and millets** and the development of agronomic practices essential to enable the plant to reveal its yield potential. As a result, during 1964-67, the dwarf wheats *Lerma Rojo* and *Sonora* 64 introduced from Mexico, the high yielding wheat strains *Kalyan Sona, Safed Lerma, Sona-like, Chhoti Lerma* and *Sharbati Sonora* selected or developed locally, the rice strains *Taichung Native* 1, *IR*-8, *Tainan* 3, *Taichung* 65 and *ADT*-27, the Jowar hybrids CSG, the bajra & HCS. 2 hybrids—H.B. 1 and H.B. 2 and the maize composites *Jawahar, Kissan, Sona, Ambar, Vikram* and *Vijay* as well as several maize hybrids **have been (actually) introduced into cultivation by our agricultural scientists.**

Multiple cropping techniques employing a a relay sequence were developed for enabling a farmer with a holding of about 2 hectares to **grow 4 crops a year** and earn a net annual income of over Rs. 10,000/- per hectare. Special agronomic methods have been devised, such as sprinkling farm-yard manure in fields sown with wheat in January, which help in raising the soil temperature and increasing the speed of germination and growth of seedlings. Further, sowing in the north-south direction helps in capturing as much sunlight as possible by the green leaves and thereby foster better and quicker growth...

The new varieties and the new agronomy currently available both for irrigated and dry areas, have provided Extension Workers with excellent opportunities for winning the confidence of the farmers quickly and for providing them with the motivation needed for change. **This is, in fact, what has happened in several parts of our country during the last two years.**

Spraying with urea helps to increase yield by over 25 per cent in wheat. The scientists of the Indian Agricultural Research Institute have found that over 30 per cent concentration of urea can be safely applied to wheat by breaking down the particle size of urea in a low volume sprayer. This has rendered **aerial spraying of urea possible in moisture-deficit areas and this can be provided as a service by the Government.**

The IARI physiologists have shown that by increasing the number of grains per ear in the

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main stem, it is possible to increase the yield of wheat in dry areas. Hence, a special variety of wheat with branched ears like Jowar is under development for dry areas. Also hybrids between rye and wheat are under development, which may also prove to be a boon to farmers in dry areas.

With the earlier tall varieties of wheat, about 30 to 40 quintals per hectare was the upper limit of the yield that could be easily obtained in irrigated areas. With the introduction of the dwarf varieties from Mexico by the IARI **in 1963, this upper limit was raised to 70 quintals per hectare.** During 1967, *Sonalika*, *Safed Lerma* and *Chhoti Lerma*, selections made at the IARI from breeding material received from Mexico, as well as *Kalyan Sona*, a selection made jointly at IARI, Ludhiana and Pant Nagar were released. Another variety approved for general cultivation in 1967 was *Sharbati Sonora*, a strain developed by treating *Sonora* 64 **with gamma radiation.** *Sharbati Sonora* has yielded 34 quintals per hectare at Coimbatore in Madras State in 85 days. In North India, it yields 60 to 65 quintals per hectare in 120 to 130 days. In addition to giving good yields, *Sharbati Sonora* has the highest protein content (16.5 per cent) among the varieties so far developed and released in India. Its protein has a high lysine (an essential amino acid) content...For obtaining still higher yields, the following attributes must be incorporated in a wheat variety :

(a) A shorter straw, the total height not exceeding about 50 cms. so that there is no lodging even when rains and thunderstorms come in March and more nutrition is fed to the plant through the soil.

(b) A long ear with over 100 grains per ear and a large number synchronously developing tillers with stiff and erect leaves capable of an efficient interception of sunlight.

The new varieties now in the assembly-line at IARI belong to the following categories:

(a) **Triple Dwarfs :** These have 3 genes for dwarfing and **will not lodge even under very adverse conditions: Triple dwarfs combining high yield, excellent grain quality and high degree of resistance to rusts are now in the final stages of assessment and multiplication.**

(b) **Hybrids between Rye and Wheat :** These have very long ears and may yieid well both in irrigated and dry areas. In addition, rye wheat (scientifically known as "triticale") has nearly 20 per cent protein and a high lysine content.

(c) **Hybrid Wheat :** As in maize, jowar, and bajra, research aiming to exploit the phenomenon of hybrid vigour is in progress in wheat. Such research was made possible by the discovery of male sterility in some wheat strains by Japanese workers.

(d) **Branched Wheat** : A mutation for branching was induced in the variety NP 797 by gamma ray treatment. This has made the development of branched wheat varieties possible. **Such varieties will have 3 to 4 times as many grains per ear as the varieties now grown** and will greatly enhance the yield of wheat both in irrigated and dry areas.

Thus, in the immediate future, the prospects are bright for developing wheats which can yield about 100 quintals per hectare.

Dwarf and high-yielding varieties have been developed in *durum* (macaroni) wheat, which is cultivated extensively in Madhya Pradesh and Mysore. In barley, the first usable form of dwarfing gene (similar to the 'Norin' dwarfing gene in wheat) was discovered at the IARI in varieties treated with chemical mutagens and this has rendered the development of dwarf and non-lodging barley varieties possible.

Until recently, plant breeding led to yield increases only in an arithmetic progression. An exception was hybrid maize whose cultivation in the United States revealed that when breeding interacts with agronomy, yields can increase in a geometric sequence. As a result of exploiting this concept of breeding plants which will respond to efficient soil and water management practices, **we are now poised**

for a major yield explosion not only in wheat but also in rice, jowar, bajra and maize. Many varieties possessing the type of morphological architecture and developmental rythm favourable for the efficient utilisation of sunlight, water and fertiliser are now available in these crops. Since adequate quantities of seeds of high-yielding varieties will be available hereafter, **it should be feasible through high yielding varieties alone to produce soon about 20 million tonnes of wheat and 50 million tonnes of rice,** provided the requisite quantities of fertilisers are available, and the interest in these crops among farmers is sustained... The development of a dwarf *Basmati* strain of rice at the IARI has opened up great possibilities in increasing the production of *Basmati* rice.

It is obvious that in the long run farmers should derive a good income by maximising the return from their investment on inputs and not through prices which cripple the consumer. In dwarf wheat, for example, the timing of the first irrigation can make as much as 8 quintals per hectare difference in yield, given the same number of total irrigations and fertiliser dose. ●●●

Appendix B

The Disaster That Never Was

Some time back, the *Economist (London) published an analysis of the Bihar Famine, with a bearing on long-term policies, to be designed and executed in a manner *so that we may have no more famines!* As such a prospect would be of crucial significance to the Indian Economy, extensive extracts have been printed below.**

WHAT HAPPENED TO THE GREAT BIHAR famine? The short answer is that there was'nt one. There should have been. Two successive droughts had destroyed three-fifths of the crop. A comparable failure left nearly 3 million dead next door in India's last great famine, West Bengal's in 1943. Early last summer reporters spoke of a 60 per cent shortage of foodgrains, of parched earth, dry wells, spreading epidemics and a combination of graft and inefficiency in administration that seemed to make a major catastrophe unavoidable. As the scorching summer skies blazed down upon villages in which all reserves—of food and even drinking water—had been used up, mass starvation would no longer be held at bay... It did not happen. The reasons have a significance beyond Bihar and beyond these particular relief operations. What has been demonstrated is the degree to which, **with the right mix of national and international co-operation, even the most apparently backward and hopeless rural areas can be brought to life...**

Not every one could be reached. Deaths from the side-effects of malnutrition — dysentery, typhus, premature births — increased sharply. And programmes, such as the fair-price shops, were accused of inefficiency and corruption. But the chief lessons of the emergency—both in nutrition and in administrative efficiency—have, in fact, proved to be the opposite of the gloomier reports and expectations.

Take nutrition first: About a third of Bihar's population belong to the lower castes, who live, year in, year out, under the shadow of acute malnutrition. It does not take much—a local shortage, a recalcitrant landlord, a dispute over the share-cropping system—to push them over the edge to near-starvation. **Millions of these people probably had their first square meal during the famine.** In deeply affected areas like Palamau, where half the population benefited from emergency feeding, and where there was extensive smallpox and cholera vaccination, **children's weight now is greater and their general health better than usual.**

As for the administration, it cannot have been wholly feckless to keep famine at bay in a state of 53 million, with 40 million affected by drought and at least 12 million within sight of death. The more culpable civil servants were suspended or transferred, and able replacements were seconded to Bihar. One or two devised a remarkably effective administrative framework for vigorous emergency action. In Palamau, the deputy commissioner broke up the basic units of administration—the blocks—into three or four subsectors under officers to whom he gave wide powers of decision-making. They were responsible for the various schemes to give work and wages to those whose harvest was lost. They supervised loans and credit, and

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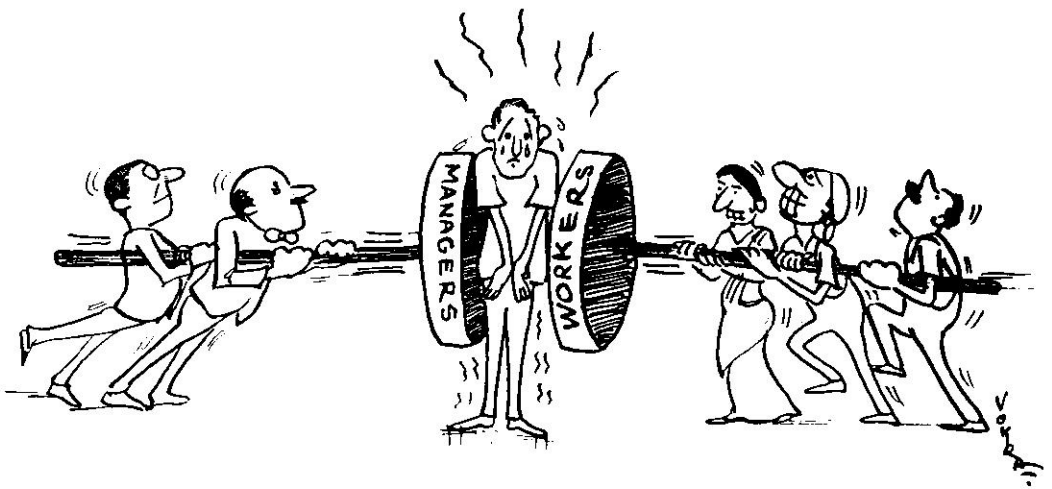
co-ordinated the work of the various voluntary agencies, helping to bring a measure of order, foresight and quick decision into what might have been a series of confused and overlapping operations.

The result of this more effective administration, combined with grain and grants coming from outside and with work schemes directly aimed at food production, has been more than the avoidance of famine. It has been **a revolution in local agriculture. The fear of famine helped to insure Bihar against future famine**. Many of the work schemes were devoted to discovering, improving and perpetuating water supplies. **More has been done for minor irrigation in the last 12 months than in all the three previous five year plans.** In the 20 months since July 1966 three times as many pumps have been installed and 1,200 new tubewells have been drilled, compared with 1,000 in the previous 15 years. With this went building of embankments, field levelling, drainage schemes and widespread restoration of old tanks and irrigation ditches which had fallen into disrepair.

Drilling teams have discovered a largely unsuspected wealth of groundwater. It lies only 10 to 30 feet below the rocky plateau at Chota Nagpur. At Nawada, the worst drought area in the district of Gaya, **a newly discovered ground-water basin could irrigate 100,000 acres of largely arid land. The resources are there. What is required is the energy and the organisation to discover and exploit them.** The famine of 1967 brought out these energies. Can they be organised for permanent use?

This question goes far beyond Bihar. **Indian agricultre may well be on the edge of a radical breakthrough to higher productivity and hence to some hope of ending the hungry half-life of the millions at the bottom of the social pyramid.** In Bihar itself, while the famine was still a threat, some 200,000 acres of land came under irrigation in Purnea district after the completion of the eastern Kosi Canal. **Farmers using the new improved seeds, and applying fertilizers lavishly, achieved yields inconceivable even five years ago**, before the new strains had been acclimatised to Indian conditions.

If some of the outside support and internal energy devoted to defeating famine in Bihar could be mobilised to extend this kind of agricultural change – which is already visible in patches throughout India – all **over the su - continent, there would be no more famines.** But at this very moment outside support looks like falling sharply away. ●●●



Jekyl and Hyde Productivity!

Ten Keys to the Growth of Economic Productivity in America

McLain & Singh*

In a world where half of the people are living in acute poverty and most countries are struggling to increase their ability to produce goods and services needed by their population, the USA has developed the capacity to produce in abundance. *The basic problem in the USA is not how to produce enough goods and services but how to keep people employed, as machines do more and more of the work previously done by human labour.*

**The USA has changed in the last one hundred and fifty years from an agrarian economy of hand labour to a giant industrial economy that is rapidly becoming automated. The changes, which began slowly, have developed at a continually increasing rate. There are reasons to believe that the rate of change will continue to increase, and that the next few decades will bring changes even greater than those that have taken place in the past century and a half. Richard Bellman, a noted computer expert of the Rand Corporation, was reported recently by the Chicago Daily News to have predicted that "2% *of the population in the discernible future will be able to produce all the goods and services needed to feed, clothe, and run our society with the aid of machines."* (italics ours)

WHY DID THE UNITED STATES BECOME technologically so advanced, compared to most of the world? The answers to this question are complex. In fact, there is no agreement among the experts as to what all the factors are or the relative importance of each. There is agreement, however, that the reasons are not related to biological or racial superiority of the American people. Authoritative scientific opinion overwhelmingly holds that biological and racial differences which can be attributed to technological progress are indetectable or of minor importance.

A unique combination of history and physical environment set the stage for the USA to develop early as an industrial leader. If any one of many elements in a combination of people, time, state of the science, or environment had been different, the economic growth of the USA could not have progressed as it did.

There was little trade in Europe during most of the Middle Ages (approximately from 400 A.D. to the late 1400's). During that era, most communities supplied their own needs. People expected only a few simple goods, *chiefly because they did not know about anything*

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else. As that era of the Middle Ages came to an end, trade and commerce grew. Merchants and landholders accumulated great wealth. At the same time, scientific investigation was developing. The Industrial Revolution came about by *bringing money and science together* to meet the growing demands for the conveniences of life about which people were becoming aware as a result of the increased trade.

The industries first affected by the Industrial Revolution, which developed along the English Channel, were those which produced staples or goods in wide demand. Chief among these were cloth, especially cotton, utensils, and tools made of iron.

As the Industrial Revolution progressed, political and economic unrest, as well as a growing awareness about other regions of the world, caused many Europeans to seek a new land in which to live. North America, alone, had tremendous new areas suited to be the homes of an active white population of European origin. The continent of Asia was already crowded. Africa is largely tropical or desert. South America is broadest in its tropics and only the narrow southern part and a few plateaus are climatically attractive to Europeans. Australia is partly tropical and largely too dry for intensive use. Only North America was relatively unpopulated and rich in natural resources, with a temperate climate. As a result, a large percentage of the European migrants came to the United States.

A selective migration occurred. A selective migration occurs when the group that arrives at the final destination differs in its characteristics from the group of which it was once a part. Some came to America because they were able to obtain large tracts of land and hoped to become wealthy. Some came to get rich by trapping and trading with the natives. Others came as indentured servants, willing to work for five years in payment for transportation to America, with the hope of becoming land owners some day. Immigrants were attracted to those parts of the country where the opportunities for them to achieve their aspirations were greatest. As manufacturing grew, the people with money who wanted to build factories, people with ideas who wanted to design machinery, and desperate factory workers who wanted higher wages than they could get in Europe settled in the industrial east. Those who aspired to be farmers came to settle on the frontier. Though many came for different reasons, which was a selective process, perhaps, the most significant factor is that those who came to the United States had **hope for self-improvement, the first key to the growth of economic productivity** in the United States. *This hope gave them drive and initiative to forge ahead* to achieve their goals.

This migration to the United States could not have occurred if the land had not been sparsely populated and relatively unused. If the migration had taken place before the Industrial Revolution, the selective processes of migration, bringing the people with the particular knowledge and skills of the advancing technology needed to develop the industrial resources, would not have occurred. This does not mean that other people living on the land and involved in commerce would not also have developed the knowledge and skills, but the selective migration undoubtedly did accelerate the industrial development of the country. No matter how it is acquired, however, the **second key** to the growth of economic productivity in the United States was the **knowledge and skills of the advancing technology.**

The eastern coastal area of the United States, which is nearest to Europe, happened to be blessed with an abundance of crucial natural resources. The rich, fertile soil, with plenty of rainfall and the fish and game, provided ample food to support a growing population. The south-eastern part has the ideal climate and soil for cotton. The north-eastern coastal waters abound with fish. Natural waterways made transportation easy and were heavily populated by fur-bearing animals. This could have made the eastern part of the United States a wealthy agricultural area, exporting its cotton, furs, and other resources to Europe and buying manufactured goods. This was, in fact, the initial

idea behind the settling of North America. In addition to all these natural riches, however, were the key resources needed for manufacturing. One of the largest deposits of high-grade coal in the world is located in mid-eastern United States. Large quantities of excellent coal lay in thick seams almost perfectly horizontal. Furthermore, the coal was located in a plateau hat had been dissected by rivers, exposing the al seams along the river banks above the r level. This made the coal easily obtain- le and easy to load onto boats, and later, s. In close proximity to the coal were stantial deposits of iron ore as well as the mestone needed for smelting the iron. So the clay needed to build kilns and fur- s, sand for glass, and other important materials. This setting provided the **key** to industrial development, **the availability of the needed natural resources.**

Increase in capital is always a necessity for bstantial economic expansion. Huge profits being made on the exports of raw materials om the United States. Also huge profits re being amassed in Europe, making large ns of money available. In order to build and larger factories, the United States ved great sums of money from foreign ntries. The situation of excess funds ing from increased trade provided the **key** to the growth of the economic ctivity of the United States, **the availability of capital funds for expansion.**

The industrial empire did not become great y by building larger factories to continue make the same goods in the same way. w ways were continually sought to develop products and to increase the efficiency of duction. This required scientific investiation. To encourage scientific investigation United States established patent laws in o to protect the rights of inventors. A erson who invents or discovers a new and l machine, product, substance, or method patent it and have the sole right to make, or sell his invention. This right is pro- for seventeen years after the time of This stimulated people with ideas do research and experimentation. Timely inventions which triggered industrial growth during the 1800's included the steamboat to make water transportation faster and upstream navigation possible, the Bessemer converter to make good steel for railroad tracks, and the steam locomotive to pull the trains. Industry can advance further only by new inventions and discoveries. A **fifth key** to the growth of economic productivity, then, is **scientific investigation.**

Although the historical timing was of major significance and the eastern United States provided a "natural setting" for industrial development, none of this would have happened unless somebody obtained the money, acquired the natural resources, employed the workers to apply the processes necessary to produce the finished goods, and then found a way to get the goods to the consumer markets. The prospect and reality of the entrepreneur making huge profits attracted the enterprise that was needed to develop American industry. As the size of factories increased, it took more and more money to build them. In order to increase the economic capacity to grow, individual operations were combined into corporations, pooling their resources for greater accomplishments. The undertaking of bringing together the capital, the labour, and the raw materials in such a way that finished goods are produced and marketed, **enterprise** is the **sixth key** to the growth of economic productivity in America.

The development of manufacturing along the eastern coast was well under way when the opening of vast lands of the central United States (from the Appalachian Plateau to the Rocky Mountains) provided another natural setting for rapid growth and development of a great industrial empire. It was just as unique as the setting in the eastern part of the country by itself was for the early development of the Industrial Revolution.

Central United States had great areas of practically unused land in the temperate middle latitudes, much of which consisted of broad plains with adequate rainfall and soil, ideal for growing wheat and raising cattle. There was also plenty of timber for building and water power for mills to grind the wheat. Another

important natural resource was one of the largest deposits of high grade iron ore in the world. This happened to be located near the shores of Lake Superior, thus permitting cheap water transportation of the iron ore on the Great Lakes to the coal areas of the East. (Coal is used in such great quantities in smelting iron that there is a tendency to bring the iron ore toward the coal, where the two can be brought together most cheaply in relation to the market.)

As information spread about free land in this vast area of opportunity, a great wave of immigration swept the nation in the late 1800's and the early 1900's. About 50,000,000 people left Europe between 1846 and 1924. Although some went to Canada, Australia and South America, 35,000,000 came to the United States. People from many other countries of the world also came during this period of migration. As immigrants streamed in to claim land on which to build their farms, the demand for farm equipment and household goods grew. This caused the factories to expand and to import more labour. The increased population in the industrial sector incresased the demand for farm goods and other raw materials, and to continue to attract more immigrants to the frontier. The railroads needed to expand rapidly, maintaining a network of transportation to bring the manufactured goods to the frontier and to return with the raw materials from the west. The frontier was so vast that the size of a farm was limited by the ability of the farmer to manage it. It was difficult to hire a farm labourer when the labourer could get land for himself. The shortage of labour fostered the development of labour-saving devices, both on the farm and in the factory. This upward spiral of production and the demand for improved practices provided the **seventh key to continued industrial growth, an expanding market.** By 1910 the frontier days were coming to an end. No longer was there an open front for expansion. World War I gave great impetus to industrial expansion, however, and led the United States into the era of mass production.

It is interesting to note, again, the unique combination of history and physical environment which interacted to create the industrial empire. If the settlement of the interior of the North American continent had taken place in the days before the railroads and other rapid means of transportation and communication made it possible for great areas of considerable diversity to be closely bound together, a multiplicity of small nations might have grown up, each in its own natural region, and each setting up its trade barriers. As it developed, however, the United States with its large land mass became one of the largest (internal) free trade areas in the world.

With an expanding market for standard products brought on by World War I, the capacity for mass production developed. Eli Whitney, who had already profoundly altered American history by his cotton gin, conceived the idea of the interchangeable parts. During the War of 1812, he received an order from the government for muskets, bu the could not get skilled craftsmen to make them. He, therefore, developed a system of training each worker to make only one part, a much simpler matter to learn. Each part was made to precise, standard specifications and was assembled with the other parts to make a completed musket. This opened the way to **mass production,** the **eighth key** to American productivity. The news of this technique spread over the world; but people in other countries where there was no shortage of skilled labour preferred to continue the old craftsman method.

One of the most profound keys to industrial growth came after World War I through the efforts of Henry Ford, more than any other man. He developed the theory that the efficiency of mass production could raise the wage scale high enough and decrease the price of goods low enough so that the masses common people, the workers, could become the consumers of the mass-produced goods they are producing. For example, if it took fi workers a year to build an automobile, none of them could have earned enough from the job to buy the automobile because the price would have to be high enough to pay for all the labour, the cost of materials, and other costs of production. *If, on the other hand, the process could be speeded up, whereby the same five workers*

could produce fifty cars instead of one, the price of the automobile could be greatly reduced, or the wages of the workers could be greatly increased, or a combination of the two. Ford introduced this theory into practice with the low-priced automobile and unleashed a whole new frontier, an economic frontier of an ever-enlarging demand for goods and services by the masses, with the financial ability to pay for the goods from the money they had earned by producing the goods. This concept of **developing the consuming power of the masses** is the **ninth key** to the growth of the economic productivity of America.

During the entire history of the industrial movement, the United States government has fostered a system of laws, institutions, and public policy to promote the development of the manufacturing sector. Huge corporations that concentrate the industrial wealth in the hands of a few have been sanctioned. Exploitation of human beings has been condoned when it was profitable. High tariffs have protected the internal markets and discouraged the export of raw materials. Public schools helped shape the minds of youth to be good workers and to support the "system". The natural resources, with which this country was so richly endowed, have been plundered.

The desire for power, prestige and wealth and other such drives have caused the industrial leaders to commit their financial resources and their efforts to continued expansion of economic productivity. There appears to be no turning back, no "stopping of the clock," but only a forward movement toward the time that "2 per cent of the population in the discernible future will be able to produce all the goods and services needed to feed, clothe, and run our society with the aid of machines." It is **commitment,** the **tenth key** to the growth of economic productivity, that has given direction to the growth in the past and will give it direction in the future.

The power of commitment is amply demonstrated by the new weapons that have been developed in times of war, and the conquests in space when effort is focussed toward that goal.

In this very over-simplified version of why the United States became the great industrial power that it is today, two important ideas should be apparent. First, what happened in the United States of America was a unique combination of history and physical environment that cannot be repeated anywhere in the world, because this is a different time in history and nowhere else is the physical environment parallel. It is impossible, therefore, to "transplant" the American "system" in any other country of the world. What happened in America is uniquely American. *What happens in India must also be uniquely Indian,* just as what happens in any country must be uniquely its own, for *the development of a country must be a measure of its own culture, its resources, and its institutions.*

The second important idea is that the keys to the growth of economic productivity in America are *not* uniquely American—only the ways in which they happened to develop in America are unique. The world can benefit from this experience. Most of the keys prevail today on a world-wide basis far greatly than they did in the United States only a few decades ago. The knowledge of the advancing technology is available to the world through high speed communication. Man's ability to find, extract and to bring together, and use the raw materials of the world presents unlimited possibility. Among the most exciting is *nuclear fusion* which (according to Amasa P Bisop, head of fusion research for the US Atomic Energy Commission) *could provide the earth with energy a thousand times the current rate, using fuel obtainable from ordinary sea water.* New plastics now under development may replace traditional raw materials such as iron, copper and aluminium. Spectacular results may be expected from the scientific developments related to synthetic fibres, lasers, fluidics, and many other fields. *Limitations heretofore placed on technical know-how of mass production no longer exist.* Capital goods can be produced in virtually whatever quantities needed. Enterprise tends to emerge when other factors of production prevail. The expanding market is inherent in the development of the consuming power of the

peoples of the world. Hope comes to people when they have reason to believe that the future can bring self-improvement, but it may be preceded by restlessness and frustration as awareness of possibility grows.

The primary key, which is missing today, for the economic development of the world is *commitment*. The scientific revolution by which we are being propelled will bring great changes in our thinking about individual lives, community relationships, national and world affairs. Nobel Laureate Sir George Thomson asks, "Will this rate of material progress which seems to be accelerating continue faster and faster, will it level off to a steady and much slower advance, or will it end in a catastrophe and a dark age ?"

Raymond Aron, philosopher, economist, and professor at the Sorbonne in Paris, has commented that the "effort to look ahead becomes all the more imperative as the changes of the human condition and social structures take place more and more rapidly."

What can we see today when we look ahead into the future? Will it all end in a catastrophe and a dark age, or will man be able to construct an "organizational structure" which will function in accordance with a humanistic philosophy which Francis Bacon, one of mankind's great philosophers, described as "such philosophy as shall not vanish in the fume of subtle, sublime, or delectable speculation but shall be operative to the endowment and betterment of man's life"? It all depends on the commitment of man.●●●

Economics Business and Productivity

DH Butani

In business parlance, practical economics is that which puts larger and larger profits into their pockets. There is really nothing wrong with this position. The economists regard profit-making as quite legitimate. In fact, the whole of classical economics is based not only on the legitimacy and validity of profit-making but on profit-making including all forms of personal gain being the main motivating factor in all economic activity. It would be difficult to deny the validity of this proposition in terms of human nature. *Practically all men and women desire private gain and to condemn it would thus be condemning the whole business of life.*

TO AVOID THE PITFALLS OF SUBJECTIVITISM the modern economist is inclined to be neutral as regards moral values. This position of moral neutrality simply means that it is *outside the competence of the economist to declare anything as right or wrong. In fact, a tradition has developed that if any economist allows his own private conception of right or wrong to vitiate his analysis, he would be committing a most deadly academic sin.*

This may be simply illustrated. Probably it would please the heart of the practial businessman that the economist *qua* economist does not recognise black-marketing. A market is just a market in economic terms, where the forces of demand and supply interact to produce what the economist calls a supposedly equilibrium price.

What then is practical economics? Not that my knowledge of it is any profound, for my own contact with private business has been rather marginal. I have, however, seen its operations somewhat intimately, in some of the economic surveys I have done, and in the capacity of an economist to one of the major scheduled banks in India. I was nearer to Big Business, when I officiated as Editor of the *Eastern Economist*, but my idealism completely insulated me from the men who sought to exercise a remote control. For the most part of my working life, I have been a professor with some sort of a high-brow attitude to private business and as a research economist, looking at private business in terms of somewhat authoritarian control. I do not think I dare call myself a practical economist.

Yet, somehow, we must get down to the practical economics of business. And that I define as being concerned, not only with the strategy of marketing and an intimate knowledge of manufacturing costs, but also a feel of the current of social change, for ultimately that really determines what things would be demanded and at what price.

Further, and this is more important, in the context of a socialist reorientation of an undeveloped economy, government's plans and policies determine even the course of autonomous business. In fact, in any real sense, private business has ceased to be autonomous. Government is not only the single largest party in the market, it is the ultimate banker in a real economic sense. The whole business of government now-a-days is a series of policy interferences which affect the distribution

of purchasing power and the whole manner and method of resource mobilisation.* Private business, therefore, is now an integral part of the whole social framework in which we find ourselves: government controls, social consciousness of fundamental rights, the worker's status as a dignified human being and citizen of a democratic state, and the like. The social *milieu* affects private business in every vital aspect of its philosophy and operation. I, therefore, consider *an awareness of the current of social change as an essential element in practical economics. In fact, even pure economics is now being considered as an integra part of the theory of social change.*

Nevertheless, businessmen would be inclined to ask what, after all, is the utility of economics for business decisions. Of course, the answer of it lies in the fact that most modern big businesses can hardly operate without professional economic advice. Most of them have regular economic advisers on their top management. Even small businesses would sometimes like to use the services of economists. They somehow vaguely feel the importance and value of economic advice but cannot afford it.

Contrasted with the situation is the fact that *not long ago most businessmen thought that they were economists themselves in their own right*; and I think we have to agree that there is some truth in it. A man doing business, successfully or even otherwise, for a fairly long period, comes to acquire what may be called an economic instinct, just as, for example, officers in Government, operating price and other controls for long periods of time, also come to have some sort of a feel of the market, which is in fact the essence of practical economics. Of course, there is—I have to confess from the depths of my own experience—a lot of presumptuousness in all this, for *the authoritarianism that characterises the governmental machinery can hardly go alongside that freedom of thought which is essential for valid analysis of economic data.*

What then is the real nature of economic decisions? Economists have for long periods of time concerned themselves with all aspects of business management, marketing, labour problems, business costs and profits and many other apparently unconnected areas of human thought and activity. Some economists have even got entangled into the very techniques of business and the very large species of economists, going by the name of steel economists, chemical economists, labour economists, government economists, etc., who live and prosper in that most affluent of modern democracies (the USA) is numberless. The species is growing here, too.

As a professional economist, I am interested in the profitability of my own business and I think that *it is professionally very profitable that the confusion with regard to the omniscience of the economist should persist as long as we can have it — till somebody calls the bluff.* However, having been a professor for the larger part of my working life, I flatter myself that there is yet a streak of intellectual honesty in my mental framework.

Let us get back to fundamentals. What is Economics? Economics is based on two very simple propositions: the world in which we live is characterised, on the one hand, by an infinitude of desires, and on the other, by the patently finite nature of its resources. Consequently, every community and every individual is faced with the problem of choice between alternatives. There are just 24 hours in the day ; and there is no genius who, within the limits of time, can accomplish all he desires. We are, therefore, at all points of time, faced with a compulsion of choice in the sense that if we take one road, we just cannot take another. This is the essential nature of an economic problem. It will thus be seen that economics as such is not concerned with wealth

*In fact the bare truth of the modern business of government is that governments create resources. Every decision of government (if we analyse it in depth) creates (or destroys) resources. Perhaps U Thant, UN Secretary-General, stated it somewhat strongly and fearlessly, not being tied to any government : "The truth, the central stupendous truth, about developed countries today is that they can have—in anything but the shortest run—the kind and scale of resources they decide to have....It is no longer resources that limit decisions. It is the decisions that make the resources...."

or money or energy or chemistry or labour or finance or banking. Every problem has its economic aspect in the sense, again, of choice between alternatives. *Every man, businessman or otherwise, is compelled by the facts of life to be an economist, in the sense of making decisions continuously between objectives which he can accomplish and objectives which he cannot accomplish.*

From this, in fact, has emerged the whole idea of opportunity cost, that is to say, the cost of something is that which has to be given up to attain that something. The cost of learning, for example, may be the giving up of money or of sleep or friendship or love. This, in fact, is the real nature of cost in economics.

Hence if we are asked as to what the substance of economics is, we have to confess that *it has no substance essentially, in the sense of an exclusive area of knowledge but that it covers the whole field of life in a somewhat limited way;* that is to say, wherever there is a scarcity of resources in relation to ends, there is an economic problem. That is the universe of economics.

Let us illustrate. When a boy, for example has to decide after graduation whether he is going to take to private business or to philosophy or to take a government career, it constitutes essentially an economic decision. It is not open to him to accomplish all the ends that he might possibly have in view. When, for example, a defence minister chooses between bombers and fighters or decides to spend more on air force than on the navy or the infantry, it constitutes essentially an economic decision. When a businessman decides how to distribute his time as between his business and his other private affairs, the essential nature of the economic decision is just the same. There are alternatives or choices, which are not all open to the individual or the community to accomplish. Even the decisions of the mystics as to the time that they will devote to the affairs of the world and the life of the spirit are in the category of economic decisions.

Economics is thus not a fundamental science in the sense of being concerned with ends or values. It is worthwhile repeating that wrong or right is absolutely outside the business of the economist. *It is not for the economist to prefer between war and peace, between democracy and authoritarianism, between soap and furniture or between steel and chocolates.* These are matters of, what the Anglo-Saxons call, values and they are outside the scope of economics.

We can now, with a clear conscience, discuss the relation between economics and business. Economics may be legitimately and validly described as a *science of business behaviour.* A businessman or one who desires to be a businessman is faced with certain choices. Economics is concerned with how those business choices are made and the basis of business decisions. In fact, in the context of economics, as we understand it, the analysis thus becomes simple and straight.

Pushing this analysis a little forward, we may also define economics as *the science of business expectations.* A man, desiring to do a certain line of business, proceeds on certain expectations, as much as a man who desires to marry. The latter has, however, a vague idea of what married life would be like, over a fairly long priod of time. The analogy is quite perfect in the sense that the businessman's expectations are really as vague. This is proved by the very patent fact that many businesses, in fact, go down. Many businesses make very much larger or smaller profits than expected. Here, of course, the economist, inclined to make his own business as profitable as possible, emerges as a research economist, trying to make a scientific appraisal of business expectations in general in the context of the overall social environment, government policies and the like, advising individual businesses of what their respective business expectations might well be. The business of economics has thus expanded considerably and it has a very bright future in India.

We may, at this stage, attempt some sort of a break-up of economic theory on the biological model and divide it into two categories, popularly called, micro-economics and macro-economics. The first type of economics, which

was the fashion at the universities, till the Great Depression, was based on the essential fact that all decisions are decisions of individuals in a real and final sense. What appears as aggregates are only statistical summations. Probably, in the context of later developments in economic thought, this would appear somewhat elementary or even ridiculous. One man desires to purchase a hat, another man also desires to purchase one, and so on. So we have an aggregate demand for hats.

The Great Depression proved that the individual was really a unit of little consequence. As a farmer he decided to plant all his acres with wheat and mortgaged his land to cover the cost of cultivation. He worked hard and produced, with favourable weather, a bumper crop; but found at the end of it that there was just no market.

Lecturing in the early thirties on agricultural prices, a Sikh student of mine asked me if I knew the price of wheat. I did not. Of course, I knew the broad trends in prices and the theory of prices. But before I said so, that student remarked : "*Sir, it is worthwhile your knowing the price of wheat. I have a farm and I have wheat on the spot which I am prepared to sell for one rupee a maund and at that price there are no buyers.*" So even if he desired to purchase a hat, he was not in a position to do so, for there was no demand for his wheat. Thus emerged, as powerfully valid concepts, the aggregates now popularly known as the total volume of employment, spendable incomes, sales, the total volume of output, and so on. If the total volume of employment declines and with it the total volume of incomes, the capacity to spend (and to save) declines cumulatively, for a fall in employment in certain lines means loss of demand by those who lose their jobs. This, in turn, means less demand for other things and so on. A whole vicious circle is thus set up. For quite some time, the economists could not find an answer, for individual decisions as such could not pull out the whole economic community out of the morass.

The late Lord Keynes, a Cambridge economist (operating simultaneously at the London Stock Exchange) tried to reorientate the whole direction of economic thought by a series of powerful publications culminating in that most refreshing of all his works (*The General Theory of Employment, Interest and Money*), which proved that it is the aggregates which mattered and individual decisions depended upon the behaviour of those aggregates. However, to use his own words, his writings were the croakings of a Cassandra ; and not until the radical experimentation of Franklin D Roosevelt, known popularly as the New Deal, did those policies attain a respectable status in the field of economic thought. The whole system of private business or what is known as capitalism would have collapsed but for those rapid series of economic decisions taken by the Great President.

Apart from top policy decisions, there is great need in these days of the knowledge of economics in business operations. These may be classified roughly under three headings : (a) business fluctuations, (b) strategy of marketing, and (c) the art of economic adjustment. Probably on a deeper analysis there is not much difference in these sub-divisions. That business is subject to fluctuations is intimately known to men in business; only that they are unable or consider it uneconomical to spend their time and energy and other resources on the appraisal of such fluctuations and the likely impact of such changes on their own individual units. It is now a general experience that there are times when business is expanding and practically all businesses are making larger and larger profits ; and there are times when profits become smaller and smaller, markets contract and the like. Every businessman knows these fluctuations as part of the game of business. Such times have to be anticipated, their causes known, and some sort of hedging done as far as practicable. Preparedness for such eventualities should be a part of business, and this preparedness must be done scientifically by valid collection and interpretation of data. By and large, however, businesses do not equip themselves with such knowledge.

As against general unpreparedness for meeting business fluctuations, businessmen

have, by and large, a good sense of strategy in respect of marketing. It is economists, particularly outside the USA, who have shown ignorance of the importance of marketing. Marketing, in fact, has been a neglected subject in economic thought on *the classical assumption that markets take care of themselves.* It was only after the Great Depression that really scientific thought has gone into the whole strategy of marketing. This is a line in which private business in this country is the most deficient. Probably, this is the line in which economists could be profitably employed by private business from almost every point of view. And it is really a great intellectual exercise to do a marketing survey: such marketing surveys get you into the depths of life. As one goes backwards and forwards in a marketing survey, the areas opened out are really charming. The economist would find this aspect of private business as a greatly enjoyable and rewarding experience. The Indian businessman knows his business intimately and deeply but he is ignorant of marketing and that is the tragedy of private business in India. *Most small businessmen lose in this country because they do not know the markets in which they buy and the markets in which they sell.* They have little knowledge of the incomes and tastes and fashions of persons with whom they deal, but the prospects are encouraging. In fact there are evidences of aggressive salesmanship almost on the American model. And economists may look ahead for substantial jobs in the direction.

After having grasped the strategy of marketing, businessmen have to develop the art of economic adjustment. We cannot dictate to markets. Markets are what they are and markets are what they will be. *Production processes are not sacrosanct. They must be adjusted to market requirements.* That, in fact, is the basis of what we call statistical quality control in the theory of productivity : that a product must possess the quality characteristics exactly as the market requires. That, in fact, is the whole theory of productivity; *that business is the most productive which has the capacity to adjust itself to market conditions.* On this, it is difficult to say, as a professional economist, what really an economist can do. Probably other species of experts, with alert mind and trained common sense, can do as well.

That brings us down to what is now called applied economics. Orthodox economists do not yet admit applied economics as a part of their system of thought. There is probably some truth in that, but there is a demand for applied economics ; and we must, therefore, know what it is about. In applied economics as we know it, the businessman first desires to know what Government is going to invest, for example, in steel: What will be the cost of labour legislation? How does 'my industry' fare in the next Five Year Plan? and so on. One cannot say, if all this is really economics. Probably economists have just come to acquire incidentally a better knowledge of all this government business than other people.

More important and probably more valid in terms of economic analysis is that part of applied economics, which is concerned with resource utilisation. For that is a matter of choice between alternatives: more of certain resources and less of others and their most economical combination—the whole series of choices which have to be continuously made from point to point really do fall within the scope of economics. The practical businessman would probably feel relieved if the whole area of economic decisions regarding resource utilisation be left to some professional economists, productivity experts and the like. Of course, the businessman would insist on his criterion of profitability. All this enquiry into the affairs of Government, what government proposes to do or not to do, all decisions for or against the various alternative methods of resource utilisation must ultimately be based on the profitability of an industrial unit. An economist cannot quarrel with that position. In fact he must treat it as a given end, and all advice regarding resource utilisation and other matters must be given with a view to maximising long period profitability of the concern of which he is the adviser.

We must now traverse the field and go over to what is called dynamic economics. That is

the whole of the socio-economic environment, as encompassing and determining the nature and the direction of business. In fact industry is now regarded as an integral part of society and one of the major contributing causes of American success in industry is the realisation of that fact by the group known as Big Business. The success of Ford, Rockfeller and others like them is due to this intimate realisation that industry, its management, its labour, are part of a society which, in order to be profitable or productive in a wider sense, must function harmoniously and the factors that enter into the harmonious functioning must be studied by social scientists. In fact, American business—every single part of it—is under continuous study by professional sociologists and economists; and business decisions cannot just be taken without such professional advice in exactly the same manner as a minister of defence must be advised by his chiefs of staff. A businessman can disregard with impunity the advice of a competent economist at as much peril (to his profits and to his career as a businessman) as a war minister who disregards the advice of his commander-in-chief on military logistics.

This whole process known as dynamic change opens out quite an area of interesting analysis. Capital formation to which such importance is now attached in undeveloped economics and even in developed economies as an employment boosting function is, on analysis, a social process. The Victorian capitalist on the whole lived austerely and amassed money unlike the modern capitalist, who, like all other persons, desires the good things of life. In the Victorian period, the worker, of course, was denied comforts of life; but Anglo-Saxon industrialists had themselves a puritanical background. The whole of the Victorian philosophy was based on abstinence. The men who founded the great trading companies worked for 14 hours a day, sitting on wooden stools or talking to cotton merchants in the bazaars of India. Capital was found out of their savings: the willing abstinence of the rich and the enforced abstinence of the poor.

This situation has now changed, for all men and women want to have all the good things of life all at once. In such a society, how does capital formation occur? This, in fact, is a pertinent question; but the point to be stressed is that *the whole thing known as capital formation is essentially a social process,* a bi-product of the working of social forces and has to be adjusted to the requirements of the social situation. One of the reasons why the State comes in as a powerful factor in the investment policies of an under-developed economy is this change in social affairs. *People are poor and they are inclined to spend all that they have. The rich have surpluses but they are heavily taxed and at the top of it they and their women and their children want to have the fullest luxury of life as far as it can go, "while the going is good".*

In the dynamics of social change it is necessary to have a full look at the labour problem. Labour has acquired a new value, a new social perspective, a whole new philosophy. In fact, the essence of the communist challenge lies in the blindness to the new position that labour has acquired in the society that has emerged out of the two World Wars. *It is a feeling that has gone deep into the souls of the people that while they are asked to make a full sacrifice of life, there are others whom society allows simultaneously to make large profits out of social disaster.* Private capitalism can only survive with a heart-felt recognition of the whole dynamics of social change involved. *Unless we all feel that we are comrades in a common task, the society in which we live faces disaster.*

What then must we do to make a rapid descent to the earth? The answer in countries like India is economic planning. It is all *a fib of the imagination to believe that the economic systems in the western democracies—the United States particularly—are unplanned economies.* The whole of the FDR code, particularly such legislation as the United States Employment Act of 1946, are types of powerful State planning. *The Board of Economic Advisers to the President, the Federal Reserve System, the Stock Exchange Commission (to mention only a few of them) are instruments of planning, in fact, more effective than planning in India, which has so far been a listing of public projects and probable lines of private activity.*

This brings us to the theory of planning, with particular reference to private business. That businessmen are interested in the Five-Year Plans, is obvious enough through the questions they ask as to how much government is going to spend, what part by deficit financing, whether plastics or petrol (and how much of it) are in the next Five-Year Plan, and so on. That private business is interested in Planning, the shape it takes, the investments that are going to be made, etc., is clear enough.

We, however, are interested in the theory. The theory of planning is essentially economic in its nature, according to the pure definition of economics: where resources are scarce in relation to ends, the problem is one of economic choice. We want steel, chemicals, cement, power, bridges, roads, food, clothing, housing —all simultaneously. We just do not have the resources ; and *we cannot leave it to the autonomous working of social forces. If we do, we shall get lot more of Coca Cola and nylons, but very little of steel and cement and education and culture.* There must, therefore, be planned investment in certain priority lines. Planned investment need not mean investment by Government, but it does certainly mean a direction of investment. The State must itself invest in those lines which are either strategic or lines in which private investment on a socially desirable scale will not occur in any reasonable period of time.

More important than this is that the State must indicate particularly the lines in which private capital, both domestic and foreign, must go. Of course, the State must simultaneously give all the incentives it possibly can; and make the climate as attractive as possible for private business, under the present social circumstances. Planning does not necessarily mean State acquisition of or control of the instruments of production.

It is in this context that we have to understand the Five-Year Plans of India, the Soviet Union, Eastern Europe and China. They are almost all probably called Five-Year Plans but that is just a name. Now Seven-Year Plans are coming into fashion; and we have also introduced perspective planning in our country, but the broad distinction between our democratic planning and planning in the communist block is now well understood. India has no intention, nor the machinery to regiment resources, as China is doing or has been done in Eastern Europe in the post-war period or was done by the Soviet Union in the period of Stalin. This is an essential, fundamental difference, though it is held by some social thinkers that in course of time the totalitarian regimes will undergo an internal liberalisation as is in fact evident in the Soviet Union and some of the countries of Eastern Europe.

Summing up : between private business and economic knowledge and sociology, there has emerged a rather intimate connection. In fact sociological researches have led to enormous increases in the productivity of American industry ; and have led to the avoidance of social tensions that might otherwise have been the cause of serious industrial strife. This line of approach has almost infinite possibilities of application in our own country.

Nuclear Illusions

Thanks to the late Dr. Homi Bhabha's superb public relations work, apart from his very real scientific and organisational accomplishments, there have grown in this country a plethora of nuclear illusions. Many people seem to think that India can make an atomic bomb tomorrow or the day after; they also seem to think that a bomb need not cost very much more than a tin of *vanaspati*.

from 'A Ditcher's Diary' in the *Capital*

Choice of Management Tools

MN Bery*

The application of the more rigorous methods of theoretical sciences to problems of industrial operations and economic activity has produced a whole array of management tools. Concurrently, the computer and its programmer, the Systems Analyst, have enlarged considerably the scope for study of multi-dimensional problems and systems. This evolution in the science of management, if we can at this point of time speak of such a science, is no coincidence. The manager and policy-maker today function in a complex technological and economic environment: an environment in a state of constant flux. And there are no simple solutions or single answers to the problems the administrator has to face. Intuition, a firm straightforward grasp of logistics, thumb rules built up over years of experience are excellent assets in relatively simple tactical situations. But to ignore the utility of applying more logically-based techniques in the strategic areas of decision making or for resolving the tangled skein of interlinked activities even at the tactical level, is like asking the pilot of an aircraft to fly without instruments and navigational aids. Meteorology, for instance, is not an exact science, as pilots have reason to know; yet they use weather forecasts along with other specific data on their aircraft and ground facilities, to set up their flight plans. The point to emphasise here is that we must first have a clear understanding of the instruments we have at our disposal and then, having chosen the one appropriate to the problem, know how to interpret the results correctly to realise the objectives we have in mind.

THE BASIS OF THE SOPHISTICATED MANAGEMENT tools is mathematical or statistical. A manager is not required to possess a high degree of proficiency in mathematics or statistics to understand them, nor does he have to be a competent programmer of computers to know what computers can do for him. All he needs is a reasonable acquaintance with the number system and algebra and a good working knowledge of how the process specialists go about their job and build up their structure. The specialist, on the other hand, has to go beyond the identification of the problem as presented to him. He has to acquire thorough familiarity with the conditions in which the problem exists, define its boundaries after evaluating the type and quantity of data he can collect and analyse in a given period of time, clarify objectives and test how close his assumptions are to realities before he can go about setting up the model of the structure he seeks to approximate and analyse.

Matching the tool to the problem is an area in which many a manager and specialist have run aground. Valuable time has often been lost and resources wasted by failure to relate the problem to its environment and objectives, not just to identify it, at the initial stages. *The attraction of sophisticated techniques is too great and has such an air of modernity about it that managers with blind faith in these methods have handed out problems to research teams when simpler yet equally scientific techniques could have given the answers in less time and*

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saved unproductive effort. Specialists have fallen into this trap just as readily.

Management Of Projects

PERT, CPM and Bar Charts, in that descending order of sophistication, are the three choices open to management in the scheduling and control of projects. The choice can be any one or all the three, each applied selectively to different aspects of the main project or to its component sub-projects. The bar chart is widely used, because it is simple to construct and alter as circumstances change and no special skill is required for its upkeep. If worked out in sufficient detail, critical elements can be identified and a "control by exception" system designed around it. Preference for this simple method is also attributable to the circumstance that in a developing economy like ours, the reliability and stability of situation factors are not assured over the whole spectrum of activities : consequently there is no knowing in advance how and when critical elements may change or new elements crop up. *By itself, sophistication may not produce better results, but it is certainly worthwhile if, in the long run, it succeeds in generating better discipline in the management of projects.*

What the Bar Chart does not show is the time-sequence relationship of interdependent activities. A 'network', built-up and annotated according to prescribed rules and definitions, does this and more. It identifies the critical sequence of activities/events—the "critical path"—and *the degrees of flexibility or slack available in the non-critical sequences.*

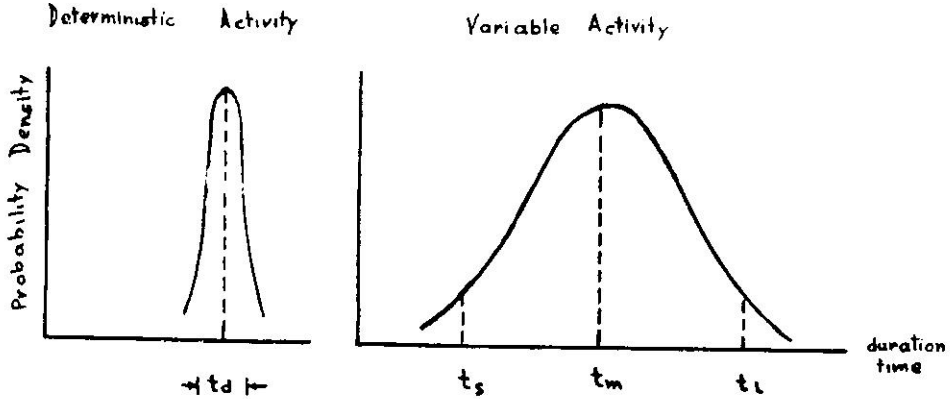
PERT and CPM have the critical Path Methodology in common. Where they differ is in the type of activity handled and the way in which the activity duration is reckoned. This difference is important. In recent years, there has been some confusion in the proper choice of technique and even greater confusion in terminology of the actual methods used.

Generally speaking, activities are of two types : deterministic and variable. A *deterministic* activity is one which, for a given set of resources, has an execution or duration time that can be determined with certainty : variations, if any, are within very narrow limits and the influence of chance on the outcome is negligible. Most construction projects are made up of such activities : excavating ordinary foundations, fabricating and erecting steelwork, laying concrete or reinforced concrete, installing plant and equipment or an electricity distribution system are typical examples of more or less fixed duration times.

Variable activities are those the outcome of which is influenced significantly by random factors, and as the duration is liable to considerable variation and cannot be fixed with certainty, three different estimates of time are required to evaluate the possibilities. R&D Projects, excavation in un-sampled soils, mining and geological prospecting, development of new products or import substitutes are examples of variable activities. The three estimates of duration are: **the shortest unlikely but possible time, the model or most likely time and longest unlikely but possible time.** Though the estimates are deduced from the informed 'opinion' of specialists engaged in the particular activities, the analytical treatment is based on the theory of probability, more specifically the probability densities of continuously variable events. Whether the probability statements are made objectively or subjectively does not alter the utility or validity of the theory, provided the judgment is rooted in experience and competence in the field. The normal distribution curves of probability densities and duration times are shown in the Figure on the next page

The CPM technique applies to the scheduling and control of construction projects and, in general, to all activities of the deterministic type. Bar Charts are usually adequate for simple projects, or in conjunction with CPM, for parts of major projects, *where the critical factors in the sequence of interdependent activities are so obviously evident that the network form of treatment becomes a needless complication.*

PERT, as the name implies, is essentially a technique for programmes and projects comprising activities the individual duration of which cannot be fixed with certainty, and the outcomes are derived by making probability



t_d = Limits of duration time variation narrow
t_s = Shortest possible but unlikely time
t_m = Model most likely time
t_l = Longest possible but unlikely time

statements about uncertainties. One aspect of the theoretical basis of the method is of particular interest. The integration of probabilities of a whole series of activities along the critical path, or any path for that matter, improves the chances of meeting the final schedule of the project. Conversely, this means that *a single activity of the variable type, included in a project made up largely of activities having a fixed duration, can sometimes introduce a greater degree of uncertainty in the final schedule than if all the activities were variable in character. Combining PERT and CPM in a single network is, consequently, not an effective way of dealing with such situations. If a variable activity is critical to the project, a more practical approach is to isolate and treat it separately and set up the CPM network, assuming a model or mean time for the variable element treating it as critical even if it is not on the critical path.* Mining schemes, preceded by prospecting, are examples of this kind of project.

The Indian environment is so fraught with uncertainties of availabilities of internal and external resources that there would be, perhaps, a temptation to apply the PERT technique to most projects. Apart from the sophistication of the method it is not easy to maintain and its adoption on what are basically CPM projects may introduce needless complications and may vitiate the principle of control by exception by multiplying the number of exceptions that have to be watched. It is far more practical to identify the particular set of critical resources, in whichever part of the network they may lie, and watch their flow separately by means of a simple bar chart. PERT is a most effective tool when a project to which it is analytically adapted is large enough to justify the continuous employment of a computer for evolving the network and its upkeep during the course of execution as well as for supplementary studies on analysis of resource allocations by linear programming, on time-cost trade offs and on the planning of operations in the different areas and phases of development.

Management of Operations

The guidance, control and planning of operations requires the assembly, interpretation and analysis of data. Management tools provide the means for realising these purposes. Most of the tools now available in the kit are not new : their origins and usages date back to the beginnings of mass production in industry —by which time the application of mathematical and statistical methods to the design and conduct of scientific experimentation and research had already been firmly established. *What is new is the change in approach: the*

endeavour to find specific and quantitative solutions to applied problems. And the electronic computer, with its capacity to process and rearrange rapidly masses of data in a variety of ways has, of course, opened the door to the analysis on a large scale of highly complex propositions. Though the ranges of activity and the computational methods overlap, the tools in the manager's kit can be arranged roughly in three groups :

STATISTICS
WORK STUDY
OPERATIONS RESEARCH

The basis of statistics and operations research is fundamentally mathematical. They differ, however, in approach and the kind of solutions offered and there is some overlapping in the analytical treatment of problems because of their common foundations in abstract mathematics. Work study is basically an empirical technique. It relies heavily on direct observations and measurements; but statistical and mathematical concepts are applied to the extent necessary in the design of methods of data collection and analysis.

Statistics is concerned with the assembly and presentation of data and finding facts logically from figures or getting as close a representation of facts as possible. The approach to problems is generally one of identifying the component aspects and tackling each separately. Its aim is to bring out the facts as it sees them, evaluate their significance and leave the inferences and judgments to the qualitative processes of decision-making. *Statistics are to the manager what the compass, sextant, charts, radar and echo-sounding equipment are to the master mariner—aids to navigation.*

Two reasons explain the popularity of statistics. First, it is one of the easiest ways of presenting and interpreting facts in the shorthand language of graphs, percentages and tables of figures. Secondly, while its more esoteric techniques are the preserve of statisticians, the forms in which it is most generally used and understood are disarmingly simple and require a mathematical facility no higher than school arithmetic. Statistics pervades every sphere of organised activity: from opinion polls to the inner sanctuaries of scientific research. Indices, ratios, means and averages, fitting data into trend patterns, evaluating fluctuations and forecasting assist management in monitoring, controlling and planning operations. The statistical techniques of sampling, ranking data, estimating probabilities, relating causes and effects, and testing the significance of associations are the handyman's tools used in a variety of analytical methods for resolving subsidiary problems.

Work Study is a branch of industrial engineering—so named because it has been developed and employed primarily by engineers for improving productivity in industry right down to the level of the individual operator on the shop floor. *The objective of higher productivity is not merely to correct obvious inefficiencies, but to exploit fully the possibilities of radical improvement in work simplification, working conditions, plant and equipment layout and in cost reduction by devising logically-sequenced and rationally-designed procedures and methods for subjecting all operations to close analysis.*

As mentioned before, work study is fundamentally empirical in content ; direct observation of operations and precise work measurements are made, and productive and unproductive activities are identified and segregated: standards are established and applied to operations, plant and equipment utilisation and layout and working conditions. The information so assembled is then sorted out, analysed and translated into process and flow charts, diagrams, graphs, network plans and into statements comparing existing with revised methods. A balance sheet is also drawn up of changes and net reduction in recurring and capital costs. In this way a new improved structure for the conduct and planning of operations is created. The solutions obtained are clearly defined and quantitatively expressed.

The technique is also adaptable to the theoretical study of operations of new projects at the planning stage.

All empirical techniques use probability theories and statistics for taking observations and measurements and in experimental work. The scope and range of work study methods has, in recent years, been considerably enhanced by the application of linear algebra, queueing theory and other combinatorial and stochastic processes of mathematics.

Work study is today a very comprehensive, multipurpose tool of analysing parts of systems and complete systems of operations where the variability of a large number of factors is, within the limits of the operational conditions, so small as to be regarded as constant. Mass production systems in industry are the most typical examples. But this definition of operations, which, of course, limits the objectives of the analysis, covers a much wider field than is generally believed. In operations analysis, work study has often yielded significant benefits when other conceptually more elegant analytical methods have either found the problems intractable or have had to adjust their objectives to produce solutions which are in no way superior.

Operations Research has been defined as "a scientific method of providing management with a quantitative basis for decisions regarding the operations under its control". Another later version defines it as "the design of an enterprise" which has been interpreted to include "the design of the systems which it uses". Yet another more recent statement, by persons experienced in guided missile systems engineering, is that "defining the need, providing the broad requirements, and final evaluations are the problems of operations reasearch".

None of these definitions give us any clue as to when and where to use operations research, although they do seem to tell us that the field lies somewhere between a "total systems approach" and "the evaluation of sub-systems within a system". Let us look at how operations research functions: it uses mathematical models for optimization of an objective or objectives.

Abstract model building is not unique to operations research. Any mathematical formula that seeks to represent a pattern of facts is a model. Statistics abounds in 'models', however crude or rough-hewn they may be. *A rigorous definition of the kind of model we mean is purely a matter of semantics and will get us nowhere. Again, categorising objectives, whether they are value judgments or not, really takes us no further because objectives are usually common to all forms of activity. We are then left with the concept of optimization and this is indeed the core of the process.*

Optimization means taking all the alternatives into account and determining which set of decisions will come closest to meeting the stated objectives. Generally, decision-making proceeds on the assumption that out of a known set of quantities or figures representing the different factors in the situation, some are fixed and others are independent variables: these are then determined in relation to the constant. Optimality analysis makes no such assumption: its approach is to recognize all the possibilities on the basis that *the occurrence of any of the possibilities depends, in fact, on the decisions taken.* Applied operations research does not, of course, pretend to be able to find the best of all possible decisions. The best that it can do is to approximate the true optimum as closely as inaccuracies of data, the limitations of the analytical tools and the difficulty of accounting for all the factors will permit.

The optimality criterion, linked with a correspondingly appropriate statement of objectives, is then the key to the choice of this technique in operations analysis. A further qualification, though less significant, is relevant. Data collection and evaluation take a much longer time than is the case with other methods. Unless the volume of analytical operations is large enough to justify computer time, this type of analysis is not worth going in for. This means that operations research is most effective when dealing with complete systems or subsystems of operations. This, of course, complicates the statement of objectives and a preliminary study for this purpose is always worthwhile before embarking on a project, however attractive it may look on the surface.

The optimality criterion can, of course, be applied to subsidiary single case problems by limiting the boundaries and the objective. This is in fact how OR — mathematical techniques are used in work study. This limited approach does not mean we are doing operations research : it only means we are using a computational process belonging to another field to amplify and make work study more meaningful.

The following simple example explains how extending the boundaries of a problem changes it from a purely statistical approach to an operations research technique. In quality control the problem is to determine how large a sample should be chosen for inspection and what the proper borderline is for the number of defectives in the lot. Statistical analysis sets up different sample sizes and rejection levels and calculates for each the probabilities that the number of defectives in the total output batch will fall short of some specified number. The sample design decisions are then made, perhaps somewhat arbitrarily, after checking that these decisions are more or less reasonable. There are obviously costs and prices associated with these different decisions. Too small a sample or too high a rejection level implies a high percentage of defectives in shipments, which may prove costly under a manufacturers' guarantee or result in loss of customer goodwill. Conversely, very rigid quality control standards are expensive and may price the product out of market. To take all these factors into account an optimization criterion is required. This problem can be transformed into standard OR — Decision Theory terms. Each relevant sample-size/rejection level combination is a strategy for the quality controller and for each of them the alternative possible pay-offs can be written up in a pay-off matrix. The optimal strategy can then be evaluated by Decision Theory methods and criteria.

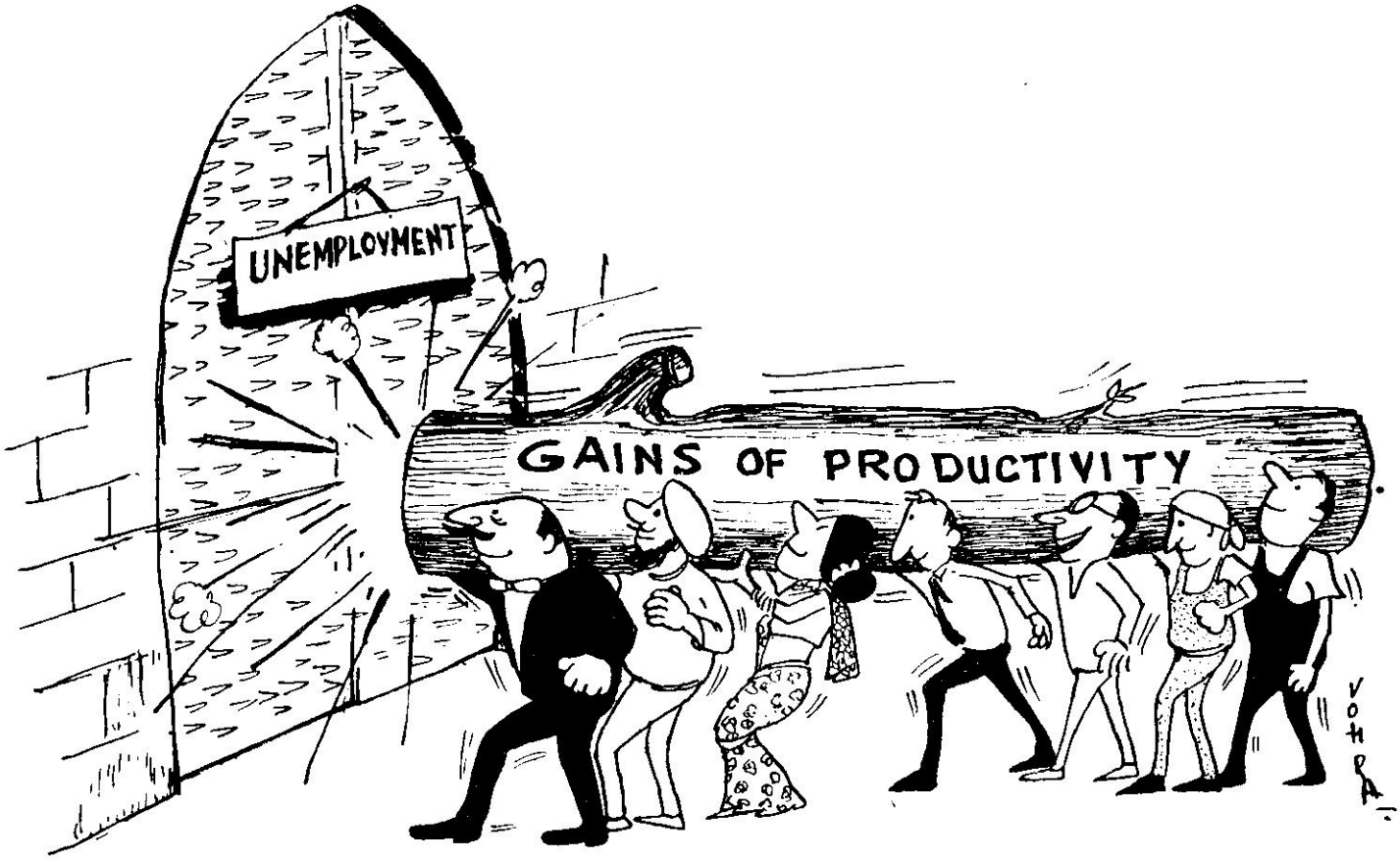
Computers & Mathematical Programming

Of the two main types of computers, the digital and the analogue, the former has the widest application in management. The analogue computer is a specialised tool for analysing engineering design and other problems involving the feedback principle, where the mathematical models are analogous to the electronic circuitry of the machine. Problem-solving is by constructing electric analogue models which can reflect continual changes in the complete physical system by feeding in changes in the component parts of the system.

The digital computer is arithmetical in concept; hence its widespread employment in book-keeping and accountancy, wherever data has to be stored and sorted out *en masse*. The arithmetic is performed at great speed and the selection of specific courses of action is made equally rapidly on the basis of numerical evidence. Any mathematical expression, representing real situations or abstract concepts, which can be transformed and programmed into a manipulation of numbers, can be processed in an identical manner. This facility makes the digital computer a truly versatile tool. The mathematical systems of analysis and the arithmetical forms into which they can be transformed and worked upon are:

Random Selection and Numerical Discrimination	: Probability and Statistics
Matrix Manipulation	: Linear Algebra
Numerical Discrimination	: Linear programming Combinatorial processes Theory of graphs
Iteration	: Theory of Functions
Numerical Simulation	: Monte Carlo methods Non-linear associations

Digital computers, though versatile in basic design, differ in the capacities of the equipment provided for input, output, storage and processing of data and for the monitoring and control of the sequence of processes. Computers have, consequently, to be more or less tailored to the specific needs of the system of activities they are expected to handle. Data-processing computer installations intended mainly for, say, accountancy work can also be oriented to problem-solving and it is always worthwhile including this requirement in the Systems Specification. One of the most important factors to be considered in the choice of problems for analysis is the time taken in setting up the computer programme.●●●


UNEMPLOYMENT
GAINS OF PRODUCTIVITY
VOHRA

Random Reflections on Management

Frank C Carracciolo*

A few years ago, Moorehead Wright, one of the Vice-Presidents of General Electric, travelled around the United States, speaking to professional societies and telling about how General Electric spent two and a half million dollars on research in the area of Executive Development and finally reached one very significant conclusion. They discovered that there is no pattern of personality traits that will, by some sort of magic formula, make a successful executive. Top-level executives come in all personality types, all sizes, all shapes and all patterns of behaviour.

THERE ARE CERTAIN BEHAVIOURAL CHARACTERISTICS that are common to almost all top-level executives. These are:

a. *Drive* : Pure physical energy is an absolute necessity. Work and the ability to do effective work for long hours is essential.

b. *A strong desire to become the top man* : Top level executives share this characteristic. These men are willing to make sacrifices and they are determined to reach the top. They have to be successful and they work hard to reach their goal.

c. *A willingness to work long hours* : These people are willing to work day and night, making sacrifices in their own personal lives to devote themselves to their organizations and their careers.

d. *Projecting an image of success* : Top executives look successful and act successful. They project a positive image of success and accomplishment.

e. *Management effectiveness* : There is no substitute for being able to do the job. The top-level executive produces, does his job effectively and conveys this impression to people around him.

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Information Theory

Information theorists talk about something they call the information loop. The information loop does not require the application of machine technology or the use of complicated data processing equipment. Basically this refers to a system whereby management creates policy and requests certain information from lower organizational levels, indicating how the policy is being carried out. Reports are synthesized for the top-level manager so that he may make appropriate decisions and further modify policy. Again, policy and instructions to implement policy are passed down to lower organization levels. This is an information loop.

The key to successful operation of the information loop is in the accuracy of information and speed of reporting, going up the chain of command. These summarized, precise reports should make it possible for the top-level manager to produce well-thought-out policy decisions. Going down the chain of command, policy implementation should be accomplished quickly and effectively. This

two-way flow of information is essential to dynamic organizational activity.

The Management Generalist

There is a widely held theory that management is a profession unto itself and that a well-trained and highly developed top-level manager can manage anything. Accordingly, some experts feel that we should conentrate on developing a specialized group of top-level executives who manage exclusively and who can be moved as needed to any required managerial assignment.

The United States Navy has maintained for many years that a top-level commanding officer at sea can also administer or manage an organizational unit on land. Accordingly, when naval officers are assigned to the Navy Department, sometimes in charge of highly technical programme areas, they do create some management problems. The civilians that they supervise usually accept the fact that Officer X will spend one year learning his job, one year doing the job and one year looking forward to his next assignment at sea. The Navy has developed an excellent programme for growing leaders and naval executives but at how heavy a price to the Navy Department in terms of poor decisions that are made while the man is learning his management job!

The point I am trying to make is this: *Where an executive administers a highly technical work area, he must acquire some technical knowledge of the area,* that is, he must know at least enough about the details of the work done at the levels below him so that he realizes the management implications of his decisions. He must understand his end of the management information loop. He does not necessarily have to be an engineer to supervise a group of engineers but he should understand their problems: what they are doing, and what the implications are of his own management decisions in terms of their work situation.

The corollary to this is that the more highly technical the area, the less the executive should be rotated. Commerce and banking, engineering, urban planning, space technology and medical research might be some examples.

Programmes that rotate executives are excellent for developing executive skills, and this is a highly laudable practice for this purpose. Rotation can also be used in large organizations where similar organizational units exist at all levels. An example would be our Bureau of Internal Revenue in the United States. Units and jobs are similar nationwide; therefore, people can be rotated among like positions with very little loss in efficiency.

We must continually ask ourselves the question : "What are we developing this man for?" Rotational assignments must come to an end at a point in time and then the executive should contribute to the organization by staying in one job for a longer period.

With these background observations, let us discuss the six main schools of management theory.[1]

A. The Management Process School

This group sees management as a way of accomplishing things through organized groups. In practice this means (1) analysing process, (2) establishing a conceptual framework for process, and (3) identifying principles underlying the process. This approach builds a theory of management and looks at management as a process that is essentially the same whether in business or government. The process remains the same but the environment of management may differ widely. Management theory is seen as a way of summarising and organizing experience so that practice can be improved.

This school of thought, often referred to as the "traditional" school, was founded by Henri Fayol.[2] Later innovators included Fredrick W Taylor.[3]

Basically, modern proponents of this school look at the functions of the manager—planning,

[1] 'Making Sense of Mangaement Theory', The Harvard Business Review, July-August, 1962, Harold Koontz.

[2] 'General and Industrial Management', Pitman Publishing Corporation, 1949, New York, N.Y.

[3] 'Scientific Management', Fredrick W Taylor, Harper & Brothers 1911, New York, N.Y.

organizing, staffing, directing and controlling —and attempt to distill fundamental principles that are true in the complicated practice of management.

B. The Empirical School

This approach to management is taken by scholars who identify management as the study of experience, followed by efforts to generalise from the experience and transfer the knowledge to practitioners and students. Typically, this is done through a "Case Study" approach or through the study of "Decision-making".

This school of thought believes that by analyzing the experience of successful managers or the mistakes of poor managers, we somehow learn about applying the most effective management techniques.

In order to benefit from management cases or experience, eventually, this group will have to draw generalizations from their research and enumerate principles. They will then end up stating many of the same porpositions as the Management Process School.

This approach has an inherent pitfall in that very few management situations report themselves in practically the same manner; thus relevant experience that can also be repeated is difficult if not impossible to duplicate. Another problem is that when a manager chooses one of several alternatives, he forever closes the door on being able to compare what might have happened, had he selected a different alternative.

Studying experience and case studies as used in the "Harvard Case Method" and the "Incident Process Case Method" is of some utility if one has the time ; however, it takes two to four hours to develop a case which may be illustrative of one principle. It has always struck me as a most indirect method of putting one's point across. Top-level executives have neither the patience nor the time to learn about management in this fashion. With young students and some middle managers, the technique has been useful and might be encouraged.

Where a dynamic group experience and the development of individuals in the skills of expression and thinking in management terms are desired, or where a specific project is worked out with a useful end result or report, the case method has a place. I would suggest that it should be used sparingly in these instances and only under the control of well-trained experts. For top-level executives, I would suggest that it be used rarely unless a useful project is involved or a report that is related to the top-level executives' organizational situation is produced as a result of the discussion.

In watching case study sessions, I have sometimes had the uncomfortable feeling that the instructor is involved in a complicated game with the students. The point of the discussion often remains either vague or incomprehensible. I think that most top-level executives resent this sort of incursion on their time. If a point of principle can be stated simply in about ten minutes and discussed in twenty more minutes, why spend three hours doing it the obscure way ?

C. The Human Behaviour School

This approach to analyzing management is based upon the fact that managing involves getting things done with and through people; therefore, management must be centred on inter-personal relations. This approach has been called the "human relations", "leadership" or "behavioural science" approach. Exponents of this school of thought seek to apply existing and newly developed theories, methods and techniques of the relevant social sciences to the study of intra and inter-personal relations, from "personality dynamics" to "relations of cultures". The stress is on the "people" part of management and the "understanding" aspects of this relationship. This school of thought focusses on the motivation of the individual and adherents of this school are heavily oriented towards psychology and sociology.

The range of thought in this school goes from (a) human relations and how the manager can understand and use this understanding, to (b) the manager as a leader and how he should lead,

to (c) a study of group dynamics and interpersonal relationships.

While human behaviour is a heavy factor in management, it would be difficult to accept many of the theories of this school as management theories although they explain many aspects of management behaviour.

Grid theory, sensitivity training, human relations training and a host of other techniques might be placed in this category. One of the basic problems inherent in the thinking of some advocates of these schools is a heavy pre-occupation with whether people are happy or well-adjusted at their work.

I personally feel that employees are paid to do a job. The organization has a mission to accomplish and people should contribute to this mission. Whether they are happy or not is incidental. I believe that there is very little relationship between production and happiness. Indeed, a little job insecurity might well increase production up to a point.

From the early 1930s and the Hawthorne experiments (which showed that varying work conditions, that is, light, favourably or unfavourably, caused production to go up consistently, with the key causal factor in production being the attention given to the group), there has been a great interest in the human behaviour school. Human behaviour must be recognized as a key and certainly it is one of the most important factors in executive development.

I think that there is great agreement on the point that human beings have goals, and value certain need-satisfying behaviour highly. We do find people exercising their material instincts, valuing job security, striving for organizational and social acceptance and working for monetary rewards which, of course, can be used to satisfy many needs. The *Human Behaviour school of thought sometimes goes too far in insisting that people need to be made happy so that the organization can function effectively.*

Indeed, I have seen some training courses that tend to be directed toward helping people find themselves or adjust. *Training courses and executive development courses should not be used as a medium to extend psychotherapy to maladjusted people. This is a business for psychiatrists.*

In fact, I would go one step further and say that *there are many highly effective top-level executives who have personality idiosyncracies, which, if altered, would damage their management effectiveness.* My point is that it should not be the business of Executive Developers to alter deep basic personality patterns unless they are willing and able to offer the individual something considerably better than what he has and I submit that one can't do this in a two-week or a three-month course. This requires years of effort.

This brings us to sensitivity training. Sensitivity training or group effort that is geared to project work to increase individual effectiveness and produce a cooperative project report can serve a useful purpose; however, "Who am I?" type sensitivity training, if not carefully controlled, can result in some of the difficulties I have already cited.

I do not mean to seem critical of the entire Human Relations School. It is important that people satisfy their needs, that they be considered as human beings and that organizations, managers, and top-level executives be concerned with the human element, *but not preoccupied to the point that they neglect whether people are doing a job or contributing to the organisation's goals.* Managers have to take a middle-of-the-road position in their approach to the human behaviour aspects of management. If employees do an excellent job, their efforts should be recognized. If they do a poor job they should be censured, demoted or disciplined in some manner. Without either recognition or censure, employees lack motivation to do a job.

D. The Social System School

Closely related to the human behaviour school (and often confused with it) is the school which includes researchers who look upon *management as a social system,* that is, as a system of cultural inter-relationships. These can be

organizational relationships or any kind a system of human relationships.

Heavily sociological in nature, this approach management does what the study of sociology —identifies the nature of the cultural ationships or various social groups and ots to show them as a related and usually system.

The spiritual father of this school was the Chester Barnard,[4] who developed a theory cooperation grounded in the needs of the vidual to overcome, through cooperation, e biological, physical and social limitations himself and his environment. Barnard's organization concept consists of any co-erative system where persons are able to unicate with each other and willing to tribute action toward a conscious common

Basic sociology and the analysis of concepts human behaviour have great value to manage-; however, *the field of management is not gy*. We are, of course, indebted to the gists for contributing a tool to study gement.

The Decision Theory School

Decision theorists concentrate on rational roaches to decision-making —the selection a course of action from various possible ves.[5] This approach may deal with decision itself or with the persons or rganizational group who make the decision, with an analysis of the decision process. expanding the viewpoint well beyond the of evaluating alternatives, many use theory to examine the nature of organi-structure, the psychological and social of individuals and groups, the pment of basic information for decisions the analysis of value considerations with to goals, communications networks and es.

[4] *The Functions of the Executive*, (Cambridge) Harvard sity Press 1938

[5] R Duncan Lucke & Howard Raiffa, *Games and* New York, John Wiley & Sons Inc. 1957

I view decision-making as a very narrow theory and *I don't think that decision-making training is the best way to develop top-level managers*. There are individuals who teach decision theory, expanding the concept to take in the nature of organization, value of decision factors, etc. This is not the most effective way to approach Executive Development.

The scientific approach to decision-making involves some of these factors:

1. Define the problem
2. Collect all relevant information
3. Indicate alternatives
4. Examine all of the alternatives and the solutions
5. Test the solutions, if you can (Operations Research techniques in some cases) make this possible
6. Select a course of action
7. Implement the action
8. Evaluate the results of the action.

After you have indicated that you use the Scientific Approach to bring together information on which decisions are based, what more can you say ?

F. The Mathematical School

In this group we have those theorists who see management as a system of mathematical models and processes. We have the operations researchers or operations analysts, sometimes called "management scientists". This group believes that, if management, or organization, or planning or decision-making is a logical process, it can be expressed in terms of mathematical symbols and relationships.[6] This approach forces the analyst to define a problem area; allows for the insertion of symbols for unknown data and through logical methodology provides a powerful tool for solving complex phenomena.

[6] Miller and Stan, op. cit. Joseph F McCloskey and Florence N Frefathen, *Operations Research for Management*, Baltimore, Johns Hopkins Press, 1954

Quoting from Dr. Harold Koontz about this school of thought—"..... mathematicians here forced on people in management the means... of seeing many problems more clearly; ... the need for establishing goals and measures of effectiveness; they have been extremely helpful in getting people to view the management area as a logical system of relationships; and they have caused people in management to review and occasionally reorganize information systems so that mathematics can be given sensible quantitative meaning."

Dr. Koontz had defined the mathematical school as an Operations Research School. There are other dimensions to this school and I would expand this to include the use of computer technology. This is *the wave of the future* and there is a great deal to be said about this area,[7] when we add computer technology to the mathematical approach.

Modern Managers face (a) increases in the size and complexity of organization structures, (b) increases in paperwork which stifle the ability to produce, (c) communications problems created by (a) and (b), (d) the need for instantaneous management response in the decision-making area (which requires up-to-date, accurate, comprehensive information), (e) increase in demands on management with less budget, and (f) increases in sheer numbers of people to be dealt with by government and business structures, particularly here in India.

In the United States, executives have turned increasingly to computer applications to solve these problems. Some of these computer applications include airline reservation systems, processing census reports, compiling technical information into data banks, banking operations (all banks now have computer coded check requirements, a recent development), machine processed accounting and addressing for magazine subscriptions, total systems approaches to organizational needs, logistics applications, issuance of payroll checks to large numbers employees (*i.e.*, Treasury Department or l corporate applications) etc.

Where a volume of paper reports or data involved, computer applications can make t work more manageable. I think that it important for executives to examine and th about certain very flat basic statements t I will make about automation or autom data processing.

1. Automation in terms of factory automation take jobs out of the economy and *does* employment.
2. Automatic data processing *may not* reduce ment. Sometimes it does and sometimes doesn't. It does reduce the level of skill requ ments for jobs and it may create more low paid, less-skilled jobs.
3. Automatic data processing is a one-way Once you automate, it is difficult to change to your former system.
4. ADP is extremely expensive and does itself in some rare instances where large vo of data are involved or where several applicat within the organization can be put on computer.
5. *Machines don't think.* Systems are only as as the systems experts who design them managers who use these systems as managem tools.
6. Managers *must* understand computer technol to manage these changes.
7. Computer technology does cause or changes leading to the centralizing o activit
8. Computer operations usually tend to increase size.
9. Computer applications force or analysis and organizational restructuring pyramid shapes to hourglass shapes. There i tendency to concentrate more decision-maki at the top and reduce the size of middle ment.
10. The introduction of computer applications the way for operations research applications.

Operations Research usually requires puter technology to analyse alternati Gaming theory, queuing theory and li programming are some of the techniqu This powerful management tool is excelle for decisions involving optimal mixtures

[7]Frank S Caracciolo : 'Developing Executive Knowledge in the Management Sciences'—Proceedings of 19th Annual ASTD Conference, ASTD Training Director Journal, July 1963, Montclair Printing Co., Montclair, N.J.

gredients, and for working out supply and ·ibution problems: Where should ware- ɔuses or supply points be located? It is uently used in military problems and has my applications. In fact, during World ar II, Operations Research was born in :eat Britain and was first used for military ɔblems.

Operations Research can be used for only :ain classes of management problems. When a model has been constructed and solutions ·e been tested, the manager can be assured that this decision reflects the best choice available to him.

Executive Development

I should now like to comment generally about Executive Development and how it relates to some of the management theories just mentioned. There are two ways to look at the development of executives.

The first method is to expose the executive to broader ways of thinking about his world through some sort of mind stretching experience, possibly a liberal education or a "Great Books" scheme or discussons with other top-level executives or academics. By developing a broader gauge human being we would hope that this executive would then make better decisions and accordingly his organization would benefit.

Another common approach is to provide the executive with information about the larger interests of his organization so that he develops a more complete understanding of relationships and goals.

The second approach is to use training based upon one of the six theories I have just mentioned or a combination of these theories. I have already provided you with a description of each of these schools of thought, with commentary about the applicability of the theory to executive development.

What are some of the ways of thinking of effective managers? and "How do you develop top-level managers"?

In the first part of this paper I spoke of drive, the ability to work (long and hard), projecting an image of success, and management effectiveness. This type of behaviour requires strong motivation and I am of the belief that this can be developed by experienced trainers, where the person being trained is willing to make the necessary sacrifices, has the proper mental equipment and attitude, and is constitutionally suited for this type of development.

Relatedness is the key to a great deal of Executive Development. Executives must see the relatedness of what they do to the mission of their organization and to the larger interest of their organization or government segment. Their decisions must reflect long and short range goals as well as serve the larger interests of their organization. The concept of Relatedness is crucial to executive development.

A management viewpoint can be developed and this is a way of thinking that characterizes almost all top-level executives. Technicians are interested in process and how things work. Top-level executives have their eye on a different horizon,—organizational goals. They are interested in whether they need more or less of something and how it relates to this goal accomplishment. They do not want to be bothered with detail that clutters up their desk. They usually delegate authority and responsibility to subordinates in order to avoid becoming bogged down in detail. They want to be presented with the essential information needed to make management decisions.

The Eclectic Approach

How should we develop today's managers and top-level executives? I submit that we must use a multifaceted approach, taking into consideration all the areas listed below and incorporating information from them into our programmes:

(a) Management principles
(b) Scientific decision-making
(c) Information theory

(d) Automatic data processing and operations research

(e) The behavioural sciences.

To these areas, in certain instances, we might add

(f) Some specific related technical skills

(g) Knowledge of Planning, programming and budgeting.

Finally, the application of special skills must be considered, particularly in a country such as India, with its multiplicity of people, cultures and ideas. Diversity must be served. Accordingly, to the above we must add as executive essentials

(h) Knowledge of language, culture and tradition, and

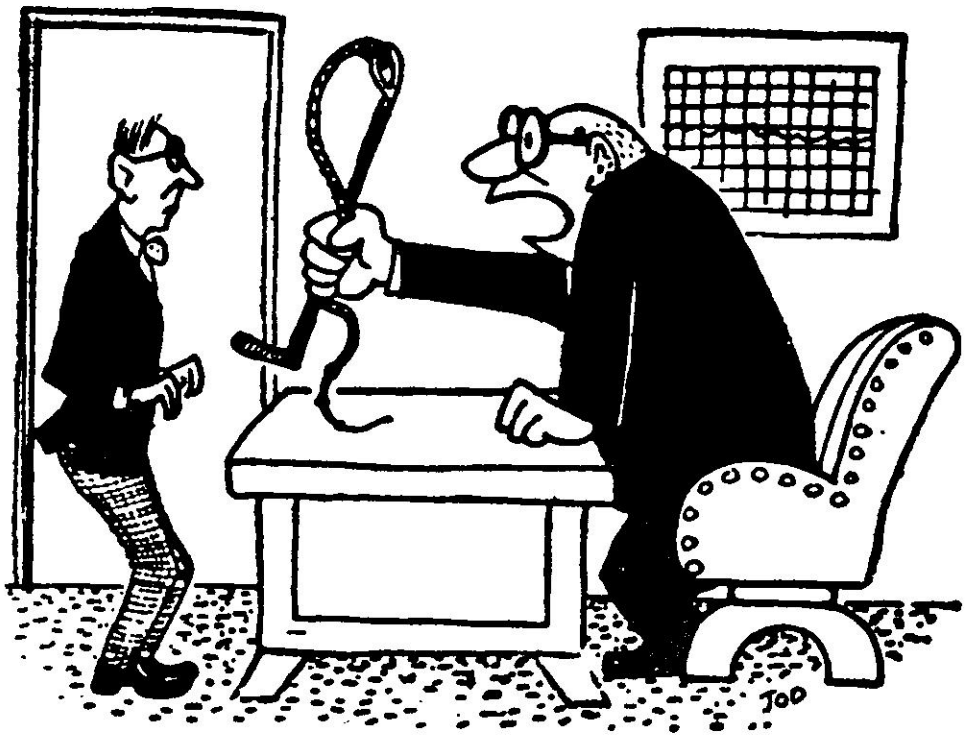
(i) Political knowledge.

The effective top-level manager uses all of these theories, ideas, concepts and ways of thinking in *proper balance* to do his job. and assist his organization in accomplishing its mission. Accordingly, executive deve should use a great deal of the same approaches theories and concepts to develop executiv ability.

Executives learn much of this from thei own leaders; however to create this type o development, there must be a favoura organizational environment, supportive training executive development and enthusiasti about growing executives who possess thes types of talents.

Conclusion

There is a challenge that faces government and business all over the world today. The leaders of our nations are working hard to meet the needs and expectations of their peoples. In order to accomplish this purpose, they must have top-level executives to carry out their policies. I submit the proposition that Executive Development programmes reflecting the best management theory and philosophy are a key part of meeting this challenge. ●●●



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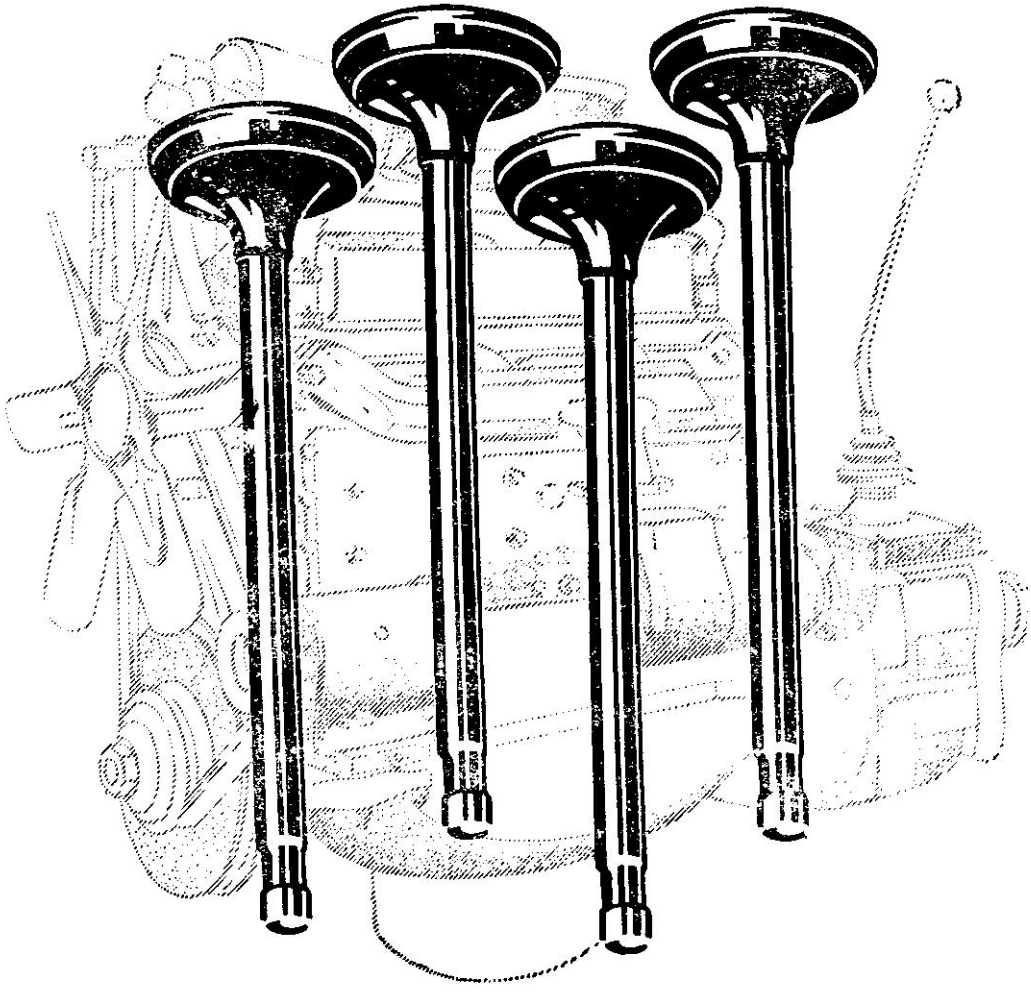

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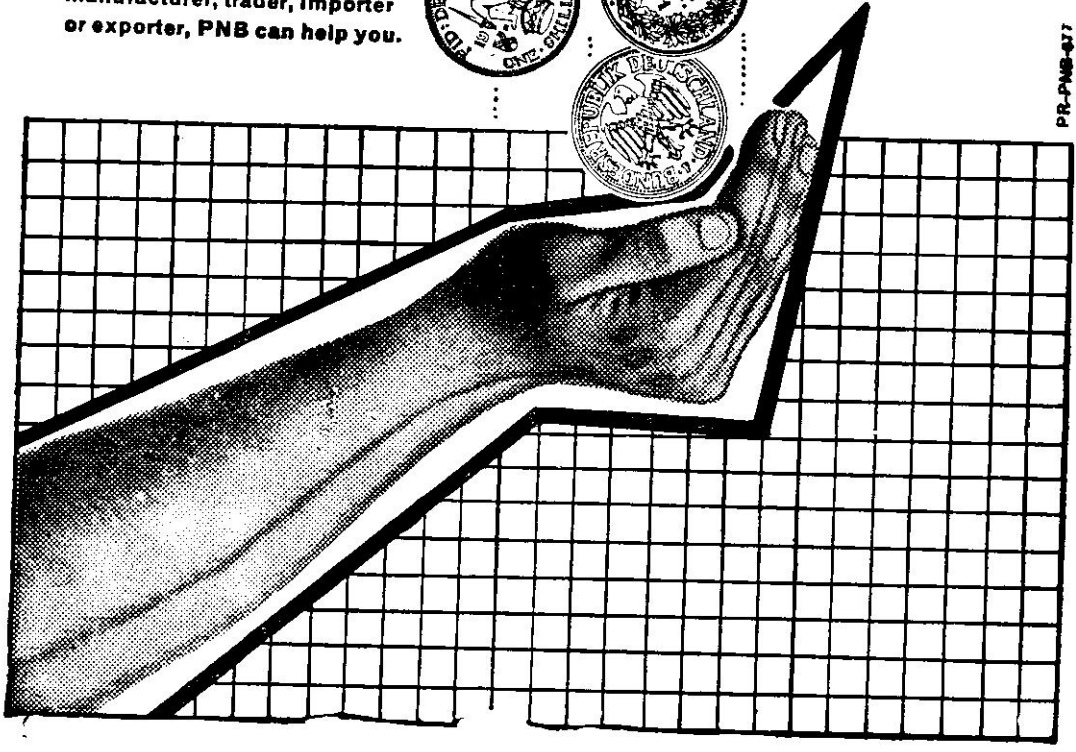

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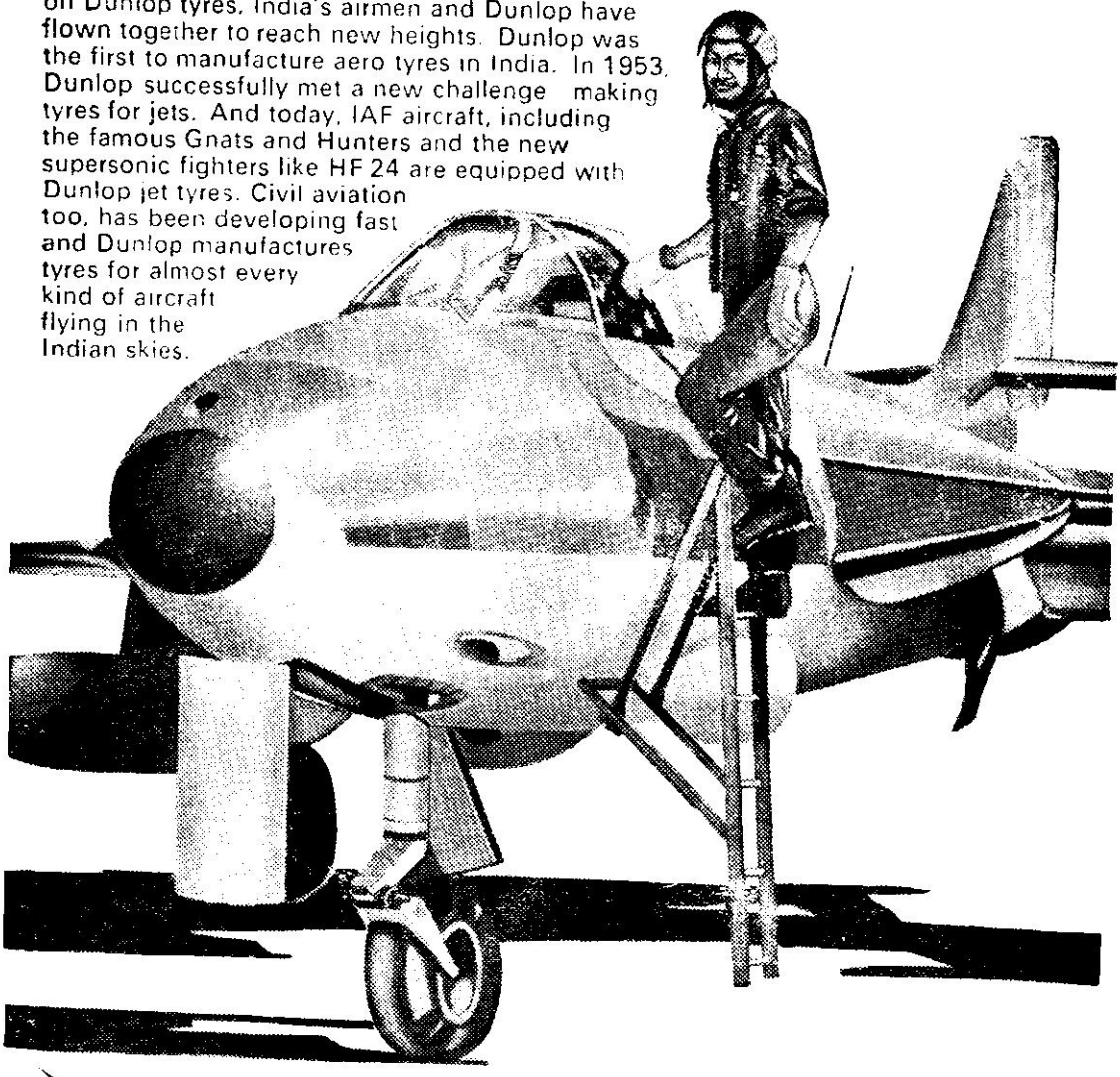

DUNLOP INDIA —keeping pace with India's Aviation

DPRC-21

Domestic Manufacture of Electromedical Equipment

TG Krishna Murthy*

The demand for electronic equipment and gadgets is rapidly going up, almost at a compound rate of 10 per cent per annum. The same is true of electronic instruments which have become invaluable in medical diagnosis, therapy and research. The marked improvement in materials availability position, since Independence, gives confidence for a substantial venture into the field. We are already manufacturing X-ray films, and we are shortly going to manufacture transmitting and X-ray tubes. Various items like precision resistors, wire-wound resistors, condensers, relays, valves, transistors etc., —essential parts of any electronic circuitry—are all being manufactured in the country.

CERTAIN SPECIALISED COMPONENTS FOR electromedical equipment, like balanced valves, low noise transistors, power transistors, very high voltage oil-filled condensors, have still to be imported, to the best of the author's knowledge at the time of writing. However, the trend is clearly towards diversification of activities by large enterprises, resulting in the development of this new branch of instrumentation. Many firms are thinking in terms of establishing new factories or expanding existing ones. Some firms are already manufacturing items which require small investment and for which components are readily available in the country.

It is now common knowledge that the functioning of the various organs of the human body—muscles, heart, brain, eye, etc., etc., can be electrically recorded. They respond to electrical impulses and they have probably their own electrical activity. Thus electrical instrumentation has vast potentialities in making the medical services more efficient.

At present, the electro-cardiograph, which has the largest demand amongst recording intruments, is being manufactured by two firms. The price of the unit is now about Rs. 8000/-; if the price could be brought down, the demand would go up threefold or more; and surely, at a time of recession the firms could cut their costs and sell it much cheaper. Many qualified physicians and cardiologists cannot afford to pay the high price. We also badly need a battery-operated cardiogram for a large part of our rural people who have not the benefit of electricity.

The electro-encephalograph, to record the electrical activity of the brain, has been found useful as a diagnostic tool in certain psychiatric and neurologic disorders. This equipment is generally a 12 or 16-channel instrument intended to pick up, amplify and record the electrical activity between any two points on

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the scalp by electrodes placed on it. Activities from different areas are fed to the various channels through a selector switch. As the voltage is in the range of microvolts, it needs amplification in the region of 10 million. This involves 3 stages of amplification, namely, pre-, intermediate and final, with appropriate filters to cut the activity from other areas.

The market cost of such a unit will be about Rs. 1,00,000/-. Here is surely a field for Productivity: for if we can cut the costs substantially, we can make the instrument available for common use, at least at the district general hospitals throughout the country. As it is, the demand at Rs. 1 lakh a piece is bound to be extremely limited.

The electromyograph has also very limited demand at its price, but it is a useful instrument for the neurological examination of muscular disorders. Multi-channel recording units coupled with transdusers would be extremely useful in monitoring various physiological parameters during cardiac emergencies and neuro-surgical procedures. All rcording units have these essential components : (a) preamplifier system (b) filter unit (c) power amplifier system and (d) recording pen. The preamplifier is composed of low noise balanced valves or transistors. The noise level has to be kept to a minimum. Generally this stage is operated by battery or by means of extremely stabilised power supply. The filter system is to eliminate unwanted signals or noise which cause interference. The valves in the final amplifier are readily available. The final stage is the recording unit. However, about 70-80 of the valves and other components have to be imported. It would be worthwhile if the manufacture of the imported items could be undertaken in the country.

Another important medical instrument is the diathermy unit. These are esentially radio frequency generators whose power output varies from 75 to 300 watts, depending on application. For physical therapy, an output of 300 watts is required. For surgical procedures, an output of 75 watts suffices. Self-rectifying high power transmitting tubes are used to generate the radio frequency current. Transmitting tubes which we are now going to manufacture, will enable us to make our own diathermy units in the country. Considering that every hospital requires diathermy units in large numbers, the demand will be quite high. Besides, portable surgical diathermy apparatus will also have a very large demand, once it is manufactured in the country. Practically all surgeons and clinics would buy one. The portable unit needs a very low power tube in a self-rectifying circuit. Generally for the portable unit, a frequency of 1 to 3 mc/s is used. For the high power diathermy units used for physical therapy and bladder surgery, frequencies of 27 mc/s and 40 mc/s are used. The demand will go up by leaps and bounds once these are manufactured and marketed at reasonable prices.

Ultrasonic apparatus has wide applications. It is used for massaging in physical medicine, for cutting in surgical procedures and for purposes of sterilisation. The unit is essentially an r.f. generator in the frequency range 1 to 3 mc/s. To convert the radio frequency energy into ultrasonic vibrations, a transducer is utilised. Generally, quartz or barium titanate crystals are used. The power intensity depends on the application. For massaging, a crystal area of 5 sq. cm. with a power of 15 watts is needed. For surgery and destruction of tissues, a much higher intensity is required. For ultrasonic scanning of the body, a very much lower voltage suffices. Crystals are being manufactured in our country. Care has to be taken during mounting of crystals to ensure maximum transfer of ultrasonic energy from the crystal on to the tissues. Generally a couplant like glycerol or water is utilised. As this technique is of recent origin and is finding wide use, there will be a good deal of demand.

Audiometers for aiding in the diagnosis of hearing disorders appear to have considerable demand. For some of these items, prompt supply against order ensures sustained demand. This is essentially an audio-oscillator, having spot frequencies in steps. The bone conduction probe has to be imported. The response

of the ears to the spot frequencies is studied by varying the intensity. The audiogram so obtained is analysed to suggest suitable hearing aid. Any medium set-up can take up the manufacture of this item. However, standard calibration facilities are necessary.

Stimulators find a very wide application; but a wide range is required to meet varied requirements. Diagnostic and therapeutic stimulators are used in the diagnosis and treatment of various types of muscular disorders. Stimulators are also sometimes used to stimulate the brain. Generally, provision is made for the variation of pulse intensity, pulse width and pulse duration. The intensity is variable up to 100 volts. Multi-output stimulators provide for various types of waveforms like d.c., interrupted d.c., a.c., rectangular and triangular. There is wide scope for marketing of these stimulators.

Various other instruments, like defibrillator, pacemaker, telethermometer, heart rate meter, are being manufactured now. However, publicity would go a very long way in creating demand. In fact, most of the equipment cited here is essential for any general hospital and polyclinic. As attempts are made to improve facilities in the large number of hospitals and medical institutions over our vast country, the demand for medical electronic instruments is bound to show a phenomenal increase.

Many institutions are most reluctant to buy instruments because of the foreign exchange difficulties and because of the inherent delay in procurement after ordering one's needs. There is likely to be a spurt in demand once some of the essential instruments are manufactured in our country, followed by recurring demand. For some time, however, the demand will be limited and in certain cases very limited. Foreign corporations manufacturing in our country have to create and stimulate demand for their products by producing standard quality equipment and spending on research and development and liaison with medical authorities and institutions. Publicity in medical journals of the country will go a long way in boosting demand. Many specialists in hospitals and medical institutions are not aware of the number and quality of equipment manufactured in our owu country. Routine circulars by book-post will not suffice. If these are followed up by personal contacts and display and demonstration of equipment at important exhibitions and conferences, one can be assured of good business turnover.

Another aspect worth consideration is the feasibility of large public and private undertakings going into this field. Certain sophisticated instruments involve large investments, specialised personnel and imported components. Such items as electroencephalograph, myograph, electron-microscope, close circuit television, computers, monitoring systems for neuro-surgery and intensive case units, multi-channel recording systems and others may be taken up by large ventures in the private or public sector. Perhaps they can afford to have a special group for tackling this aspect of instrumentation.

Generally, no undue extra investment is involved on test gear, etc. Some special spares are essential. It has been noticed that some of the big ventures have developed gadgets like audiometer, hearing aids, defibrillator, pacemaker etc. However, they have not been able to market these effectively due to obvious reasons. It would be worthwhile if some items are given over to small or medium units on recurring royalty basis. In this connection it may be said that the reason why industry is reluctant to utilise the development work of our national laboratories is the demand for exhorbitant lump sum royalty. *Research and Development units can never become commercial enterprises.* Fundamentally the approach is so different. In our country this aspect has to be appreciated in its proper perspective; and once this happens, most of the instruments in the electromedical field will be manufactured by small and medium units.

In our country X-ray equipment is being manufactured by **Escorts, Siemens** and **Elpro** at their factories in Faridabad, Bombay and Poona. Electrocardiographs are being

manufactured by **BPL** (India) Ltd., and **Cambridge Instruments.** Nuclear Instruments are being manufactured now on a large scale by the Electronics Corporation of India, Hyderabad. Instruments like pH meters, PE calorimeters, flame photometers, electrophoresis apparatus, etc., so essential for the analysis of body fluids, are all being manufactured in our country. Other items manufactured include stimulators, medical oscilloscopes, defibrillators, pacemakers, telethermometers, etc.

Lists appended to this article provide relevant data. Appendix I indicates the applications of equipment. Appendix II gives an idea of items being manufactured. Appendix III indicates briefly the list of instruments that could be taken up for manufacture. Appendix IV provides an idea of the marketing cost of certain selected instruments, and Appendix V lists some of the manufacturers of essential components so necessary for development and manufacture of electro-medical equipment.

APPENDIX I

	Use
1. Recording Instruments :	
(a) Electroencephalograph	Diagnosis & localisation of brain disorders like tumour, epilepsy, trauma, etc
(b) Electrocardiograph	Diagnosis of various types of heart disorders
(c) Electromyograph	Diagnosis of disease of muscles
(d) Electroretinograph	Diagnosis of retinal flaws
(e) Multi-channel recorders	To study various physiological parameters like blood pressure, temperature flow, etc. using transducers
2. Stimulators :	
(a) Nerve & muscle stimulators	Diagnosis and therapy of nerves and muscles
(b) Convulsive stimulators	Stimulate brain after inducing convulsion in various types of mental disorders
(c) Non-convulsive stimulators	To counter barbiturate poisoning
(d) Cortical stimulators	During brain surgery to elicit abnormal electrical activity in the cortex
3. Diathermy Apparatus :	
(a) Long wave Diathermy	In physiotherapy for treatment of arthritis, myositis, bursitis etc
(b) Short wave Diathermy	In surgery, for coagulation and cutting
(c) Microwave Diathermy	Used to achieve better localised deep heating
(d) Ultrasonic unit	Used in physiotherapy, surgery, sterilisation and scanning of organs
4. Transducers :	
(a) Pressure	Study of various fluid pressures in the human body
(b) Temperature	Study of temperature of various parts of the human body
(c) Flow	Flow rate measurements
(d) Displacement	Displacement Studies
5. Resuscitators :	
(a) Defibrillators	To arrest ventricular fibrillation which follows a heart attack, electric shock, etc
(b) Pacemakers	To counter heartblock and allied disfunctions. Long-term battes operated
(c) Lung Ventillators	Long-term ventillation of lungs during respiratory disorders

6. Artificial Organs :	
(a) Artificial heart-lung machine	During surgery, the human heart and lung are bypassed and the machine takes over the functions
(b) Artificial kidney	During renal insufficiencies, takes over the functions of the human kidney
7. X-rays—Radioisotopes :	
(a) Grenz Rays 25 KV	Superficial Therapy
(b) Soft X-rays: 50 KV	—Contact Therapy
75 KV	—Diagnosis
100 KV	—Superficial Therapy
(c) Hard X-rays :200 KV	Deep Therapy
1000 KV	Supervoltage Therapy
(d) Radio Iodione (I 131)	Diagnosis of thyroid disorders
(e) Radio Strontium (Sr. 90)	Eye applicator
(g) Radio Phosphorus (P32)	Brain Tumour localisation
8. Electronarcosis :	
(a) Electrosleep Unit	To induce sleep in insomnia patients, chronic headache and various other neurologic and psychiatric disorders
(b) Electroanaesthesia Unit	To induce anaesthesia electrically for purposes of surgery
9. Audiometer	To measure the auditory performance of the ears and aid in diagnosis of hearing disorders
10. Electron Microscope :	To study viruses etc. using the very high resolution achieved by the electronic technique.
11. Television	As an aid in teaching and for research purposes
12. Computers	As an extremely useful aid in diagnosis, planning, etc.
13. Lasers	Most likely to promote knifeless surgery and therapy of eye lesions and certain types of cancer
14. Analytical Instruments :	
(a) Colorimeters.	Evaluate the concentration of sample under investigation
(b) pH Meters	Measurement of acidity or alkalinity of body fluids.
(c) Electrophoresis apparatus	Study of migration of fluid particles under influence of electric field. Protein separation studies
(d) Spectrophotometers	Identify substances using spectral characteristics
	Identification of organic groups
	Determination of reaction rates
(e) Flame photometers	Quantitative estimation of calcium, sodium, potassium in body fluids
(f) Electronic cell counters	Counting of white and red blood cells more accurately and rapidly

APPENDIX II

Items Manufactured in India

1. Electrocardiograph
2. Stimulators
3. Diathermy unit
4. X-Ray equipment
5. Nuclear instruments
6. Defibrillator—Pacemaker units
7. Medical Oscilloscope
8. pH Meter
9. PE Colorimeter
10. Flame Photometer
11. Telethermometers
12. Hearing Aids
13. Tape Recorders
14. Aids for the handicapped
15. Audiometers

APPENDIX III

Items Possible to be Manufactured

Small Set-up	Medium Set-up	Large Set-Up
Electronic Stethoscope	Audiometer	Electroencephalograph
Telethermometers	Diathermy units (long wave, short wave and micro wave)	Electromyograph
Sphygmomanometers	Ultrasonic apparatus	Electron microscope
Stimulators	Transducers and relevant instrumentation	Multi-channel recorders
Endoscope—Cautery units		Polygraphs
Electronarcosis units		Neurophysiological and Neurosurgical set-ups
Defibrillator		Monitoring Consoles
Pacemaker		Closed circuit television
Heart-rate meter		Computers
Hearing Aids		Vector cardiographs.
Aids for the handicapped		

APPENDIX IV

Demand Position of Some Selected Items

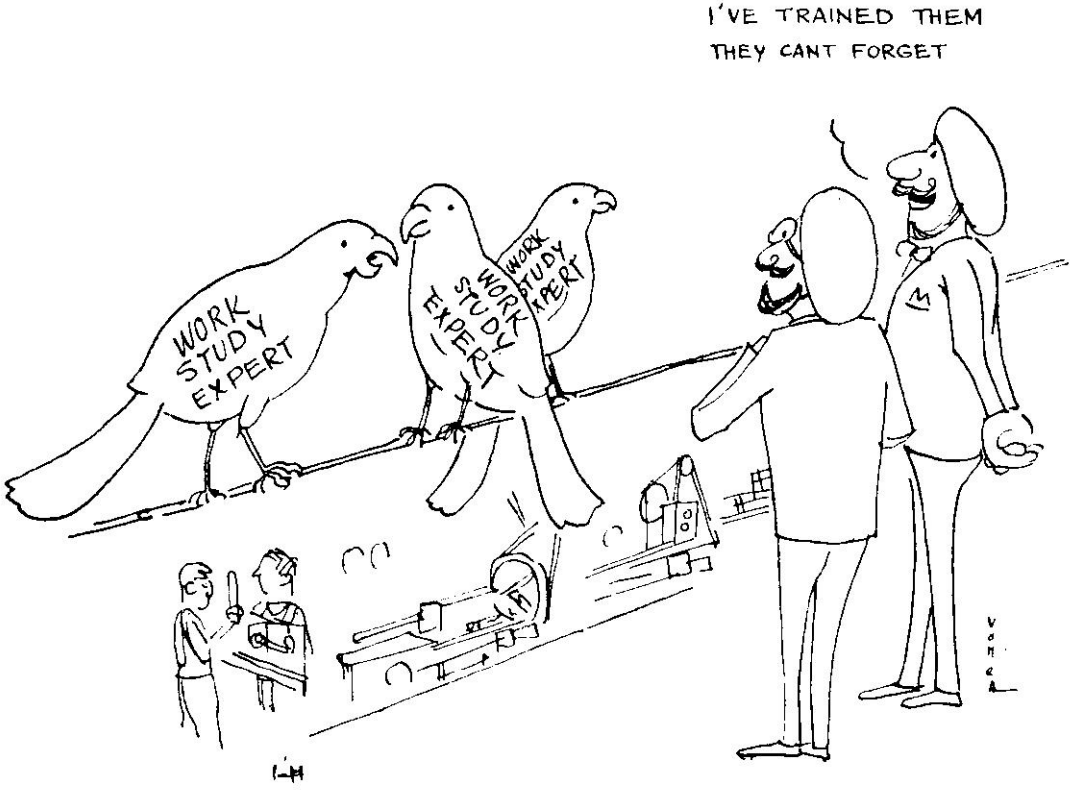
	Name of Item	Marketing Cost (approx)	Annual Demand (approx)
		Rs.	
1.	Electro-encephalograph	1,10,000	30—50 Units
2.	Electro-myograph	40,000	30—50 Units
3.	Electro-cardiograph	7,500	500—1000 Units
4.	Stimulators (assorted)	1,000-10,000	500—1000 Units
5.	Audiometer	6,000	100—250 Units
6.	Colorimeters	2,500	100—250 Units
7.	pH Meters	1,500	1000 Units
8.	Defibrillator	3,000	50—100 Units
9.	Pacemaker	1,500	50—100 Units

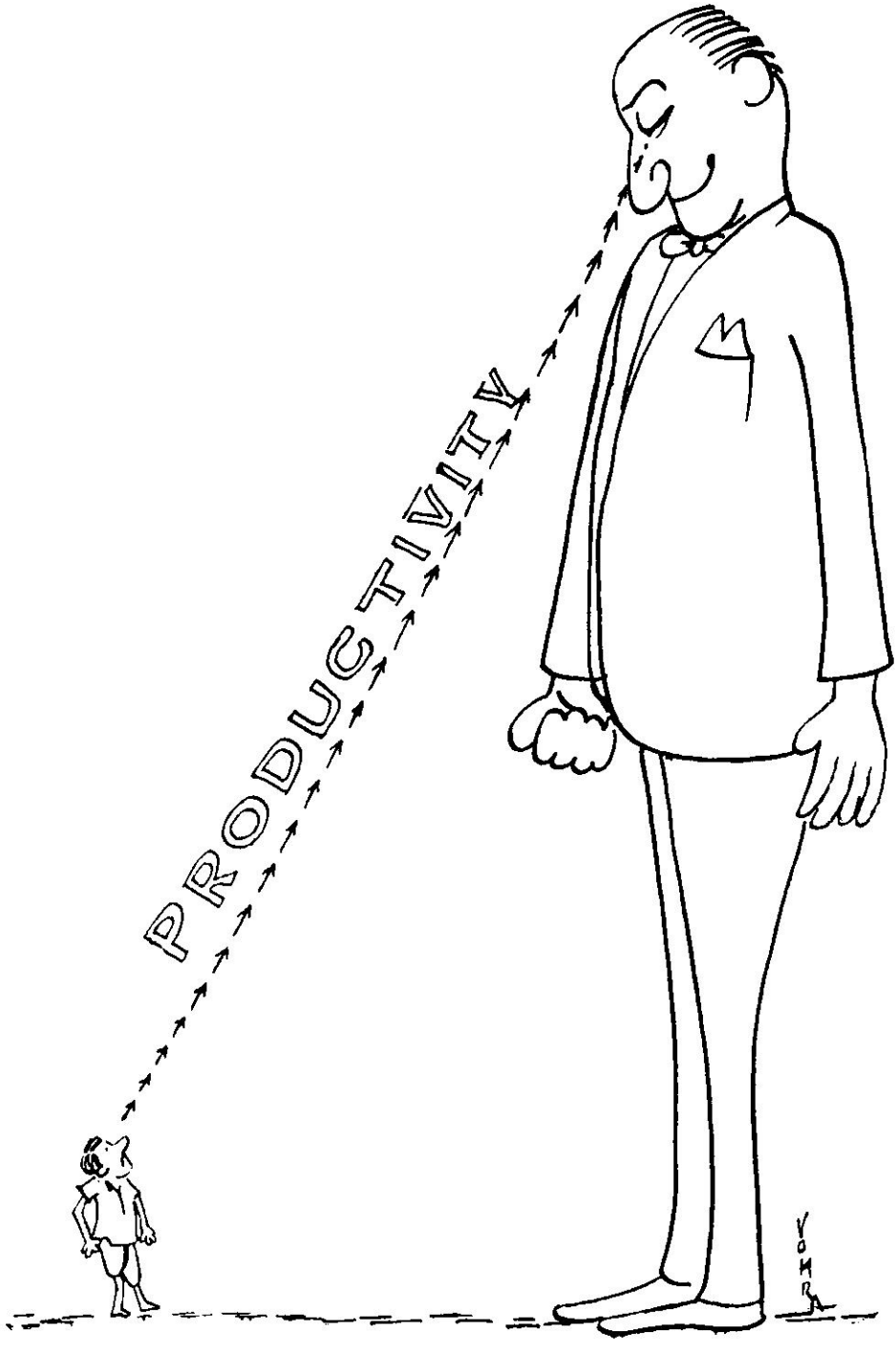
APPENDIX V

Some Manufacturers of Essential Components

Name of the Manufacturer	Items Manufactured
1. Indian Telephone Industries Ltd., Bangalore-16	Paper condensors, relays etc.
2. Radio & Electricals Mfg. Co. Ltd., Bangalore-18	Paper & electrolytic condensor, band switches, cable, hook up wire etc.
3. Bharat Electronics Ltd., Bangalore-13.	Transistors, valves, crystals, mica condensors
4. National Aeronautical Laboratory, Bangalore-17	Transducers
5. Electronics Corporation of India, Hyderabad	Precision resistors
6. Eastern Electronics (P) Ltd., Faridabad	Condensors, precision resistors etc.
7. Rescon Mfg. Co., Poona	Precision resistors and Potentiometers
8. R. V. Mehta & Co., Calcutta-1	Wirewound resistors and Potentiometers
9. M.C. Engineering Co., Faridabad	Toggle switches etc.

10. Villait Electronics Industries Ltd., Calcutta.	Group boards, output terminals, neons etc.
11. Semiconductor Ltd., Poona	Thermistors, transistors, varistors
12. Usha Rectifier Corporation, New Delhi	Silicon transistors, rectifiers
13. International Rectifier Corporation, Faridabad	Metal rectifiers, transistors
14. Automatic Elec. (P) Ltd., Bombay	Panel meters
15. Bajaj Electricals Ltd., Poona-4	Panel meters
16. Gammont Kalee (P) Ltd., Bombay-67	Panel meters
17. British Physical Lab. (P) Ltd., Palghat	Panel meters
18. Asian Electronics, Bombay	Precision resistors, Styroflex condensors




PRODUCTIVITY
VOHR

A Breakthrough Technique in Paper Pulp

RS Sawhney*

The author claims that Alkaline Grinding of hardwood (grinding in the presence of caustic soda) with special reference to the wood known as *Boswellia Serrata* (*Salai*) is a breakthrough technique for achieving massive increases in the output of mechanical pulp, to meet the mounting demand for paper, consequent on increases in population, literacy and the tempo of industrialisation. As it is, the mechanical pulping process (conversion of wood into ground wood) requires an enormous consumption of energy which is the major headache of the newspaper printing industry. It appears to be the claim of the author that the method of alkaline grinding would reduce materially the demand of the paper industry on electric power. In fact, recent developments in the technology of ground wood pulp are in the direction of reducing the energy requirements of the grinding process. In the original paper submitted by the author for publication in the NPC Productivity Journal, substantial documentation on this point had been furnished. The piece printed below has, for reasons of space, omitted much of the documentation material, though the substance of the thesis remains intact.

DURING THE LAST TEN YEARS, THERE HAVE been marked developments in the technology of pulp manufacture, along the following lines:

—Improvement of the pulp-stone

—Improvement of the mechanical pulp grinders

—Grinding process variables

Consistency (pit)
Temperature
Pressure
Burring technique
Pulpstone composition
Stone speed (peripheral)
Stone submergence
Stone surface/Friction coefficient
Wood

These studies have led to improvements in mechanical pulping process, but still there are problems plaguing the uniformity and technical process control; and the belief persists that for the production of good quality ground wood we require high energy consumption.

Various processes have been employed for increasing pulp strength and grinder production:

(i) Chemi-ground wood (Great Northern)
(ii) ALB Semi-Cell process (Austrian Patent)
(iii) Cold Soda process
(iv) Chemi-Mechanical process
(v) Refiner ground wood or chip ground wood (Super ground wood)

*Chemical Technologist, National Newsprint and Paper Mills, Nepanagar (Madhya Pradesh)

(vi) Anker process (pitless grinding)
(vii) Coarse grinding, followed by refining.

The quality of pulp is superior and stronger because of improvements in the burst factor, breaking length, tear factor, etc. These favourable results are achieved at a substantially reduced level of energy consumption; and process problems, resulting from extractives and pitch, become simultaneously less intractable.

Obviously this constitutes a formidable technical achievement which has attracted the attention of ground-wood chemists and technologists. The author claims that this technique using 0.005 per cent. NaOH in circulating water reduces energy consumption by as much as 11 per cent. It also improves very considerably the tensile strength of paper, alongside a slight increase in pulp production.

In fact there has been, practically since the beginning of the 20th century, a widespread recognition of alkaline grinding in pulp manufacture as evidenced by several publications, particularly German and Russian.

There is, however, another method of improving ground wood pulp by the addition of a chemical. Besides all these laudable achievements, one more method of improving groundwood pulp is that addition of a chemical gets automatically activated by the high temperature already there and entails no other expenditure.

Elsner, J C, in his Patent (German) — 211047 — (CL 55A : 1), mentions that the addition of alkalies to the grinder shower water facilitates easy separation of wood fibres into long/fine fibres.

Skalicky, C, in his Paper "Production of Mechanical Pulps by Coarse Grinding with Subsequent Refining" (*sbornik vyskumnch prac odborn celulozy A Papiera* : No. 7: 9-28 (1962), mentions that the alkalinity of grinder waters, if maintained within reasonable limits, improves the strength characteristics of mechanical pulp.

Alfthan, G V, in his Paper "Mechanical Pulping of Today" (*Paperi Ja Puu—Papper ech Tra Paper, Timber*: 38/No. 9. 421-424—1956), states that the "Grinding can be carried out with pulp stones rotating above the pulp level in the grinding tray or with the addition of caustic soda (NaOH) or sodium sulphite (Na_2SO_3) to the back water. The latter method would increase the capacity and decrease the power consumption by as much as 8-9 per cent." He further adds that it is possible that these methods would become even more popular in the years to come.

Schwartz, F, in his Paper "Development Trends in the Technology of Grinding" (*Zellstoff H Papier*: 8 (12), 455-464, (Dec. 1959), mentions another type of grinding in which the solution for the chemical reaction is added on the grinder stone or in the pit. In Scandinavia, 250-300 grams of caustic soda (in the powdered form) are added to the wood pocket, resulting in an increase in burst factor. Sodium bisulphite used similarly goes to increase the brightness.

Perry, H J, in his Paper "Trends in Mechanical Pulping Operations' (P and P Mag., Can., Vol. 50, 94-97, April 1949) says that the logical place to treat ground wood pulp chemically is in the grinders. He also refers to the Russian work on the use of alkaline solutions in grinding.

Chambers, A R, in his Patent (U.S.) 1813, 988 (July 1931), describes the use of sodium chloride as an additive in the grinder shower and claims longer/better/tougher fibres and increased production per grinder by operating the grinder in brine solution.

Parsons, S R, in his Paper "The Caustic Extraction of Aspen Ground wood," describes the treatment of groundwood pulp from certain hard woods (especially Aspen) with caustic soda. He claims **raising the tensile strength by as much as 100 per cent** or higher, making the strength of hard wood pulp equal to that of spruce ground wood.

Adms, DO and Hughey, G B, in their patents (U.S.) — 2435, 566 (Feb. 1948) : 2516, 664 (July 25, 1950), describe the use of an "Alkali extraction for upgrading the brightness response

in the peroxide/hypochlorite bleaching of ground wood produced from woods containing tannins. The amount of alkali specified is 2 per cent and no mention is made of strength improvement.

Dr. Gartner, W, in his Paper "Improvement in Beating of Popular Chemical Pulp and in the Grinding of Poplar Wood by Means of Chemicals", mentions that by grinding wood in alkaline medium, very remarkable improvements are obtained. During the grinding process organic acids are formed and the pH is lower than 7.0. The improvement of ground wood pulp quality by increased grinding temperatures is a well known fact, but on account of formation of acids, particularly while grinding poplar wood, the resultant pulp takes a very disagreeable red colour, for avoiding which Poplar has to be ground at low temperature (cold ground pulp), the pulp also has a low strength. But by increasing the pH by using chemicals (oxygen-releasing) it is possible to get a hot ground pulp also from poplar.

Some recent patents indicate the possibility of still greater advantages, if the poplar wood is impregnated with alkalies and oxygen-releasing liquids, before grinding. Grinding of this pre-treated wood in a grinder (pocket or continuous) results in the production of double quantity of ground wood (chemi-mechanical pulp) at the same power consumption and in the same time, thereby **reducing the specific power consumption** to 50 per cent. This chemi-mechanical pulp* (ground wood from pretreated wood) has :

—different strength properties and general behaviour during paper making than normal stone ground wood

—strength properties corresponding to those of semichemical pulps: this makes possible replacement of not only spruce ground wood but even the chemical pulp.

—lower beating degree and improved drainage chracteristics (desirable for higher paper machine speeds).

*The brightness of this Pulp can be very easily adjusted according to the end use and other conditions.

Dr. Gartner states that the alkaline grinding helps in combating the "Pitch" troubles. According to his estimates, 70 per cent. of the cost of chemicals is covered by the decrease in energy consumption.

Dr. Bersano, P, in his paper "Utilisation of Poplar Pulps" mentions having tried chemicals in the dilution water at the grinders and achieving success as regards brightness, for instance, through the addition of sodium bisulphite. Also tests have been carried out by grinding pre-impregnated wood for improving strength and other characteristics. Poplar is responsive to impregnation especially when logs are submitted to hydraulic pressure of some k.g./c.m.^{2}, the impregnation liquor consisting of sodium bisulphite and hydrogen peroxide. The results in respect of physical characteristics and brightness have been satisfactory, but the economic difficulties in operation and the corrosion occurring in the grinders because of sulphur dioxide or in the pulpstone due to the presence of sodium (Na) prevented continuing in such a manner.

Dr. Swartz, JN, in his paper "Newsprint from Broad Leaf Woods", mentions that if the logs are chemically impregnated with $Na_2SO_3 + Na_2CO_3$ or NaOH solutions the grinding process results in pulps of higher strength and fibre length, higher rate of grinding (output) and much lower energy consumption than in the case of untreated woods under the same grinding conditions which would give short-fibred and low-strength pulps.

It has been found that an admixture of this treated ground wood pulp with normal bamboo chemical (sulphate) pulp in the percentage 80 : 20 gives strength characteristics equivalent to normal newsprint.

This process of pretreating of *Boswellia Serrata* (*Salai*) with caustic soda before grinding promises not only increased ground wood pulp production with improved strength characteristics and folding endurance but also increased and improved newsprint production, and low H.P.D./ton at the wood pulp grinders.

Kothari, PS, in his paper "Indigenous Newsprint" (1964), mentions having obtained

quite satisfactory "Cold Soda Pulp" from *Boswellia Serrata* (*Salai*) having strength characteristics (burst factor 11.1 ; breaking length 2240 meters and tear factor 29.6) at a freeness of 137 c.s.f. The introduction of this cold soda pulp in the newsprint and chemical pulp would lead to a stronger and better end-product.

Henry, RW, in his paper "Cold Caustic Soda Pulp in Newsprint Manufacture" (1960) (Pulp and Paper Prospects in Asia and the Far East) (FAO-UN-TOKYO), mentions that hard woods are more suitable and responsive to cold soda pulping than soft woods. The cold soda pulp forms an important component of the newsprint furnish and the freeness recommended is 90-130 c.s.f. for an optimum combination of drainage/wet strength. The newsprint furnish at Australian Newsprint Mills consists of 17 per cent semi-bleached *Pinus Radiata* kraft, 23 per cent eucalyptus cold soda pulp, 60 per cent eucalyptus ground wood now as against the original furnish containing 18 per cent *Pinus Radiata* semi-bleached kraft and 82 per cent euclyptus ground wood. Machine speeds of 1500 rpm. have been attained and a speed of 1400 rpm. is being regularly run on a machine with an open head box and an open draw at couch. Substitution of 23 per cent cold caustic pulp for ground wood has led to increase the machine speed by 6.5 per cent. Burst factor of mixed stock increased by 3 points and tear factor by 5 points and a corresponding increase in strength of finished newsprint of 2 points burst factor and 2 points tear factor (both cross and machine direction).

Provided brightness is within 5 points G.E. of the remaining components of the furnish, all characteristics of newsprint made up to 30 per cent cold soda pulp would remain satsifactory, excepting a small decrease in opacity.

The practical upper limit of cold soda pulp with any mixed furnish for satisfactory newsprint appears to be somewhere between 30-40 per cent.

No particular difficulties were experienced in machine-running with cold soda pulp, the only notable change being that the draw between sections had to be reduced to compensate the shrinkage tendency of sheets more than in ground wood.

Mardon, J, in his paper "Australian Paper Making Scene", mentions that in North American practice, grinding in the presence of caustic soda has not met with sufficient success because of reduction in opacity and because extractives remain with the pulp instead of being dissolved with the eucalyptus. In Australia the extractives are easily removed on the washers and the opacity is not affected. This not only results in better quality pulp, but also in much less power consumption for the Australian industry.

How alkaline grinding proved to be a boon to the Australian paper industry was shown in the period of power rationing, necessitated by water shortage in the main catchment area of Tasmanian Hydro-Electric Commission stations. This is a very good case study in favour of alkaline grinding. Alkaline grinding had to be introduced overnight, for there was not sufficient power to go round. Experience showed that by the new technique not only was the demand for power reduced, but improvement in quality and colour of pulp (ground wood) was effected because of tannin removal. The resulting newsprint was superior. There were, however, these shortcomings : Higher cost of caustic soda, and a little lowered recovery of pulp from wood.

Mr. RW Henry (A.N.M's Managing Director) mentions that during the power rationing period, the volume/cost of production of newsprint were very near to planned levels. He further says that the knowledge gained in operation of alkaline grinding process would be of enormous value, should power restrictions occur again or should the mill be expanded. He adds "that properly conducted research is probably the best investment an organisation can make. The monetary value of production losses averted by adopting the alkaline grinding process developed by A.N.M. research during restrictions on power was nearly as much as their total expenditure on research since production started at Boyer 23 years ago."

M/s. Pearson AJ, Somerville JL, and Elder RA, in their paper "The Grinding of Eucalyptus Wood in the Presence of Caustic Soda", describe the grinding of eucalyptus pulp wood in the presence of caustic soda solution at pH 9.3, resulting in a decrease of 20 per cent in the energy unit consumption required for a pulp of constant strength characteristics at an unchanged unit energy consumption. The alkali dissolves out some of the polyphenolic compounds present in the eucalyptus, and after a washing and subsequent adjusting of pH to 4.0 the alkaline ground wood is sufficiently improved and better in brightness than normal ground wood.

They further say that the removal of these materials decreases loss of brightness suffered by the newsprint containing this ground wood in passage through the drier (paper machine) and this ground wood is readily brightened by zinc hydrosulphite and under suitable conditions a gain of 16-20 units is possible.

In their paper "The Production of Eucalyptus Ground Wood from Impregnated Billets (G.I.B. Process)" M/s. Elder RA, Job JG and Pearson AJ review the developments in the use of eucalyptus species by Australian Newsprint Mills for newsprint grade ground wood production, and indicate that complete utilisation of forest resources is not possible due to satisfactory pulps from young regrowth timber being not available.

"G.I.B. Process" which promises high quality ground wood, involves the impregnation of the wood billets with cold caustic soda (NaOH) solution at 600 lb./sq. inch for 2 hours, prior to grinding. 3 per cent alkali consumption could give pulps from a number of species which had strength properties double that obtained in alkaline grinding of untreated wood. Higher alkali consumption gave still increased pulp strengths, but liquor at 50°C gave decreased strength and prolonged impregnation time or vacuum pretreatment did not alter the strength. However, with increasing time of storage between impregation and grinding, a progressive brightness was found.

Incorporation of 13 per cent G.I.B. pulp in the newsprint furnish for both the paper machines during a two-day trial period gave newsprint an increase of 10 per cent burst and smoothness with practically no change in other properties. The first machine has a wire width of 160 and runs at 1250 rpm, whereas the second runs at a speed of 400 rpm and has a wire width of 230 inch.

The expansion of Australian Newsprint Mills is based on G.I.B. process and they claim to be producing newsprint whiter than the world's standard. The expansion programme is well on schedule and is expected to be completed by January 1969, raising the company's output by 70,000 tons per year with the installation of athird newsprint machine—278" wide and speed 2500 rpm.

Alkaline Grinding and Hard Wood Ground Wood Mill

A look at the spectacular results of alkaline grinding of eucalyptus at Australian Newsprint Mills shows that the process holds a great promise for ground wood mills based on hard woods, and it acquires particular importance in a situation where there is chronic power shortage. At Nepa we have both the hard wood and the shortage of power at wood pulp grinders.

Summing up, Alkaline Grinding of *Boswellia Serrata* (*Salai*) would mean :

(i) Increased/improved ground wood pulp strength,

(ii) Pulp strength would increase further if the energy consumption is maintained at the old level,

(iii) Strength would still go up if the stones are kept diller as the grinding rate goes up by 30 per cent.

Thus it would be possible to have all the three factors operating towards increased strength, if we so desire, at a constant level of output of energy; or we can have a 30 per cent increase in output, with two out of three factors contributing to increased strength.

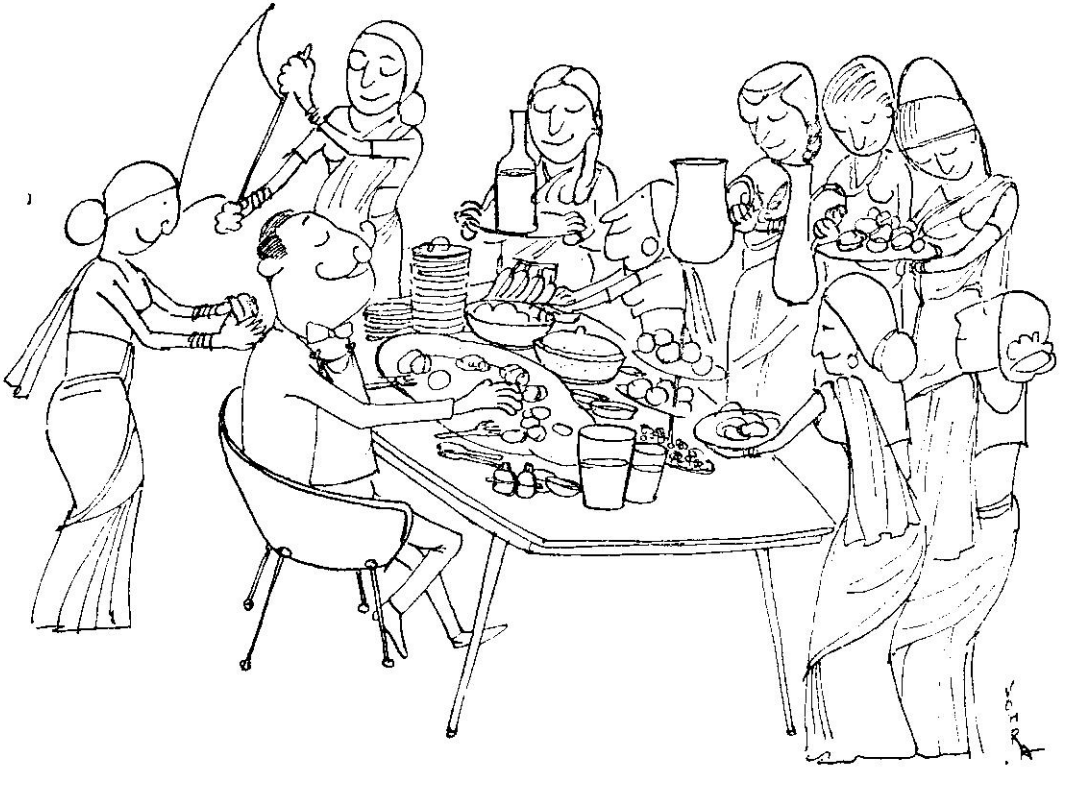
Alkaline grinding would, however, give us a dark-coloured pulp at the grinders because of extraction of tannins by caustic soda. A good wash will remove the coloured compounds (may use a little sodium hypochlorite for

bleaching and then give a second wash to remove the residual alkali (or may avoid bleaching) and give it a second wash and then neutralise the pulp alkali with H_2SO_4, bringing down the pH to 4-5 at the Decker chest stage, thereby getting a reasonably bright ground wood Pulp.

The incidental advantages of alkaline grinding, not fully covered, may also be listed here:

a. Improved web strength
b. Equivalent drainage with less of fines/chop/splinters
c. Lesser or reduced burring frequency—better pulpstone (stones and burrs cost foreign exchange)
d. Bad dried stained wood (due to rain) and fungi-affected wood would be not much of a problem as the alkali present during grinding would solubilize most of the dirt/fungi due to high temperature in the grinding and that would be removed in subsequent operation—washing, bleahcing, screening. Cleaner ground wood means cleaner newsprint.
e. Reduced pitch and slime, resulting in cleaner paper
f. No corrosion problem
g. Improved ground wood strength would mean lesser percentage of chemical pulp per ton of newsprint and lesser cost of newsprint
h. Improved ground wood strength also would mean improved paper machine run and less breaks
i. NaOH percentage (on the bsis of moisture-free wood) would be lesser compared to A.N.M., as our pH in the grinder pit is 7-7.5 as against 3.8.
j. Softens chips (at present the source of breaks at the calendar — a huge loss).

As hardwoods are most receptive to alkalies and our wood is hard and due to the tempo of development the aggregate demand for power is likely to exceed the aggregate supply, alkaline grinding is, in the author's opinion, the answer to the increased demands of society for paper, particularly newsprint. ●●●




GOAL
VOHRA

Close Tolerance Reaming

MC Shah*

Considerable economy is achieved when precision holes can be produced by reaming, without grinding or lapping. The author has here worked out the feasibility on a production basis, under controlled conditions, to produce holes within a tolerance of 0.0002" or less. To successfully ream within such close tolerance, proper consideration has to be given to several basic principles that are often overlooked or disregarded, with consequent diseconomies.

TO BEGIN WITH, EVEN UNDER FAVOURABLE conditions, a reamer will produce holes slightly above its own size. How much oversize would depend on the material (say .0005" in steel). Also, when selecting a standard commercial reamer for a particular diameter, manufacturing tolerances must be considered.

When holes are to be produced to close tolerances, a reamer must be carefully measured with a micrometer to select one as close to the desired size as possible. However, if oversize, the tool can be reduced in diameter by running it backwards in a reamed hole, preferably in cast iron.

Assuming we have to ream a hole 0.625" (± .0005) in steel. Since the maximum hole diameter may be 0.6255", the reamer will cut 0.0005" over its own diameter; therefore, the reamer must be at least 0.0005" smaller than the maximum diameter of the hole. Allowing 20 per cent. of the hole tolerance, or 0.0001" as a safety margin, one may use a reamer of 0.0006" under 0.6255" or 0.6249" diameter.

Speed, feed and stock removal are important factors when precision reaming. Speeds for machine reaming may vary considerably, depending on material, type of machine, etc. In general, most machine reaming can be done at 1/2 speed commonly designed for drilling.

Feeds for reaming are usually much higher than those employed for drilling, often two to three times greater. Feeds should be sufficiently heavy to prevent glazing. However, too high a feed may reduce the accuracy of the hole and impair the finish. The basic idea is to use as high a feed as possible and still maintain the required finish and accuracy.

Insufficient stock for reaming may result in a burnishing rather than cutting action. Too much stock often causes oversize or rough holes. Consequently a certain amount of experimenting may be necessary.

Most reaming operations require a coolant or lubricant, except cast iron which is usually

*Works Manager, Cooper Engineering, Satara Road

reamed dry. The use of coolant will prolong tool life and improve the finish of the hole. Also a good point to remember: should a reamer cut slightly oversize, it may be flooded with coolant. The amount of coolant used will generally have a direct influence on the finished hole size. On a production run, the flow of coolant should be constant and controlled.

Mis-alignment between the reamer and the work will cause tapering and out of round holes. This can be prevented with the use of a floating holder.

The advantages of the close tolerance reaming are economically favourable because of the possibility of eliminating two expensive operations, grinding and lapping. These advantages should not be overlooked by any company that is seeking means to cut costs in today's competitive markets. ●●●

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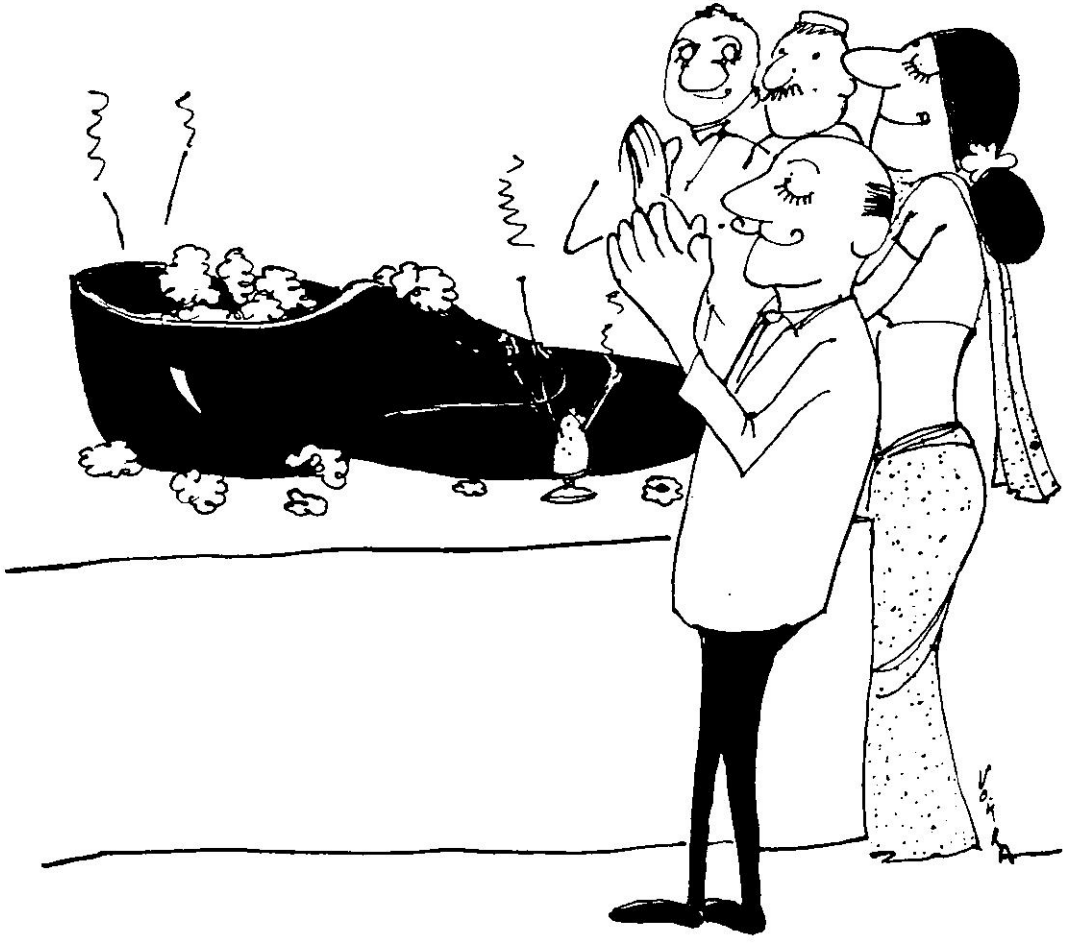

Application of Empirical Formulae in Time Rate Setting in Piece Production Fabrication

K Kanakaraj*

In industrial production, more often than not, it is necessary to assess the work content of a fabricated item in terms of the time required for its completion, before the job is actually taken up for manufacture. This has particular significance in heavy fabrication industry where production is of the nature of "repeated piece production of similar jobs" and where the work content in terms of time is the basis for planning, assessment of the requirement of men and machines, shop scheduling, loading and forecasting the probable date of completion of a particular fabricated job with the available capacity. Such work assessment is also needed for cost calculations for commercial purposes and setting targets for direct shop incentives.

FIXING OF TIME RATES FOR THE TYPICAL operations involved in a particular fabrication job is not entirely possible by the use of predetermined synthetic time standard data compiled in most of the technologically advanced countries. Wherever possible, however, synthetic time standard data must be compiled and used: for example, for various methods of welding and for different fabrication machines such as presses, prebending machines, rounding rolls, bending machines, tube expenders, shearing machines, saws and other plate working machines used for manufacture.

The purpose of this article is to explore the possibilities of "time rate setting" for manual elements of operations in the manufacture of fabricated items. The method is explained here for a particular case.

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Let us take the case of a fabricated bed plate of a heat exchanger as shown in the figure on page 71. After gas-cutting/shearing the plates to the required sizes and the edges gascut/ machined for welding, depending on the type of weld prescribed as per design, the plates are to be matched and fitted one after another as per marking by a fitter for tack-welding and subsequent welding of the complete bed plate.

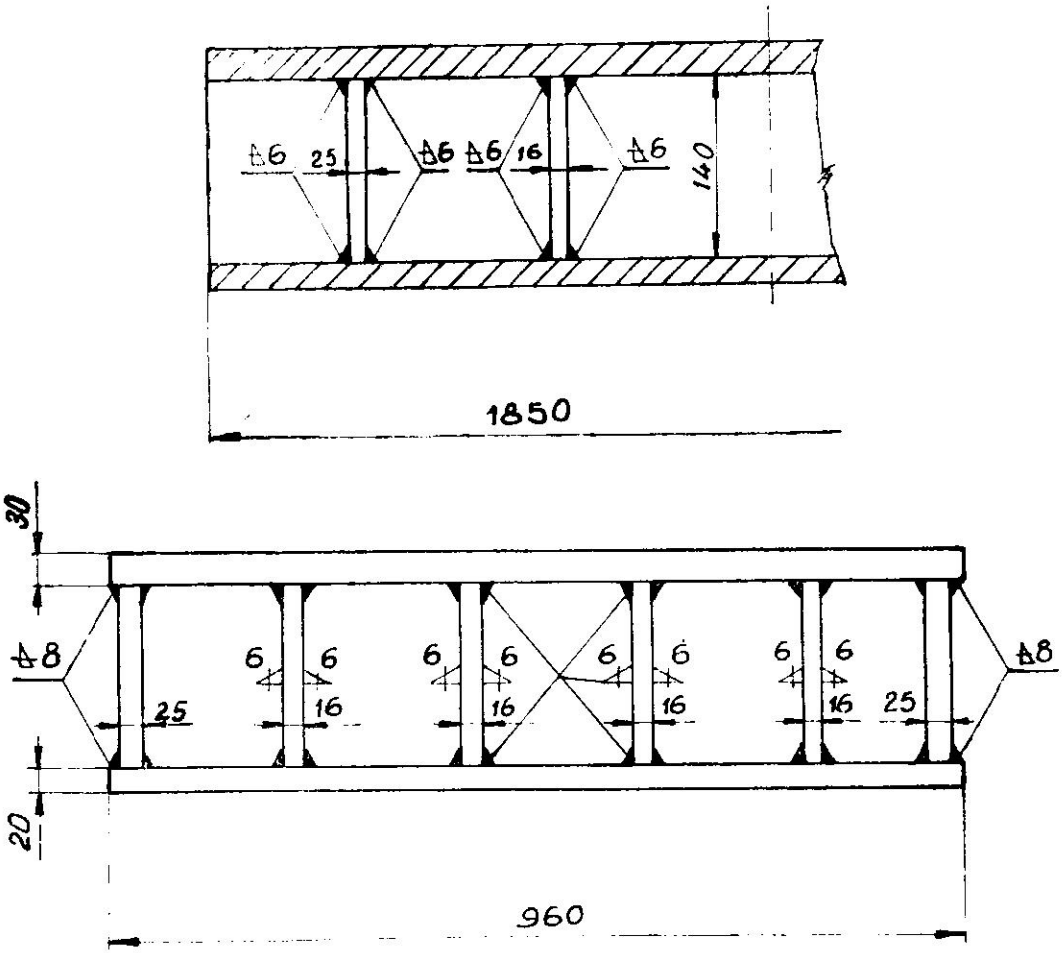
Time rates can be set for machining the sides and edges of the plates and also welding from predetermined time standard data and the fitter's time can be estimated from the empirical formulae given below :

$$t = \sqrt[3]{A^2} \times K_1 = A^{0.66} \times K_1$$

or $$t = \sqrt{G} \times K_2 = G^{0.5} \times K_2$$

where t = elemental time in minutes

A = influencing area in square centimeters
G = influencing weight of the part in kg.
K_1 = factor for area and
K_2 = factor for weight



The factors K_1 or K_2 are determined as follows :

At first, matching and fitting of plates for tack-welding have to be timed for different sizes of a particular shape, say, for flat rectangular plates. Then depending upon the type of work, either the influencing weight of the fitted part or the influencing area of the fitted part is taken into consideration for evaluating the factors K_1 or K_2. For example, for simple mounting of parts either for assembling or for tack-welding, the influencing factor is the weight of the part and for matching and fitting the part for the purpose of tack-welding, the area of contact of the fitted part is the influencing factor.

As explained above, time observation is carried out for the manual element of, say, matching and fitting or mounting of plates for tack-welding or assembly. Knowing the influencing area "A" or the weight of the part "G" and the observed time "t" for the element, the factor K_1 or K_2 is evaluated. A sufficient number of observations of time are made either for the same type of jobs or for jobs ranging from simple to complicated nature and thus either an average factor (for area or for weight)

for a particular type of job is deduced or a range of factors for a range of jobs from simple to complicated nature is obtained.

Having thus obtained the factors, the elemental time for matching and fitting of parts for tack-welding of similar jobs can be easily calculated by applying the factors in the formulae.

Similarly, the time required for flame levelling of the part deformed subsequent to the welding operation can be calculated. Here the influencing area is the area influenced by the welds. This is given by the total length of the welds in cm. multiplied by the average thickness of the welds in cm.

For example, for matching and fitting of simple to medium parts the factor for area (K_1) can be taken as 0.3. to 0.4 and for levelling by flame the factor range is 1.1 to 1.3

It must be noted here that by using the above formulae only the main part of the operational time is obtained. The preparation time or set up time is to be estimated by experience.

Estimating Total Time

From the design drawing a detailed process layout is made for the structure, giving the sequence of the appropriate operations like shearing, gas-cutting, hand grinding, levelling, machining, fitting, tack-welding and welding, levelling and final machining. Then for each operation, depending on the types of elements involved, the required times are estimated either by using the synthetic time standard data or by the formulae. To the time thus obtained various allowances are added, expressed as percentages and then the set up time or preparation time is fixed from experience and added to the main time. This gives the total operational time. Similarly the times for all the operations involved are calculated and the sum of these gives the total estimated time for the complete fabrication of the job.

The procedure explained above gives a sufficiently accurate estimation of the Standard Time for the type of manufacturing organization and for the purposes mentioned above. ●●●

Human Body Worth 85 Billion Dollars in Atomic Terms

Not long ago, our bodies were priced at 98 cents each—the worth of the average human being's chemical content . . . Now, the E.I. Dupont company comes up with a study showing our body atoms contain a potential energy of more than 11 million kilowatt-hours per pound. The average man—by this new, proven theory—is worth about 85 billion dollars.

The Improvment Curve*

DK Sen

The author was introduced to this concept, called the Improvement Curve, the Learning Curve or the Experience Curve, through the good offices of the Industrial Engineering Department of the Aero-space Division of the Boeing Aircraft Corporation in Seattle, Washington. He saw it in action there and followed it up through the literature published on the subject by Boeing. He has given below what he learnt on the subject.

TO REMAIN ALIVE IN A COMPETITIVE MARKET like the USA, a manufacturer must produce quality products on schedule and at the lowest possible cost. This is quite a tall order. A firm, must, therefore, have accurate estimates on their ability to produce on schedule, before spending money on tooling and starting a big production programme.

The Improvement Curve is used as a tool to provide the answers to many manufacturing problems when

Estimating production costs,

Estimating production time and manpower,

Comparing various costs.

Although the Improvement Curve was developed principally by the aircraft industry, it has been found that it can be used by almost any manufacturer.

The Theory

Basically, an Improvement Curve is a line on a graph, representing the following facts :

(1) The time required to do a job will decrease each time the job is repeated, and

(2) the amount of decrease will be less with each successive unit.

The theory is really very simple. A man learns as he works. The more he repeats a certain operation the more efficient he becomes and, therefore, the time required to produce each unit declines.

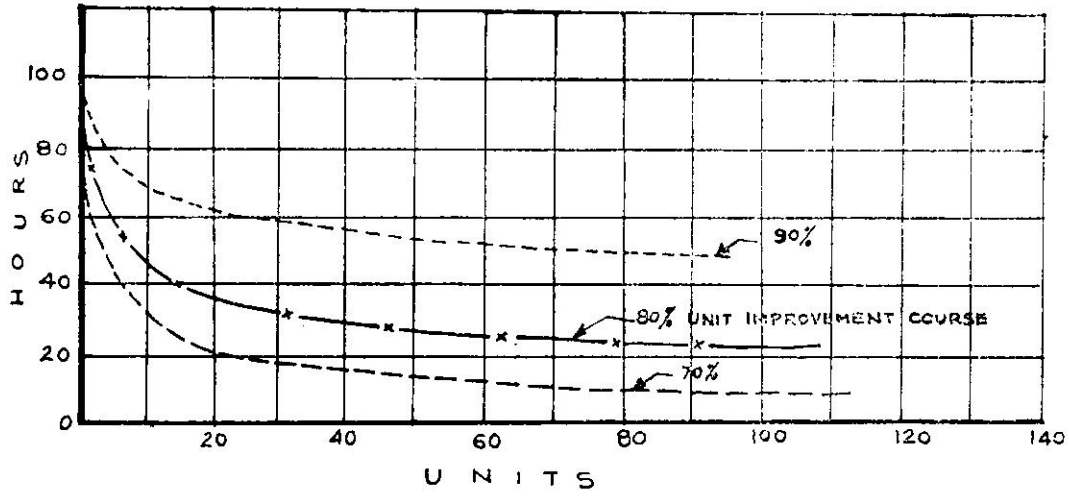
The same thing is true of manufacturing. It does not take nearly as much time to produce automobile 1000 or airplane 1000 as it did to produce unit 500 or unit 1.

How does this happen? It is because everyone in the company learns by doing. Improvement is shown all along the line. Top management, the engineers, the planners, the tool designers and builders, the supervisors and their men all learn to do their jobs faster and more efficiently. "Know-how" gets stored in the mind of everyone concerned. Experience teaches everyone the tricks of his trade. He gets a surer grasp of it and he does it with ease and speed.

To sum up the theory -the more times a person performs a given task, the faster he or she can accomplish it. Also that the reduction in time becomes less with each successive unit. These facts have long been recognized. What was not known until recent years was that the *rate or improvement remains regular enough to be predictable. Production tends to improve*

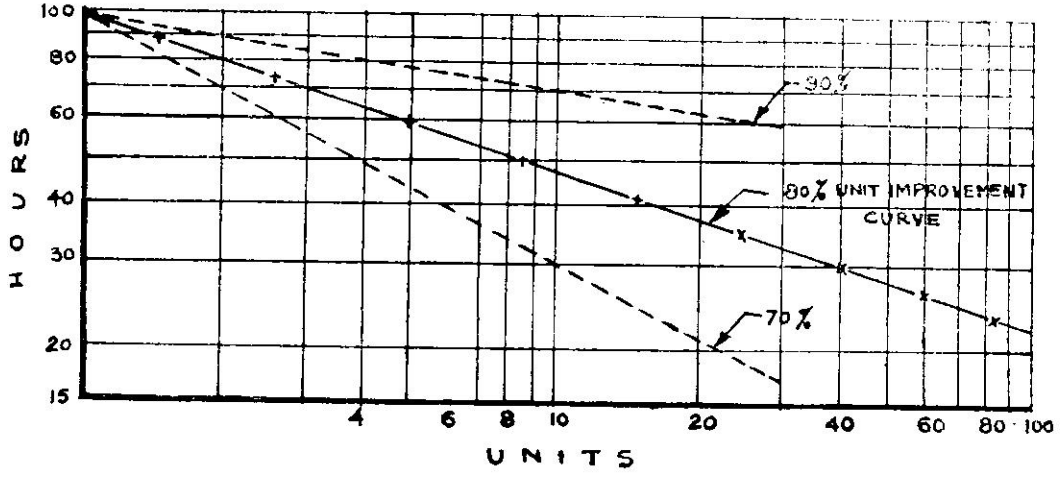
*The readers may find it useful to read alongside with this article, Prof. Jyotirmoy Banerjee's research piece published in the Monsoon 1967 issue of this Journal (page 174)

FIG. 1(a)



ARITHMETIC PLOT

FIG. 1(b)



LOGARITHMIC PLOT

by a constant percentage each time production is doubled.

This trend can be projected by a curve which is a geometric progression that expresses the decreasing cost required to accomplish any repetitive operation as the operation is continued. The cost may be in terms of money or in terms of manhours. The curve forecasts that the cost required to produce an article will decrease each time that the article is produced and that the amount of decrease will be less with each successive unit. The slope of the curve is expressed as a percentage : 80 percent, 75 percent etc. This slope is simply the expression of the ratio between the cost of any unit and the cost of twice that unit. For example on an 80 percent improvement curve, if 100 hours are required for the first unit, the second unit will require 80 hours, the fourth 64 hours, and so on. A tabulation of this relationship is shown below :

TABLE I

Unit No. 1				100 hrs.
No. 2	80% × Unit No.	1 = .80 × 100	= 80	hrs.
No. 4	80% × „ „	2 = .80 × 80	= 64	„
No. 8	80% × „ „	4 = .80 × 64	= 51.2	„
No. 16	80% × „ „	8 = .80 × 51.2	= 40 96	„
No. 32	80% × „ „	16 = .80 × 40.96	= 32.77	„
No. 64	80% × „ „	32 = .80 × 32.77	= 26.21	„
No. 128	80% × „ „	64 = .80 × 26.21	= 20.97	„

In the table each unit represents twice as much production as the one shown before, and each manhour figure is only 80 percent. of the figure that goes before This is because production tends to improve by a constant percentage each time output is doubled.

Forecasters can use this theory and project the actual manpower requirements for each unit when they know the manpower required for the first unit.

This may sound to be too mathematically precise to be true. Nevertheless actual experience and the study of production figures seem to show that the average percentage trends are found in nearly every production line.

One might also think that it is unreasonable to expect this time reduction to go on indefinitely. It would seem at first glance that the speed of production would eventually reach an exceedingly high rate; but such is not the case. The quantity of units produced must be doubled each time to get the 20% reduction in time. Although the time required steadily decreases, the quantities produced approach infinity even faster.

A graph of this curve on ordinary graph paper is shown in Figure 1(a). For use in estimating, however, the curve is generally charted on a logarithmic scale which has the property of showing the curve as a straight line Figure 1 (b). This curve is referred to as a "Unit Curve".

It is evident from Figure 1 (a) that due to the sharp decline in the beginning the curves are not readable accurately for the early units, and that many plot points are necessary for the construction of each curve, whereas the straight line curves in Figure 1 (b) can be read with equal accuracy throughout the range and can be plotted from 2 plot points or 1 point and the percentage of the curve.

There are many factors or variables that affect improvement in industrial production; in actual practice, therefore, each of these will show up on the improvement curve if plotted from steep declines in the body of the curve, though the general gradient will still be maintained.

Various tables have been compiled for making improvement curve calculations. One such table, printed on page 74, gives values of each unit as well as cumulative values of successive units for an 80% improvement curve.

TABLE II

No.	80% Curve Unit Value	Cumulative	No.	80% Curve Unit Value	Cumulative
1	100.0000	100.0000	21	37.5267	1,036.0203
2	80.0000	180.0000	22	36.9688	1,122.9891
3	70.2103	250.2103	23	36.4436	1,159.4327
4	64.0000	314.2103	24	35.9477	1,195.3804
5	59.5637	373.7740	25	35.4783	1,230.8587
6	56.1683	429.9423	..	..	..
7	53.4489	483.3912	50	28.3827	2,012.1696
8	51.2000	534.5912	..	..	..
9	49.2949	583.8861	75	24.9095	2,672.7245
10	47.6509	631.5370	..	..	..
11	46.2111	677.7481	100	22.7061	3,265.0776
12	44.9346	722.6827	..	..	..
13	43.7915	766.4742	150	19.9276	4,323.3467
14	42.7591	809.2333	..	..	..
15	41.8199	851.0532	200	18.1649	5,271.9891
16	40.9600	892.0132	..	..	..
17	40.1683	932.1815	300	15.9420	6,966.3269
18	39.4359	971.6174	..	..	..
19	38.7554	1,010.3728	500	13.5246	9,884.7055
20	38.1208	1,048.4936			

"You've returned from a course in Inventory Control! This is practical business, my dear... Learn all your Productivity Techniques from me..."

Dear Sirs,

PROGRAMMES FOR JUNE - DECEMBER 1968

Executive Development Programmes *Technique-based courses*

Given overleaf is the schedule of our training courses for the second semester, June- December 1968. Details are available in Prospectus No. 5 which is already with you.

During the last 4 years, about 2000 executives from all parts of the country, belonging to over 400 organisations, have taken advantage of NITIE training programmes.

NITIE faculty, consisting of ILO and Indian specialists, are endeavouring to meet the changing needs of Indian organisations. Besides restructuring existing programmes and introducing new concepts and techniques, we are offering new courses on Computer Systems & Applications, Operations Research, and Business Statistics.

FUTURE PROGRAMMES - 1969

Programme for Management Trainees *In collaboration with All India Management Association*

We are happy to announce that NITIE is finalising a plan for management trainees who are fresh entrants to the Industry. Most companies take every year a few management trainees who are trained within the company for periods ranging from 1 to 2 years, before being assigned responsibilities. To strengthen the training efforts of such companies, NITIE will be starting a sandwich programme wherein, trainees will spend about 7 months at NITIE and 5 months in the company. They would initially take a three-month foundation course at NITIE, return to the company for a three-month induction on company's policies, procedures, products and processes, come back to NITIE for a four-month training in functional areas of management and techniques, and finally return to the company for a project. The programme will be a joint effort by the companies and NITIE, right from recruitment through course design, teaching, appraisal and placement.

Unit-Based Programmes

Presently NITIE is conducting over 40 courses, structured and offered on inter-company basis. However, a few companies have expressed interest in NITIE running programmes tailor-made to their specific requirements - having a mix of functional areas and techniques. We propose to start a few such unit-based courses - unit being a factory, a company, an organisation or an industry. These special programmes will be a collaboration between NITIE and the organisations concerned in areas such as assessment of training needs, selection of trainees, determination of quantum and nature of courses for the various groups, course design, teaching, continuous appraisal of the participants' performance, etc.

Details of the above two new schemes will follow. Meanwhile, we invite your suggestions in this regard. We would also be happy to discuss these schemes with you.

Yours truly,

N.S. Ramaswamy

N.S. Ramaswamy
Director

NATIONAL INSTITUTE FOR TRAINING IN INDUSTRIAL ENGINEERING
A Government of India Project with U.N. assistance through I.L.O.

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EXECUTIVE DEVELOPMENT PROGRAMMES

SCHEDULE FOR JUNE – DECEMBER 1968

COURSES	NO OF WEEKS
At BOMBAY Residential	
Work Study	10
Method Study	6
Work Measurement	6
Plant Design & Layout	6
Office Organisation & Methods	4
Job Evaluation & Merit Rating	3
Waste Reduction	2
Value Engineering	2
Production Management	4
Production Planning & Control	6
Stores & Inventory Control	3
PERT/CPM	2
Product Engineering	3
Production Engineering	4
Systematic Plant Maintenance	4
Sales Budget & Forecasting	2
Industrial Marketing	4
Market Survey	4
Human Relations	2
Motivation Techniques	3
Business & Industrial Management	4
Cost Estimating & Pricing	2
Management Controls	2
Computers-Systems & Applications*	2
Business Statistics*	2
Operations Research*	2
At MADRAS Non-residential	
Management Controls	2
Sales Budget & Forecasting	2

WEEK STARTING FROM: JUNE 17, 24; JULY 1, 8, 15, 22, 29; AUGUST 5, 12, 19, 26; SEPTEMBER 2, 9, 16, 23, 30; OCTOBER 7, 14, 21, 28; NOVEMBER 4, 11, 18, 25; DECEMBER 2, 9, 16, 23, 30

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At Bombay – Residental
Rs. 125 per week

At Madras – non-residentail
Rs. 95 per week

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M		3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	**21**	28	4	11	18	25	2	9	16	23	30
T		4	11	18	25	2	9	16	23	30	6	13	20	**27**	3	10	17	24	**1**	8	15	**22**	29	5	12	19	26	3	10	17	24	31
W		5	12	19	26	3	10	17	24	31	7	14	21	**28**	4	11	18	25	**2**	9	16	23	30	6	13	20	27	4	11	18	**25**	
T		6	13	20	27	4	11	18	25	1	**8**	**15**	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
F		7	14	21	28	5	12	19	26	2	9	**16**	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	
S	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	
S	**2**	**9**	**16**	**23**	**30**	**7**	**14**	**21**	**28**	**4**	**11**	**18**	**25**	**1**	**8**	**15**	**22**	**29**	**6**	**13**	**20**	**27**	**3**	**10**	**17**	**24**	**1**	**8**	**15**	**22**	**29**	

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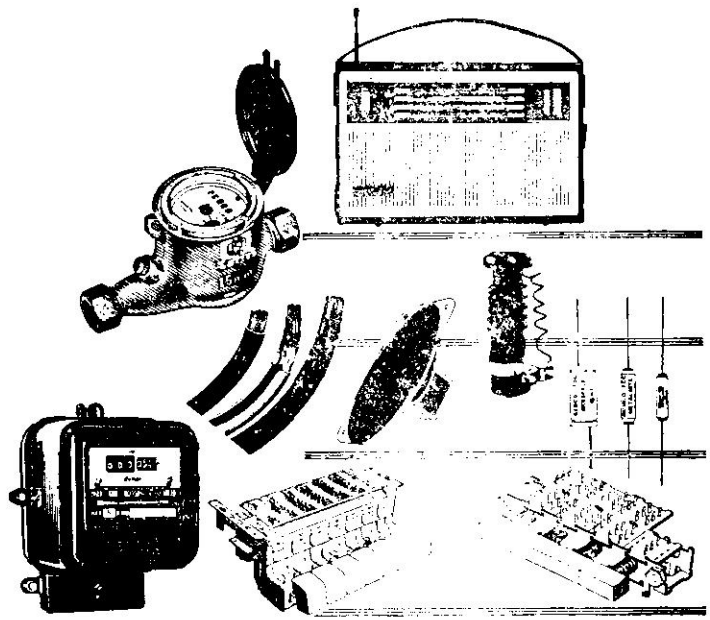

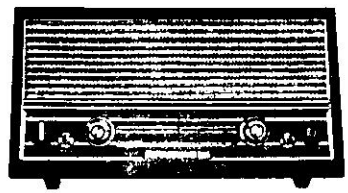

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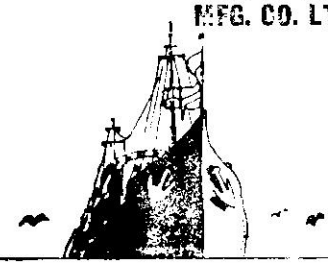

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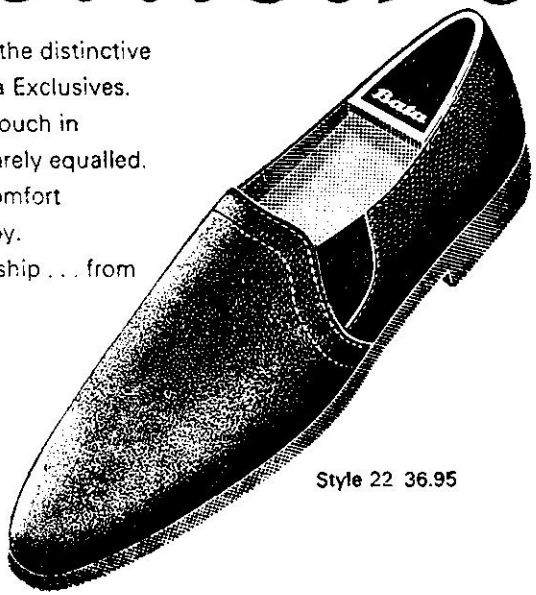

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Uncertainty In Production How To Analyse It?

S Sundara Murthy*

The occurrence of chance events is not uncommon in manufacturing operations. In fact, at least some degree of uncertainty is practically always present in each of the many variables that affect the economics of production. The effect of these variables on any measure of value can only be judged by trial and error. The process can be expensive and time-consuming. The author has here worked out a statistical method by which the occurrence of chance events may be reasonably estimated and the diseconomies resulting from blindly trusting to chance may be minimised.

IF THE PROBABILITY DISTRIBUTION OF THE relevant variables, or in other words, the relative frequency of occurrence of the different chance events, is determined on the basis of past record or from an actual study, the effect of the variables on the chosen measure of value may be determined to a reasonable degree of accuracy. This procedure, known as the Monte Carlo analysis, makes use of a table of random numbers. It improves the process of judgment by minimizing the range of the variables. The procedure can be better explained in the context of a practical situation.

Let us consider a problem where a job shop usually receives orders for special parts. The orders for the same parts may not be repeated again. For various reasons the shop may have to reject some of the manufactured products as not meeting the specified standards; therefore a decision has to be taken regarding the total number of products to be scheduled for production every time an order is received.

The relative frequency of the rejection rate is established from previous records of shop performance. It is expressed as a ratio of the total units scheduled to the number of good pieces produced. This information should be helpful in deciding the number of units to be scheduled every time. The decision should also be based on the set up costs and the variable costs for each product, because, if a larger number of products than that of customer order is finished as good parts, the variable costs for the products in excess of the requirement can be considered as extra production costs. If the products are fewer than the customer ordered number, it would result in additional set up costs. A production schedule should be based on these additional costs as well as the probability of the rejection rate.

Table I, on page 86, gives a summary of the frequency or rejection rate as assessed from past records.

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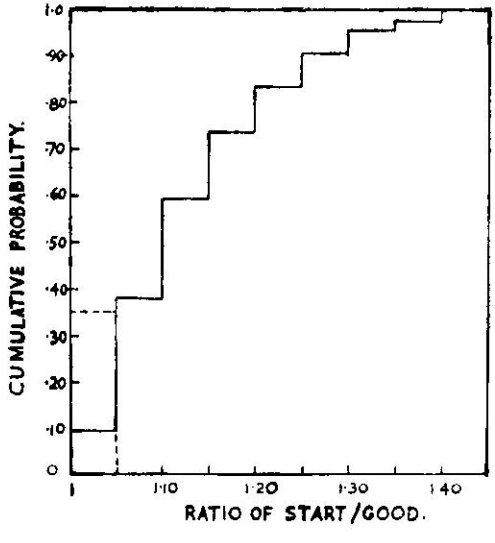
TABLE I

No. of units scheduled / No. of good units produced	% Frequency	Cumulative frequency
1.00	9.5	9.5
1.05	28.5	38.0
1.10	21.3	59.3
1.15	14.3	73.6
1.20	9.5	83.1
1.25	7.3	90.4
1.30	4.8	95.2
1.35	2.4	97.6
1.40	2.4	100.0
	100.0	

The above information can also be expressed in the form of a cumulative frequency distribution chart as shown in Figure I.

FIG. I.



When the data are arranged in this fashion we can organise an artificial simulation in order to decide the characteristics of the variables based on the measure of value. The following steps are followed in Monte Carlo analysis:

Step 1

Assign random numbers from a table of random numbers to the various values of the variables in such a way that the frequency of appearance of the random numbers exactly equals the frequency of appearance of the variables.

To illustrate this, let us assign from a table of random numbers with three digits as shown in Table II the numbers 000 to 094 — to the value of 1 for the reject ratio in Table I.

TABLE II

925	915	539	186	789	657	396	579	132
424	179	760	731	722	834	425	051	212
467	465	907	574	205	495	039	005	990
032	921	643	304	573	145	089	166	001
865	042	002	999	967	967	264	349	605
305	156	389	047	700	164	316	698	912

Thus the relative frequency of choosing any number between 000 to 094 from among the numbers available from 000 to 999 in a three-digits random number table is 095 which is equal to the relative frequency of a value of 1.00 of the chosen variable in the current example.

Continuing the same process we will assign the following random numbers to the different variables:

TABLE III

Reject Ratio	Random Numbers Assigned	Frequency of Random Numbers
1	000—094	.095
1.05	095—379	.285
1.10	380—592	.213
1.15	593—735	.143
1.20	756—830	.095
1.25	831—904	.073
1.30	905—951	.048
1.35	952—975	.024
1.40	976—999	.024

Step 2

Choose a random number from the table and decide the corresponding value of the reject ratio. This is just the effect of an artificially simulated production run. Assuming various possible values of the number of units scheduled, we can determine the various cost values with this value of the reject ratio. Let us compare these results for three different scheduled values of 40, 50 and 60 units for a customer demand of 40 units. The average costs determined after a sufficient number of such simulations should be helpful to decide the optional value of the production schedule. The results are shown in Table IV.

Depending upon the accuracy needed, this type of analysis may be done for closer ranges of production schedule quantities. A sample simulation for the above three values of scheduled units for ten times shows the lowest average cost for a production run of 50 units.

Conclusion

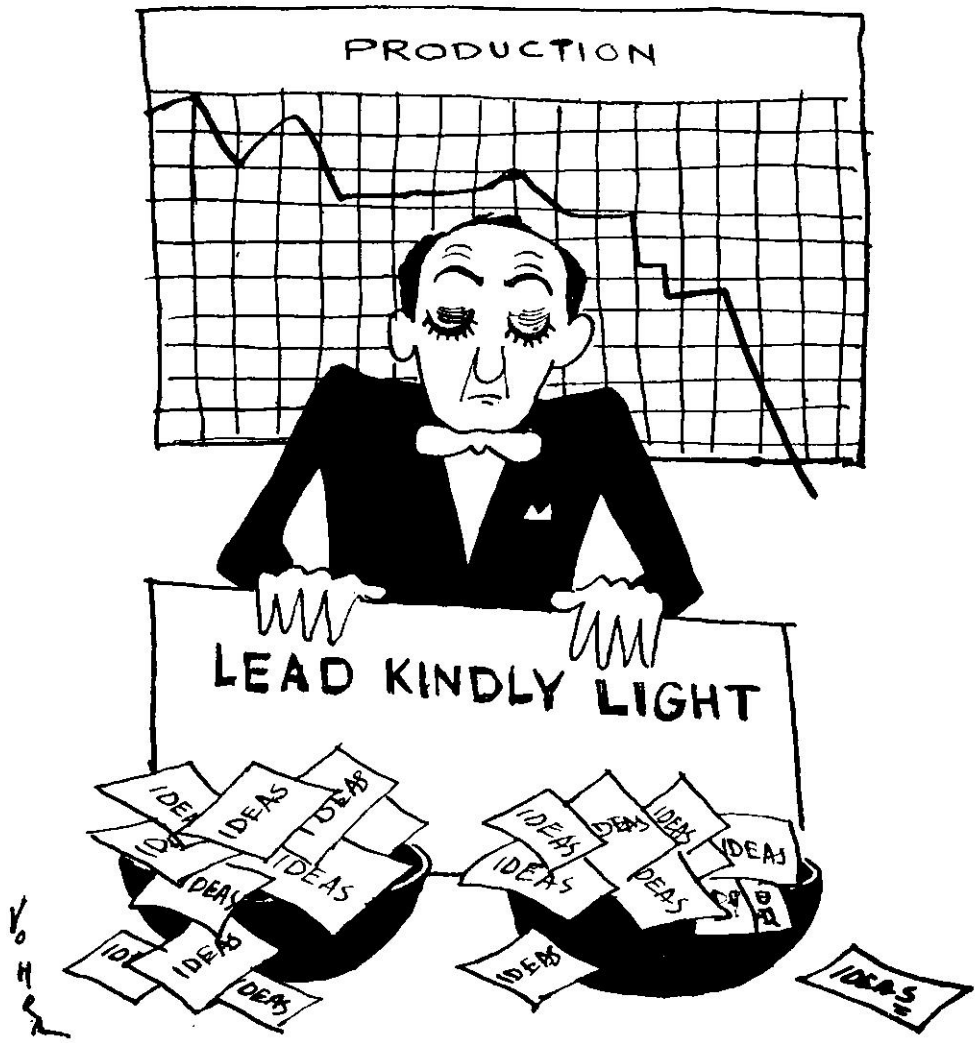
The principle can be extended for analysing any manufacturing function where the variables which determine the value of production vary under certain conditions of uncertainty. For example, in determining a reorder-point in inventory control to prevent loss due to stock-outs, a knowledge of the relative frequency of

TABLE IV

Schedule No.	Random Number	Corresponding Ratio	Excess Costs when scheduled units are: 40 — No. of good units produced	40 — Excess variable cost	40 — Set up cost	50 — No. of good units produced	50 — Excess variable cost	50 — Set up cost	60 — No. of good units produced	60 — Excess variable cost	60 — Set up cost
1	925	1.30	31		20	38		20	46	6	
2	424	1.10	36		20	45	5		55	15	
3	467	1.10	36		20	45	5		55	15	
4	032	1.00	40			50	10		60	20	
5	865	1.25	32		20	40			48	8	
6	305	1.05	38		20	48	8		57	17	
7	915	1.30	31		20	38		20	46	6	
8	179	1.05	38		20	48	8		57	17	
9	465	1.10	36		20	45	5		55	15	
10	921	1.30	31		20	38		20	46	6	
Variable cost Re. 1/- per unit.		Total excess costs			180		41	60		125	
Set up cost Rs. 20/- per run.		Averages excess cost run			$\frac{180}{10}=18$		$\frac{101}{10}=10.1$			$\frac{125}{10}=12.5$	

stock-outs with various levels of reorder-points may help to determine the optimum level of the reorder-point by the use of Monte Carlo analysis.

In some cases a slightly modified method of reckoning the variable values corresponding to each random number drawn from the Table is also useful. Instead of assigning random numbers to each of the different variables the cumulative frequency chart as shown in Figure 1 may be drawn and the corresponding value for each random number during a simulation may be read from this chart. The random number chosen in this case refers to the value of cumulative probability. ●●●



Statistical Methods of Job Evaluation

B Chandrasekhara Naidu*

Research is there in almost all the fields; but little work has been done in the field of Job Evaluation to make it more scientific.[1] In the Point Method of Job Evaluation the factors weightage is the basic thing on which the accuracy of the evaluation depends. So far the practice has been to compare the factors weightage with that of similar organizations and take a decision for the concern for which the evaluation is to be made. Such a decision involves a drastic assumption; and an evaluation of this type cannot be called scientific. An attempt has been made here to work out a scientific basis for the factors weightage. An actual study was carried out in an engineering industry where factors weightage was obtained by a systematic approach to the problem.

JOB EVALUATION HAS BEEN DEFINED AS "the process of analysis and assessment of jobs to ascertain their relative worth, using the assessment as a basis for a balanced wage structure." It aims at an equitable distribution of the total wage fund among all the jobs of different skills, efforts and responsibilities, so that each job receives a share proportionate to its contribution to the process of production. This objective can only be achieved when the relative value of each job is known. Hence the first essential in establishing a sound wage structure is the assessment of the worth of each job in relation to the other jobs within the department, plant and community.

*Head of the Department of Industrial Engineering, Orient General Industries Ltd., Calcutta

[1]Readers may see the article on 'Job Evaluation at Hindustan Steel', published in Vol. VIII-3 of this Journal

The aims of the present Study are

(1) To make Job Evaluation more systematic and scientific

(2) To examine the statement of the pioneers that "Too many factors are not necessary"

(3) To test the validity of the saying that "Job evaluation should be carried out on a particular type of Job"

(4) To establish a sound wage structure.

With these four objectives in mind a decision was made to evaluate factory jobs in the engineering industry. Some supervisory and clerical jobs were included purposely to test the validity of the above statements. After making a preliminary survey, thirty jobs (see Table I) were selected from Foundry, Machine, Erection and Smithy shops and their job descriptions were written in specially designed Job Description Forms, containing a description of the operations, duties, methods, working

conditions, equipment and material used, lines of authority and other essential facts about the Job.

TABLE I

Sl. No.	Designation	Basic salary in the grade	D.A.	Total
1.	Chargeman 'A'	260—350	65	325—415
2.	Chargeman 'B'	200—300	65	265—365
3.	Chargeman 'C'	150—225	60	210—285
4.	Mistry	100—185	55	155—240
5.	Turner H.S. Gr. I	125—185	55	180—240
6.	Marker of H.S. Gr. II	80—160	50	130—210
7.	Machinist Skilled	60—130	50	110—180
8.	Apprentice Mechanic Gr. I	55— 67	50	105—117
9.	Material Despatcher	40— 60	40	60—100
10.	Rough grinder	35— 60	40	75—100
11.	Muccadam	35— 40	40	75— 80
12.	Khalasi	30— 35	40	70— 75
13.	Head clerk	160—250	60	220—310
14.	Shunter	75—105	50	125—155
15.	Sign Writer Skilled	60—130	50	110—150
16.	Spring Maker Gr. II	60—160	50	130—210
17.	Material Inspector	100—185	55	155—240
18.	Storeman	55— 85	50	105—135
19.	Painter	60—130	50	110—180
20.	Forge Smith H.S. Gr. I	125—185	55	180—240
21.	Coremaker H.S. Gr. I	125—185	55	180—240
22.	Fitter Skilled	60—130	50	110—180
23.	Furnaceman Incharge Gr. II	80—160	50	130—210
24.	Storeman	55— 85	50	105—135
25.	Fitter Skilled	60—130	50	110—180
26.	Slinger Semi-skilled	35— 60	40	75—100
27.	Furnaceman Incharge	60—130	50	110—180
28.	Drop Smith H.S. Gr. II	80—160	50	130—210
29.	Yard Porter	35— 50	40	75— 90
30.	Rigger Special	60—130	50	110—180

A Critical Analysis of these jobs was made on the basis of the following sixteen factors which contribute to the total value of the Job:

I. Education, Skills etc. :

1. Education
2. Training
3. Experience
4. Initiative and ingenuity
5. Sociability
6. Intelligence and mental ability.

II. Effort :

7. Mental or Visual demand
8. Concentration
9. Physical demand

III. Responsibility (for) :

10. Machinery, equipment and process
11. Material and Product
12. Safety of self and others
13. Work of others
14. Quality

IV. Working Conditions :

15. Hazards
16. Environment

These factors have been defined in simple language to convey the same meaning. Unlike the old practice of assuming the factors weightage, an attempt has been made to get the factors weightage statistically by using the technique of period comparison.

Method of Paired Comparison

Presented with all the factors and asked to rank them as per their importance, it is very difficult to arrive at a valid judgement. The factors are here arranged in all sorts of possible pairs: each time one pair is presented, judgements are recorded in a specially designed chart. The judgement is checked for consistency by calculating the coefficient of consistency K which is given by

$$K = 1 - \frac{2!d}{n^3 - 4n} \quad \text{for n even number}$$

$$1 - \frac{24d}{n^3 - n} \quad \text{for n odd numbers,}$$

where 'd' is the number of inconsistent judgements and 'n' is the number of factors. Here

we see the value of K is unity when the number of inconsistent judgements is zero and its value is less than unity when there are inconsistent judgements and K value becomes zero when there are maximum number of inconsistent judgements. The maximum number of inconsistent judgements is given by $\frac{n^3-n}{24}$ if 'n' is an odd number, and $\frac{n^3-4n}{24}$ if 'n' is an even number

In the equation for the calculation of K, the only unknown is 'd', whose value can be mathematically calculated either by the Geometric Method or otherwise.

Geometric Method

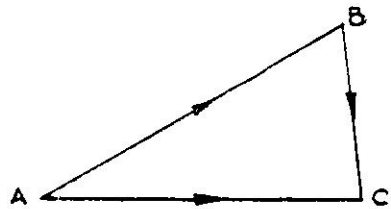
This method is tedious if the number of items is too many. From this method we can find out where the inconsistency has occurred.

From Figures 1 and 2, we see that in the case of three items the consistent choice would take the form of a resultant triad whereas the inconsistent choice would result in the formation of a circular triad. Here the direction of the arrows indicates the direction of the decreasing preference. If the numbr of items are seven we can represent them by a polyad, as in Figure 2, from which the number of circular triads can be counted. Since this is tedious for sixteen factors, the other mathematical method is adopted.

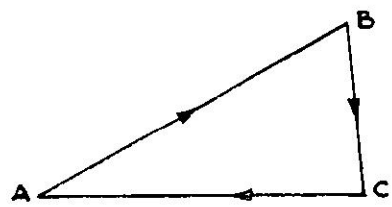
Judgements are filled in, as in Table 2. The notation used is as follows: If the item in the row is more important than the item in the column, it is denoted by 1. On the other hand if the item in the column is more important than the item in the row, then it is denoted by 0.

The symbol 1 in each row is added and is denoted by S. The expected number of occurrences, E, in each row is given by n-1/2. The quantity $(S-E)^2$ is calculated and all such quantities are added and denoted by T. The maximum value of T is given by $n^3-n/12$. The number of inconsistent judgements is $\frac{T_{max}-T}{2}$.

Knowing the value of d, K can be calculated.



CONSISTENT CHOKES
GIVE A RESULTANT TRIAD
FIG. 1.



INCONSISTENT CHOICES
GIVE A CIRCULAR TRIAD
FIG. 2

TABLE II

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Row Sum S	$(S-E)^2$
A		0	0	0	1	0	1	0	1	1	1	0	1	0	1	0	7	0.25
B	1		0	1	1	1	1	0	1	1	1	1	1	1	1	1	13	30.25
C	1	1		1	1	0	1	1	1	1	1	1	1	1	1	1	14	42.25
D	1	0	0		1	0	1	1	1	1	1	1	1	1	1	1	12	20.25
E	0	0	0	0		0	0	0	1	1	0	1	0	1	1	1	6	2.25
F	1	0	1	1	1		1	1	1	1	1	1	1	1	1	1	14	42.25
G	0	0	0	0	1	0		0	1	1	1	1	1	0	1	0	7	0.25
H	1	1	0	0	1	0	1		1	1	1	1	1	0	1	1	11	12.25
I	0	0	0	0	0	0	0	0		0	0	1	1	1	0	0	3	20.25
J	0	0	0	0	0	0	0	0	1		1	1	1	1	0	0	5	6.25
K	0	0	0	0	1	0	0	0	1	0		1	1	1	0	0	5	6.25
L	1	0	0	0	0	0	0	0	0	0	0		1	1	0	0	3	20.25
M	0	0	0	0	1	0	0	0	0	0	0	0		1	0	0	2	30.25
N	1	0	0	0	0	0	1	1	0	0	0	0	0		0	0	3	20.25
O	0	0	0	0	0	0	0	0	1	1	1	1	1	1		0	6	2.25
P	1	0	0	0	0	0	1	0	1	1	1	1	1	1	1		9	3.06
																	TOTAL	$= T-258.81$

Coefficient of Consistency

We know from Table II the value of $T=258.81$ and with $n=16$ items to be compared, the expected frequency of the symbol 1 per row is $E=\frac{n-1}{2}=7.5$. This value of E is used in the table to calculate the value of $(S-E)^2$. Now the maximum possible value of T is given by

$T_{max}=n\,(n^2-1)/12=16\,(256-1)/12-340.$

The number of circular triads (inconsistant judgements) is then given by

$$d=\frac{T_{max}-T}{2}=\frac{340-258.81}{2}=41.$$

The coefficient of consistency $=K=1-\frac{24d}{n^3-4n}$ for 'n' even number.

$$1-\frac{24\times 41}{16\,(256-4)}=1-0\,24$$

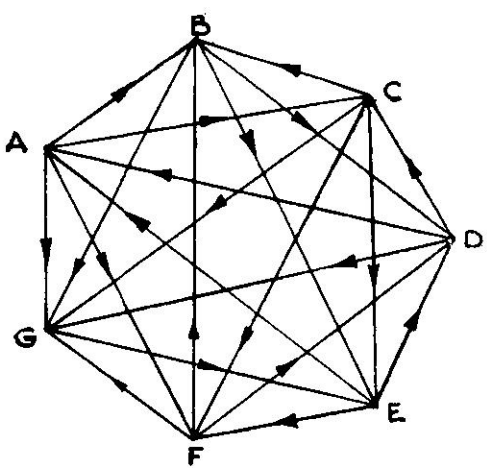
$$=0.76$$

This indicates the measure of consistency.

Eight judgements have been taken whose K value is more than 0.25. Each cell of individual judgements is added up, resulting in the formation of F-Matrix.

TABLE III

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
A	4	7	2	5	7	4	5	4	5	5	4	5	5	4	6	6	A = Education
B	1	4	1	5	4	7	4	5	4	5	5	4	5	6	6	5	B = Training
C	6	7	4	4	7	5	7	7	6	6	6	7	5	5	7	7	C = Experience
D	3	3	4	4	5	3	6	4	4	5	5	3	4	4	3	3	D = Initiative and Ingenuity
E	1	4	1	3	4	2	4	2	2	4	4	3	3	4	4	5	S = Sociability
F	4	1	3	5	6	4	3	4	4	4	5	4	5	5	6	6	F = Intelligence
G	3	4	1	2	4	5	4	2	2	3	3	3	2	1	4	3	G = Mental or Visual Demand
H	4	3	1	4	6	5	6	4	3	2	2	2	4	4	3	4	H = Concentration
I	3	4	2	4	6	4	6	5	4	5	5	4	4	3	6	6	I = Physical Demand
J	3	3	2	3	4	4	5	6	3	4	3	3	4	4	4	5	J = Responsibility for machinery, equipment & process
K	4	3	2	5	4	4	5	6	3	5	4	2	2	2	1	2	K = Responsible for material and product
L	3	4	1	5	5	3	5	6	4	5	6	4	3	2	1	3	L = Responsible for safety of self and others
M	3	3	3	4	5	4	6	4	4	4	6	5	4	2	1	2	M = Responsible for work of others
N	4	2	3	4	4	3	7	4	5	4	6	6	6	4	2	1	N = Responsible for quality
O	2	2	1	5	4	3	4	5	2	4	7	7	7	6	4	1	O = Hazards involved
P	2	3	1	5	3	2	5	4	2	3	6	5	6	7	7	4	P = Surrounding environment



PREFERENCE POLYAD

FIG. 3.

F-Matrix

Table 3 shows how many judges (out of eight) have preferred A when compared with B, C and so on. Here the diagonal of the table has been taken as equal to N/2 for obvious reasons, where N is the number of judges.

P-Matrix

When all the cells of the F-Matrix are divided by N (the number of Judges) we get the formation, P-Matrix.

Z-Matrix

For each P value of every cell of the P-Matrix there comes a corresponding Z value from the table. These values of the rows are added up and in this, some are negative. So a certain quantity is added to make them positive. These values give the relative importance of the factors and from those relative values the percentage importance has been calculated, as shown on page 94.

Sl. No.	Factor	% Weightage
1=A =	Education	= 10
2=B =	Training	= 10
3=C =	Experience	= 15
4=D =	Initiative and Ingenuity	= 5
5=E =	Sociability	= 4
6=F =	Intelligence	= 10
7=G =	Mental or Visual demand	= 4
8=H =	Concentration	= 5
9=I =	Physical demand	= 10
10=J =	Responsibility for machinery, equipment & process	= 4
11=K =	Responsibility for material and product	= 4
12=L =	Responsibility for safety of self and others	= 4
13=M=	Responsibility for the work of others	= 4
14=N =	Responsible for quality	= 3
15=O =	Hazards involved	= 4
16=P =	Surrounding environment.	= 4

TABLE IV

Job No.	Wage	Points Obtained
1	325—415	487
2	265—365	400
3	210—285	338
4	155—240	231
5	180—240	276
6	130—210	198
7	110—180	198
8	105—117	156
9	80—100	121
10	75—100	136
11	75— 80	117
12	70— 75	104
13	220—310	260
14	125—155	186
15	110—180	175
16	130—210	201
17	155—240	181
18	105—135	159
19	110—180	165
20	180—240	204
21	180—240	240
22	100—180	194
23	130—210	115
24	105—135	222
25	110—180	206
26	75—100	155
27	110—180	189
28	130—210	248
29	75— 90	113
30	110—180	145

Job specifications have been written in specially designed Job Specification forms which contain a statement of the qualities that a worker must possess to perform the Job in a satisfactory manner. The number of degrees for each factor was decided as per the requirements in the shop and each degree was defined in the shop floor language. Points for each degree of every factor were awarded on the basis of arithmetical progression relationship. A committee of five members was formed to rate the factors and the average of their rating has been taken. The average rating was multiplied by the corresponding factor weightage to get the total Job points. The list of the Jobs with their wages and points obtained is given in Table 4.

A graph was plotted (see Figure 4) between wage *versus* points obtained and maximum and minimum line equations were found out by using the principle of least square which came to be $y = -3.46 + .68\ x$, and $y = 74.6 + .74\ x$ respectively. The coefficient of correlation was calculated between the theoretical points and obtained points which came as high as 0.946. Wage line drawn excluding the points contributed by the three factors—Sociability, Responsibility for material and product, and Responsibility for the work of others—showed the same trend as the previously drawn wage line, indicating the unimportance of those factors, as contributing to the total relative value of the Job. The statement of the

pioneers that "TOO MANY FACTORS ARE NOT NECESSARY" seems, therefore, to be correct.

Wage Structure

After consultation with the management, minimum and maximum wages were fixed at Rs. 70/- and Rs. 325/- per month, with twelve grades. Assuming a grade differential of n, the twelve grades were 70, 70n, $70n^2$, $70n^3$, $70n^4$, $70n^5$, $70n^6$, $70n^7$, $70n^8$, $70n^9$, $70n^{10}$, $70n^{11}$. Since the last grade is equal to the maximum wage, equating these two we have

$$325 = 70n^{11}$$
$$\therefore n = 1.15$$

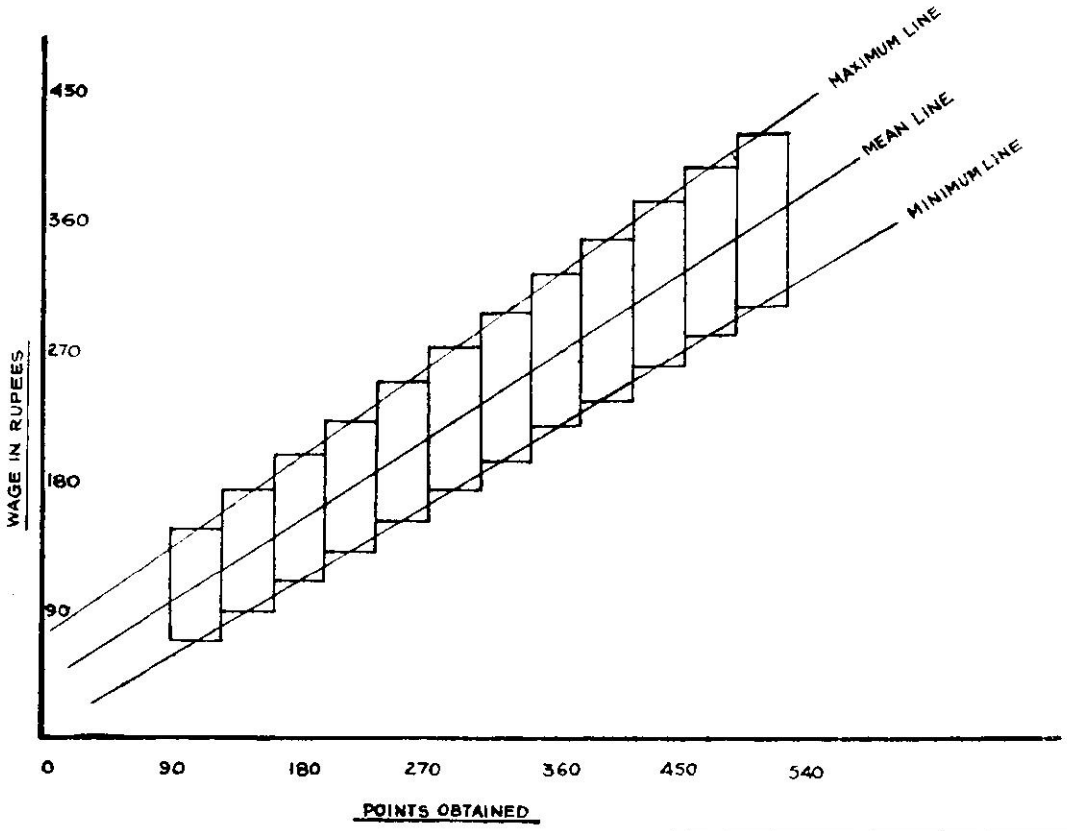
Thus the minimum wage for all the twelve grades was fixed. Regarding fixing up of the ceiling for each grade, a survey was made of the existing grades which on an average came to 45 per cent of the minimum of each grade as its grade range. It was decided to take 50 per cent. of the minimum of each grade as its grade range. The final list of the grades with their grade range is given in Table V.

TABLE V

Grade No.	Grade
1	70—105
2	80—120
3	92—138
4	106—159
5	122—183
6	140—210
7	160—240
8	184—276
9	212—318
10	244—350
11	270—376
12	290—418

The points range for each was calculated as follows :

The maximum points obtained were 487 and the minimum 104, the difference in the points range being 383. Since there are twelve grades, the points range for each grade is equal to 383/12 or 32, assuming equal distribution of points for each grade. The grades are shown graphically in Figure 4.



The recommended grades were compared with the existing grades. Here we found some jobs overpaid and some underpaid. Since we could not reduce the earnings of the worker in any case due to possibility of labour unrest, we recommended that in cases where recommended grades were less than the existing grades a personal allowance was to be given to keep the total earnings the same every time. The list of recommended grades with personal allowances is given in Table VI.

These personal allowances are applicable only to those people who were already in the grade. If a new man was promoted to the grade he would not be enjoying the personal allowance, but would only get the recommended grade. This was made clear by the management.

We found that clerical jobs could not be accommodated in this set-up. This shows that the theory of the pioneers that "JOB EVALUATION SHOULD BE CARRIED OUT ON A PARTICULAR TYPE OF JOB", is valid.

In applying the method of paired comparison to obtain the factors weightage judges were asked to choose one factor out of two indicating the importance of one factor over the other. This resulted in a more scientific evaluation and the results were very satisfactory, indeed.

TABLE VI

Sl. No.	Designation	Existing Scale	Obtained Grade No.	Obtained Scale	Personal allowances	Total earnings in the Grade
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Chargeman A	325—415	XII	290—418	Nil	290—418
2.	Chargeman B	265—365	X	244—350	Nil	244—350
3.	Chargeman C	210—285	IX	212—318	Nil	212—318
4.	Mistry	155—240	V	122—183	40*	162—223
5.	Turner H.S. Gr. I	180—240	VII	160—240	Nil	160—240
6.	Marker Off H.S. Gr. II	130—210	IV	106—159	40*	146—199
7.	Machinist Skilled	110—180	IV	106—159	Nil	106—159
8.	Sign Writer	110—180	II	80 —120	30*	110—150
9.	Spring Maker	130—210	IV	106—159	30*	136—189
10.	Material Inspector	155—240	IV	160—159	60*	166—219
11.	Storeman	105—135	V	122—183	Nil	122—183
12.	Painter	110—180	II	80 —120	30*	110—150
13.	Forgesmith H.S. Gr. I	180—240	IV	106—159	70*	176—229
14.	Drop Stamper H.S. Gr. I	180—240	VI	140—210	30*	170—240
15.	Yard Reporter	75— 90	I	70—105	Nil	70—105
16.	Rigger Special	110—180	II	80—120	30*	110—150
17.	Core Maker H.S. Gr. I	180—240	V	122—183	50*	172—223
18.	Fitter Skilled	110—180	IV	106—159	Nil	106—159
19.	Spring Maker H. S. Gr. II	130—210	I	70—105	60*	130—165
20.	Storeman	105—135	II	80—120	25*	105—145
21.	Fitter Skilled Machine Shop	110—180	IV	106—159	Nil	106—159
22.	Slinger Semi-skilled	75—100	II	80—120	Nil	80—120
23.	Furnaceman Incharge	110—180	IV	106—159	Nil	106—159
24.	Apprentice Mechanic Gr. I	105—117	II	80—120	25*	105—145
25.	Material Despatcher	80—100	I	70—105	Nil	70—105
26.	Rough Grinder	75—100	II	80—120	Nil	80—120
27.	Muccadam	75— 80	I	70—105	Nil	70—105
28.	Khalasi	70— 75	I	70—105	Nil	70—105
29.	Head Clerk	220—310	VI	140—210	80*	220—290
30.	Shunter	125—155	IV	106—159	Nil	106—159

*If a new man is promoted to this grade he will not enjoy the extra personal allowances.

Increasing Agricultural Productivity Role of Institutional Credit

BS Mathur*

The current debate about Social Control or Nationalisation of Banks, particularly in the context of the paucity of credit facilities for Agriculture, shows the crucial importance of the subject, if we are serious about providing sufficient food for the people, sufficient raw materials for Industry, alongside substantial surpluses for exports directly, and indirectly through industrial processing. If Indian Agriculture is to foot all this Bill, it must enjoy institutional credit facilities on a commensurate scale, to enable it to acquire and invest the inputs into the land in the form of fertilisers, improved seeds, improved implements, improved storage and improved transportation facilities. We cannot expect the cultivator to scratch the land with bare hands, and feed us. He must be aided adequately on an institutional, not on a money-lender basis; and the harvests will pay back both in cash and kind, what the country invests in Agriculture. *The increase in Agricultural Productivity is really of a self-financing nature.* **This is the Author's thesis.**

PRACTICALLY EVERYBODY NOW REALISES THAT the pass to which planning has now been reduced is due to the inadequate attention paid to the Development of Agriculture. Professor William H Nicholls has pointed out the various ways in which rising agricultural productivity supports and sustains industrial development. He has very rightly stated that a low productivity in agriculture cannot be made good by imports of food, except at a cost, in the form of worsened terms of trade which would itself inhibit industrial growth. Prof. Papi of the University of Rome has stated the issue precisely: "To give an impulse to the economic development of any country it is indispensable to increase productivity per man and per unit of land, in the production of foodstuffs, agricultural raw materials and essential goods."

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The present state of affairs can be graphically presented in statistics: if the present food supplies were distributed at the rate of 2300 calories per person per day, nearly 50 million out of 500 million people would have no food to eat! If the same food supplies were distributed at the US consumption rate of 3190 calories per person per day, over 150 million would be without food!

Obviously, a radical effort is immediately necessary. According to the Fourth Plan Draft, food production was to be increased to 120 million tonnes. This meant an increase of nearly 6 percent in the case of foodgrains and a little over 5 percent in the case of non-foodgrains. As bringing additional area under cultivation would mean heavy expenditure on new irrigation works, an immediate and substantial increase in output can only be brought about through intensive cultivation.

For a breakthrough in agricultural stagnation, it is essential, rather imperative, that the farmer be stimulated and helped so that the same land can be used for multiple cropping and for increasing substantially the yield per acre.

Studies conducted by various institutes amply demonstrate that by providing better seeds, fertilizers and other inputs, India can substantially raise the yield of foodgrains. There is not the least doubt that with adequate inputs the yield per acre can be increased three to fourfold. It is gratifying to note that an ambitious programme of production of fertilizers, production and distribution of high yielding, fertilizer-responsive and non-lodging varieties of wheat and paddy and hybrid varieties of maize, bajra and jowar has been drawn up. It is also proposed to expand the production of plant protection material, including pesticides.

This brings us to the subject of credit, without which these inputs cannot get into the land. Most of our farmers are very poor and their resources are far too meagre to permit them to make use of various inputs. It is obvious that without adequate and timely credit, they would not be able to carry out the various schemes of agricultural improvement. Additional finance would also be needed for marketing and processing. Mr. John D Black, Harvard Professor of Economics has rightly stated: "If we are all concerned about increasing total agricultural output in the shortest time, we must provide credit first and foremost. This will enable farmers to buy more labour-saving equipment, more seeds and fetilizers. The history of agricultural development in all advanced countries shows that an integrated system of institutional credit in fact laid the foundation of agricultural prosperity.

Private Credit Unproductive

In most underdeveloped countries, agricultural credit is supplied largely by private agencies. This private credit has, however, not proved beneficial to the farmer inasmuch as it hardly provides any incentive to effect improvement in the land. The farmer is not interested in increasing the yield by putting more inputs as there is a genuine apprehension in his mind that the increased yield would be unjustly appropriated either by the money-lender by making credit more costly or by the landlord by increasing the rent. The credit provided by the private agencies is thus unproductive as its main object is not to improve agriculture but to bring the farmer in the grip of perpetual indebtedness. In the *Agrarian Unrest in South East Asia*, Mr. Eric Jacoby says: "He (money lender) seldom cares about the use of the money he lends out and frequently encourages his clients to continue borrowing as long as they could give additional security."

In sharp contrast to this situation the objective of institutional credit is to make a breakthrough in the vicious circle of poverty, rack-renting, usury and debt and thus stimulate the farmer to boost agricultural productivity. This would mean, in the words of Dr. Horace Belshaw, "the conversion of static into dynamic credit."

Though the importance of institutional credit is recognised as basic to the development of agriculture, yet the same is conspicuous by its absence in most of the underdeveloped countries. This fact is highlighted by Table I.

TABLE I

*PER CAPITA UTILIZATION OF INSTITUTIONAL AGRICULTURAL CREDIT IN SELECTED COUNTRIES**

(US Dollars)

Name of Country	Credit in Use per head of Agricultural Population
Burma	0.5
Cambodia	0.3
Ceylon	2.9
India	0.6
Japan	28.2
Philippines	12.4
Thailand**	6 to 11.63

**Credit Problems of Small Farmers in Asia and the Far East*, FAO, p. 16.

***ERIC H JACOBY : *Agrarian Unrest in South East Asia*, p. 250.

It is obvious that not much headway has been made in the development of institutional credit for agriculture. In most of the countries of South East Asia an attempt has been made to develop institutional credit for agriculturists on co-operative lines. The co-operative approach has certainly a relative advantage over other agencies inasmuch as co-operatives have direct contact with the farmers and can easily understand the needs and requirements of the farmers on the one hand and supervise the utilization of the loan on the other.

In spite of these advantages, the unpleasant fact is that co-operative institutions have not yet succeeded even on a modest scale, to cater to the needs of the agriculturists as can be seen from the following table:

TABLE II

*SHARE OF CO-OPERATIVES IN AGRICULTURAL FINANCE IN SELECTED COUNTRIES**

Country	Date of start of Crop Co-operative movement	Co-operative finances as % to total borrowings
1. Malaya	1922	7
2. Thailand	1916	13
3. Philippines	1915	Membership covered 10 % of the villages
4. India	1904	22.5
5. Ceylon	1912	4.1
6. Pakistan	1904	13 (Punjab)

In India cooperative credit has made some significant progress during recent years. In fact, the figure printed in the Table would be now outdated. Even taking it as 26, it means an enormous increase over the 1951-52 position.

However, the problem of rural credit in India is so vast and variegated that at least in the conceivable future the cooperative would not be able to cope up with the needs and requirements of our farmers. In 1961-62 the total requirement of rural credit was estimated at about Rs. 1238 crores. In 1965-66, the last year of the Third Plan, the same was put at about Rs. 1400 crores. The Ministry of Food, Agriculture and Co-operation had estimated that by the end of the Third Plan the co-operative would be able to provide credit to the tune of Rs. 400 crores. This obviously meant that a wide gap of Rs. 1,000 crores was to be filled in by other agencies. As credit is the lifeblood of agriculture, it is imperative that all out efforts should be made to persuade all the existing institutional agencies to bridge the chasm. And if the present agencies are inadequate to cope with this stupenduous task there seems to be no reason why new agencies should not be established. One thing, however, is patent that agricultural development can hardly wait until co-operatives become strong enough to provide all the credit requirements of the peasantry. Faith in co-operatives should not be carried to such extreme as to rule out any other institutional agencies from the field. During the Third Plan the programme of agricultural development leaned too heavily on co-operative credit. Its poor performance in many parts of the country is, however, a red signal that it would be a collosal blunder to repeat the mistake in the post-Third Plan Period.

Role of Commercial Banks

Commercial banks have not played, so far, any significant role in providing agricultural finance in India. The Central Banking Enquiry Committee reported thirty-five years ago that "the banks do not look upon agricultural finance as part of their general business and play little part in the supply of credit to the agriculturist". Since then there has not been any material change in the situation and the virtual divorce between agricultural finance and banks has continued unabated even to this day. Not only has there been no increase in the volume of advances to agriculture, there has been, on the contrary, a substantial fall in the share of agriculture in the total advances made by the banks. An index of this disquieting situation is provided by the fact that

*Table compiled on the basis of figures given by Sri PR Baichwal in his article : "Some Problems of Agricultural Credit in South East India", International Co-operative Alliance. Figures for India based on All India Rural Credit and Debt Survey.

the share of agriculture in the total advances of the banks which had rallied from Rs. 11.3 crores in 1955 to Rs. 25.7 crores in 1959 slumped to Rs. 4 crores at the end of March 1965. The proportion of agricultural advances to total advances fell from 2.7 per cent to 0.2 per cent during the last decade. In 1964-65, out of the total loans of Rs. 2,095 crores advanced by the scheduled banks, agriculture got a ridiculously low sum of Rs. 4 crores which was less than half of Rs. 9 crores advanced in 1963-64, meaning thereby that *agriculture gets about 20 paise out of every hundred rupees advanced by the banks.*

Agricultural Credit Corporation

In view of the imperative necessity of institutional credit for agricultural development and the inability of the existing institutions like co-operatives and the commercial banks to cater to the growing needs and requirements of credit, the Government of India has rightly decided to establish Agricultural Credit Corporations, particularly to improve the institutional credit facilities in some of the States like Rajasthan, Orissa, West Bengal and Assam. These Corporations are expected to serve the areas which are not adequately covered by co-operatives. They would provide credit on the basis of crop loan system. The Corporation would finance cultivators raising wheat and paddy on the condition that the borrowers agreed to repay the loans by delivering grain at fixed points to the Food Corporation of India or its agents.

The primary objective of the new institutions in this sphere is to fill in the hiatus in the field of rural credit. They are expected to supplement and not supplant any existing agency in the field. In fact these corporations are envisaged to be a transitional arrangement and are expected to be withdrawn from the scene as soon as the co-operative structure gets sufficiently rehabilitated to fully cater to the needs of the farmers.

The establishment of these corporations would go a long way in the evolution of a better system of rural credit in India. It would fill in the wide gap in the inadequacy of institutional credit. The timely and adequate credit to be provided by these institutional agencies would considerably encourage our farmers to make use of various inputs so indispensable for increasing agricultural productivity.

In the mean time every effort should be made to revitalize and reorganise the co-operative credit structure so that it may become the main and the most important agency for providing credit to the small farmers. As commercial banks are the chief purveyors of finance, they should also be encouraged to play a more creative and purposeful role in the task of agricultural production by providing credit to medium and large farmers. There seems to be no reason why the Reserve Bank of India should not provide to commercial banks various facilities provided to the co-operatives to the extent they finance agriculture. The Food Corporation of India, as suggested by its former Chairman, may give a guarantee in part or in full to the banks in respect of advances made for growing food crops provided the farmers who received the advance entered into a contract to supply their produce to the Corporation. The strategy during the post-Third Plan Period should be to develop all these varieties of credit institutions so that they may be able to fully cater to all the credit needs of our newly created small proprietors.

The temptation to tell a chief in great position the things he most likes to hear is one of the commonest explanations of mistaken policy.

—Winston Churchill

Food Self-sufficiency Through Materials Management

PG Menon*

It is the author's contention that the Technique of Materials Management (Mm) can enable India to grow sufficient food for the people, utilising the country's own natural resources and expertise. Mm is an integrated technique, which treats the market forecast, design, production, distribution, acquisition, storage, maintenance, handling, and flow of materials as inter-dependent parts of a whole system. It utilises the latest techniques of operations research, value analysis, critical path method, standardisation, scientific inventory control, etc, etc. It helps one *to distinguish what one would like to be done from what can in fact be done,* **and it shows what resources are required, at what time and in what quantities to fulfill any target.**

THE TECHNIQUES OF MATERIALS MANAGEMENT, originally developed to tackle industrial problems, can also be applied to the agrarian sector. Consider, for example, the fact that half of India's 40,000 tractors are idle for lack of spare parts. This is because the Government ignored materials-planning and programming, and the determination of safety stocks. Different types of tractors have been brought from various countries. This has resulted in a vast variety of spares being used. Were all the tractors of even one area or a similar make, Farmer A could borrow spares from Farmer B, and so on. The Fertiliser Manufacturers Association of South India maintains a 'pool' of spare parts. This has considerably reduced machine stoppages. Such reduction in the variety of types of spares also reduces safety stocks considerably. If 16 spares are used during a period, the safety stock will be 4 if all the spares are alike, 6 if there are two varieties of spares, and 8 if there are four varieties.

*Editor, Materials Management Journal, New Delhi

Another example of waste may be cited, as showing ignorance of the elements of Materials Management. A certain state was seriously affected by power-shortage because of the low water level of a dam. It was attributed to an 'Act of God'—2 years of scant rainfall. On the other hand, a chemical firm in Gujarat survived (and still survives) similar calamities by applying the Mm technique. In the first instance, water was classified as a 'top priority' item of stores for them (as it is for an electricity-generating organisation), because of *the high cost of being without water.* The inventory of water in its reservoir is demarcated into two sections : working stock, and reserve stock. When the safety level is reached because issues of water exceed receipts, all uses other than for production are drastically curtailed, or banned. All further 'issues' are daily scrutinised by a special committee. If continued failure by the 'Supplier' leads to stocks dropping to the danger level, then water may be issued only by the General Manager. The firm has divided its uses of fresh water into 200 specific categories. It has listed the degree of essentiality of each category, and the extent

to which sea-water and/or re-cycled fresh water can be used for each category, and if so, as what percentage of fresh water. The firm has calculated the damage and financial loss likely to be caused by using sea water and by closing down certain operations. But the loss would be much greater, were the plant to close down completely.

No correlations* have been worked out for most crops between the yield and the number of irrigations, their spacing, their duration, the maximum and minimum quantities of water. For example, 18 inches of water, if applied unsystematically, give only 50 bushels/acre of beans; but 6 inches applied at the optimum times (during flowering and fruiting) can give 48 bushels/acre. What is the cost of providing 12 inches to produce 2 extra bushels? What is the national 'profit' from this marginal yield, especially as that water could have been used elsewhere?

A B C analysis (the Pareto principle) is another simple but crucial technique. If you break down a problem, you will find that a small percentage (or 'A' problems) of these sub-problems constitute the key ones.

A B C analysis gives the order in which these problems should be tackled. Applied to the problem of food, it shows that the reduction of wastage can sharply increase the availability of food. In the absence of precise data, experts differ widely in their estimates of the quantity of food, especially grains, wasted in India. But the CSIR feels that 50 per cent may be wastage: 25 per cent in the field, by rot, rodents, insects, birds ; 10 per cent in transit ; 15 per cent in storage. High priority should be given to controlling the Rat, as well as the Bandicoot, which is a major menace. An effective rat poison now exists. However, more research is necessary. For instance, locusts rarely lay eggs without the help of gibbereline, a hormone found in green leaves. So, rainfall in the desert means a plague of locusts in the due course. Is there a similar connection, as peasants aver, between the flowering of the bamboo and an increase in the rat-population? Dr. PH Deoras of the Haffkine Institute says that India's 2400 million rats eat and spoil annually about 24 million tonnes of grain (worth about Rs. 2,000 crores), *i.e.* 20 per cent of the total production. Preventive measures are simple, well-known, and effective, if they are applied systematically and in the right areas. In the absence of reliable data, no one knows how much is wasted and where ; in the absence of integrated government management, many preventive measures are hampered or resisted by some Government department or another (aerial spraying by helicopters, for example). India has yet to practise a proven technique for eliminating insects. This technique consists of breeding a particular species of harmful insects in captivity, sterilising the males through irradiation. Released during their mating season, they surpass any man-made device for tracking down their females, which in due course will lay sterile eggs, making their population decline.

The industrial techniques of Design and Process-Control are equally applicable to agriculture. If the designer is made aware of the problems of the market-place and of the 'shop', he can help to increase productivity considerably. For example, take as intractable a thing as the tomato vine. To pick an acre of tomatoes requires 700 manhours, even in the efficient United States. High labour costs ($1½ per hour) make this a good field for mechanisation. But the tomatoe-vine is a floppy thing, and its 'tentacles' wrap themselves around the moving parts of machines. Its fruit ripens few at a time, so mechanical pickers tend to deliver green fruit, the few ripe ones being smashed by the fall: being spherical, the impact is concentrated on a small area. An economic machine for picking tomatoes was designed in the US only when an engineer and a geneticist combined their specialities to 'redesign' the vine and the picker, the genetist keeping in mind the engineering and cost limitations of any equipment that would be required to pick any given design of vine. The new vine is a commercial success in the US. Being smaller

*This is not correct, as the author could easily see from the mass of agricultural and irrigation research papers, published in India during the last 50 years !
—**Editor**

and sturdier, it does not get tangled in the picker; about 90 per cent. of its tomatoes ripen simultaneously ; and the oblong tomatoes distribute the force of their fall over a flat surface. By 1942, similar tomatoes of excellent flavour had been developed at the Government Agricultural Research Centre in Guntur. But this piece of research was never commercialised.

This does not mean that the research organisations should not continue their research, but with some knowledge of the needs of the market, and with some system of feed-back. For example, many Indian orange growers do not know that oranges keep longer if the stem is cut a little away from the orange instead of being plucked right off, or that oranges do not ripen (in the sense of getting sweeter) after plucking, as they contain no starches. It would not cost much to spread this knowledge among orange growers.

Trees and bushes can be 'designed' for easier picking, since one can make stems and branches grow in a desired direction by applying 'tiba' (2, 3, 5-tri-iodobenzoic acid). This induces the growth of 'tension-wood', which makes stems grow away from the earth (negative geotropism). Flowering and germination are controlled by the relative length of the night and day. Extra yields are possible by changing this pattern, and the time of the yield can also be fixed in advance, thus helping to fulfil the criteria of Right Purchasing : the right quanity of the right quality from the right source at the right time. Yields can be increased from the right source at the right time. Yields can be increased by about a third by irradiation, before planting, with concentrated sunlight or equivalent artificial light. Ripening can be delayed by removing, in a partial vacuum, the gas ethylene, 0.001 per cent of which is present in the inter-cellular areas of fruit. Bananas, for example, can be stored for 3 months at 0.2 atmospheres (*i.e.*, one-fifth the pressure at sea-level), in a 100 per cent humid stream of air kept at 16°C to remove the internal heat given off by the bananas.

Marketing and Distribution are necessary even for items of the right quality produced at the right time, at an acceptable cost. The prices of fruits and vegetables are identical throughout the US, except for transport costs. From the 150 odd producing areas, the US Department of Agriculture in Washington DC receives telegrams daily, indicating the quality and quantity of each type of produce; and from 45 cities which form the main 'mandis', information is telegraphed to the department by the transport agencies, warehouses, and jobbers, regarding rainfall and drought, regarding what has come, of what quality, in what condition, and for what price. The department's daily Market News Service evens out prices by making possible a 'free market' in the classical economic sense. Price is influenced not only by quantity but also by quality, essentiality, and urgency.

Quality is definable by various objectively measurable standards, using instruments like refractometers (which show the sugar content of, say, melons), calorimeters which measure the heat given off by certain vegetables and fruits (the greater the heat-content, the greater will be the cost of cooling to the desired storage temperature), micrometers (which can measure the egg-white in an unbroken egg).

The prices of many fruits and vegetables in the US stay constant throughout the year, because of two substitute sources: one is cold storage and fresh freezing ; the other is the tinning industry, which absorbs over 70 per cent of the production of certain crops. The result is a timing of supplies to suit the market. To take an extreme example, URGENCY is the temporal fact of essentiality. A consignment of, say, cranberries may hardly sell, even of the best quality and at the lowest price, if it reaches the market the day after Thanksgiving. *Only 5 million people are engaged in growing food in the U.S.* ; *8½ million are engaged in marketing it.* By co-ordinating the market forecast, inventory control, and transportation, primary receivers with small premises can receive 15 tons wagon loads of perishables.

These principles of the product-flow, acquisition, distribution and handling of materials are profitably being applied by a few food processing firms in India. One vanaspati rfim has reduced its finished goods inventory

by Rs. 40 lakhs; it also gets a recurring saving of nearly Rs. 30 lakhs a year in packing costs. About Rs. 1 crore of blocked capital was released in all, through operations research. And the 21 days on the average that vanaspati spent between the factory and the consumer was reduced to 5 days. The available supply of many perishable foods can be increased, without the use of refrigeration, by such reductions in their 'waiting-time'. For example, 40 to 80 per cent. of all the fruit transported by the Railways rots in transit. The average speed of an Indian Goods Train may be 240 miles a day, but the average speed of a goods wagon is only . . . miles per day, because a wagon only moves after there are enough loaded wagons to form a train. Mr. Jagjit Singh and his men have tripled the efficiency of certain Railways through Operations Research, with practically the same resources (men, wagons, engines, tracks). More could be done, were various ancillary facilities not lacking in India. On the handling side are suction-hoses for loading and unloading grain, conveyor-belts from the prime source to the transport, fork-lift trucks and cranes at air-ports and railway stations, and the use of pallets (a sort of platform on to which a unit load can be 'built'). Packaging, too, generally fails to fulfil the primary function of protecting the contents (from moisture, physical impact, insects, fungus etc.) for the minimum overall cost. Apples are often air-freighted from Kashmir in heavy wooden crates, because the growers are not sure of their contents reaching the market in sellable condition.

Extremely inefficient containers like the sack cannot be eliminated in the absence of wagons tailor-made for each commodity, and with facilities for loading and unloading. The Indian Railways should lay down standards for pallets and containers, and should construct special wagons. The U.K. alone has over 1,000 such wagons. The interchangeable pallets have standard prices, like sacks. And, further, by once incurring higher initial expenditure to make those pallets and containers reusable, there will be a recurring saving in the transport costs (of which the container cost is a component).

Storage has been badly neglected in India. The annual cost of storaging anything comes to at least 25 per cent. of its cost. In the U.S., 2½ cents is taken as the monthly cost of storing one bushel of wheat. The 25 per cent storage cost in India does not include the cost of spoilage. For food-stuffs in India, the real cost is probably very much higher, especially as 15 per cent of India's food production is spoilt in storage (according to CSIR). In tropical countries, food-stuffs deteriorate so rapidly that 'cheap' PWD-type barns are not economic. Proper storage requires the control of temperature and of rodents, artificial ventilation, perhaps with poisonous gases to control pests, or inert gases to keep the food from germinating. Operations Research can show the costs of such storage, as well as the monetary value, including foreign exchange, of the food that is saved. OR can also show where warehouses could most economically be located. To do so, one would 'follow' the routes of the flow of food, and the periodicity and the quantity of the flow, from the producing to the using areas. This would help to determine the location of the storage-points and their capacity ; it would also enable one to forecast the requirement of traffic facilities, as well as (through Linear programming) to minimise the cross-movement of foods. This is what the vanaspati-making firm did.

The existing acreage under food must be utilised better, especially as only about a third of all the cultivable land in India receives water from the dam-and-canal systems, even after 20 years. The greater use of 'artificial' fertilisers is one way of increasing the productivity of land. The reasons for failure in this field are well-known. One way of manuring certain types of crops is to 'weed' them with quick-growing vegetables like peas or beans, which also provide 'by-product credit' in the form of about Rs. 300 worth of food per year per acre. Rice fields can similarly be 'weeded' with certain edible varieties of small fish.

Other useful methods, such as the 'Japanese style' of rice cultivation were introduced too early, before the farmers' attitudes and habits

had been made compatible with the requirements of such methods. This is an example of how even the best of techniques fails if it is not considered as part of a system.

India feeds over half the cattle in the world, yet gets less milk than little Denmark. For reasons of sentiment, one cannot kill off even useless and destructive cattle. The 'productivity' of dairying can be increased. Artificial insemination is the cheapest way of increasing the quality of the 'production-unit'. The shortage of high-quality heifers for breeding can be overcome by transferring the fertilised ova of superior heifers into scrub heifers. The design, process know-how and production control of the finished product (the calf) will be determined by the chromosomes of the two donors, while the cow which actually gives birth will be only a somewhat inferior factory-shed. This technique is making a commercial breakthrough in Europe : it is significant that one of its scientific pioneers is an Indian.

Poultry eggs are another high-protein food with potential demand, were prices lower. Egyptian priests 4,000 years ago ran poultry farms and incubators, as efficiently as our poultry farms set up with foreign collaboration. A high-grade layer can produce nearly 300 eggs a year. And if, through artificial light, it is subjected to an 'artificial' day of 6 hours of light and six of darkness, it can lay over 600 eggs a calendar year, especially if its metabolic rate is raised by hormones, etc. The same formulae which are used to determine when to replace an industrial machine can show when a hen should be declared obsolete. Assembly line techniques can be applied to egg-production, by insulating hens from each other because they are less likely to pass on diseases; even a slightly wounded hen is likely to be pecked to death by the others; and hens panic easily and get crushed to death in the ensuing pile-up. The assembly-line technique also permits the recovery of a valuable by-product : a hen produces about as much high-grade fertiliser as does a guano bird of equivalent weight, and guano is imported.

Small-scale poultry-keepers in India can benefit by adopting the industrial approach. Taking the example of quality, which really refers to the cheapest combination of the criteria necessary to satisfy the requirements of the end-use, it would be found that the fertilised eggs for consumption are overdesigned. Non-fertilisation would reduce the capital investment (both fixed and working) in cocks, and would considerably increase the shelf-life of an egg, since it is not designed to develop. Eggs would keep even longer if made impermeable to air. The laquering solutions used abroad contain sulphur, which is imported and expensive in India. But using value analysis, a young Indian scientist has evolved brine-bath treatment which can keep unfertilised eggs fresh for about three weeks in the Indian summer, without refrigeration.

There can be no organised dairy or poultry industry on a large scale until raw materials (animal food) are available more regularly and far more cheaply. In India, grains are a bad starting material for conversion by poultry into protein ; and as for cattle-fodder, India has only about 19 per cent of its land area under forest; while even industrial Germany has over 25 per cent.

Animal-feed need not be derived from items which are now consumed by humans. They can be made synthetically, from the produce of land and sea. Synthetic foods are also excellent for human consumption, as both rice and wheat, India's staple foods, are deficient in protein, and in certain amino-acids (*e.g.* lysine and methionine) which are essential for growth in children. Synthetic foods for human consumption should be taken up for introduction, as a long-term measure. It is difficult to say, whether we in India can get used to de-matured fish-flour, or 'mutton' kebabs made from seaweed. Ancient mores give to food peculiar symbolic values, and malnutrition makes it difficult to digest new foods, and also tends to fixed behaviour-patterns. However, 'new consumers' can be gained by a well-organised 'sales-drive'.

Let us examine some 'static' methods, each of which can at least marginally reduce the pressures on currently desired foods. From the land, yeasts, (including those from

the wastes from sugar, textile and paper mills), groundnut flour and cotton-seed flour can be processed into tasteless high-protein foods, and then flavoured. The Regional Research Laboratory, Hyderabad, already produces about 150 tons a year of 'Hyro' from cotton seed, which is now used only by pharmaceutical firms. Cotton seed is nutritionally superior to groundnut, and the 2 million tons of cotton seed now available in India can give 0.35 million tons of flour. But the experts who press for this form of utilisation ignore the reprecussions of diverting away what is now a cattle-feed, without providing a substitute. One square mile gives only one-fifth of animal protein as of vegetable protein.

The SEA covers 70 per cent. of the earth's surface. Even the shallow waters of all the continental shelves equal the land area of Asia. Plankton, minute plant-animals, form 90 per cent of the life in the sea. Like plants, they synthesise CO_2 under the influence of sunlight, which penetrates about 90 feet under the sea. Stimulating the growth of plankton is analogous to fertilising a field. About 10,000 tons of plankton are required to produce a ton of a commercial fish like *tuna*.

India still fishes the way the ancients hunted. Elsewhere, one finds the aquatic herdsman and the aquatic farmer, and an efficient industry based on them. For example, 5000 kilos of mussels per acre are harvested annually in the Gulf of Taranto (Italy). Scientists have evolved ways of herding fish and of increasing stock. Fishing is being based on how fish feel, hear, and smell. Certain smells attract certain types of fish, or a man might drive off a whole school merely by washing his hands overboard. New types of 'nets' (and a net is a materials-handling equipment) consists of dye-curtains, because many species of fish will not swim from clear into turbid water, or through air bubbles from under-water hoses because fish regard the bubbles as solid. Another barrier consists of reproducing the sound made by the fish themselves when alarmed. Selective inventory control is possible because different sizes of fish respond to electric pulsations of different frequencies, enabling one to line up the desired size between anode and cathode. Once herded together into a live store, suction-pumps haul them into the boat. These techniques are already in commercial use in the Caspian and in the Atlantic. Purchase-forecasting is being done by the Bureau of Commercial Fisheries, USA, which finds that there is a correlation between the water-temperature off Hawai, and Skipjack in the mid-Pacific. The Japanese Government maintains a most elaborate service for fish-forecasting.

It is good periodically to thin out a species; it is bad to overgraze. Through forecasting techniques, and through the use of radar-equipped planes and sonar-equipped boats, potential sources of supply are located, and their optimal 'output' calculated. In order to increase the quality, the University of Washington, for example, selectively breeds salmon. And Operational Researchers are trying to determine the optimal period for 'harvesting' any particular species of fish, by finding out which of the various spawning periods to choose.

At a conservative estimate, the world's annual catch of fish is 45 million tons, while India can export only Rs. 2 crores worth of fish a year, despite an abundance of Tuna and Pilchard (Sardines). The fishing fleets of even small countries like Norway and Japan are floating factories equipped with spotter-aircraft, factories that process even an entire whale, wasting nothing.

The world's catch of fish could easily increase fivefold, especially when there develops a proper market for fish-food, which is ground-up fish, bones and all, of non-popular species. Minus water, fat, and smell, this *atta* is about 80 per cent protein, and costs about Rs. 1.5 a kilo. It is becoming so popular as animal feed in the US that Cargills, the world's largest traders in grains, and therefore interested in animal feeds, have built in Peru a 'pilot-plant' to produce 40 tons of fish-flour per day.

Seaweeds (algae) are another major source of fodder and manure. Many types of edible sea weeds are found along the Indian coast. Sea weed meal is commercially produced in many countries. Agar-agar constitutes

about 40 per cent. by weight of seaweed, and Japan produces about 3 million lb. per year, of which 2 million are exported. India already imports 20 tons a year. Agar-agar can be produced in India by a small plant for about Rs. 10 a kilo : the selling-price varies between Rs. 15 to 20. Algae contain enough vitamin G to replace dried milk for poultry-feed; it also makes old hens lay, and sheep produce better wool. Chlorella, a small fresh-water algae requires little water, multiplies rapidly, and can be harvested repeatedly. An acre of surface gives annually about 30 tons, 50 per cent of which is protein. Algae also help to get rid of organic industrial wastes (of sugar factories, etc.) by releasing, during photo-synthesis, the oxygen required by bacteria to break down effluents. The Hindustan Sugar Mills at Golagokoranath is experimenting with this process. Algae-impregnated paper can be used to assess soil-fertility. This process takes more time than chemical analysis. But it is simple, cheap, and requires no apparatus.

Petroleum is a source of food. Bacteria resembling yeast feed on the waxy part of kerosene and gas, and multiply. The organisms are dried into a white powder (50 per cent protein) resembling dried milk ; the residual oil and gas are suitable for diesel engines. Two tonnes of protein can be got per MM cu. ft. natural gas.

'Linear programming' can be used to so blend animal-feed that the requisite nourishment is obtained for the lowest cost. Suppose that there are various animal-foods at various prices, each containing different quantities of different essential elements (fats, vitamins etc.), with some foods perhaps containing certain essential elements. Merely by using pencil, paper, and high school arithmetic, anyone trained in linear-programming can, in about half an hour, select the most economic mix.

The scientists have done their share towards solving the food-problem. But the lack of integrated implementation is marked : the fish caught off Calcutta by the mechanised ships manned by Japanese experts rotted ; rotted because the quality required by the market had not been assessed (Bengalis prefer fresh-water fish) ; rotted because no distribution methods had been worked out with alternate markets in mind: rotted because there were no arrangements to convert the unsold fish into some other marketable form.

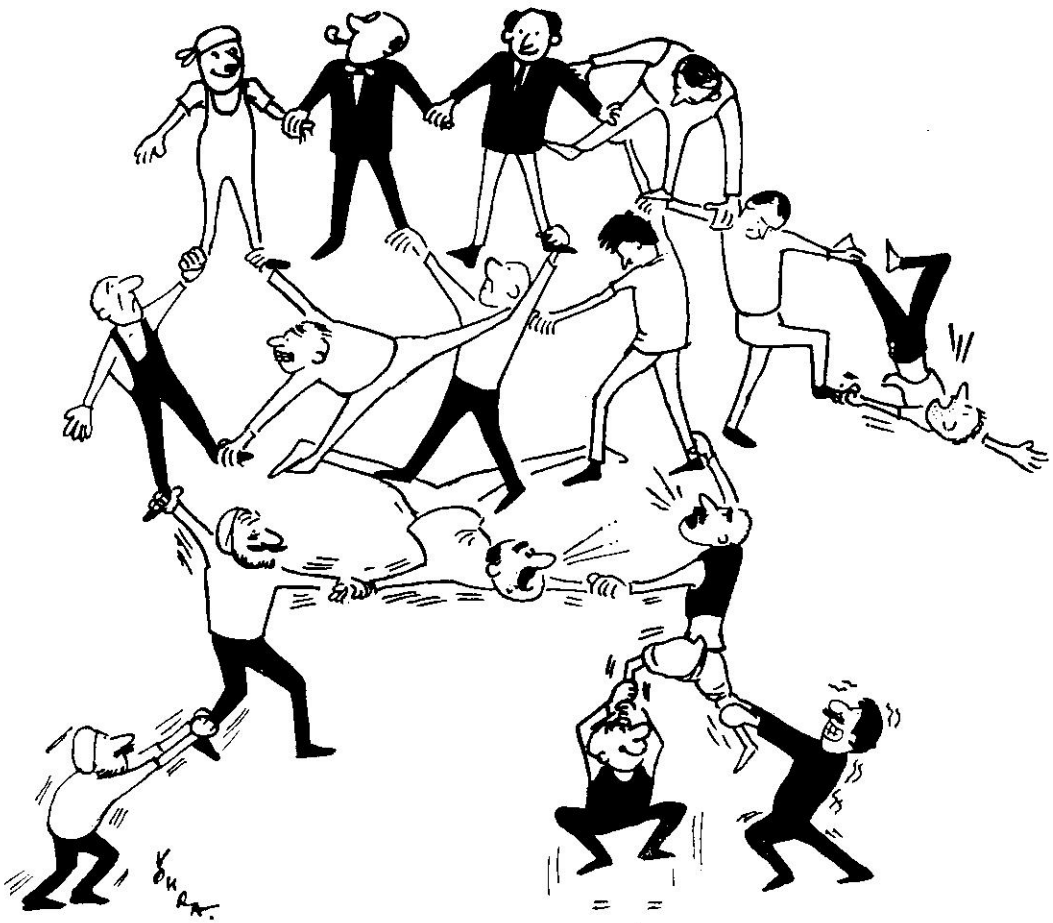
This again reiterates the need for an integrated approach. 'Crash' measures to increase food-production should not irresponsibly distrub the ecological balance. If more water is poured on the land than can drain away, then in time the land becomes barren because of the sub-soil salts seeping up. The use of pesticides to destroy certain pests has resulted in the destruction of other forms of extremely useful life. Grazing and the felling of trees in the rain-catchment areas have resulted in costly floods, and in costly dams to check the floods. Such destruction of forests, sometimes in the name of agriculture (*e.g.* in the Terai), will have two long-term effects : drought, and erosion. Tropical countries lose about 8 acre/feet of water annually in un-forested areas because of seepage and evaporation. Forests induce local showers, preventing the formation of dust-bowls. Mechanised systems of agriculture are wasteful in the absence of scientific inventory control. Transport facilities should precede an increase in agrarian productivity ; otherwise much of the produce will not reach the consumer.

Russia's resources exceed ours. And yet her Government has admitted the failure of the 'virgin lands' scheme. Let India learn from Kruchshev's mistakes, which were :

1. The failure to distinguish between plan and programme;
2. The failure to use an integrated approach;
3. That a profit-oriented approach not only motivates men to higher productivity, but that profit is still the best unit for measuring any performance which involves the production of goods and services;
4. That the philosophy of profit together with an integrated approach summarised by a network technique, such as PERT, would have enabled those in control to know, well in time, where corrective action was called for.

India can indeed feed herself without foreign charity, merely by reducing wastage by 8 per cent but only if she investigates all the factors

that can be used to produce the required intake of food, and evaluates the relative utility of each of these factors *vis-a-vis* the role they can play in the over-all programme, and only if she calculates the 'cost' of each of these factors in terms of time, money, manpower, skills. Besides having to quantify all that needs to be done, she must also determine how each of these things must be done, and when, and by whom, and with what. ●●●



This is what we are !
Why talk of Productivity ?

Production of Raw Jute During Four Five-Year Plans

Gopal Rukhana*

The Partition caused a peculiar situation for Indian Jute Mills, for only 19 per cent of the total production of raw jute in undivided India came to our share. This led to an intensive drive towards improving indigenous raw jute supplies. The author has surveyed the position through the Three Plans and as envisaged in the Fourth Plan Draft, with an eye on the Element of Productivity in obtaining additional supplies.

THE FIRST PLAN TARGET FOR JUTE WAS SET at 53.9 lakh bales. The actual achievement at the end of the First Plan was 42.00 lakh bales during 1955-56. The shortfall was due to the emphasis having been placed on extensive rather than intensive cultivation: in fact much of the additional crop was grown on marginal lands where the unit yield was low and the quality of fibre poor. Quality was sought to be improved through excavation of new retting tanks, renovation of old tanks and multiplication of improved seeds.

The production target for the Second Plan was set at 55.4 lakh bales, with specific stress on improvement of unit yield to 3.0 bales per acre as against 2.4 bales obtained at the end of the First Five-Year Plan, apart from extension of area by 3.9 lakh acres. Also attention was given to the production of high quality jute. The emphasis was on cultivation through fertilisers, improved seeds, improved implements (seed drills and wheel hoes) plant protection measures and excavation of retting tanks.

The target for the Third Plan was 62 lakh bales, to be attained by 1965-66. This included incidentally, but significantly, a further rise in yield to 3.5 bales per acre through increased inputs. Table I shows the statewise break-up of area, production and unit yield of jute and mesta during the Third Plan. To bring the statistics uptodate, Table IA has been constructed to give corresponding data for 1966-67, the first year of the Fourth Plan that was. Table II gives detailed year-by-year data, alongside averages realised during the three Plans.

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TABLE I

Third Plan Period

(1 bale=400 lbs)

State	JUTE			MESTA		
	Area (000 acres)	Prodn. (000 bales)	Yield per acre (bale)	Area (000 bales)	Prodn. (000 bales)	Yield per acre (bales)
West Bengal	1089.0	3115.5	2.85	273.0	612.2	2.25
Tripura	30.2	86.3	2.83	31.0	75.0	2.34
Assam	336.6	912.0	2.70	21.0	31.0	1.48
Bihar	470.3	1051.3	2.24	148.0	252.0	1.69
Orissa	116.0	327.2	3.78	38.0	72.0	1.93
Uttar Pradesh	51.6	167.2	3.24	—	—	—
Andhra Pradesh	—	—	—	196.0	391.0	1.99
Other States	—	—	—	203.0	175.0	0.88
ALL-INDIA	2093.7	5659.5	2.69	910.0	1608.0	1.76

TABLE IA

1966-67

State	JUTE			MESTA		
	Area (000 acres	Prodn. (000 bales)	Yield per acre (bale)	Area (000 acres)	Prodn. (000 bales)	Yield per acre (bale)
West Bengal	1046.3	2852.6	2.8	158.1	316.2	2.0
Tripura	33.1	106.5	3.2	32.1	79.4	2.5
Assam	336.6	983.5	2.9	24.5	36.3	1.5
Bihar	397.1	938.3	2.4	97.1	198.2	2.0
Orissa	106.5	281.6	2.7	40.3	60.0	1.5
U.P.	49.4	153.0	3.1	—	—	—
Andhra Pradesh	—	—	—	219.2	367.2	1.7
Other States	—	—	—	215.0	146.8	0.7
	1969.0	5315.5	2.7	786.3	1204.1	1.5

TABLE II

All-India

Year	JUTE			MESTA		
	Area (Lakh acres)	Prodn. (Lakh bales)	Yield per acre (bales)	Area (Lakh acres)	Prodn. (Lakh bales)	Yield per acre (bales)
FIRST PLAN :						
1951-52	19.51	46.78	2.40	..	..	..
1952-53	18.17	46.05	2.53	4.84	6.82	1.41
1953-54	11.96	31.29	2.62	4.63	6.50	1.40
1954-55	12.43	29.28	2.36	5.28	10.18	1.92
1955-56	17.39	41.97	2.41	6.18	12.01	1.97
AVERAGE	15.89	39.07	2.46	5.23	8.88	1.67
SECOND PLAN :						
1956-57	19.08	42.88	2.25	7.33	14.78	2.01
1957-58	17.42	40.52	2.33	7.64	12.91	1.69
1958-59	18.11	51.58	2.85	8.25	14.88	1.80
1959-60	16.85	46.05	2.73	7.04	11.18	1.59
1960-61	15.12	39.82	2.63	6.89	11.31	1.64
AVERAGE	17.32	44.17	2.56	7.43	13.01	1.75
THIRD PLAN :						
1961-62	22.80	63.47	2.78	9.60	16.92	1.76
1962-63	21.03	54.06	2.57	9.37	16.84	1.80
1963-64	21.45	61.36	2.86	9.72	18.59	1.91
1964-65	20.72	59.73	2.88	8.88	15.71	1.77
1965-66	18.69	44.35	2.37	7.91	12.34	1.56
AVERAGE	20.94	56.59	2.69	9.10	16.08	1.76
1966-67	19.69	53.16	2.70	7.86	12.04	1.50

It will be seen that though, compared to the immediate post-Partition position, there has been a marked improvement in supplies, there has been a consistent decline in both acreage and output for some years; but the per acre yields have on the average continued to rise, despite aberrations from peak levels attained earlier.

Table III gives a detailed idea of the progress of Jute development measures taken during the Second and Third Plans.

TABLE III

Progress of Jute Development Measures All India

Year	Fertiliser		Improved Seed		Line Sowing	Plant Protection	
	Quantity (000 Tonnes)	Area covered (000 acres)	Qty (000 quintal)	Area (000 acres)	Area Covered (000 acres)	Area Covered (000 acres)	No. of retting tanks (Old and New)
SECOND PLAN :							
1956-57	6.441	128.60	0.904	31.06	7.66	40.17	4,519
1957-58	6.756	134.76	1.411	49.19	10.43	73.11	4,341
1958-59	13.823	275.99	2.152	75.32	14.33	187.12	3,012
1959-60	15.942	317.30	3.990	139.05	21.12	83.54	2,721
1960-61	13.976	278.20	4.122	143.70	29.96	135.35	2,612
AVERAGE	11.388	226.97	2.516	87.66	16.70	103.86	—
THIRD PLAN :							
1961-62	25.71	257.1	5.129	179.66	44.04	320.0	4,037
1962-63	18.78	187.8	5.472	191.49	55.56	**	2,825
1963-64	11.72	117.2	4.932	172.77	68.59	**	2,222
1964-65	14.88	148.8	6.070	212.42	71.00	188.91	3,621
1965-66	15.04	150.4	6.373	222.96	62.38	174.56	2,617
AVERAGE	17.23	172.3	5.595	195.86	60.31	272.82	—
1966-67	40.00	451.0	7.741	271.00	93.00	not available	not available

*2029 tonnes of Urea were also sprayed in West Bengal and Orissa with a coverage of 2.03 lakh acres.
**Mild attack was controlled.

The demand estimate of raw jute as given in the original Fourth Plan Draft for 1970-71 is given in Table IV. The total target of 110 lakh bales consisted of 90 lakh bales of jute and 20 lakh bales of mesta.

The development programme may be grouped under the following categories :

1. Extension of double cropping to cover additional 9.20 lakh acres.
2. Introduction of high-yielding varieties to cover 4.55 lakh acres.
3. Intensive cultivation to cover 20.11 lakh acres.

The total production target for 1970-71, with statewise break-up, is given in Table V.

TABLE IV

	lakh bales
1. Export of 12 lakh tons of jute goods (in terms of raw jute and mesta)	67.20
2. Internal consumption of 6 lakh tons of jute goods (in terms of raw jute and mesta)	33.60
3. Village Consumption	3.00
4. Export of raw jute	1.00
5. Buffer stock (out of 20 lakh bales to be built in 5 years)	6.00
TOTAL	110.80 or 110.00

TABLE V

STATE-WISE TARGET FOR ORIGINAL FOURTH PLAN DRAFT PERIOD

Area-Lakh Acres
Production-Lakh Bales

Particulars	West Bengal	Bihar	Assam	Orissa	Uttar Pradesh	Tripura	Total
1. Base Year (avg. of 1961-62 to 1964-62)							
Area :	11 12	4 93	4 39	1 24	0.52	0.30	21.50
Production :	33 38	10.93	10 20	3.58	1.62	0.84	60.55
2. By introducing double cropping programme							
Area :	3 72	2.50	..	2 98	..	..	9 20
Additional Prodn. over base :	9.16	5.75	..	8.94	..	..	23 85
3. By introducing high-yielding Strains							
Area :	2.0	1.50	0.55	0.30	0.12	0.08	4.55
Additional Prodn. over abase :	0.40	0.30	0.11	0.06	0.02	0 02	0.91
4. By intensive cultivation programme							
Area :	10.40	4 93	3.00	1.02	0.46	0 30	20.11
Additional Prodn. over base :	5 25	4.44	1.84	0.51	0.16	0.13	12.35
5. Total Possibility							
Area (1, 2) :	14.84	7.43	3.39	4.22	0.52	0.30	30.70
Production (1, 2, 3, 4) :	48.19	21.42	12.15	13.09	1.80	1.01	97.66
6. Target for 1970-71							
Area :	14.84	7.43	3.34	4.22	0.52	0.30	30.70
(1, 2)	46.00	19.00	12.15	10.04	1.80	1.01	90.00

*Production in 1963-64 seems to be a reasonable base for Assam because adverse weather in recent years reduced the yield much below normal.

The base year and the target of additional output for mesta as envisaged for 1970-71 are given in Table VI.

By an arrangement made by the Indian Jute Mills Association and the National Seeds Corporation for the growth of foundation seeds of improved quality, seed multiplication is carried out by registered growers in selected areas. The Government of West Bengal has developed a 1000 acre area in Midnapur for the establishment of a large farm to produce seeds. The Government of Bihar has also set up a farm on about 6000 acres of land to produce quality seeds.

Other things broadly remaining the same, it is expected that the yield can be increased to the extent of 15% by the use of improved seeds only. The Indian Jute Mills Association maintains two packing centres of improved jute seeds, one at Serampur in West Bengal and the other at Purnea in Bihar. The seeds are tested at packing centres for germination and moisture content. Only those seeds having germination of 90% and moisture content below 10% are forwarded for distribution to cultivators. Any bag of seeds failing to satisfy the standards is discarded. If the seeds are found to contain a higher amount of moisture, they are dried to bring them within the specified limits. Only after passing out the tests at packing centres, these are distributed in packages of one Kg. through various agencies.

Fifteen compact blocks spread over fifteen mesta and jute growing districts in West Bengal, Assam, Bihar, Orissa and Andhra Pradesh were taken up for demonstration of intensive cultivation. Six intensive cultivation blocks for trained cultivators were set up by industry for those not covered by the demonstration programme so that the trained persons may apply new farm techniques in their areas.

A research-cum-demonstration project has also been introduced to advise farmers in the application of the required doses of fertilisers and adopting correct cultural practices for obtaining maximum jute yield per acre under different soil and climatic conditions.

Foliar spraying of urea fertiliser on jute plants was introduced in the season 1965-66 and it is expected that on this account alone, 10% extra production can be obtained.

TABLE VI

Statewise Production and Target of Mesta Production during the Original Fourth Plan Draft Period

State	Base Year's Prodn. (avg. 1961-62 to 1964-65)	Target of Additional Output	Production (1970-71)
West Bengal	6.65 lakh bales	1.85 lakh bales	8.50 lakh bales
Bihar	2.24 ,, ,,	0.76 ,, ,,	3.50 ,, ,,
Assam	0.29 ,, ,,	0.21 ,, ,,	0.50 ,, ,,
Orissa	0.74 ,, ,,	0.26 ,, ,,	1.00 ,, ,,
Tripura	0.76 ,, ,,	0.24 ,, ,,	1.00 ,, ,,
Andhra	4.01 ,, ,,	1.49 ,, ,,	5.50 ,, ,,
Other states	1.81 ,, ,,	0.19 ,, ,,	2.00 ,, ,,
TOTAL	17.00 ,, ,,	5.00 ,, ,,	22.00 ,, ,,

This reduces the fertiliser requirement of the crop to 25% and produces better results than would have been obtained from the soil application of urea.

In fact striking results were achieved from the aerial spraying of jute crops with a combination of fertiliser and insecticides during 1967-68 season. In what was a joint effort by the Government of India, four State Governments and the US Agency for international Development (US AID), some 12,500 acres in Assam, Bihar, Orissa and UP, selected as providing an adequate range of climatic and soil conditions, were sprayed. Jute plants in spray-treated fields attained an average height of approximately 12 feet: by comparison, untreated fields averaged a growth of 9 to 9½ feet. Data on relative weight yields showed an increase of from 20 to 50 percent of fibre on sprayed fields. The urea fertiliser was supplied by the Government of India, the insecticides, the field support and landing strips by the State Governments. The aviation unit furnished one aircraft to spray 2500 acres in Assam and the US AID provided funds to contract aircraft from private operation to spray a total of 10,000 acres in the other three States.

Prospects For 1968-69

A target of 90 lakh bales of raw jute during the coming season (1968-'69) has been set, consisting of 73 lakh bales of jute and 17 lakh bales of mesta. For attaining the target, no extension of acreage over the normal is envisaged. The entire additional production is planned to be raised through larger yields per acre by intensive cultivation, aided by inputs of various kinds. Improved seeds will cover an area of 8.25 lakh acres. 15.14 lakh acres will be fed by fertilisers. The total estimated requirement of fertiliser to feed the target area is 58,500 tonnes of ammonium sulphate, 17,200 tonnes of urea for soil application and 6,100 tonnes of urea for foliar spraying.

As regards the original target of 110 lakh bales to be obtained by 1970-71, it would depend largely on irrigation, as about 60% of the total production is planned to be raised by double cropping.

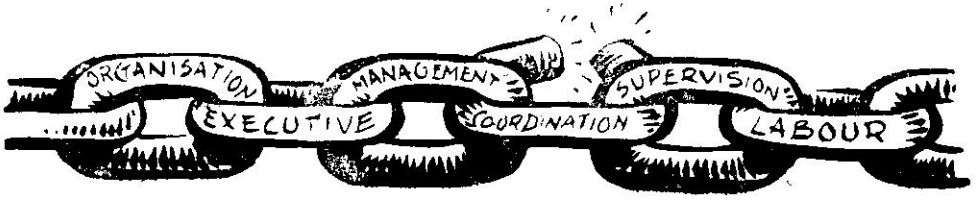
Regarding the cost of jute manufacture, a brief note may be appended here. The major cost components of jute manufacture are raw jute (60%) and wages (20%). It is contended that these elements are not wholly amenable to management control. However that may be, the industry, on a longer view (in order to stay competitive), must address itself wholeheartedly to the task of reducing its manufacturing costs to the extent possible.

Not much headway, however, is possible in this direction unless there is an early breakthrough in the productivity of the average Indian jute farm. We are still at an average of 2.8 bales, compared to Pakistan's 3.5 bales per acre.

Further, Indian industry, in order to be competitive abroad must increasingly switch over to higher quality ranges of production. The present output of good class fibre is roughly 9 lakh bales, which would need to be stepped up to a minimum of 12-13 lakh bales in a couple of years and to 20-21 lakh bales by the end of the Fourth Plan period.

What is therefore needed is a massive effort, primarily on the part of the Government* to organise the inputs including retting facilities as per target set and carry out the necessary propagation of the intensive cultivation methods so as to realise higher yields, both quantitatively and qualitatively. ●●●

*What about the Industry? And what about the workers in the Industry: their productivity, wages and welfare?
—Editor



Size of Farm and Adoption of Improved Practices[1]

Gokul Parikh* & Usha Sharma**

Suggesting a new strategy for agricultural development in the Fourth Plan Draft, the Planning Commission said : "... the long-term objective is to organise the use of high-yielding seeds, together with a high application of fertilizers which in turn have to be supported by a package of improved practices."[2] In the achievement of this objective, the whole-hearted co-operation of cultivators is obviously of crucial importance. Several socio-economic factors are responsible for motivating farmers and shaping their attitudes in regard to acceptance of new practices. The research paper, published here, while it does not enter into the psychological aspects of motivation, acceptance, etc., analyses the statistics of actual acceptance against the background of the agricultural situation as it obtained in the Bulsar District, selected for Intensive Agricultural Development Programme, referred to as IADP.

IT IS NECESSARY—IN FACT, IMPERATIVE, in the context of the need for rapid growth —to study the factors affecting farmers' attitudes. Apart from the profitability of using new practices, the size of holding, ownership rights, irrigational resources, group outlook (caste)[3], educational background (literacy) and sub-occupations are some of the economic and social factors which tend to influence the response of the farmers to improved practices. The present paper, however, seeks to study the relationship, if any, between farm size and acceptance and rate of adoption of improved farm inputs.

It is generally observed that the acceptance of various types of improved agricultural practices increases with the increase in size of holding. Secondly, there also appears to exist a certain relationship between the rate of application of improved farm inputs and the size of operational holdings. The present study is designed to test these hypotheses.

The data needed for the study were gathered for the 50 sample holdings in the 5 selected villages of Bulsar District. The villages and cultivators were selected on the basis of multi-stage stratified random sampling methods,

1. This study is based on information collected from selected sample farmers in the area under study: IADP District, Bulsar. The authors desire to record their grateful thanks to Prof. VS Vyas, Head of the Department of Economics and Sri. Madhukar Maharaja, Research Officer, Centre for Studies in Economics of Dairying, Vallabh Vidaynagar, for their valuable comments and suggestions in the preparation of this paper.

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2. *Fourth Five Year Plan, Draft Outline*, Planning Commission, Govt. of India, p. 175.

3. See 'Acceptance of Improved Practices and Their Diffusion Among Wheat Growers in the Pali Disrtict of Rajasthan'—KALYAN MAL CHAUDHRY *and* MADHUKAR MAHARAJA, *Indian Journal of Agricultural Economics*, Vol. XXI, No. 1 (Jan.-Mar. 1966)

devised at the Farm Management Centre, Vallabh Vidyanagar. The information about the use of fertilisers, improved seeds, pesticides and insecticides during the *Kharif* season of 1966-67 was collected by the cost accounting method.

Characteristics of Selected Farms

The frequency distribution of these 50 sample farms by different size-groups clearly reveals the preponderence of small farmers in this area (See Appendix I). The relevant data show that more than 80% of the farmers are in the operational holding groups of less than 5 hectares and that their average size of holding is 1.81 hectares. The average size of the farms for all the 50 holdings taken together is 2.8 hectares. The total area cultivated by these farmers is 130.92 hectares of which the maximum (35.12 per cent) is in the group of farmers cultivating between 2.51 and 5.00 hectares followed by 23.70 per cent in the 7.51 to 10.00 hectares group. Farmers in the smallest group, viz., less than 2.50 hectares group who formed 52 per cent of the total sample cultivators, operated only 17.07 per cent of the total area while 10 per cent farmers belonging to the last two groups (i.e. 7.51 to 10.00 and 10.00 and above hectares groups) cultivated 32.35 per cent of the area.

Irrigation

The adoption of improved practices, especially chemical fetilisers would depend on the availability of irrigation facilities because of the complementarity between these inputs. The available information on this aspect (vide Appendix I) shows that farms in the first and third size-groups were the least irrigated, the proportion hovering around 14 per cent of the cultivated area. The subsequent two size-groups operating between 7.51 and 10.00 and 10.01 and above hectares of land, however, possessed irrigation facilities for nearly half of their lands, while the farmers having operational holdings of the size between 2.51 and 5.00 hectares had 30 per cent of the cultivated area under irrigation. Of the total area of 130.92 hectares cultivated by all the sample farmers, nearly 32 per cent was irrigated.

Cropping Pattern

The crop distribution of 130.92 hectares of land cultivated by the sample farmers shows that maximum (or 45.6 per cent) area was devoted to paddy. This is understandable because paddy is the principal crop of the district in general, and this tract in particular. Paddy is also the staple item of food and has an assured and ready market. However, some farmers supplemented the cultivation of Paddy by Jowar, an inferior cereal. As a result, 12.5 per cent of the area was found to be under jowar while the famous fruit crop of this tract of Gujarat, viz., mango accounted for 21.4 per cent of the area. Thus these three crops paddy, mango and jowar together covered 80 per cent of the area of sample farmers.

The relationship of the cropping pattern, with the size of operational holding, reveals that the area under paddy decreased with the increase in the size of holding whereas that under mango increased. As such, while more than two-third of the area was devoted to paddy by the farmers in the smallest group operating less than 2.50 hectares of land, the farmers in the highest group (10.01 hectares and above) had only one-fifth of the area under paddy. Conversely, the area under mango in the former group was less than 2 per cent as against 60 per cent in the latter group. The two important cash crops, viz., cotton and sugarcane did not, on the whole, cover any considerable area. Still, however, the farmers in the fourth group (7.51 to 10.00 hectares) devoted 11.4 per cent of their area to cotton and 4.8 per cent to sugarcane. Among other crops inferior cereals such as *nagli, adad, kodra,* were important. The cultivators operating land between 5.01 and 7.50 hectares were growing these crops on as much as 30 per cent of their area.

The crop pattern obtaining on the selected farms seemed to be largely related to the availability of irrigation fcilities. Factors such as consumption habits, relative profitability, marketability, size of farm, etc., do influence the decisions of individual farmers to grow particular crops; but the present study revealed irrigation to be the most predominant factor

influencing the cropping pattern. For instance, farmers in the third group devoted 30 per cent of their area to inferior cereals (Appendix II), mainly because theirs was characteristically dry farming. Appendix I shows that only 14.5 per cent of their lands were irrigated. As against this, on the farms in the last two groups cultivating more than 7.50 hectares of land, half the area was under irrigation and consequently mango, cotton and sugarcane were important crops, besides paddy. In fact, as large as 60 per cent of the area of the biggest farmer was under mango, a crop which required to be irrigated. Similarly, cotton and sugarcane, for which irrigation was an important input, occupied more area in the fourth group, 7.50-10.00 hectares, as compared to the other groups.

Size of Farm and Adoption of Improved Practices

As mentioned earlier, the area selected for the present study forms a part of the I A D P District of Bulsar. It is well known that stepping up farm productivity through improved agricultural practices such as improved seeds, chemical fertilisers, insecticides and pesticides etc., constitutes the core of the Package Programme.

The success of the Programme would, therefore, naturally depend on the awareness, acceptance and adoption of different types of improved practices among the cultivators. In this context, it may be recorded that out of the 50 sample farmers, 50 per cent were not even 'aware' of the 'Package' of inputs, despite the fact that the IAD programme had been in operation in this district for five years: farm plans were as yet not prepared for as many as 50 per cent of the selected farmers. The distribution of sample cultivators by different size-groups shows that proportionately more farm plans were prepared for middle and big farmers than those for the small farmers.

As a logical corollary of the above, it is found that the adoption of improved practices, viz., chemical fertilizers, improved seeds and plant-protective inputs, both in the individual form and in combination, also displayed a generally increasing trend from the smallest size of holding group to the biggest (See Table 1).

TABLE I

SIZE OF HOLDING AND PROPORTION OF FARMERS ADOPTING DIFFERENT IMPROVED PRACTICES

Size of operational Holding (hect.)	No. of Cultivators	No. of adopters of Improved practices				
		At least One	At least Two	At least Three	At least Four	At least Five
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Below 2.50	26	21 (80.77)	9 (34.62)	3 (11.54)	1 (3.85)	..
2.51-5.00	15	12 (80.00)	11 (73.33)	10 (66.67)	8 (53.33)	3 (20.00)
5.01.-7.50	4	2 (50.00)	1 (25.00)	1 (25.00)	1 (25.00)	1 (50.00)
7.51-10.00	4	4 (100.00)	4 (100.00)	4 (100.00)	3 (100.00)	2 (50.00)
10.01 and above	1	1 (100.00)	1 (100.00)	1 (100.00)	1 (100.00)	1 (100.00)
Total	50	40 (80.00)	26 (52.00)	19 (38.00)	14 (28.00)	7 (14.00)

Except in the size group, 5.01 to 7.50 hectares which displays some peculiar characteristics, the rate of adoption in terms of acceptance of more and more practices increases with the increase in the size of holding. If we define adoption of more than one practice at a time as 'package', then the percentage of farms adopting the larger 'package' increases with the size of holding. In the large size groups of 7.51 to 10.00 hectares and 10.01 hectares and above, all the farmers have adopted the 'package' of four practices. On the other hand, only 14 farmers (28 per cent) on the whole have adopted the 'package' of four practices. 'The package of five practices' which is the main theme of the I A D P has not found favour with the vast majority of farmers. Only 14 per cent have adopted all the five practices under review. However, the percentage of farmers adopting 'full package' indicates an increasing trend with the increase in the size of holding.

Extent of Adoption of Improved Practices

It is clear from the above table that chemical fertilisers (verified to be the input adopted by those falling in the category of adopters of 'at least one' practice) was found to have been adopted by 40 farmers. The most popular practice, adopted by as many as 80 per cent of the farmers, was thus chemical fertilisers among which ammonium sulphate, urea, and super-phosphate were the most prominent.

In Tables 2 & 3 are set out the details of the area covered under each input as well as the actual rates of application by size of holding groups. It is common knowledge that mere coverage of area under improved input is of little significance, if the rates of application of these inputs are far below the optimum levels.

TABLE II

SIZE OF HOLDING AND PROPORTION OF AREA COVERED UNDER DIFFERENT PRACTICES

(in % area)

Size of Operational Holding (hect.)	Net area sown (hect.)	Nitrogenous fertiliser in terms of Ammonium Sulphate	Phosphatic Fertiliser in terms of Single Super Phosphate	Improved Seeds	Pesticides Insecticides
(1)	(2)	(3)	(4)	(5)	(6)
Below 2.50	22.35	58.88	17.45	11.68	..
2.51—5.00	45.98	61.42	14.81	27.51	16.72
5.01—7.50	20.25	24.99	9.88	3.70	18.27
7.51—10.00	31.04	40.14	27.51	26.03	36.47
10.01 and above	11.30	40.80	100.00	24.25	59.20
TOTAL	130.92	48.53	24.86	20.49	22.46

TABLE III

SIZE OF HOLDING AND RATE OF APPLICATION OF IMPROVED INPUTS

Size of Holding (hect.)	Rate of Application (Kgs./hect. cultivated)			
	Nitrogenous Fertiliser in terms of Ammonium Sulphate	Phosphatic Fertiliser in terms of Single Super Phosphate	Improved Seeds	Pesticides-Insecticides
(1)	(2)	(3)	(4)	(5)
Below 2.50	49.23 (84.12)	15.51 (76.44)	1.95 (81.93)	..
2.51—5.00	62.12 (106.15)	12.71 (62.64)	2.86 (120.17)	0.13 (10.32)
5.01—7.50	13.11 (22.40)	12.10 (59.64)	0.54 (22.69)	0.15 (11.90)
7.51—10.00	84.71 (144.75)	31.89 (157.17)	2.79 (117.23)	4.53 (359.52)
10.01 and above	71.72 (122.56)	43.36 (213.70)	3.45 (144.96)	1.48 (112.70)
AVERAGE	58.52 (100.00)	20.29 (100.00)	2.38 (100.00)	1.26 (100.00)

NOTE : Figures in brackets indicate percentages to the respective average rates of application for the sample as a whole.

The above data suggest that nitrogenous fertilisers were more extensively used than the other improved inputs. It is seen that nitrogenous fertilisers covered 48.05 per cent of the cropped areas as against only 24.9 per cent by the phosphatic fertiliser. Secondly, the average rate of application of nitrogenous fertiliser was 58.52 Kgs/Hect. while that of phosphatic fertiliser was only 20.31 Kgs./Hect. The area covered by the other two practices under study *viz.* improved seeds (such as Z-31 for paddy, B.P. 53 for jowar and Digvijay for cotton) and pesticides and insecticides (such as Savin, Endrex, Endrin, Diazinon, etc.) was relatively small, being 20.5 per cent and 22.5 per cent respectively. Besides, in absolute figures, the average rates of application of these two inputs were also extremely low, being 2.40 and 1.30 Kgs./Hect. respectively.

A further analysis of the intensity of adoption of these improved inputs suggests that the rate of application per hectare is by and large higher in the large size groups than in the case of small size groups.[4] The correlation coefficients worked out between the size of the farms and quantity of N fertilisers, quantity of P_2O_5 and quantity of improved seeds used are quite high and significant (See Table 4).

Although, the per hectare rates of application of the inputs under study increased with the increase in the size of holding, the differences in the average rates of application per hectare for all these inputs were not found statistically significant. This may be mainly due to the

4. Reference is invited to the 'Report of the Committee on Fertilisers, Govt. of India (1965), pp.8 and 163.

TABLE IV

Co-efficient of Correlation between	Value of 'r'	Significance
Size of holding and Nitrogenous fertiliser	0.67	Significant at 1 per cent level of significance
Size of holding and Phosphatic fertiliser	0.60	Significant at 1 per cent level of significance
Size of holding and Improved seeds	0.44	Significant at 5 per cent level of significance

wide variations in the rates of application within a group. To test the homogenity of average quantity of inputs applied per hectare (means), the method of Analysis of Variance was used. The F values obtained (except for P fertilizer) were greater than one but not significant at 5 per cent level. However, the value of 'F', being greater than unity in respect of N fertiliser and improved seeds suggests that the 'inter-size group variations' were larger than the 'intra-size group variations' and it may hence be concluded that the size of holding has some impact on the rate of adoption.

However, the farmers in the size group, 5.01 to 7.50 hectares, accounted for the uniformly low rates of application of all the inputs. A deeper probe revealed the crucial impact irrigation (complementary input) had on the rate of adoption.

Size of Farm, Irrigation and Rate of Adoption

In the holdings and size groups where irrigation potential was proportionately large, the rate of application of these immediate response-bearing inputs, *viz.*, fertilisers, improved seeds, etc., was higher. A few other studies[5] have also arrived at similar conclusions. The correlation coefficient between the percentage of area under irrigation and the rates of application of nitrogenous fertilisers comes out to be positive with a value of 0.86, thus indicating the close relationship between the adoption of improved practices and the availability of irrigation facilities. This is due to the fact that adequate water supply is a pre-condition for using improved practices like improved seeds and fertilisers. More so, the high-yielding varieties of paddy, hybrid varieties of jowar grown in the district and the commercial cum-fruit crops like sugarcane, banana and mango require a certain minimum of irrigation. Hence, the cropping pattern in the various size groups was also found to be closely related to the availability of irrigation facilities with the farmers.

Crop-Wise Application of Improved Farm Inputs

The study shows a positive and high correlation between size of farm and irrigation potential. In this context, we may examine the actual rates of application *vis-a-vis* the recommended doses for specific crops. Only the major crops *viz.*, paddy, jowar, mango, cotton and sugarcane have been covered. (See Table 5). In the larger size-groups of 7.50 to 10.00 hectares and 10.01 hectares and more where the proportion of irrigated area was larger, the proportion of crops grown such as paddy, cotton, jowar, sugarcane and banana was higher, as a result of which the adoption of improved practices in terms of average quantity applied per hectare was also found to be higher.

In the size group, 7.50 hectares to 10.00 hectares, which accounts for the highest percentage of irrigated area (50 per cent), the rates of application of improved inputs per hectare was found to be much higher as compared to those in other size groups ; this was attributable to the predominance of crops like paddy, jowar, sugarcane, banana and mango. On the other hand, the farmers in the size group, 5.00 to 7.50 hectares, with the lowest irrigation potential, were extensively growing rain-fed crops such as *kodra*, *adad* (pulses) and *nagli* (all together accounting for 31 per cent) which were not adequately supplemented

5. See 'Economic Efficiency of Small Farms of Central Gujarat' (mimeographed) by Dr. VS Vyas, Agro-Economic Research Centre, Vallabh Vidyanagar

TABLE V

Size of Operational Holding (hect.)	Paddy				Jowar				Mango	
	Average rate of N.F. in terms of A.S.	Reco. dose %	Average rate of P.F. in terms of S.S.P.	Reco. dose %	Average rate of N.F. in terms of A.S.	Reco. doses %	Average rate of P.F. in terms of S.S.P.	Reco. doses %	Average rate of N.F.in terms of A.S.	Reco. doses %
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Below 2.50	95.64	42.69	88.89	63.49	31.74	28.34	..	..	..	..
2.51—5.00	154.30	68.88	93.36	66.69	17.38	15.52	2.26	1.61	27.54	7.34
5.01—7.50	53.51	23.89	188.68	134.77	..	..	..	..	..	..
7.51—10.00	71.47	31.91	53.19	37.99	..	..	..	..	..	..
10.01 and above	287.72	128.45	150.21	107.29	..	..	..	..	..	..
Total	117.86	52.62	90.94	64.96	21.11	18.85	2.26	1.61	27.54	7.34

N.F. = Nitrogenous Fertilisers
A.S. = Ammonium Sulphate
P.F. = Phosphatic Fertilisers
S.S.P. = Single Super Phosphate
Reco. = Recommended

by the improved inputs, due, firstly, to the nature of crops (may be due to cost and returns) and secondly, the inadequacy of water supply.

Sugarcane seems to have been taken special care of: almost 100 per cent of the recommended level of N was applied to it. However, the area under sugarcane was too small (2.23 hectares or 1.7 per cent) to warrant any definite generalisation.

On an average, 117.9 Kgs. of nitrogenous fertiliser was applied per hectare of paddy by our sample farmers. Interestingly, this coincides exactly with the finding contained in the Second Report of the Expert Committee.[6] The Committee observed : "Rate of application of nitrogenous fertiliser to paddy was 117 Kgs. per hectare as against the recommended rate of 224 Kgs. per hectare. By farm-size groups, the big farmer applied over-doses of both N and P to paddy while the fourth group of farmers operating between 7.51 and 10.00 hectares of land did not apply even one-third of N and a little over one-third of P. The extent of adoption of N and P fertilizers was, however, greater in paddy crop as compared to other crops according to different size-groups. Unlike the Committee's observation that the rate of application of nitrogenous fertiliser to paddy decreased with the increase in the size of holding, the present study did not reveal any consistent trend. The variations, for instance, were so large that it ranged from only 71.47 Kgs./Hectare (or 24 per cent of the recommended dose of 224 Kgs./Hect.) in the third holding group (5.01 to 7.50 hectares) to as high as 287.72 Kgs./Hect. (or 128 per cent.) in the biggest size-group (10.01 hectares and above).

6. Second Report (1960-65), Expert Committee on Assessment and Evaluation; I.A.D. Programme, p. 327.

		Cotton				Sugarcane			
Average rate of P.F. in S.S.P.	Reco. doses %	Average rate of N.F. in terms of A.S.	Reco. doses %	Average rate of P.F. in terms of S.S.P.	Reco. doses %	Average rate of N.F. in terms of A.S.	Reco. doses %	Average rate of P.F. in terms of S.S.P.	Reco. doses %
(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
..	..	50.00	44.64	..	..	..	..	..	..
..	..	35.71	31.88	..	..	1124.47	179.92	526.32	93.99
..	..	22.50	20.09	22.50	16.07	66.67	10.67	66.67	11.91
..	..	33.33	0.29	58.02	41.44	1125.00	180.00	..	..
13.45	4.27	N.G.	..	..	..	N.G.	..	..	.
13.45	4.27	37.06	33.09	46.28	33.06	619.16	99.07	186.30	33.27

	Paddy	Jowar	Mango	Cotton	Sugar
Recommended dose of N.F. in terms of A.S. (Kgs./hect.)	224	112	375	112	625
Recommended dose of P.F. in terms of S.S.P. (Kgs./hect.)	140	140	315	140	560

With regard to jowar, however, the results of our sample study were very much different from those arrived at by the Committee. It is seen from Table 5 that only 21.1 Kgs. per hectare was the rate of application of nitrogenous fertilisers to jowar whereas the Committe's finding was that it was more than four times this figure (92 Kgs. per hectare). However, fertiliser application to jowar was too little to be commented upon. Besides, it was restricted to only small farms. The average rate of application of N and P fertilisers for both jowar and mango as a percentage of recommended doses indicated a certain indifferenc on the part of cultivators, in respect of fertiliser application. The farmers covered by the present study applied only 18 per cent. of the recommended level of nitrogenous fertilisers to jowar whereas the Committee found that the percentage was much higher (82 per cent).

In respect of cotton, however, there was a decreasing trend with the increase in size of holding. While 44.6 per cent of the recommended doses of nitrogenous fertiliser was actually applied by the farmers in the first group, only 0.3 per cent was applied by the farmers operating more than 7.50 hectares of land. Small farmers thus seemed to be meticulous in the cultivation of cotton, perhaps due to the fact that it was the only crop, which provided cash to small holders. Of the cropped area in the fourth group of farmers cultivating between 7.51 and 10.00 hectares of land, 11.37 per cent was devoted to cotton. This was the maximum in comparison with the remaining size-groups. The application of N fertilisers to cotton in this group, as stated above, was, however, almost absent, being as low as 0.3 per cent of the recommended level. In brief, it appears that unlike small farmers, big farmers did not bestow particular care on

the cultivation of cotton. A study[7] into the Economics of cotton cultivation in Sabarkantha district has also revealed, that the small farmers applied more of nitrogenous fertilisers as compared to the middle and the big farmers.

Based on a study of 50 selected cultivators of the I A D P district Bulsar (South Gujarat), it is evident that the acceptance of improved practices generally increased with an increase in the size of holding. Secondly, this study has also revealed that irrigation was the dominating factor determining both the coverage of area and the rates of application of improved practices. The choice of crops grown by the farmers was largely govered by the availability of irrigation facilities which in turn determined the acceptance, type and rate of adoption of improved farm inputs, more especially the chemical fertilisers. The third significant observation that emerged from the present study is that there was a positive and high correlation between the size of holding and proportion of area irrigated. In fact, it was observed that farm size and availability of water resources through irrigation facilities were jointly responsible for determining the acceptance of improved practices. Nevertheless, the variations in the deviation of the actual rates of application of various inputs from the recommended doses are quite large for different crops : these might not, however, be wholly and conclusively attributable to factors such as size-level of farms or availability of irrigation ; these require a special study into the profitability of using improved farm practices for different crops.

APPENDIX I

DISTRIBUTION OF FARMS: OPERATED AND IRRIGATED AREA BY SIZE OF HOLDING GROUPS

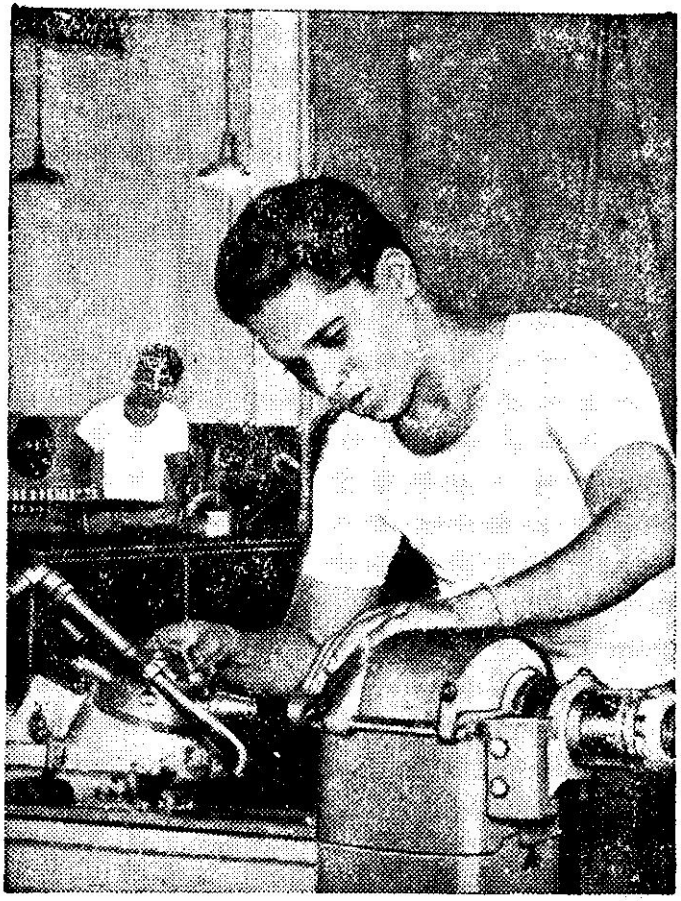
Size of holding (hect.)	No. of farms	Area sown (hect)	% area irrigated
(1)	(2)	(3)	(4)
Below 2.50	26 (52.00)	22.35 (17.07)	14.77
2.51—5.00	15 (30.00)	45.98 (35.12)	30.19
5.01—7.50	4 (8.00)	20.25 (15.46)	14.47
7.51—10.00	4 (8.00)	31.04 (23.70)	50.99
10.01 and above	1 (2.00)	11.30 (8.65)	49.73
Total	50 (100.00)	130.92 (100.00)	31.74

APPENDIX II

CROPPING PATTERN

Size of operational holding in hect.	Paddy		Jowar		Mango		Cotton		Sugarcane		Miscellaneous		Total net area	%
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Below 2.50	15.23	68.14	3.37	15.08	0.42	1.88	1.85	8.28	..	..	1.48	6.62	22.35	100.00
2.51-5.00	22.82	49.63	8.37	18.20	7.50	16.31	3.09	6.72	0.19	0.41	4.01	8.73	45.98	100.00
5.01—7.50	9.55	47.16	..	..	3.70	18.27	0.40	1.98	0.54	2.67	6.06	29.92	20.25	100.00
7.51—10.00	10.10	32.54	4.59	14.79	9.75	31.41	3.53	11.37	1.50	4.83	1.57	5.06	31.04	100.00
10.01 and above	2.33	20.62	..	..	6.69	59.20	..	..	..	..	2.28	20.18	11.30	100.00
TOTAL	60.04	45.86	16.33	12.47	28.06	21.43	8.87	6.78	2.23	1.70	15.40	11.76	130.92	100.00

7. 'Economics of Cotton Cultivation' : A Study in a Selected Region of Sabarkantha District in Gujarat by Madhukar Maharaja, Agro-Economic Research Centre, Vallabh Vidyanagar, p. 80 ●●●



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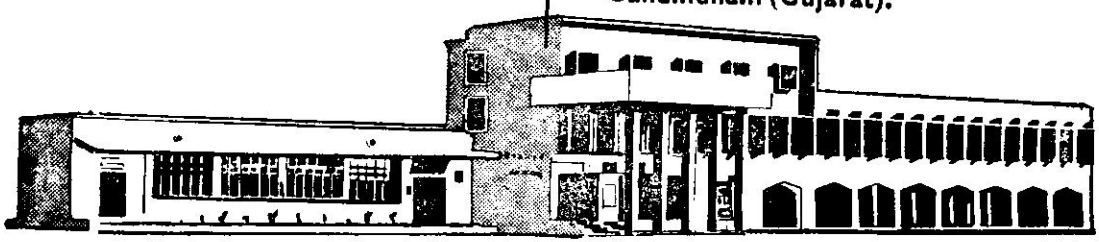
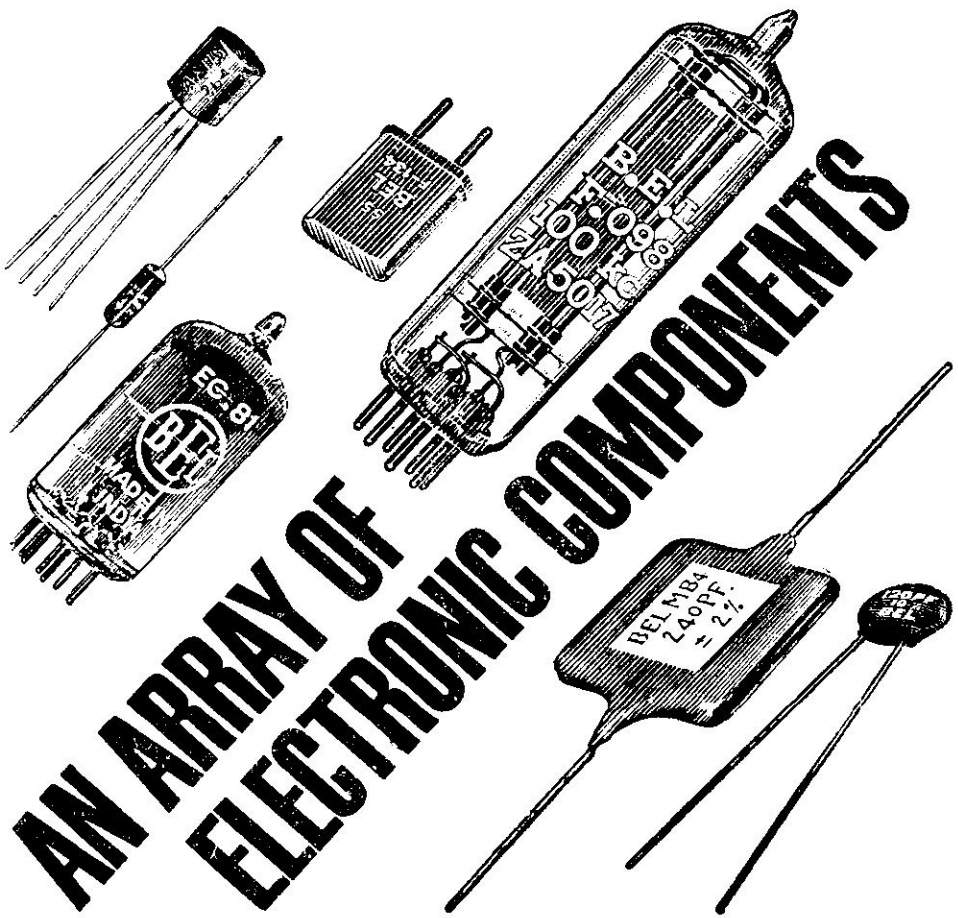


MINISTRY OF COMMERCE, GOVT. OF INDIA

dovp 67/445



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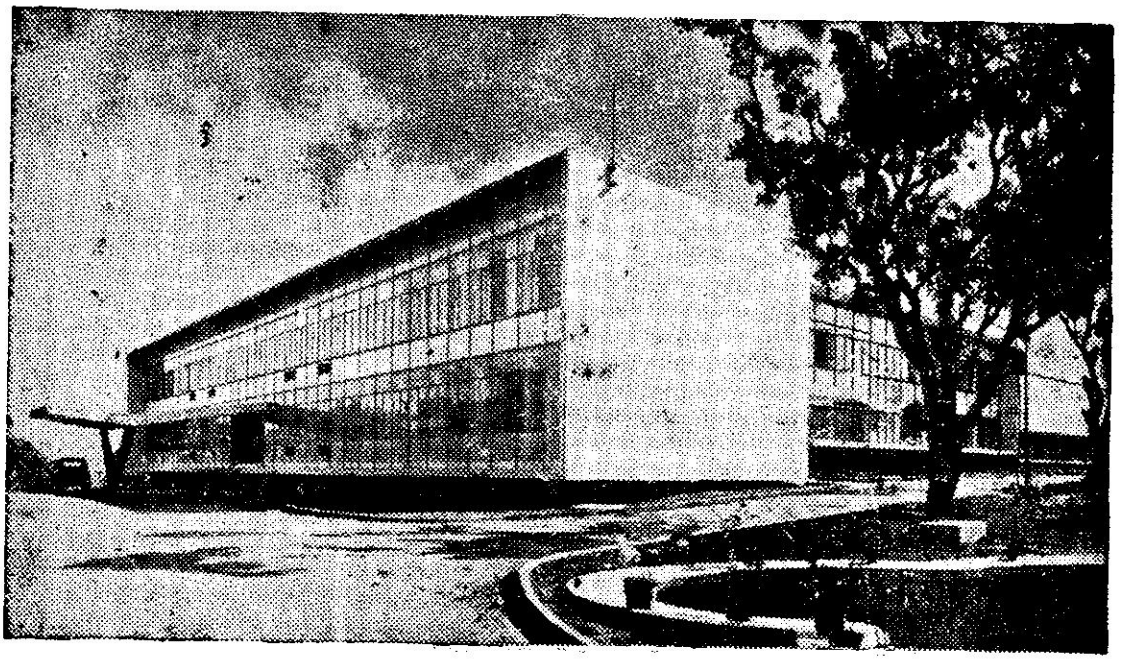

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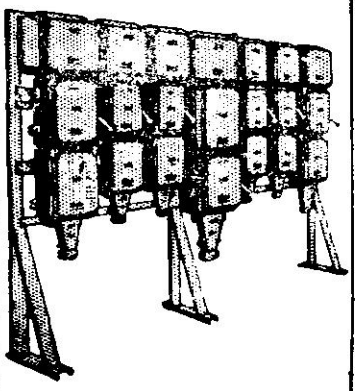

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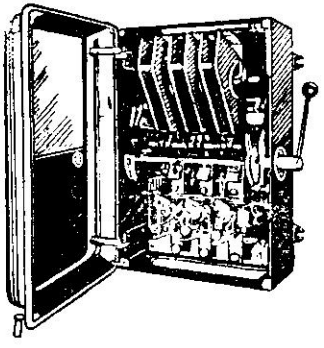

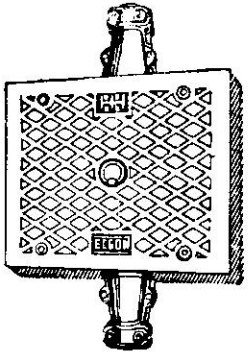

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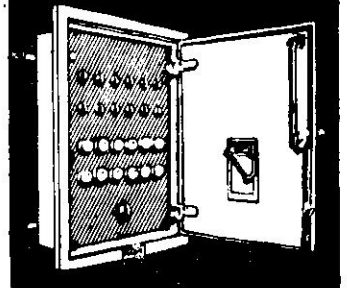

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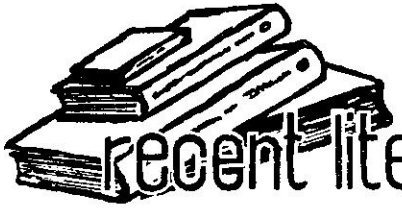


recent literature on productivity

Small Scale Industries In India

It was a masterly stroke of diplomacy and public service for the Small Scale Industries Development Commissioner to have organised an extraordinary exhibition of Small Scale Industries on the occasion of UNCTAD-II in order to 'sell' our products and techniques to the distinguished men and women who had gathered from all parts of the world to discuss the problems of Trade, Aid and Development of the underdeveloped countries of the world. This has certainly created an international image of India, as representing not only the ancient erotic impulses carved out at Khajuraho, but also Modern India bubbling with energy and enterprise in its small scale industries sector.

AS IF THIS WERE NOT SUFFICIENT, THE Development Commissioner (Small Scale Industries) followed it up by (or rather brought out simultaneously) what should really be called not a book but a Tome, weighing several kilograms, which probably is its only disadvantage, but it would surely deter any reasonable book thief. The Development Commissioner deserves to be congratulated for this publication, both for the enormous value of information that it contains and also its propaganda value. If a million copies of this could be sold abroad, it would do the country a lot of good including a substantial earning of foreign exchange. The Book, however, bears no price, at least visibly, so that it could be sold in foreign markets at a discriminating price of 10 to 20 dollars, depending on the purchasing power of each country ; and in some countries which would not buy, we may, through our diplomatic missions, present a number of copies, to earn goodwill and push up the image of the country as a small scale but, nevertheless, substantial industrial power.

It is difficult to count the pages of the book. There are, to begin with, 'n' full page testimonials printed on art paper, beginning with Rashtrapati Zakir Husain and ending with Sri KB Lall, Secretary, Ministry of Commerce, who says, "The role played by the Development Commissioner, Small Industries Organisation in accelerating the process of their development and helping them to produce sophisticated goods conforming to recognised standards is very important and all those connected with it deserve appreciation". This is a well deserved tribute to the workers of the office of the Development Commissioner of Small Scale Industries.

Then we have an Introduction by Sri KL Nanjappa, the Development Commissioner, himself. In five pages of printed material, which includes the usual courtesies expressed to people above and below him, Sri Nanjappa has given a bird's-eye view of the phenomenal growth of small scale industry not only in numbers, but also in the employment of sophisticated techniques, including the manufacture and export of microscopes, transistors, surgical instruments, diesel engines, automobile parts –things for which we were dependent on imported supplies, not very long ago. Sri Nanjappa's saga of small industry development is worth reading by all those who believe in the future of this country.

Then come a number of articles by the VIPs of the Ministry of Industrial Development, including our present Chairman, Sri NN Wanchoo, and senior persons concerned with small scale industrial development, besides one distinguished economist, Dr. PS Lokanathan, the Founder-Chairman of the National Productivity Council. The articles are very well illustrated and it is pleasing to find a number of photographs of the late Jawaharlal Nehru, and the other Prime Ministers uptodate, very charming photographs of women working in small scale electronic factories, etc. etc. The articles are well illustrated with facts and figures.

We have then nearly 200 pages dealing with the Programme and Progress of small scale industries : the concept, the organisational set up, techniques, credit facilities, hire purchase etc. etc. The amount of information compressed in these pages is invaluable. A number of pages have been devoted to simply-constructed bar diagrams, which indicate the phenomenal growth of small industry in terms of government aid, small scale industries, the number of factories, employment, gross output, etc. etc.

We have then a whole section dealing with small industry development in practically each state of the Indian Union : Andhra Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Jammu & Kashmir, Kerala, the Punjab and the resurgent Rajasthan, ending with West Bengal in the forefront.

This is followed by a detailed mention of the various organisations which serve the small industry sector including the Development Commissioner's office, headed by Sri KL Nanjappa, (with M. Com. from Tokyo) assisted by a number of highly qualified officers listed over 4½ pages of closely printed small type material. The Book — or the Tome as we have called it –indicates that this large empire of the DCSSI is well equipped, in terms of technical personnel, to deliver the goods.

Then we have also the staff of the Small Industries Services Institutes in various states of the Indian Union, along with a number of extension centres, listed similarly on as many as 27 pages. In a significant sense this constitutes the real capital of the country, if someone could use it for the good of the people.

This is followed by a short story "Sita Ram Becomes an Entrepreneur" drafted and illustrated on the same lines as the 'Roshan Lal' story printed in this Journal several years ago.

A whole section deals in considerable depth with individual small scale industries in engineering, chemicals, plastics, electronics, sports goods and a number of other lines. A number of pictures follow, indicating significant profiles of small industries in actual operation. A list has been given of the various items, giving a cross-section of the items exhibited for the benefit of the UNCTAD delegates. These 8 pages are extremely impressive and show the part played by small industry in the Industrial Revolution that has taken place since Independence. The main facts about small industry development and small industry organisation are then summarised over a couple of pages. These are worth reading and should really have been put at the beginning along with Sri Nanjappa's Introduction.

We have then a list of industries which, in the opinion of the Development Commissioner, have a scope for development in the small scale sector. A number of memoranda are given here dealing with research processes developed in the national laboratories for prospective

small industries and how they should go about getting all the facilities which they need, including raw materials, credit, etc. etc.

Quite a few pages afterwards we find an interesting select bibliography of publications of Small Industries. This has been very well drawn up, except for the fact that a Special Issue of our Productivity Journal, for long a reference volume in the line, does not find even a mention. A number of articles published in some issues of the Productivity Journal have, however, been cited. Considering the volume of work done by the editors, the omission of the NPC special issue on Small Industries in the bibliography is not a serious fault and can be corrected in a second edition which the Development Commissioner's office is bound to bring out on account of foreign demand. In any case NPC has been appropriately abbreviated on page 529, as an organisation worth mentioning in a volume on Small Industry development.

The commercial part of this book is very interesting, for it contains as many as 367 pages of advertisement of small industrialists and their products. Whatever may have been charged per page, it is obvious that the advertisers and not the Government of India have paid for the production of this volume. Surely Sri KL Nanjappa deserves to be congratulated on this account. It shows what a determined public servant can do, even without financial resources.

The Book is beautifully printed, with an impressionistic cover design, bearing ultra-modern cubic structures. Then we have an opening page which is highly mystical, with a caption "They Bless Us" : what that means, God knows, but it is delicious to be blessed, particularly when it is 'us' who are going to be blessed and 'they' are going to bless us, whoever 'they' may be. Surely, besides business, small industry development in this country is not without its mystique ; and there are quite a few female photographs, which shows that the small scale industry organisers are not altogether oblivious of the possibilities of Freudian psychology. ●●●

Plantation Workers*

THOUGH probably outdated by rapid political and economic developments, this ILO publication on Plantation Workers is a mine of information, not only with regard to the wide range of plantations covered—banana, cocoa, coffee, palm oil, rubber, sisal, sugarcane and tea, but also with regard to the number of countries in three continents—the Cameroons, Ivory Coast, Mauritius, Tanganyika in Africa; Colombia, Costa Rica, Ecuador, Peru in South America; and Ceylon, India, Indonesia, Malaya in Asia. Very obviously, the range of plantations covered as also the range of countries surveyed entitle this publication to a wide reading, particularly among research workers; for not only have the social and economic conditions on the plantations been exhaustively analysed but the background of political and social conditions has also been incisively examined, for as everyone knows, these have now a direct relevance to the conditions under which plantation labour works, which is the principal interest of ILO in the whole business. But the experts knew, however, the nature of their job so that they have gone into the whole matter in very considerable depth.

The interest of the ILO is obvious enough, for plantations are really the oldest colonial type of industry organised to exploit each colony's raw materials and cheap labour for

*Published by International Labour Office, Geneva, 1966, pages 284, price $ 3.50; 24s. 6d.

the colonists' commercial gain; however the origin of the whole business has hardly any direct relevance to the present situation, for two important reasons: one, if the planters had not provided the necessary investments and the necessary organisation and enterprise, the condition of native labour would have been far worse: in fact while comparison by European or American standards would reveal a rather sordid state of affairs on the plantations, the condition of native labour outside the plantations in respect of wages, conditions of work and living are far worse than on the plantations; secondly, what is historically more important, the whole situation has undergone a sea change, as the analysts in this publication have, in fact, noted. The social, political and economic changes of the past few years have greatly influenced the structure of plantation economy. The great plantation of the past has lost much of its importance, and today usually takes the form of large industrial or commercial enterprises, big production co-operatives, or undertakings in which agronomic research is carried out concurrently with growing for the market.

This ILO Survey was undertaken as a result of a convention and a recommendation (No. 110) passed by the General Conference of ILO in 1958. The formalities with regard to the ratification of this convention are of little importance, for most countries have by now sufficiently rigorous labour laws, which guarantee at least the ILO standards of social security. In India, we have a Plantations Labour Act, which precisely defines a plantation as one with an area not less than 10.117 hectares and employing not less than 30 workers.

In fact, in the context of the ILO survey of 13 countries, India has the highest statistical position with a plantation area covering as much as 46 per cent of the total area under plantations in all the 13 countries under consideration. Asia as a whole has also the highest area under plantations. Taking the ILO surveyed countries, the four Asian countries have 24 million hectares under plantation, as against 14 million in the five South American countries and only 2 million in the four African countries.

There are, however, certain countries such as Mauritius, Malaya and Ceylon, Ivory Coast and Brazil in which the plantation economy is dominant, covering as it does more than half the cultivated area in these countries. It is still more important in the first three countries namely Mauritius, Malaya and Ceylon because in these countries, there is comparatively little area left for expansion of cultivation. Such is not the situation either in Africa or in South America. In South America, particularly in the countries surveyed, hardly 10 per cent of the area is cultivated, of which plantations occupy 25 to 40 per cent, so that in the country as a whole, plantations would be covering 2 to 5 per cent of the area. In the Cameroons and Tanganyika in Africa, plantations cover only 5 per cent of the cultivated area in each of the countries.

The productivity of these plantations is, however, very important because in several countries, plantation products such as cane sugar, cocoa, coffee, rubber, sisal, tea are primarily grown for export and often form a major part of the country's export earnings. Of the plantation products, banana and cotton are categories by themselves. They are mostly grown for home consumption and in the case of cotton, a large part of the exportable supplies comes from the non-plantation areas of the U.S.A. and the U.S.S.R. In banana, South America produces two-thirds of the total supplies (Brazil contributing a quarter of the world's production) and India produces over 10 per cent, and has begun to enter the export market. However, the major exporters are the Cameroons, Costa Rica, Ecuador and Colombia where banana is grown largely for export.

Plantation rubber, of which Malaya produces 40 per cent and Indonesia 25 per cent, is almost wholly exported; sisal and cocoa exported to the extent of nearly 90 per cent, coffee 68 per cent, tea 55 per cent, cotton 33 per cent, banana 18 per cent.

The Book is throughout full with such important statistics, besides much relevant information. In fact, the position of each product has been so thoroughly surveyed that the research worker would find quite a substan-

tial volume of readily available information in the Volume. In respect of banana, for example, particularly when it is grown on large plantations in South America, it is pointed out how the famous United Fruit Company of the USA which has played such an explosive part in the politics of the region, "monopolised all production and trade in bananas in Central America and Columbia." What has happened in recent years is extremely significant from the point of view of social and political developments: "For various reasons this Company has ceased work on enormous stretches of land. Some of this land has been abandoned, others given to Government for distribution to peasants (for instance in Guatemala); others again have been sold to companies belonging to the country itself (for instance in Colombia)..." With all this, the United Fruit Company, along with another foreign company (the Standard Fruit Company) continued to dominate the politics and economics of the region, despite compulsory and voluntary liquidation, referred to above.

From the productivity standpoint, the following observation in respect of cocoa is significant. In the countries where smallholdings are in the majority (Cameroon, Ivory Coast) the existing large industrial plantations achieve a much higher productivity than the small-scale holdings.

It is also significant that some of the large foreign plantations maintained social services on a fairly large scale. The following observation occurs in respect of foreign rubber plantations in the Cameroons and the Ivory Coast. All these firms, together with the Firestone Company, from which comes most of Liberia's output, are organised in big industrial ensembles; the plantations themselves form real villages, with their own public services, hospitals, boats for transporting the rubber, airports and markets.

Thus it is clear that it is the large plantations which have higher productivity and better conditions of working. Even the coconut trees on the small holdings in Malaya "are often somewhat mediocre in quality" (p. 17). In fact, "the Tea Board of India considers as uneconomic all privately-owned plantations of less than 37 hectares and company-owned plantations of less than 75 hectares" (p.18) Some of the countries, therefore, are taking steps to establish large plantations and to prevent fragmentation. The ILO Report rightly observes : "the usual result of fragmentation is to increase the precariousness of plantations workers' living conditions, particularly as regards housing, hygiene and health."

In some of the countries, Co-operatives are coming up. In the Cameroons, for instance, there are Co-operatives not only for banana crop, but also for coffee, cocoa and tobacco. There is a Banana Planters Co-operative in the Ivory Coast. The National Bank of Costa Rica has established a co-operative development department; but, by and large, planters co-operatives in South America are still dominant. Even "in Peru most of the big sugarcane plantations belong to foreign companies, notably to the Grace Company of North America" (p. 24).

Apart from an analysis of these important factors, this ILO Publication also gives valuable statistics on plantation yields. In banana, India occupies the fourth place, but in sugarcane the very last place in terms of yield per hectare, as shown in the following tables.

Yield of Banana in tonnes per hectare

1.	Brazil	28.8
2.	Costa Rica	27.0
3.	Ecuador	17.2
4.	INDIA	13.7
5.	Ivory Coast	11.2
6.	Colombia	8.1
7.	Malaya	7.6
8.	East Cameroon	4.6

Yield of Sugarcane in tonnes per hectare

1.	Peru	105.5
2.	Hawaii	103.0
3.	Indonesia	91.3
4.	Colombia	81.8

5. South Africa		70.7
6. Formosa		70.4
7. Australia		62.5
8. Mauritius		60.8
9. Puerto Rico		60.7
10. Mexico		55.5
11. U.S.A.		51.5
	World Average	**48.8**
12. Fiji		47.2
13. Brazil		40.5
14. Argentina		33.6
15. INDIA		**33.6**

The only consolation that we can have is being bracketted at the very end with Argentina. This ILO publication also gives some other productivity statistics but these are obviously incomplete on account of the basic lack of statistics in the area.

It is in the analysis of political factors that the objectivity of ILO observers reaches a fairly admirable limit: how in the West Cameroon, for example, the foreign corporations have sought to obtain the best possible taxation rates. ".....The large plantations have already for some years formed a sort of consortium, offering a united front to the federal government authorities at Yaounde in the search for satisfactory politico-economic answers..." It is also shown how the foreign planters are themselves on tenter-hooks, not knowing what direction Government policy would take; and there has been, in some parts of Africa, a flight of foreign capital. "...In Mauritius a certain degree of social and racial tension, largely caused by overpopulation, has led to the withdrawal of foreign capital from several sugar-manufacutring companies."

There are, of course, certain oases in the desert—"...Ivory Coast has demonstrated that governmental action, if it is properly conceived and designed in particular to give effective guarantees to foreign capital, can do a great deal to encourage production and productivity in plantations. Such a policy, combined with the relative social calm of the country, has encouraged the inflow of foreign capital for investment in plantation farming."

Over large areas, however, insecurity is becoming a serious disinvestment factor. In Cameroons political and tribal rivalries have led to banditry, guerilla and other forms of violence over vast areas. In Colombia "in the coffee-growing areas, the brigands, often with the help of clandestine support, are said to have created a fall in the value of land which they then bought cheaply from the owners, whose only desire was to get away to areas of safety. Whatever the true reasons for these disturbances in Colombia—it is almost impossible to make them out clearly—they have produced results, if only by the length of time they have lasted, so important as to have been described as the most profound social and cultural change in the rural areas of the country since the Spanish conquest."

Though some improvement is subsequently referred to, by and large the ILO gives a fairly accurate but rather disturbing picture of the plantation scene, at least politically and by implication in terms of economics.

Quite a number of interesting and valuable chapters follow dealing with the labour force, conditions of work, labour-management relations, including wages, hours of work, conditions of employment, standards of living, etc, etc.

The conclusions of the ILO Report may be summed up in the following extracts:

"The contribution of the large plantations to economic and social development has been most marked in Africa where, in order to meet modern production requirements and help to raise living standards, plantations sometimes act as large-scale production and marketing co-operatives as well as research organisations, which use their huge landholdings for agricultural research in addition to producing tropical commodities for the international market.

The economic and social usefulness of large plantations is still acknowledged in many countries.

In countries where plantation products are the main source of foreign exchange, plantations tend to employ a large and sometimes even a major proportion of the country's agricultural labour force, as in Cameroon, Ceylon, Colombia, Malaya, Mauritius and Tanganyika.

Despite the efforts of governments and many plantation Managements the conditions of employment of plantation workers are not everywhere as good as they should be, even though a marked improvement has taken place in recent years.

Most countries require plantation managements to provide their workers with suitable accommodation, and in some cases the law even sets minimum standards; but in practice the workers are badly housed, especially on the small and medium-sized estates. Even on the large estates it is not uncommon to find the workers housed in compounds or overcrowded family accommodation. The resulting promiscuity does not help to improve standards of hygiene and health.

Plantation workers' food is just as unsatisfactory as their accommodation. They are nearly always badly fed and their diet is monotonous and unbalanced. Most of them hardly ever—if at all—eat such essential foods as meat, eggs, milk and dairy products or certain fruits and vegetables. Their staple diet consists of tubers, roots or rice."

Despite the *tragedy* revealed by the ILO experts, as characterising the life and working conditions of plantation workers, the publication would be a rich source of information for intensive research workers who might like to delve into these human problems of phenomenal importance in the lives of the common people.●●●

Role of Industrial Engineering

THE Kerala State Productivity Council (Ernakulam) must be complimented for having produced an excellent Report of an in-country team which they sent out to study the role of industrial engineering in increasing productivity. A number of very competent professionals including CGG Panicker, Managing Director, ACBI (Trivandrum), SK Warriar, Indian Aluminium (Alwaye), PH Ramaswamy of FACT, GP Pillai of Travancore Cochin Chemicals Ltd., AS Menon of Indian Rare Earths and our young Devarajan went round some of the big concerns at Bangalore (HMT, ITI, Kirloskar Electricals), Enfield, Integral Coach, English Electrics, T.I. Cycles, Indian Pistons and other factories at Madras; and a couple of works at Coimbatore.

They have submitted a very good Report which is worth studying. Of course, industrial engineers like all other professionals are naturally inclined to believe that their techniques can bring a new heaven and a new earth, particularly to a poor country like India; and they are inclined to believe that they can play a vital role even in such ticklish matters as labour-management relations, though the behavioural scientists have in recent years argued that sociologists and social psychologists would probably do a very much better job, and that *industrial engineering in its own right and in its true sphere can really do an amazing job.* This Report shows that it really can.

The underlying philosophy is, in fact, very well expressed: "the best way to fulfil the social obligations is to produce goods and services at reduced costs and to generate surpluses for the country's development." In fact, no economist could have stated the position in more appropriate language.

Of course, the statement with which Chapter I begins that one industrial engineer is reasonable enough for 250 employees, would be rather outdated for a dynamic economy: in fact, considering the wide diversity of industrial processing from automated chemicals manufacture, steel production, customer-oriented machine tool manufacture, automobile assembly etc, etc., it is rather hazardous to make a generalization. Apart from this, however, many of the conclusions and recommendations of this Report are marked by profundity, deep knowledge and a social conscience.

A few of these conclusions and recommendations are strung together here to indicate the general trend of thinking among the Group: "...the involvement of middle management in I.E. activities is not up to the desirable extent... *the team did not find much evidence of taking workers into confidence as far as I.E. activities are concerned*.....I.E. function is best performed if other routine functions are not entrusted to it and if it remains as an independent task force or brain trust...no company studied, not even a single Engineering unit, was making use of such useful tools as Value Analysis.....The team recommends that I.E. departments should have strong *Methods Wings*.....The Team recommends that bodies like the N.P.C., I.L.O. or professional organisations of industrial engineers should appoint a committee to evolve a uniform and consistent system of allowances for the industries in India..... The non-existence of *joint consultative machinery* to settle disputes regarding work standards and the absence of regular systems for the maintenance and updating of standards are serious deficiencies in the field.....Most incentive schemes start at subnormal levels of performance and have helped to reach near-normal levels of performance...an upper ceiling on performance imposed on labour under some schemes is unjustifiable. The practice of one company, which does not revise the standard without method changes, even if a few workers earn abnormally high bonus, will help to win the confidence of labour in the Incentive Scheme.....outmoded practices of arbitrary wage determination continue in a substantial number of industrial organisations including some major units.....The effect of D.A. and incentive earnings on wage differentials is a subject which deserves research studies by academic institutions and professional organisations.....only a few have computerised the function and non-use of Operations Research techniques for the purpose...majority of the organisations studied have not applied scientific inventory control methods like A.B.C Analysis, Fixation of Max-Min Reordering levels and order quantities, Perpetual Inventory etc... only a very small section of our industries have introduced Preventive Maintenance Schemes... Generally Indian industrial organisations have not kept pace with the application of modern control techniques and new management tools... *sufficient attention is not being devoted to proper utilization of materials*... The most important factor adversely affecting the productivity picture in India is *the neglect of the importance of human productivity* under the ill-conceived notion of cheap labour. This has led to a position where the labour cost per unit of output in India is more than that in advanced countries with higher wages...

The Team has also drawn attention to insufficient utilisation of costly modern machines, and what is rather serious, non-professionals, heading industrial engineering departments due to reasons of protocol, particularly in public sector undertakings. We really don't know if the sample at the disposal of the Team was sufficient for a valid generalization but the point certainly does need attention, for *we shall win the battle of productivity not by protocol but by hard, correct and devoted work.* ●●●

Industrial Programming*

IT IS RATHER SURPRISING THAT FOR ONCE MSS could write such a book after having produced, in rapid succession, much excellent material : *Capital Maintenance in Indian Industry, Practical Cost Accounting for Cotton Mills* and *Interfirm Comparisons in Textile Industry.*

In fact, we reviewed the last-mentioned publication in the previous issue of this Journal in rather fulsome terms.

The natural desire to make quick money and the persistence of the black market in the Book Trade, despite general slump in industry, have probably been rather irresistable temptations for MSS (our Old Boy) who felt called upon to write on a Topic of the Day, though IPY is over!

This pamphlet on Industrial Programming is supposed to be a panacea for industrial 'damsels in distress', bloated by long periods of inflation, but now too delicate to stand the purgation of the slump. It is written in the hope that managers of sick companies would jump at this recipe for *Rejuvenation through Reorganisation.* It is a very happy and flattering thought that MSS should try to "stimulate rational thought" in a rather too irrational world; but these sick company proprietors don't need such befuddling mathematics as are wholly unnecessarily presented in this volume, when the problems are really quite easily comprehensible in plain straightforward terms.

It is probably irreverent to quote Keynes's comments on pseudo-mathematical analysis, but it would, nevertheless, be refreshing to read what he wrote in the *General Theory of Employment, Interest and Money* : *"Too large a proportion of recent "mathematical" economics are mere concoctions,* as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols."**

Really, Company owners troubled by problems created by the current recession are not in need of mathematics. In the first instance, they have collected a lot of personal capital and they can very well rest on their oars. They have probably already managed to retrieve their capital, in fact, many times over; and their investments have been yielding them what Marshall rightly called 'quasi-rent'. In any case they know the art of liquidation, which in fact proves very profitable to them, incidentally also serving a social purpose, because technicians who know their job buy over these concerns at modest prices and with the capacity to run them efficiently. They also have the last alternative, used with considerable finesse during the post-Nehru period of passing on the junk to Government in the interests of labour, because how can any decent Government put so many people on the streets? The late Prime Minister Jawaharlal Nehru had an innate economic wisdom of refusing to buy the junk of industry.

That this Book deals with such defunct companies is obvious from the statistical tables printed on page 24 onwards. The condition of plant and machinery in company number one, two and three is described as 'worn out and unsatisfactory performance; worn out, poor working, etc; worn out, obsolete, etc; and their solvency position : 'entire capital wiped out' is common to all the three companies, with 'doubtful solvency' added to company number 3. In fact, the tables which follow show company 'A' with assets of the book value of over Rs. 50 lakhs, now worth less than Rs. 6 lakhs ; Company B with book value of over Rs. 54 lakhs, just worth about Rs. one lakh ; the position of Company 'C' is similar.

MSS, the clever man that he is, knows the truth. "After examining the details in regard

**Industrial Programing*, An Analytical Study, by Dr. MS Srinivasan, published by Emcons, GPO Box No. 761, Bombay-1 pages 48; Price Rs. 5

**See the article on pseudo-mathematical economics, printed elsewhere in this Journal.

to any enterprise, if it is found that there are no potentialities for the company to overcome the situation, with reasonable external assistance, justified the position of security, then the unit will have to be included in a list, which will enlist cases requiring more radical measures." It would, in fact, be worthwhile for MSS to publish a sequel to this volume, containing just this radical list of companies beyond redemption. To be sure, it would be a long one: probably, means could be found even to make money out of it, if the market could be appropriately tapped.

The Book is full of a lot of verbiage such as optimization or utilisation of available resources: the achievement of stabilised economic working so that future economic progress and growth is facilitated, etc. etc... Both in language and conceptual analysis, the Book is very much below the usual MSS standard. ●●●

Factory Organization*

IT'S A little difficult to review this Book, partly because the author has drawn substantially upon past issues of this Journal, also because editorial and printing defects take a good deal away from what otherwise would be a very valuable publication, containing an enormous amount of material on Factory Management, Departmentalisation, Labour Relations, Wages and Incentives, Site Selection, Production Control, Layout, Materials Handling, Purchase Organisation, Stores Organisation, Time and Motion Study, Depreciation, Costing, Industrial Safety, Industrial Legislation. A substantial volume of material has been packed into each of these chapters; and the author has taken great pains.

The following words taken from the first page are, however, illustrative of the rather poor presentation and poor printing of the Book:

> "However strong, a man may be his qualities and strength, are limited.
>
> Frederick Win slow Taylor. . . . The Taylor's Principles. . .
>
> Henry Fayol, a French Industriolist, perhaps was the first person to disclose the universality of management principles."

The above has been printed here, with its grammar and punctuation, as found in the Book itself. We find from the preface that the author claims to have written the Book primarily to meet the requirements of Indian students reading for the engineering diploma examinations. So far as the material content is concerned, the author deserves praise for the pains he has taken, but when bringing out a second edition, he would be well-advised to employ a part-time editor and a proof reader; and we can tell him from our experience that apart from the satisfaction derived from being fair to one's readers, the cost will be more than recovered from the additional sales due to good quality of production and presentation. ●●●

*By VSR Moorty of Government polytechnic, Visakhapatnam, available at Mani Publishing Centre, Dondaparti, Visakhapatnam-4 (A.P.), pages 172 (including illustrations), price Rs. 3.75

The Design and Analysis of Experiments*

THIS IS A CHEAPTER EDITION OF THE FAMOUS book on 'Design and Analysis of Experiments' by Professor O Kempthorne. Its first edition was published in 1952. As the normal U.S. edition of the book is highly priced, most of the students and research workers find it difficult to procure the book for themselves. Thus it is a very right venture on the part of Willey Eastern Private Limited to print a cheap edition of the book for the benefit of research workers, students and other users of Statistical Methodology in this country.

The book has since gained world-wide recognition as a standard work on Design and Analysis of Experiments. It contains 29 chapters (appended by several statistical tables) covering most of the aspects of the Desi-n and Analysis of Experiments. The chapters on (i) elementary statistical notions, (ii) introduction to the theory of least squares, and (iii) the general linear hypothesis, or multiple regression, and the analysis of variance are particularly helpful for a proper appraisal of the Statistical Methodology required for design and analysis of experiments in various fields. The book is well suited for students preparing for their M.Sc. or Ph.D degrees, research workers, and other users of Statistical Methodology in fields like agriculture, animal husbandry, chemical engineering, industry, etc. Professor Kempthorne has described in detail the different methodologies needed for the construction of various types of designs, along with the rationale behind their analyses.

After the publication of the first edition of the book, of which this is a cheap reprint, much work of considerable importance has been done in the field, *e.g.*, Designs for exploring response surfaces. A revised edition, covering researches in the field since the publication of the first edition will be of considerable help to research workers. ●●●

*By Kempthorne, O; Wiley Eastern Private Ltd., New Delhi, 1967, XIX+631 pp; Price Rs. 13.75

"The city is on fire ! Where is our Fuel Efficiency Expert ?
What colossal waste of heat !
. . .We must organise research on waste heat utilisation. . ."

Better Materials Management

I am glad to know that you have now taken a policy decision to make your journal research based.

According to me, there are other methods than case studies to evolve valuable research material. I would like to cite an example of some work in which I am presently engaged.

You may be aware that I am in the purchasing field for some years and I have been associated with National Association of Purchasing Executives (NAPE). We have decided to make a close study and establish relationship of stocks and sales ratios of various industries. If these ratios are established, they can be taken as norms or indicators for judging the health of industries; and improvements or better productivity can be suggested by changing these ratios for the better. You will agree that when this research progresses, we will have much valuable material available.

Better productivity through better materials management is our objective and to that aim, we are trying to channellise our work. I am, at present, not keen to contribute a research-based article in the journal, because frankly I have first to make some research and get necessary fruits to be able to impart some useful information to others. However, I thought I may take an opportunity to find out how best NPC can help us in organising the type of research work that we are about to undertake...
—PN Vakil, Purchase Director, Sarabhai Chemicals, Baroda—3

Automation

Thank you for your letter and also for forwarding Mr Nadkarni's reply to my comments. There can be an endless argument about the pros and cons of Computerisation. Mr Nadkarni's reply urges me to say a few words. Surprisingly enough, we both agree

on many points. Coming to the specific point of disagreement, my observations are as follows:

When I said that punched card department staff would be the first victims of Computerisation, I meant that punched card staff would not be taken to Computer section on the plea that they ar not academically qualified, that they do not possess the necessary aptitude or they do not have the necessary skill to manage a Computer section. Normally, managements prefer to have higher qualified people so as to make them easy for promoting punch and verifier operators to higher positions as and when vacancies occur. Some managements, in order to avoid Union-Management conflict, may give option to employees to choose their career either as punch operator or get transferred to other departments.

I agree with Mr. Nadkarni that punch section gets enlarged as a result of Computerisation; and Mr. Nadkarni agrees with me that promotional chances are marred by introduction of Computers. This fact itself is enough to create frustration among staff and an agitational attitude takes birth against Computers. Mere transferring of displaced staff would not solve the problem. Later on they have to face the problem of stagnation and lack of prospects.

In agreeing with Mr. Nadkarni for introduction of Computers in India, I do not see eye to eye with his point that some adjustments (adverse!) are bound to occur. Years of hard and sincere work of operators should not be neglected. A hasty decision dashes o pieces the hopes and aspirations of workers. Whatever may be the merits of the Modern Marvel, here is a human problem encompassing within itself Personnel Management and Psychology, which cannot be sacrificed at the altar of Automation. Seeds of frustration and hatred are sown and nurtured if utmost care is not taken to see that displaced staff are suitably placed. By suitably I mean, with job satisfaction and comparable chances of promotion. Finally, may I add that I am for introduction of Computers for progress and prosperity and not for unsatisfactory job displacement and consequent frustration...—**M ANANDA RAO, 20 V Main Road, Chamarajpet, Bangalore**

The Souvenir Volume

Just a line to congratulate you for your article on "The Great Tradition" in the Souvenir Volume — Spring '68 issue of 'Productivity'. It's a brilliant article and I do hope you expand it into a book. Before concluding, permit me to congratulate you for the quality of production and the contents of the Souvenir...—**SUBHAYU DASGUPTA, Director, Calcutta Productivity Council**

Productivity Does Not Require An Import Licence

I have gone through the various matters dealt in the journal and each article is thought-provoking. The illustrating technique "laugh and learn" through cartoonic depiction is highly commendable.

I enjoyed your article "The Great Tradition" and some of the facts stated therein need rational thinking. In the history of 20 years of industrial growth, we have blamed workers squarely for low productivity and lower efficiency and what not. Let us put the cards straight on the table and do some heart searching. With this low productivity, most of the private industries were observed having ample spare capacities, while working in one shift only, leaving Public Undertakings aside. I wonder, what would have happened with the industrial economy if the working efficiencies would have been, say as we dream of, 80%. Are the managers prepared for that? Will they be able to feed the workers with the work continuously, without laying them off? I leave this for the readers to judge.

The supervisory class has started believing in the principle of 'No work—No mistakes—No explanation—No Punishment'. It is commonly argued on the dining tables, that 'A' is now in a soup because he took more interest

in the work. Workers, no doubt, have the will to work, but are not interested to work. Strikes, threats and pressure tactics have become the rule rather than the exception. And just glance into the statistics! Most of the simple demands were acceeded to and implemented through strikes only Why? The fault lies with the poor management and let us admit boldly and should not feel ashamed in calling a spade, spade. Let us create faith in the working class because, as it stands now, every move of management is being looked at with a suspicious eye. It is always true and selfless leadership which matters, and unfortunately that is lacking!

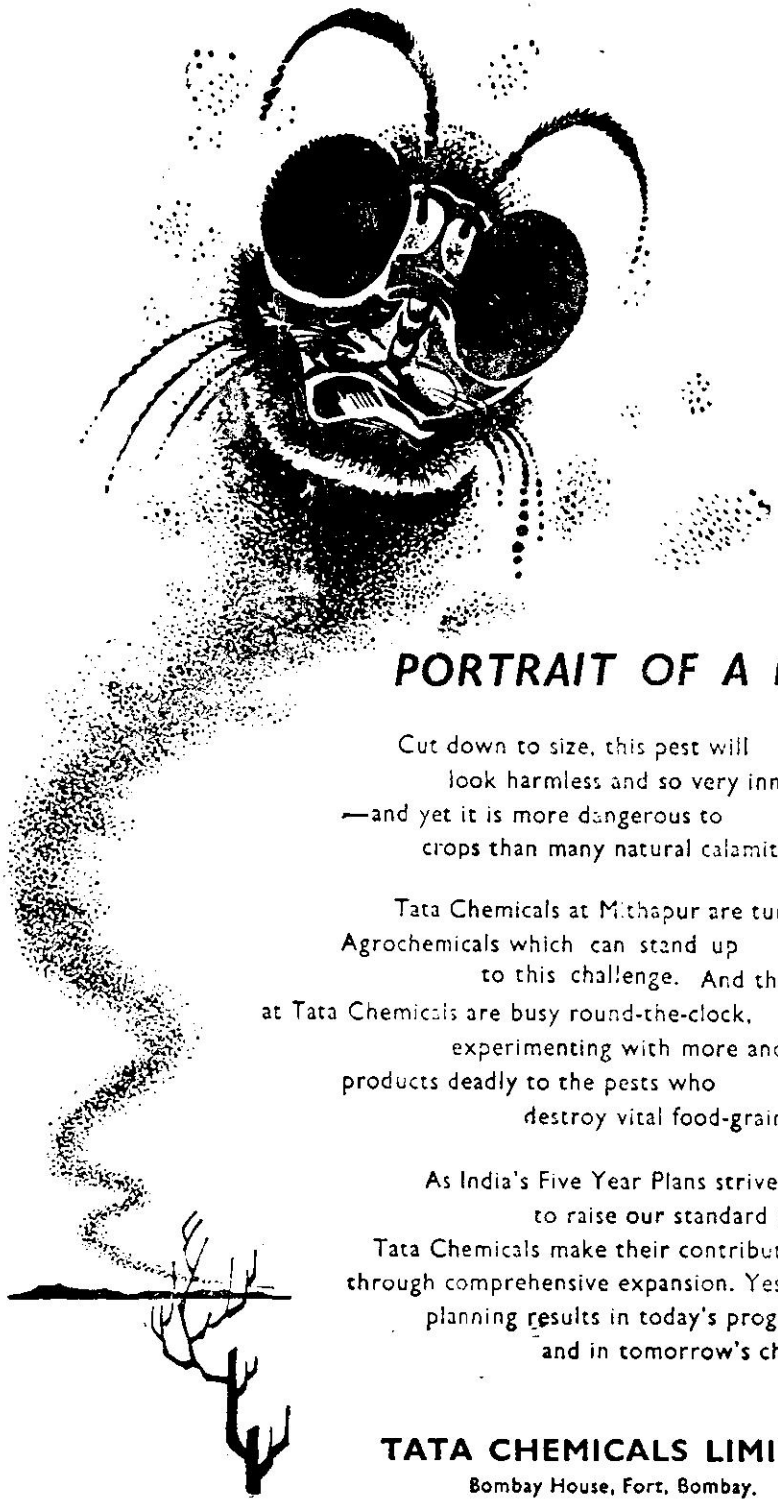
We, as a nation, are very poor in monetary resources only, and not in minerals, manpower, land and knowledge. Turn a few leaves of the past history of so-called highly developed countries, and we will find that they have built through the proper exploitation and utilization of their countries' resources! Be proud in tapping Indian resources. This needs concerted efforts and not speech-making or slogan-shouting by every Indian—may be Biharee, Punjabi, Bengali or Madrasi. Even it does not matter whether we express ourselves in English, Tamil or Urdu as the productive technique needs no langague, caste or state barriers. Steel will remain steel and can only be divided into mild or alloy steel but not into Assamese or Kashmiri steel. Then why put fruitless efforts in turning Indian metals into regional metals like old Alchemists of middle ages, who spent most of their precious time in turning base metal into gold. *Concentrate more towards productivity, learn it, understand it and implement it. This does not need import licence or foreign exchange* and can be acquired by reading NPC Journal which is a quarterly publication

....PS AHLUWALIA, Assistant Superintendent, Heavy Electricals (India) Ltd., Bhopal.●●●

Hitler refused to be a civil servant!

"No amount of persuasion and no amount of 'grave' warnings could break down that opposition. I would not become a State official, not on any account. All the attempts which my father made to arouse in me a love or liking for that profession, by picturing his own career for me, had only the opposite effect. *It nauseated me to think that one day I might be fettered to an office stool, that I could not dispose of my own time but would be forced to spend the whole of my life filling out forms...* The fields and the woods were then the terrain on which all disputes were fought out... The father would not abandon his 'Never', and I became all the more consolidated in my 'Nevertheless'... To study history means to search for and discover the forces that are the causes of those results which appear before our eyes as historical events. The art of reading and studying consists in remembering the essentials and forgetting what is not essential... *I was determined to become 'something'—but certainly not a civil servant...* The whole Ring Strasse had a magic effect upon me, as if it were a scene from the Thousand-and-one Nights... Obstacles are placed across our path in life, not to be boggled at but to be surmounted. And I was fully determined to surmount these obstacles, having the picture of my father constantly before my mind, who had raised himself by his own efforts to the position of a civil servant though he was the poor son of a village shoemaker. I had a better start, and the possibilities of struggling through were better. At that time my lot in life seemed to me a harsh one; but today I see in it the wise workings of Providence. The Goddess of Fate clutched me in her hands and often threatened to smash me; but the will grew stronger as the obstacles increased, and finally the will triumphed... And I am even more thankful because I appreciate the fact that I was thus saved from the emptiness of a life of ease and that a mother's darling was taken from tender arms and handed over to Adversity as to a new mother. Though I then rebelled against it as too hard a fate, I am grateful that I was thrown into a world of misery and poverty and thus came to know the people for whom I was afterwards to fight... Finally, he throws aside the last vestiges of true leadership and begins to play politics. This means that the politician becomes one of those whose only consistency is their inconsistency, associated with overbearing insolence and often times an art of mendacity developed to a shamelessly high degree... When a man has reached his thirtieth year he has still a great deal to learn. That is obvious. But henceforward what he learns will principally be an amplification of his basic ideas ; it will be fitted in with them organically so as to fill up the framework of that fundamental *Weltanschauung* which he already possesses. What he learns anew will not imply the abandonment of principles already held, but rather a deeper knowledge of those principles... Outside my architectural studies and rare visits to the opera, for which I had to deny myself food, I had no other pleasure in life except my books."

—from Adolf Hitler's '*Mein Kampf*'



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Beware of Formomania!

RP Nadkarni*

'Family planning' and 'Birth Control' have become the subject of everyday talk. We have realised, never mind though late, the need for controlling our ever-increasing population. That a controlled rate of birth helps raise the standard of living has been proved by the experience of western countries. That proliferation of population adds to our misery is also an accepted fact.

AND JUST HOW TRUE THIS IS OF 'FORMS' TOO! Just as the larger the number of mouths to be fed, the more serious becomes the food problem for a nation, so the greater the 'form population' in an office, the more is the resulting complication. Forms should not, therefore, be allowed to proliferate. Thoughtless and uncontrolled introduction of forms can become quite a costly affair. Forms, therefore, need to be wisely designed and properly controlled. In fact, Forms Control ought, under the present threatening circumstances, be adopted as radically as Family Planning—with an earmarked budget provision as for Family Planning, if we are to prevent in time the flood of forms – like the flood of files since Independence - that might swamp all work in all offices, just as the flood of babies has swamped the Economy.

And Forms control must begin with 'forms design'. This is not as simple as drawing a few horizontal lines or vertical columns with some headings under which some details are to be filled by someone. Each of these steps is important, and as such, calls for careful planning. What details should a form incorporate? Are all those necessary at all? Do some of them appear in some other form? Would they mean duplication of work? Would the forms be filled in by hand or typed? What should be the spacing then? How many copies should be taken, and why so many? Who would fill in the form and who would use it? Would the sequence of details appearing in it simplify copying work, communication and further processing work? How would the form appear, and what is its size? Would it offer ease of reference, handling and storing?

All these considerations go into the careful designing of a form. It is, therefore, not a simple job to design a form as one would think it to be. However, once a form is designed properly by taking into account these various factors, it can definitely make one's work simple later.

Forms design is no doubt a specialist's work but everyone should be familiar with at least the fundamental principles of forms design, so that when one wishes to introduce a new form one can apply them. What then are these principles?

*Forms should be functional, simple in design and should contain the minimum number of details, as *the clerical work of filing forms is several times costlier than the cost of stationery for forms.* The purpose of the forms should be to provide only the requisite data and not to crowd up the paper and obscure important information.

*Administrative Officer, Voltas Ltd., Bombay

*Juxtaposition of information to be recorded in the form should conform to the sequence of details to be copied from sources or according to the sequence of end use of the information, whichever is more important. It is easier and quicker then to fill in or refer to the form.

*Adequate space should be provided for entries, to enable easy writing and reading. How often do we come across say, the column for name so narrow and the next one for say, monthly earnings so large that the name encroaches on the earnings and the figures get mis-aligned, making it difficult to total them up !

*If forms are filled out by typing, the lines should be spaced out to conform to the typewriter spacing and the idle run of typewriter carriage should be minimised. If this point is neglected, typing out a form can be time-consuming on account of frequent adjustment of the form on the typewriter.

*The size and boldness of lettering and lines on the form should be such as to simplify reference and give more prominence to the entries filled, than to the headings. Certain important headings could be in larger or bolder print or in different colour than others (but such forms may be costlier to print).

*The number of copies of a form should be restricted to the minimum. This will not only mean some saving in stationery costs, but also a reduction of filing work and filing space. Unnecessary copies lying about in an office or going to wrong hands can be embarassing and wasteful. When an unrelated form comes to someone, he has at least to spend some time glancing through it and then transferring it to the waste paper basket! Isn't it a double wastage—of one's precious time and costly stationery ?

*Quality of paper for a form should be selected properly. Forms for internal use and those that are not to be retained for long could be made out of paper of cheaper quality. But those meant to be kept for long have to be of a durable quality.

*The size and shape of a form should not only offer convenience of filling but also of handling and filing. It should also be tailored according to standard size of paper sheets available in the market, to achieve economy. Cutting out special or odd sizes from standard sizes can turn out to be a costly affair.

*Instructions for the use or routing of form may be indicated on the form, but they should be put clearly, properly and briefly. Such instructions help the form move into the correct hands without delays or going astray.

*Forms should be properly coded and copies should have different colours to simplify sorting, routing and filing. Codification and use of colours help quick identification.

How To Control Forms

So far we have discussed the factors that need to be carefully considered while designing forms. Forms thus designed are to be introduced, used and controlled properly.

As implementation of a new procedure is usually linked with the introduction of new forms, they should be ordered on time. If possible, the stock of old forms should be used up before introducing new forms. If implementation of new forms is delayed, a small quantity of old forms may be ordered to keep things moving. If old forms are large in number they could be used for some internal/ rough work, as any delay in implementation of new forms and waiting for old stationery to be consumed fully could be costlier, as the benefits of the improved procedure would not be achieved until then. The cost of stationery is usually insignificant when compared with the costly manhours spent in filling forms.

In order to effect economy in printing, the requisite quantity of forms should be computed and ordered. If the quantities are large, they should be ordered on suitable 'phased delivery' basis to save capital block-up, and storage space and to avoid loss on account of deterioration.

After having ordered the right forms in right quantities at the right time, the next task is to introduce them rightly. For this, all persons concerned with the use of the forms should be informed about the new forms, their use and routing. This is very important if the new forms are to serve a useful purpose. This information could be passed on either through a circular letter accompanied by copies of the form, preferably filled by illustrative entries (this is more effective as the recipient can then understand the form and its use better) or better still, by calling a meeting of concerned persons and explaining to them their respective roles in the use of proposed forms. A demonstration of this sort helps all understand the use of forms correctly. Any doubts should be

suitably clarified at this stage, to enable all to use the forms most effectively.

After all is said and done, who is to control the birth and growth of forms? Although everyone should remember the 'principles of Forms Design' enumerated above while designing forms, it is advisable to associate an O & M man with forms design.

An O & M man solves the problem of forms design and control in two ways:

1. by analysing all the existing forms and evolving better ones if necessary and eliminating the unnecessary ones. This, however, may be time-consuming, particularly in large organisations with a plentiful variety of forms.

2. by studying each form and the connected procedures as and when a form is re-ordered. This sort of piecemeal approach is, in practice, found to be more economical and effective.

The need for careful design of forms assumes great importance in electronic data processing, as the more scientific the design of forms from the functional view point, the quicker can be the transcription of data from the form into the punched cards or magnetic tapes that constitute the input to a computer. If the sources (forms) are themselves not prepared carefully, the punching of cards or tapes may take time and the entire purpose of processing data at lightning speed would be defeated. Proper forms design is, therefore, a very important prerequisite of an electronic data processing system.

Forms are thus tools in one's hand. The better they are, the more effectively and quickly could one dispose of one's work. ●●●

When You Are Not the Boss

K S Bhatnagar

DOESN'T MATTER IF YOU ARE NOT, THOUGH it is better to be one. As a boss you can order about and take pride in getting the work done. But what about those who are ordered, for no one likes to be ordered. Unfortunately the latter outnumber the former. The latter have to adjust to the boss and, as luck would have it, the bosses change sometimes rather frequently, resulting in a continuous process of adjustment to the predicament of the latter. Certainly no one likes to take orders, but how to get out of it? Why be sorry and say "If I were the boss!" That may or may not be. In one capacity one may be the boss but in another, in the second or even the third line. In a field office one may be the boss but in the head office he may be far below in the hierarchy and then he may say: 'If I were the boss!'

Yes, no one likes to be ordered about, but there is no escape. Someone will always be there to order. Then, why not make the most of the bad bargain, and it is not difficult.

To be second in the line is a tough job. You have to have a lot of tact. Problems are many and varied. While on the one hand you have to keep relations with your boss, you have to exert and extract work from those below. And the greatest trouble is from colleagues, who are trying to outshine you and be in the better books of the boss. It is a formidable job and your success or otherwise depends on 'how best you are able to strike the balance and manage the job with the least possible trouble to the boss and with the least strain with the subordinates.' Each of these fields needs the highest amount of tact, a deep insight into human relations and the last but not the least, hard work and perseverance.

So when you are not the boss, put yourself a question: "Why am I there?" and the answer to this question is the key to your success. There is only one answer to this question and it is "to be useful to the organisation" and this can be achieved by being helpful and useful to the boss. The responsibility of efficiently running the organisation lies on the boss. Since one man cannot perform all the functions, necessary help is provided by giving him deputies and assistants, hence the necessity of assisting the boss to the best of your ability.

This business of being useful brings you in contact with four classes of people and your chances of success are in direct proportion to the relations you maintain with each group of persons. Cordial relations pave the way to success and then nothing succeeds like success; but strained relations sap your energy, initiative and drive and make you peevish and you cut a sorry figure. Harmonious and healthy relations with the superior, subordinates, colleagues and sister-organisations make or mar the chances of success.

Your success depends, to a great extent on your relations with the boss. Cordial relations give you peace of mind which is a pre-requisite of a healthy office. Problems can be tackled, solutions found, staff taken care of, new ways and means for improvements thought of and made. For all this, a healthy mind is a pre-requisite. In case of strained relations, one

is likely to be irate, short-tempered and most of the time is spent in squaring up matters arising out of this atmosphere ; no constructive work is possible, which further aggravates the situation. Hence for the well-being of the staff, of the office, officers and self, the relations with the boss have to be cordial and smooth, and these can be so if the watchword is 'To be useful to the boss.'

Each office has to perform two types of functions, executive and administrative. An Executive Engineer or a manager of a workshop, for example, has to complete the work by a scheduled date and within the estimates. In the course of the execution, he needs machinery to prepare the blue-prints of projects, arrange payments of the bills, arrange supplies, and run the office. Since it is not possible for him to attend to all these functions, he has been assisted by a deputy or deputies who unfortunately happen to be you, or you are one of them. You have to run the administration in such a way that the Executive Engineer is left free to take care of the execution of the work that has necessitated the establishment of a division. In this sense, your role becomes all the more important. You are not there to find fault with the boss (there are quite a few who indulge in it). You are there to ensure that, consistent with the rules and procedures, bottlenecks are avoided and there is an even flow of men and materials to the site of work. You are there to help and not to hinder the work. If there is difficulty, the Executive Engineer will not be happy and this will reflect on the office management, that is, on the men who are in the second line. The watchword therefore, has to be usefulness to the organisation.

Now this business of being useful takes us to other fields. In running an office or an organisation, three factors play a vital role : relations with colleagues, relations with sister organisations, and relations with the staff. To be in a position to deal with these successfully, you must know the environment and the climate you are in and for these you have to know the office, the organisation and its antecedents. This requires intensive study in the early days. The various sources of information about the organisation have to be tapped and a working knowledge obtained and mastered. Annual reports, audit reports, office orders, union minutes, punishment cases, special reports, inspection reports, welfare measures are some of the many sources which can provide valuable information. This critical study with suitable mental and diary notes on the one hand reveals the organisation and its men ; it also places you in possession of necessary information about the organisation, which is handy when you discuss organisational problems with the boss who naturally expects you to help him solve problems.

With expanding telephone facilities, the importance of cordial relations with colleagues within the organisation and with sister organisations is increasing. Many a time, decisions have to be taken by consultation on telephone and unless proper personal relations exist, this facility may not be of much avail. If the relations are harmonious and cordial, one call or one personal visit can settle the problem, without the boss being aware of what you have done. In the office, since all the Sections have to work in a co-ordinated manner, relations have to be cordial with colleagues. Such contacts and methods of work relieve the boss of a lot of avoidable work as also keep him out of difficult situations; and service rendered at such times is what matters.

You have to keep your mind open and not have preconceived and dogmatic notions about things. You can learn from everyone you meet and have to have respect for the views of others. You may not agree, but they do present you with an opportunity to examine problems from different angles.

You cannot be content with looking at things; you have to see them, understand them, learn from them and then act. For, "to look is one thing, to see what you look is another, to understand what you see is a third, to learn from what you understand is still something else; but to act on what you learn is all that really matters."

And now comes the relations with the staff who are the work tools. You have to look to

them in getting the work done. There is nothing like a happy and contented staff for efficiently running an organisation, and in this regard you have to discharge the role of a supervisor. It is a very difficult and exacting role, but there is no escape. If you want to be useful to your boss, you have got to be a good supervisor. The staff is your tool. By skilful and methodical use of these tools and with proper tact, you can do the job. You have, therefore, to know the job. You have to be aware of your responsibilities. You have to know how to instruct. You have to have the capacity of leadership and finally you have to have an insight into the working, and capacity to improve the working. You have to have faith in your subordinates. They will rarely fail, if you trust. The human aspect is what matters: the staff is working under you and you have to treat them as human beings. They are as sensitive as you are and so a friendly attitude pays. You have to be patient with your men and never use the language of ridicule. You have to be careful in pulling up. *No one can tolerate a public dressing.*

You have to maintain discipline, but you have to be human and sympathetic. It has to be remembered that it is the lack of firmness and sympathy that breeds dissatisfaction. You have to have the courage of conviction to stand by what you have done. This is the sure way to win respect from the subordinates. You must not shun to give the credit where due. The policy of 'heads I win, tails you lose' has to be avoided. You have to create the impression that if someone wants to meet you, he will have a patient hearing.

The welfare of the staff has to be supreme in your mind. A constant endeavour to keep the good of the staff is the key to have a band of loyal workers. Little things can create discord and tension. Working conditions have to receive special attention. They comprise adequate space, adequate furniture, good ventilation, good light, sanitation, good housekeeping, measures for preventing accidents, etc. Any attempt at improving these is appreciated by the staff and gives you a better hold, though the converse is not true. You then have a disgruntled staff and that saps your energy in a hundred different ways. Positive action pays dividends, not in arithmetic but in geometric progression; and naturally under such conditions, you are on the right side of the staff and consequently on the right side of the boss since he will not be required to solve the petty problems of the staff.

Being the second fiddle in the organisation, your job will be advisory as well. On many occasions, your views may not find favour but there is nothing to feel sorry about it. Your experience may be limited as compared to your boss's and then you may not be aware of certain aspects that may weigh with him in arriving at a decision. If, however, you feel strongly about it, you can give your views once again; and if still he stands by his decision, your responsibility is over, and your duty clear. You have to carry out the order as if it was your own suggestion. You have to know the limit. Personalities should not be brought in office matters. If the boss writes strongly it should be taken that the office of the boss is writing to the office below that the work needs to be pulled up. It is not 'A' writing to 'B'. It should be taken in the spirit it has been written. You should be happy that such occasional notes from the higher-up help and give you a handle to act.

Each office or organisation has a set of rules for the conduct of its business. A certain set of rules and procedures come at the inception and quite a few are added gradually, based on experience. You need not look for guidance for everything in rules. Broad-based commonsense having roots in rules is what is required. Rules are there for conduct of business. They are the means and not the ends. If they do not help and operate harshly and do not appeal to commonsense, a realistic view has to be taken. Such wooden rules need to be modified. It is the humane and sympathetic approach as against the rigid and inhuman one that matters and such approach only harmonises the working and keep the joints well greased.

The main thing that counts when you are in the second line is to what extent you take responsibility for what you do as well as to what extent you relieve the boss from inter-

ference and to what extent he can rely on you to get the work done. The former raises you in the esteem of the subordinates, while the latter in the esteem of the boss. *The man with the capacity of taking responsibility is regarded by the boss as the pillar of the organisation and by the subordinates as the sheet anchor.* You have to take care that you do not err in this respect. Any mistake, and you lose the respect of the subordinates and the confidence of the boss-- and these are both suicidal. It is correct that by taking decision and responsibility you may commit mistakes and sometimes you may have to pay heavily but you will have the satisfaction of doing the work. The boss, if you have his confidence, will not doubt your bonafides. But the converse is not true. Certainly if you do not take decisions, you will not commit mistakes, but then you will be just nobody in the organisation and neither the staff nor the boss will have any soft corner for you.

For proper working of the office, there is the necessity for planning and keeping safety valves. The maxim 'Plan your work and work your plan' has to be kept in mind. Many times a work is undertaken without much thought and at the time of execution, difficulties arise, sometimes so insurmountable that either it has to be abandoned or redone. This causes financial loss, apart from valuable time, and is naturally a cause for concern to the boss. Hence the necessity to plan ahead, to assess difficulties, to provide for the safety valves, so that you are not at cross roads at any stage. You have to cultivate the practice of going round your charge as a must in the morning. This is a very healthy practice and keeps you on the one hand in contact with the staff and colleagues, and on the other you are able to assess and settle the problems on the spot, creating a spirit of confidence all round.

In a nutshell you have to give vitality to the organisation. It has to be made dynamic, and enthusiasm for work has to be created in one and all and then you need have no worries. And mind you, this can only be had if you are dynamic and enthusiastic yourself.

In the words of an experienced administrator, "you have to possess commonsense with a sense of fairness and honesty . . . . If you deal with your subordinate staff with fairness and if they know you are fair and sympathetic, you have very little trouble from them. If you develop team spirit amongst the people under you and have a sense of honesty, fairness, justice and sympathy, then you will succeed in life. Behave unto them as you expect them or your superiors to behave unto you. If you are asked for giving advice, give it honestly ; and having given your advice, on receipt of orders from your superiors, you must obey them faithfully and loyally without any mental reservations."

Keeping the foregoing in front, you need not be sorry for not being the boss and you need have no regrets. ●●●

Suppose You Took Off the Engine

The Advertising Association used to include in its speakers' notes a standard anecdote about Wrigley, the chewing-gum tycoon. He was sitting in the club car of a fast train when two strangers accosted him. 'Everyone chews your gum, Mr. Wrigley', said one, presumably with his mouth full, 'and yet at every station we pass there are huge advertisements of your gum. Couldn't you save all that expense by now ?' 'Gentlemen,' replied Wrigley, 'how fast would you say that this train was moving ?' 'About 70 miles an hour'. 'And how fast would it move after five minutes if you took the engine off ?'

—from the New Statesman

The Pseudo-Mathematical Method

J M Keynes*

IN HIS 'GENERAL THEORY OF EMPLOYMENT, INTEREST AND MONEY', LORD KENYES used mathematics to the extent necessary. In the course of the argument, however, the author had occasion to examine the 'recent' mathematical advances in economic science; and at places, he could not hold his heart and went at the economists, who *used mathematical techniques, whether essential to the argument or not*, without making clear that in the dynamics of economics, the use of mathematical formulae involves assumptions and limitations, which are seldom clear to the persons to whom the arguments are addressed. Keynes referred bitterly to "the pitfalls of a pseudo-mathematical method, which can make no progress except by making everything a function of a single variable and assuming that all the partial differentials vanish....."

Later, discussing the Theory of Prices, he expressed himself at length on the relative merits of the mathematical formulation and the commonsense argument : "It is a great fault of symbolic pseudo-mathematical methods of formalising a system of economic anlysis...that they expressly assume their strict independence between the factors involved and lose all their cogency and authority if this hypothesis is disallowed; whereas in ordinary discourse, where we are not blindly manipulating but know all the time what we are doing and what the words mean, we can keep 'at the back of our heads' the necessary reserves and qualifications and the adjustments which we shall have to make later on, in a way in which we cannot keep complicated partial differentials 'at the back' of several pages of algebra which assume that they all vanish. *Too large a proportion of recent 'mathematical' economics are mere concoctions*, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols . . . ."**

*General Theory, p. 275 (Macmillan, 1960 edition).

**Ibid, p. 297-8

Thieves Talk of Principles

"Thieves talk of principles ; then they come to an agreement: 'You rob to the right and I rob to the left ; and let there be no more talk of principles."

—Romain Rolland in the *'Soul Enchanted'*

Perplexing Productivity

S Chandran*

The conference room was humming with activity. All the senior Executives of M/s. Unithought & Co. were getting in one by one. Some were seen to carry bulky books, in addition to their files and papers. Moods and gestures among them varied widely. Prominent among the participants were the Works Manager, Efficiency Services Manager, Accounts Manager, Marketing Manager, Inventory Controller and the Personnel Manager. (The Company believes in high-sounding modern management designations.) It was 11 a.m. All were eagerly awaiting the arrival of the General Manager who was to preside over that day's Company Productivity Meeting. Oh! he had just come in time.

THE GENERAL MANAGER LOOKED BUOYANT. IT WAS HE WHO HAD ARRANGED FOR THAT DAY'S meeting. He started initiating the discussion on the company's productivity drive.

"Gentlemen! you are all aware of the purpose for which we have met here today. It is to review the productivity achievements during the past week in our factory. I am very much interested in raising the productivity level and achieve economies to combat the effects of the present industrial recession and competition.

Our slogan should be "Promote Productivity or perish". (He had recently attended a one-day seminar on 'productivity' conducted by the Consultants, 'Muddling Management Men'.) I would like to meet you all and discuss your problems on productivity more often.

Let us now hear the Works Manager's report on productivity achievements during the past week." A beam of smile on his face showed signs of understanding and confidence in the successful outcome of this 'Productivity Meeting'.

The Works Manager was no less jubilant. He placed his report on the table. He said: "I have already circulated my report, so I take it as read. The achievements can be stated in a nutshell. The Productivity ratio has increased from 10 to 11 — an increase of 10%. There has been a 10% increase in production also—from 800 units to 880 units". A feeling of pride pervaded his posture.

"This seems to be a creditable achievement. Any comments or suggestions from anyone?" The General Manager looked forward with eagerness.

"The Works Manager has not taken into consideration the idle time". The Efficiency Services Manager started pointing out the mistakes in the calculations.

*Organisation & Methods Executive, Shaw Wallace, Madras

"The idle time has also been reduced by 50%—from 200 hours to 100 hours per week". The Works Manager asserted his position.

"That's fine. Production and productivity have gone up by 10% each; the idle time has gone down by 50%. And what else are you talking about?" There was surprise in G.M.'s tone.

The Efficiency Services Manager began to explain. "The position is as follows :

Previous Week	Particulars	Week Under Review
800	Production in Units	880
80	Available manhours	80
20	Idle time in manhours	10
60	Productive manhours	70
13.33	Productivity Ratio (Production ÷ Productive Manhours)	12.57

So it can be seen that productivity expressed as a ratio of output per productive manhour has been reduced during the week from 13.33 to 12.57—a reduction of 5.7%". His analysis looked convincing.

"You mean to suggest that there has actually been a reduction of 5.7% in productivity instead of a 10% increase?" The G.M.'s enthusiasm was slightly dampened.

Then the Accounts Manager drew the attention of all. "Productivity is a ratio between 'output' and 'input' of resources. We should not be guided by mere labour-hour productivity ratio. During this week the cost of living index has gone up, resulting in increased Dearness Allowance to workers. Further, as some of the junior workers were absent, some senior people were drafted in. These have led to an increase in weekly wages from Rs. 500 to Rs. 600. Hence productivity expressed as a ratio of production per Rupee of labour wages has been reduced during the week from 1.6. to 1.47—a reduction of 8.1%." The knowledge of the Accounts Manager was unquestionable.

"There is another aspect of productivity which cannot be forgotten", the Inventory Controller butted in. "With a view to reducing idletime for want of material, we have overstocked raw materials and stores items on the basis of indents from the Works Manager. The finished goods are not moving out quickly. Thus the inventory carrying cost has gone up from Rs. 8000 to Rs. 10,000. So, productivity expressed as a ratio of output to the inventory cost has been reduced from 0.1 to 0.88—a reduction of 12%." Wrinkles of worry could be seen on the controller's forehead.

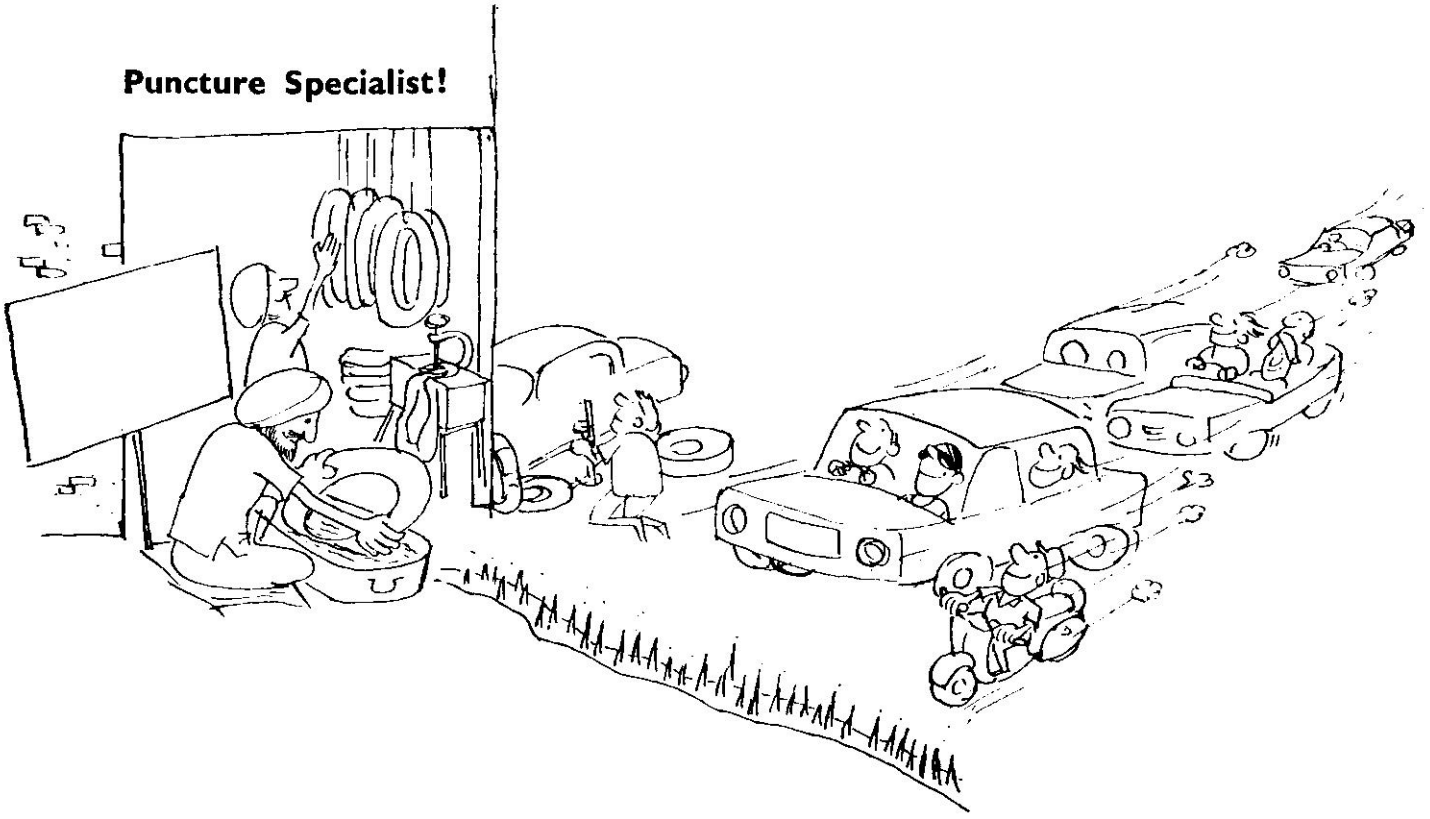
"That takes us to the vital factor of working capital", the Accounts Manager continued. "With the increase in the cost of material, labour and overheads, the requirement of working capital has gone up. Let us not forget that we are paying 9% interest on our overdrafts from the Bank. Productivity viewed as a ratio of output to the working capital has been reduced by 5%." He seemed to have expounded everything he knew.

"Where are we now? What do we understand by productivity?", the G.M. looked perplexed.

"In a broad and fundamental sense, the problem of increasing productivity may be said to be the problem of making more efficient use of all types of resourecs in employment—of using them to produce as many goods and services as possible at the lowest possible real cost. Unless this is achieved, I will not be able to sell in this competitive market". This analysis of the Marketing Manager, who had once attended a three-month course on 'Management', was not at all comforting to the Works Manager.

The Personnel Manager had his say too. "Whatever we understand by productivity, the personnel problems it creates are many. Whether we have in reality increased productivity or not, the workers have started clamouring for "Productivity Bonus". If there are no real savings, wherefrom are we going to give this bonus?"

The General Manager, puzzled and perplexed, wanted to end this babel of tongues. "I could never imagine that many people talking about productivity would talk about quite different things. I feel, we were understanding each other much better before we had this Productivity Meeting. So, I am adjourning the meeting *sine die*." ●●●



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Whitley Councils in The Civil Service

GEC Trounce*

The system of Whitley Councils has been in operation in the British Civil Service since 1919 ; in the opinion of senior Treasury officials as well as civil service trade union leaders it has been a success. With attention in India focussed once more on the institution of Whitley Councils, it may be useful to review the story of Whitleyism in Britain and to consider its origins and the reasons why it has stood up so well to hard use.

BY WAY OF BACKGROUND IT IS NECESSSARY to explain that trade unionism was not viewed with favour by the Heads of Government Departments in the days before the first World War, and civil servants who took an active part in organising their colleagues were liable to incur official displeasure. Staff Associations, where they existed at all, were in a most rudimentary state and for the most part the Treasury refused to acknowledge them.

Grievances could be brought to attention only in one of two highly unsatisfactory ways: by a Memorial submitted through the Head of the Department, or by means of a Parliamentary Question. The former method usually failed because the Head of Department could—and often did—refuse to submit it to the Treasury, or sent it with a minute of his own which was calculated to prevent its being given serious attention.

The Parliamentary Question usually involved a great deal of trouble and inconvenience to the questioner and produced only vague and unsatisfactory replies. A third method—that of addressing questions direct to the Financial Secretary to the Treasury—while a little more productive than the other two, still left much to be desired both in speed and effectiveness. The pattern of staff relations in the Civil Service was, therefore, highly unsatisfactory. Grievances mounted up; the Treasury ignored them until the level of agitation gave rise to public comment; then would come a Royal Commission or a Select Committee which swept away some of the causes for complaint and reduced the head of steam; and finally the whole dismal process would repeat itself.

This out-of-date system could not survive the strains and stresses of the first World War and in 1916 the Government set up a Select Committee of the Cabinet under the Chairmanship of J.H. Whitley to consider future methods of negotiation throughout the major industries. Whitley recommended the establishment of Joint Committees of employers and workmen which became known as National Joint Advisory Councils, or more briefly, Whitley Councils.

The Government of the day did not immediately concede the applicability of the

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Whitley system to the Civil Services : indeed its first reaction was that these Councils were meant for "industry" and that the Civil Service did not come in this category. The weakness of the Government's position was soon recognised, however, and the Chancellor gave way. Even then he could not accept the Staff Side's view of the way in which Whitley Councils should function : he thought they ought to be no more than advisory bodies and that questions of policy, administration, promotion, superannuation and discipline should be excluded from their scope. There was a further struggle before the Whitley Councils became true negotiating bodies on which members could speak as equals. With this unfortunate background it is not surprising that the Official Side came to regard the Whitley Council as a highly suspect organisation designed to weaken discipline and administrative control while the Staff Side used it primarily as a handy way of airing grievances. It took many years and a second World War to bring both sides to realise the value to themselves and the public of the machinery which they were allowing to rust away.

The basic objective of Whitleyism is "to secure the greatest measure of co-operation between the State in its capacity as employer and the general body of the Civil Service in matters affecting the civil service with a view to increased efficiency in the public service, combined with the well-being of those employed ; to provide machinery for dealing with grievances and generally to bring together the experience and the different points of view of representatives of the administrative, clerical and manipulative civil service."

On the Official Side of the National Whitley Council sit the nominees of the Chancellor of the Exchequer who are all very senior civil servants, many of them Permanent Secretaries of Departments. The trade union or Staff Side nominees are appointed by Staff Associations acting either singly or in groups. Full meetings of the National Council are comparatively rare and much of the real business is done behind the scenes by personal contact between the Chairmen of the two sides, or by informal meetings of small groups of experts.

The same pattern is found in the Whitley Councils of individual Departments. The Official Side Chairman is the Permanent Secretary of the Department; the Staff Side Chairman is chosen by the various associations making up the trade union team and usually serves for a limited period of three or four years. In the deliberations of the Council it is usual for the two Chairmen to act as spokesmen for their respective sides and to put over the agreed Official or Staff view; to achieve this it is necessary for each side to have preliminary talks and to get to know one another's thoughts and feelings pretty accurately. There is rarely anything like a debate at Council meetings (although strong opinions may be expressed by either side) and never any question of putting an issue to the vote. If one side wishes to raise some question which it knows will mean hard thinking by the other it is customary to give informal notice of its intention; if this is not done, the question usually has to be taken away and considered for the next meeting, or left for discussion between the two Chairmen.

Some departments—the Ministry of Labour for example—have a regional system of Whitleyism which repeats in each administrative area the pattern of negotiation followed in the main Departmental Committee. Here also the sub-committies on departmental procedure and instructions, staff training, staff transfer and other matters of official interest do much useful work and seek to implement the basic purpose of Whitleyism—an increase in the efficiency of the public service.

In all Whitley activity the spirit is everything and the machinery itself counts for very little. Departmental Heads have come to accept the fact that even their most junior staff will occasionally have something to contribute towards the running of a machine in which they, after all, have the closest public contact; and the staff on their part realise the need for discipline and the ultimate responsibility of Ministers and their civil service chiefs. Those who serve on the Staff Side of a Whitley Council very quickly learn the need for working together as a team. There is sometimes, a conflict of interests between the unions com-

prising the Staff Side ; if their differences are not ironed out before the main Council meeting they soon become obvious to the Official Side, usually with unsatisfactory results. In any event, a Staff Side divided against itself will do real harm to the members of its constituent Associations and to the cause of Whitleysim. Given goodwill on both sides and a readiness to compromise and work together in mutual respect there is much that a Whitley team can do for the Department they serve and for one another. So far as Britain is concerned there is no doubt that in spite of their shaky start Whitley Councils have fully proved their worth. *No Head of Department or Staff Association leader would now seriously advocate their abolition or deny that public business runs much smoother for their existence.* ●●●

Germany's Breakthrough in The Nuclear Field

EFK Haubold

BY 1980, W. GERMANY WILL BE THE WORLD'S third largest producer of nuclear power. This development is symbolized by a high temperature thorium breeder at Juelich, which was developed over the last ten years by Professor Schulten, sponsored by the firms of BBC and Fried. Krupp. The main features of this breeder are: It can use any type of fissible material, plutonium, uranium or uranium-thorium, and can thus be adjusted to the market conditions at any given time.

German nuclear science, after an impressive come-back following its belated post-war start, has now received the seal of commercial success. A few weeks ago, the first German built merchant ship, Otto Hahn, named after the German physicist who fathered nuclear fission, was launched at Kiel. The first civilian vessel of its kind, after America's Savannah and Russia's Lenin, its reactor is based on the principles applied in the Savannah, but has at the same time important improvements particularly in the field of fuel and operational economy. Built at a construction cost of 52 million D-marks (Rs. 104 million), this ship represents an international venture. While the nuclear propulsion unit was supplied by Interatom together with DEMAG and Deutsche Babcock & Wilcox, the fuel elements and the ventilation equipment came from a German-Dutch consortium.

"Completion of this Euratom project was but one of a burst of achievements with which the German nuclear-energy programme wound up 1967, and which lent substantial support to the claim that W. Germany has suddenly become the atomic leader of Europe", writes *Newsweek*. Of even more importance, however, is the recent signing of three major contracts which indicate the long awaited breakthrough to strictly commercial nuclear power in W. Germany. The third contract furthermore shows that W. German supplier firms have finally succeeded to break into the US-dominated international market:

> A 600 MW power station is to be built near Hoexter on the Weser by AEG-Telefunken for the Hanover Preussenktelera power company. It will have a boiling water reactor.
>
> A 640 MW station with a pressurized water reactor at Stadersand, North Germany, is to be built by Germany's other big reactor company, Siemens AG for the Preussenelektra subsidiary, Nordwestdeutsche Kraftwerke AG and Hamburgische Elektrizitaetswerke.

Each of these projects will cost more than 400 million D-marks (Rs. 800 million). They mark a breakthrough in two respects:

Firstly, they indicate that utilization of nuclear power in W. Germany will get a considerable boost in the near future since both projects are proof that W. Germany's industry can build competitive units. Secondly, export orders will come to Germany on an increasing scale:

> For more than a year the world's leading electrical firms have been competing for a somewhat unique order: to build the first nuclear power plant in Latin America. Some two months ago it became clear that the W.Germans had won the race. An Argentinian order for a complete 318 megawatt nuclear power station has been received by the giant Siemens AG (Munich/Berlin) electrical concern.

It is the first foreign order for a complete nuclear power station and regarded by the industry as even more important than the two large 600 and 640 megawatt reactors which are to be installed in W. Germany. Siemens will build the new nuclear power plant at Atucha, 100 km northwest of Buenos Aires. It is expected that the plant can go on stream by 1972. The cost of the project is estimated at 300 million D-marks (about Rs. 60 crores). The Argentine government's decision to place the order with a W. German firm reveals a development hitherto known only to experts in the nuclear field. As far as nuclear power stations are concerned, the W. German firms are way ahead of their leading competitors in the U.S., U.K. and France. Comments the French newspaper "Le Monde": "This triumph will strengthen the position of W. Germany's industry in the entire Latin American market".

It was a German scientist, Professor O. Hahn, who in 1938 succeeded with the first nuclear fission. But up to 1955, regulations issued by the Allied Powers did not permit any atomic research by W. Germany. When the ban was lifted, companies like AEG-Telefunken, Siemens AG., GHH-Gutehoffnungshuette, M.A.N., DEMAG and Babcock had to fight against heavy odds. Not only had they lost valuable time, but their competitors abroad– particularly in the U.S.—benefitted from sizeable government contracts which Bonn at that time could not provide.

Meanwhile, a new export possibility appears to be opening up for W. Germany. A Dutch power supply group is planning the construction of a 300 to 400 megawatt power station in 1973, and the W. German-Dutch "AECON" consortium has reportedly been invited to submit tenders. The AEG-Telefunken electrical concern of Frankfurt/Berlin is a member of the consortium.

Since the inception of the German Atomic Programme, the reactor industry has arrived at a certain division of labour. The five main contributors are: (1) AEG-Telefunken, which as a result of ties with General Electric developed the boiling water system; (2) Siemens AG, under arrangements with Westinghouse proceeded with the pressurized-water reactor, originally adopted for practical operation in nuclear-propelled submarines of the US-Navy, and also developed several modified versions of the heavy-water reactor advocated by the Canadians; (3) Interatom, a joint venture of DEMAG, Deutsche Babcock & Wilcox, and North American Aviation, abandoned its original efforts with an organic moderated and cooled reactor in favour of the development of the sodium-cooled reactor. (Deutsche Babcock & Wilcox last year tranferred its entire reactor section to Interatom, after working on the gas-cooled graphite-moderated reactor of British origin); (4) German Brown, Boveri & Cie. and Krupp joined forces in the Brown Boveri/Krupp Reaktorbau GmbH., which has gone in for the development of a novel type of noble gas-cooled, high-temperature reactor with a unique fuel supply system (pebble bed reactor); (5) the joint group of GHH-Gutehoffnungshuette and M.A.N. nuclear technicians is one of the biggest in German reactor building.

The new science report of the W. German government outlines the future tasks in the nuclear field as:

> Development of advanced converters and thermal breeders (breeder reactors are believed to be the answer to future energy requirements as, in addition to producing nuclear power, they "breed' more atomic fuel in the process);
>
> Development of fast breeder reactors;

Safeguarding of the so-called "fuel cycle", *i.e.*, long-term supply of uranium, production of fuel elements, reprocessing of irradiated fuel elements, plutonium technology, waste disposal;

Utilization of radio active rays, and radiation protection.

Considerable facilities to tackle these tasks are available. Apart from universities and Max Planck Institutes nuclear research is carried out in special centres, created in the past ten years: Juelich, Karlsruhe, Hamburg, Garching, and Geesthacht.

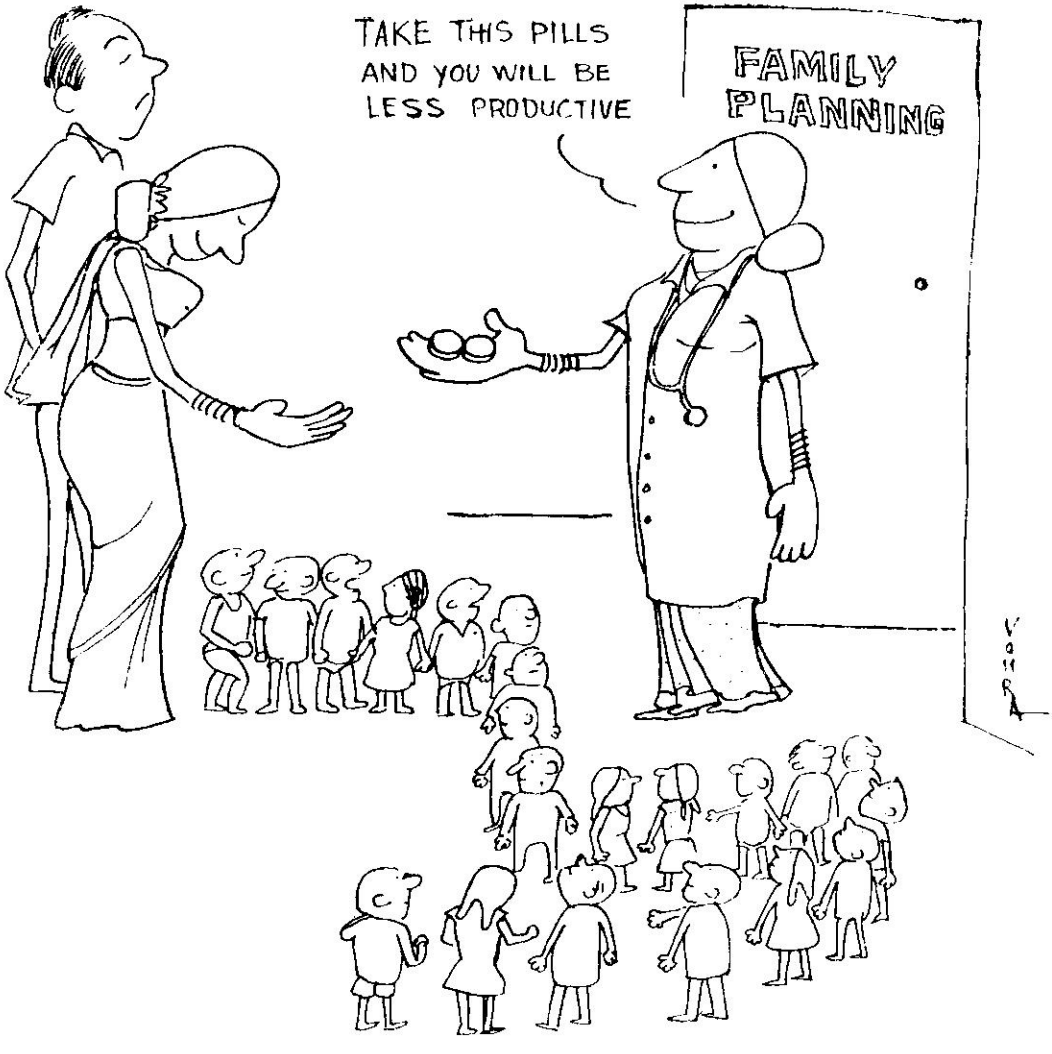
All these centres of nuclear research have specific jobs to do within the German Atomic Programme. Some of them are centres of so-called "big science", which deals with projects that stretch over many years and involve enormous personnel, material and financial requirements. These centres bring together scientists and technicians, they bring about a new combination of research and industry, and in them new forms of cooperation between state, industry and universities develop. These centres maintain close contacts with the relevant universities, institutes of technology, and Max Planck Institutes. Some nuclear research centres work under association agreements with Euratom.

While the nuclear power share in W. Germany's total energy supplies is so far insignificant, few experts doubt that atomic power stations will become of ever increasing importance to the German economy in the next quarter of a century. The recent Middle East Oil crisis has fortified many energy experts in this view.

By 1980, the installed capacity of nuclear power stations is estimated to rise to 30,000 MW, accounting for 30% of total power capacity and even 40% of total electricity production in W. Germany. Of total primary energy requirements in W. Germany nuclear energy will then supply 16%. A study for the year 2000 suggests that by that time nuclear power stations will supply over 40% of total primary energy requirements. With this in mind, the semi-official German Atomic Forum recently prepared a memorandum recommending to the Government measures for the promotion of large nuclear power stations. The recommendations include tax concessions, investment aids in the form of credits, special depreciation allowances, financial guarantees, and the inclusion of nuclear power stations in capital aid agreements with developing countries. ●●●

Which do you mean ?

Asked whether winning was very important, Trudeau, the new Canadian Prime Minister replied : 'Not so very. But, then, Plato said it wasn't wise to choose leaders who cared too much.' When a reporter asked: 'Will you give up your Mercedes ?' Trudeau replied: 'Which do you mean ? The sports car or the girl ?'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A ROUGH BUT SIGNIFICANT MEASURE OF PRODUCTIVITY ABROAD IS THE EXTENT TO WHICH nuclear power is being used for what used to be extremely difficult, expensive and, in fact, very explosive jobs. Recently, in the United States, in New Mexico, the exit of natural gas had become clogged due to a hard stratum of rock, which could not be tackled by normal means without considerable risk and expense. Now it was inexpensively and easily done through an underground nuclear explosion. Matters have gone so far that the U.S. Atomic Energy Commission has prepared a long list of engineering, geological and scientific proforma projects which in its opinion can be exploited easily through nuclear bombing: not only that but the Commission is prepared to make the nuclear bombs available for these purposes at very cheap prices. For a sum of only $3,50,000, a good American can buy a 10-kiloton blast; and there is a price concession, if he buys a couple of megatons.

The United States has an official Plowshare programme according to which nuclear power is readily available for excavation. Formerly, it took any amount of manpower and bulldozers and time and money for the construction of a canal. Now for canal construction, for deepening a harbour, for diverting a river, for blasting a mountain pass or the excavation of subterranean reservoir, nuclear blasting is the easiest and the cheapest. It is now well-known that if a nuclear bomb is planted underground at an appropriate depth, big craters can be produced on the surface; and the release of radio activity would be insignificant if sufficient care is taken. With persistent trouble over the Panama Canal, Americans are playing with the idea of a new isthmus canal between the Atlantic and the Pacific. A feasibility study is under way, and the cost of conventional as against nuclear explosives is being calculated. Quite some time back, there were reports on similar lines for a canal parallel to the Suez.

From the research point of view the developments are extremely significant, for the occurrence of extraordinary conditions of heat, pressure and neutron radiation with underground detonation and the production of a great variety of elements and isotopes are matters which in their scientific implications we cannot afford to pass over.

In fact, there are quite a number of other civilian uses for nuclear explosives:—e.g., in respect of recovery of minerals, petroleum and natural gas. Now it is known that even from low grade ores, copper can be recovered by nuclear blasting, then leaching out the copper with acid. American Companies have an experimental plan on these lines in Arizona. There is another study going on, concerning the release of oil shale from oil deposits. There is a project known as Project Gasbuggy under which a mass of sandstone 4000 feet below the surface is being blasted in order to liberate gas. If the project succeeds, it might mean a doubling of the reserves of gas in the USA. India needs to increase its power resources along these lines.

Among the legitimate objections to the non-proliferation treaty, there is one which would deny the signatories the right to make bombs even for commercial purposes, but here our American friends have an answer: they will be prepared to supply bombs to signatories of the non-proliferation treaty at cost price! ●●●

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"If the man will raise the sail, the wind will fill it"

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