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SCIENCE AND NATIONAL PLANNING*

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INTRODUCTION

1. In recent years the Anniversary Meeting is being held separately from the Annual Meeting ; and the tradition has been for the President to select a subject for the Anniversary Address from some branch of science of which he is a student and give a general review acceptable to other scientists. As I cannot claim to have specialized knowledge of any particular subject, I looked at the Presidential Addresses of some of my distinguished predecessors for guidance. From the inauguration of the Institute in 1935 I found a continuing concern with problems of organization of scientific research in India. The functions and responsibilities of the National Institute of Sciences have also been reviewed a number of times. Looking back I had the feeling that many of the problems are still with us in one form or another.

2. In 1938, exactly 20 years ago, Meghnad Saha selected for the Presidential Address the "Problem of Indian Rivers," and pleaded for the initiation of systematic studies to lay a scientific foundation for flood control, irrigation, and navigation. He also gave a full discussion of benefits which would accrue by generation of cheap electrical power out of the energy of running water. He had mentioned at that time: "This is a subject which is just beginning in India but its importance has not been properly realized." He referred to poverty and unemployment; and asserted that "industrialization [was] the only solution of the poverty problem." He also referred to planning in Russia, and pointed out that "when the Supreme Council of the Soviet adopted Lenin's resolution for the electrification of the country, it was the USSR Academy of Sciences, and not a committee of bureaucrats which was requested to give a plan." He concluded his address with the following words :

> "If we desire to fight successfully the scourge of poverty and want from which 90 percent of our countrymen are suffering, and lay the foundation of a strong and progressive national life, we must make the fullest use of the power which a knowledge of Nature has given us. We must rebuild our economic system by utilizing the resources of our land, harnessing the energy of our rivers, prospecting for the riches hidden under the bowels of the earth, reclaiming deserts and swamps, conquering the barriers of distance and above all, we must mould anew the nature of man in both individual and social aspects, so that a richer, more harmonious and happier race may live in this great and ancient land of ours."

3. The picture in the mind of the scientist twenty years ago has already become real in the great river valley schemes of India. This is the task of the scientists, to formulate the shape of things to come, not as wishful thinking but based on the

*Anniversary Address at the National Institute of Sciences of India by the President, Professor P. C. Mahalanobis on 5 January 1958.

knowledge of Nature and worked out in accordance with the methods of science. The two basic problems, poverty and unemployment, mentioned by Saha still remain as acute as ever. The only way out is through rapid industrial development based on science and planning. I feel this is an appropriate subject for my address.

"SPUTNIK"

4. On the 4th of October, 1957, an artificial satellite "Sputnik" was launched by USSR followed in a month's time by a second and bigger one carrying a live dog. We received this news when our Council was in session; and on the 6th October, at the desire of the Fellows of the Institute assembled at the Annual Meeting, we sent a message of congratulation to the USSR Academy of Sciences.

5. The way to outer space beyond the earth's atmosphere was thus opened for the first time. It is a great triumph of science. Epochs of history can no longer be demarcated in terms of dynasties or of war between nations but must be thought of in terms of the progress of science and technology.

6. The upsurge of science in what we call the West (that is, in the countries of Europe and North America) led to the industrial revolution characterized by the use of machinery driven by steam, and later by electricity, for the production of goods, and brought about a rapidly increasing level of living in the industrially advanced countries during the last 100 or 150 years. This increase in industrial production gave the West its superiority in armaments; and brought practically the whole world under its domination. Striking developments occurred during the last fifteen years. Atomic energy (for bombs and for electricity), high-speed rockets, guided missiles and satellites have been developed and have great dangers. They also have much of promise for the future, if we do not get involved in a suicidal nuclear war.

7. As scientists, it is very much our concern to understand the significance of recent events. Russia was practically an underdeveloped country at the time of the Revolution forty years ago. The launching of the "Sputnik" from this country became possible only because of the revolutionary progress of science and technology in Russia in the course of one single generation. In Russia, as in all other industrialized countries of the world, scientific research and industrial production have been closely coupled; progress of one has been both cause and effect of an advance of the other. It is this integrated advance of science and industry which has made it possible for USSR to attain its present leading position in the whole world.

SCIENTIFIC RESEARCH AND ECONOMIC DEVELOPMENT

8. In all industrialized countries we find a close association between the attention given to scientific education and research and the rate of increase of industrial production and, hence, of the improvement in the standard of living. Consider the three nuclear Powers, UK, USA and USSR, and also two underdeveloped countries, China and India, which have the two biggest populations in the world and much natural resources. Table 1 shows the population, production of steel, and output of energy in 1955 in these five countries. The equivalent total energy in terms of million tons of coal is given in col. (7) which includes all forms of commercial energy but does not include fuel wood and dung. In Table 2, col. (3) gives the per capita national income at 1955

prices in the currency of the country concerned; col. (4) the per capita production of steel in kilograms; and col. (5) the total commercial energy in equivalent kilowatt hours. Approximate data on expenditure on scientific research are given in cols. (6), (7) and (8). The actual expenditure (expressed in rupees at official rates of exchange) is given in col. (6); and is shown as a percentage of the national income in col. (7). Finally, the expenditure on research per person is shown in col. (8). Sources are mentioned briefly in the footnotes to the Tables; and more detailed information and comments are given in two Statistical Notes (1) and (2) at the end of the Address.

TABLE 1. POPULATION AND PRODUCTION OF STEEL AND ENERGY : 1955

country	population in million	electricity	steel (ingots)	coal	oil	energy (all forms) in terms of coal
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		10^9 kwh	million tons			
USA	165	629	106.2	448	336	1364
USSR	200	170	45.3	276	71	442
UK	51	94	20.1	225	0.15	249
China	608	12.1	2.9	93	0.79	96
India	382	8.5	1.7	39	0.29	45

Sources: All the figures except population in China are taken from the *UN Statistical Year Book*, 1956 : population, pp. 21–36; steel, pp. 261–262; coal, pp. 138–140; oil, pp. 143–144; electricity. p. 290–294 and energy (all forms), pp. 308–310. The figure for oil in China relates to 1954. The Chinese population figure is taken from statistics prepared by the State Statistical Bureau of the People's Republic of China (in Chinese).

TABLE 2. ECONOMIC DEVELOPMENT AND EXPENDITURE ON RESEARCH : 1955

country	estimates per person per year				approximate expenditure on research		
	national income		steel ingots	energy (all forms)	actual	p.c. of national income	per person
	unit	amount					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			kg	kwh	Rs. crore	%	Rs.
USA	$	2000	644	13,753	2550	1.8	154
USSR	roubles	5000	226	3,367	2200	1.8	110
UK	£	300	394	8,118	430	2.1	85
China	yuan	135	4.8	267	65	0.4	1.1
India	Rs.	250	4.5	200	15	0.15	0.38

Sources: Figures in col. (3) are derived from the *Statistics of National Income and Expenditure, UN Statistical Paper, Series H,* No. 10, for USA and UK; *Economic Bulletin of Europe*, May, 1957, for USSR; statistics prepared by the State Statistical Bureau of the People's Republic of China, for China; and *Estimates of National Income*, 1948-49—1955-56, Government of India, for India. Figures in cols. (4) & (5) are derived from Table 1. Figures in column (6) are collected from miscellaneous sources indicated in Statistical Note (2) at the end while figures in cols. (7) & (8) are derived from the figures in col. (6) and those in Table 1.

9. The estimates are admittedly approximate and there are well-known difficulties in international comparisons of income and expenditure. Prices and the structure of prices vary widely from one country to another. Concepts and definitions used in different countries are often different. For example, the American figure for expenditure on research includes industries. It is possible that research carried out in industrial concerns is not included in the Russian figure. Nevertheless some striking contrasts come out clearly in Table 2.

10. The three great powers have the highest per capita income, energy, steel and expenditure on research. China is way behind but has already outstripped India in all items, although only a few years ago China was less developed than India. Expenditure on research is Rs. 65 crore in China compared to Rs. 15 crore in India, or more than four times higher. As a fraction of national income, China spends 0.4 percent which is nearly three times higher than the Indian figure of 0.15 percent. The "per person" expenditure in China is Rs. 1.1 per year which is again three times higher than the Indian expenditure of Rs. 0.38 per year. In 1943 Dr. J. C. Ghosh in his Presidential Address to the National Institute had raised the slogan of "one percent of the national income per year for scientific research." The three advanced countries are spending nearly twice as much at present; and China has almost achieved half the target while, after 15 years, India has gone only one-sixth of the way.

11. Table 3 shows the available number and the out-turn of engineers and doctors in the five countries. Col. (2) gives the population in million to serve as a basis for comparison; cols. (3), (5), (7) and (9) give the years of reference. Col. (4) shows the estimated number of engineers available (in thousands), and col. (6) the annual out-turn (in thousands). In the three advanced countries the out-turn figures refer to training at University level; in China and India the figures include both graduates and diploma-holders. Col. (8) gives the available number of doctors (in thousands), and col. (10) the annual out-turn (in thousands); the out-turn figures refer to graduates in all countries. The corresponding numbers per million of the population are given in the lower half of the table.

12. The three advanced countries have much higher numbers of both "available" and "out-turn" of engineering and medical personnel. USSR has established a definite lead over both USA and UK; the actual number and proportionate out-turn of both engineers and doctors in USSR are more than double those of USA. This indicates a striking superiority in technical man-power, the effect of which is bound to be felt in an increasing measure in future. Scientific and technical man-power requires a longer period of maturing than basic heavy industries. In this respect USSR now occupies, beyond dispute, the leading position in the world. It is reasonable to infer that this lead has some connexion with the launching of the "Sputnik."

13. China and India are much behind the more advanced countries. The available number of engineers and doctors are roughly of the same order in both China and India but China still has appreciably fewer than India on a population basis, namely, 132 engineers per million of the Chinese population against 188 engineers per million of the Indian population with 116 and 183 per million as the corresponding figures for doctors. It must be remembered that engineering and medical education of the modern type had started several decades earlier in India. China, however, has left India behind

in the out-turn of both engineers and doctors. The number of engineers coming out every year is 30.9 per million in China or 60 percent greater than the Indian out-turn of 18.4 per million in 1955. As regards doctors, the out-turn of China is 11.2 per million against 8.1 per million of India, or 40 percent greater.

TABLE 3. NUMBER AND ANNUAL OUT-TURN OF ENGINEERS AND DOCTORS

country	1955 population (10⁶)	engineers				doctors			
		total available		annual out-turn		total available		annual out-turn	
		year	number (000)	year	number (000)	year	number (000)	year	number (000)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
USA	165	1950	518.8	1956	26.0	1955	218.1	1955	7.1
USSR	200	1956	721.0	1956	71.0	1955	299.0	1956	20.0
UK	51	1956	78.5	1954-5	2.8	1956	85.0	1952-3	1.9
China	608	1955	80.2	1955	18.8	1955	70.5	1955	6.8
India	382	1955	71.9	1955	7.0	1955-6	70.0	1954	3.1
		....number of persons per million of population....							
USA			3144		158.0		1322		42.5
USSR			3605		355.0		1495		100.0
UK			1539		55.0		1674		37.3
China			132		30.9		116		11.2
India			188		18.4		183		8.1

Sources: given in Statistical Note (3) at the end of the Address.

14. With the rapid expansion of scientific and technical man-power and of scientific research in USSR there has also been a rapid expansion in the industrial production of the country.[1] The expansion of scientific and technical man-power and of scientific research, on one hand, and rapid increase of industrial production, on the other, are but two aspects of the same transformation. USSR and China (and India) have large natural resources which can be utilized for the benefit of the men who live in these countries. Such utilization or exploitation of natural resources can be done only with the help of scientists, engineers, and technical personnel. It is clear that scientific research and availability of scientific and technical personnel are the important factors in the economic development and "power" of nations, however it may be measured. It is also clear that India is lagging very much behind in these respects.

[1] Due to destruction of steel factories during the civil war, the production of steel had fallen to 200,000 tons in 1920 but rose to 18.3 million tons in 1940; dropped to 12.3 million tons in 1945 due to destruction during the war; and rose to 45.3 million tons in 1955 with a target of 68.3 million tons in 1960. Output of black coal (in million tons) increased from 99.4 in 1945 to 276.1 million tons in 1955 and has a target of about 415 million tons in 1960. The output of electricity in billion (thousand million) kilowatt hour rose from 43.3 in 1945 to 170.1 in 1955 with a target of 320 bkwh in 1960. The rate of increase in the USSR is far higher than that achieved in the USA, UK, or West Europe.

In China also the rate of development has been very rapid since the beginning of the First Five Year Plan in 1953. Production of steel (in million tons) rose from 1.8 in 1953 to 5.2 in 1957 with a target of, possibly, 15 million tons in 1962. Production of coal (in million tons) increased from 67 in 1953 to 122 in 1957 and has a target of about 200 million tons in 1962. The output of electricity (in billion kilowatt hour) increased from 9 in 1953 to 19 in 1957 with a target of about 43 in 1962. (All figures have been taken from official Chinese sources).

ECONOMIC AND SOCIAL CONDITIONS IN INDIA

Consumer Expenditure

15. The two great problems of India are poverty and unemployment which are but two aspects of economic stagnation and under-development. Since 1950 the National Sample Survey (NSS) has been collecting information on social and economic conditions in both rural and urban areas of India. Some of this material has been given in the Statistical Appendix from which much interesting and significant information can be obtained. I shall give a few selected examples.

16. The following Table 4 gives in cols. (1) to (4) information on the total consumer expenditure for the whole of India (rural and urban, excluding Jammu & Kashmir) during the period December 1955 to May 1956. Cols. (1) and (3) give the

TABLE 4. DISTRIBUTION BY SIZE OF (*a*) CONSUMER EXPENDITURE : 1955-56 AND (*b*) LANDHOLDINGS (1953-54) : ALL-INDIA

by total consumer expenditure in rupees per person per 30 days[1]				by size of land-holdings in acres[2]			
percent of population	limit of expenditure in rupees	percent of population	limit of expenditure in rupees	percent of households	limit of size of land-holdings	percent of households	limit of size of land-holdings
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
upto	less than	upto	less than	upto	less than	upto	less than
1. 5 p.c.	Rs. 3.2	55 p.c.	Rs. 15.7	5 p.c.	0.2 acre	55 p.c.	4.0 acre
2. 10 ,,	,, 6.2	60 ,,	,, 16.9	10 ,,	0.5 ,,	60 ,,	4.7 ,,
3. 15 ,,	,, 8.4	65 ,,	,, 18.4	15 ,,	0.7 ,,	65 ,,	5.7 ,,
4. 20 ,,	,, 9.8	70 ,,	,, 20.0	20 ,,	1.0 ,,	70 ,,	6.6 ,,
5. 25 ,,	,, 10.4	75 ,,	,, 22.2	25 ,,	1.3 ,,	75 ,,	7.9 ,,
6. 30 ,,	,, 10.9	80 ,,	,, 24.9	30 ,,	1.7	80 ,,	9.7 ,,
7. 35 ,,	,, 11.6	85 ,,	,, 28.6	35 ,,	2.0 ,,	85 ,,	12.6 ,,
8. 40 ,,	,, 12.4	90 ,,	,, 35.8	40 ,,	2.4 ,,	90 ,,	16.2 ,,
9. 45 ,,	,, 13.4	95 ,,	,, 44.2	45 ,,	2.8 ,,	95 ,,	26.0 ,,
10. 50 ,,	,, 14.6			50 ,,	3.3 ,,		

percentage of the population, and cols. (2) and (4) the limiting expenditure in rupees per person per 30 days.

17. It will be seen from the first line that 5 percent of the population or nearly 20 million spend less than Rs. 3.2 per person per month; and from the second line that 10 percent or more than 38 million people spend Rs. 6.2 per head per month. From the bottom line of col. (2), we find that 50 percent or *half of our countrymen, nearly 200 million in number, live on Rs. 14.6 per month or less than half a rupee per day*[3] *per person.* It would be also seen that even 90 percent of the population spend less than Rs. 35.8 per

[1] Based on National Sample Survey (NSS) : 10th Round, December 1955—May 1956, All-India (rural and urban) excluding Jammu & Kashmir.

[2] Based on National Sample Survey (NSS) : 8th Round, July 1954—March 1955, All-India rural area only.

[3] One rupee is about 21 US cents and 1 shilling 6 pence in British currency.

month or just over a rupee a day. That is, *only about 10 or 11 percent of the population of India can spend more than one rupee a day.* This would give some idea of the poverty in which our countrymen have to live.

18. Many other facts regarding conditions of living can be found from the Appendix Tables A.1.0, A.1.1, and A.1.2. The rich actually spend more on food-grains but proportionally less in relation to their total expenditure as can be seen from Table A.1.1. However, both actual and proportional expenditures on sugar, milk and milk-products, and clothing are relatively much higher among the rich, showing that these are essentially luxury items. It is interesting to observe that medical care is apparently the greatest luxury; the poor can have very little of it, and medical expenses go up very steeply as the level of expenditure increases.

Land owned by Households

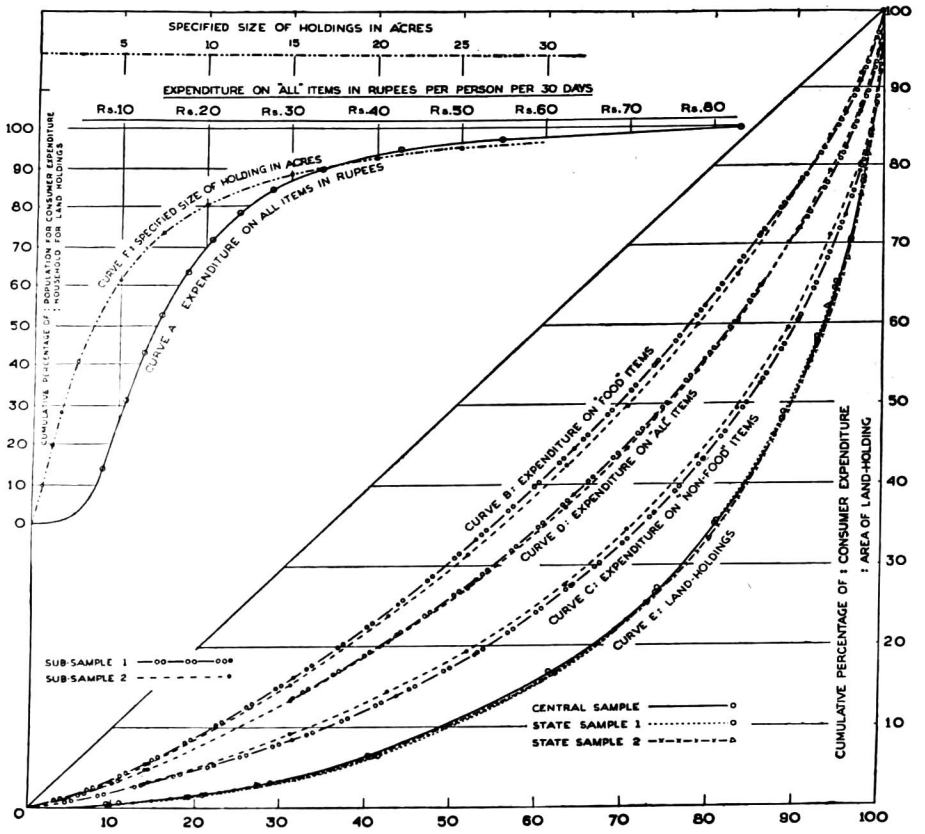
19. Similar estimates are given in cols. (5) to (8) of the same Table 4 in respect of the size of the holding of lands in acres owned by any assigned percentage of households who own 0.1 acre or more of land. (Households owning less than 0.1 acre were omitted to exclude landless labour and non-agricultural households). It is seen from this table that 20 percent, or one-fifth of the households, have 1 acre or less; fifty percent have less than 3.3 acre; 75 percent have less than 7.9 acre; and 90 percent less than 16.2 acre. Most of the households in the rural area own very little land.

TABLE 5. CONCENTRATION CURVES OF (*a*) CONSUMER EXPENDITURE: 1955-56 : AND (*b*) LAND OWNED BY HOUSEHOLDS 1953-54 : ALL-INDIA

	(a) persons or (b) households	consumer expenditure on all items by persons from		total land owned by households from	
		bottom (0)	top (100%)	bottom (0)	top (100%)
	(1)	(2)	(3)	(4)	(5)
	.....cumulative percentages.....				
1	upto 5 p.c.	1.5	18.2	0.2	34.2
2	10 „	3.2	28.8	0.4	48.8
3	15 „	5.2	36.6	0.9	58.6
4	20 „	7.6	44.0	1.5	66.5
5	25 „	10.1	49.9	2.3	72.5
6	30 „	12.8	55.3	3.1	77.5
7	35 „	15.5	60.5	4.6	81.0
8	40 „	18.8	65.6	6.2	84.6
9	45 „	22.3	70.0	8.1	87.5
10	50 „	26.1	73.9	10.5	89.5

20. The disparity between the rich and the poor can be seen more clearly from the concentration curves shown in the accompanying chart and also from Table 5 above. The percentage of the population or, alternatively, of households is shown in col. (1). In each line, col. (2) shows what percentage of total expenditure (of the whole

CONCENTRATION CURVES
FOR CONSUMER EXPENDITURE AND LAND HOLDINGS



BASED ON NATIONAL SAMPLE SURVEY ALL-INDIA

(Two curves based respectively on two interpenetrating samples 1 and 2 are shown for each concentration curve to indicate the margin of sampling error.)

CURVE A : Distribution by expenditure on 'all' items in rupees CURVE B : Concentration curve for expenditure on 'food' items CURVE C : Concentration curve for expenditure on 'non-food' items CURVE D : Concentration curve for expenditure on 'all' items	10th ROUND (December 1955–May 1956)
CURVE E : Concentration curve for land holdings CURVE F : Distribution by size of land holdings	8th ROUND (July 1954–March 1955)

population) is shared by the percentage of population from the *bottom* as given in col. (1) of the same line; col. (3) gives the share of the same percentage of persons but from the *top*. Thus, the lower 5 percent of the population of India share only 1.5 percent of the total consumer expenditure, while the top 5 percent of the population share 18.2 percent of the total expenditure. We also find that while the lower 25 percent of the population share 10 percent of the total expenditure, the top 25 percent share 50 percent; and that the lower half has 26 percent while the upper half of the population share 74 percent of the total expenditure.

21. Similar estimates are given in cols. (4) and (5) of Table 5 in respect of the proportion of land owned by different percentages of households. The bottom 5 percent own very little land, only about 0.2 percent or less, while the top 5 percent own 34 percent of all lands owned by households. In the same way, it can be seen that the bottom 20 percent have 1.5 percent against 66 percent of all lands owned by the top 20 percent. The lower half of households have 10 percent against 90 percent owned by the upper half. Disparities are much higher at the top. For example, the top one percent of households owns approximately 13 percent of the total land; the top two percent nearly 21 percent; and the top five percent of households own 30 percent or almost one-third of all lands owned by households.[1] The concentration of landholdings is clearly much greater than that of household expenditure.

Employment and Unemployment

22. Some information on employment and unemployment is given in the Statistical Appendix, Tables A.3.1, A.3.2, and A.3.3. I should explain that there are great difficulties in adopting in India the concept of 'unemployment' used in the advanced countries of the world, where practically all gainfully employed persons receive wages and salaries or have earnings in money (except for time spent by members of a family on their own household work). It is, therefore, possible to specify in an objective manner whether a person is gainfully occupied or is out of work. There are, of course, technical difficulties of standardizing the definition of unemployment even in the advanced countries but these are not very serious. In an underdeveloped country like India, on the other hand, there is inevitably a great deal of ambiguity in defining unemployment in an objective manner. Much of the work in household enterprises, in both agriculture and cottage industries, is done by members of the household and is not paid for in money. Also, a large number of persons work on their own account, such as weavers, tailors, carpenters, smiths, barbers, small store-keepers, etc. These people may have enough work to keep them busy the whole day; or they may have to sit idle for a part or most of the time; or may have practically no work in hand; and yet they can never be called technically "unemployed" in accordance with the concept used in the more advanced countries. The above considerations must be kept in mind in interpreting the information given in the Statistical Appendix based on the National Sample Survey covering about 24,700 households in the 9th Round: May–August 1955, and covering about 17,600 households in the 5th and 6th Rounds, December 1952–August 1953. It must also be remembered that all estimates, being based on sample surveys, have margins of errors of sampling.

[1] By interpolation from the tables.

23. Subject to these warnings, we may say broadly that about 160 million persons (or roughly 42 percent out of an estimated population of 382 million in 1955) were in the labour force, that is, were either engaged in work or were seeking work. Among them, 2.2 million were "unemployed" in the technical sense of the advanced countries [Table A.3.1], which, however, has no clear meaning in India. In fact, only about 13 million persons, who work under Government and public authorities or in private organized large scale enterprises, have employment of the type usual in the advanced countries [Table A.3.2]. The technical concept of "unemployment" can be strictly used only in the case of these 13 million persons (out of a total labour force of 160 million), but is not applicable to the remaining 147 million who work in household or small scale enterprises.

24. In an underdeveloped country it is, therefore, necessary to consider how many persons have to sit idle a part or most of the time for lack of work and other economic reasons. From the information collected by the NSS it would seem that nearly 20 million persons normally work one hour or less per day, 27 million work two hours or less per day, and nearly 45 million persons are engaged in gainful work for 4 hours a day or less [Table A.3.1, portion B.2]. In NSS, 5th and 6th Rounds: December 1952–March 1953, it was found that nearly 30 million persons have gainful work for less than 5 days in the month, 39 million less than 10 days, and 53 million less than 15 days in the month [Table A.3.1, portion B.3]. In another enquiry, NSS : 7th Round, October 1953–March 1954, it was found that about 45 million persons were working part-time. They were asked supplementary questions; and from the replies received it seems that among them about 10 million persons were not able to work full time partly on account of their own ill-health or on account of the illness of other members of the family; over 23 million (or about half) gave reasons of an economic nature such as lack of demand for their labour, lack of tools and raw materials, slack and off season, etc.; and 13 million gave other reasons. Finally, in NSS : 9th Round, in reply to a specific question, nearly 12 million persons stated that they were seeking additional work and would be available for 4 hours of work or more per day. [Table A.3.1, portion B.1].

25. From the above account it would be seen that it is difficult to give a precise figure for unemployment or underemployment in India. The estimate would depend on which particular concept and definition is used to measure unemployment or underemployment. However, it may, perhaps, be broadly stated that there can be scarcely any doubt that *10 or 12 million persons are either unemployed in the technical sense of the more advanced countries or are severely underemployed. If consideration is extended to those who are sitting idle for more than half or two-thirds of their working time, the number would probably rise to 25 or 30 million persons.*

26. Some more specific information is available regarding unemployment among the educated defined as matriculates and persons having higher qualifications. It is estimated that their total number in 1955 was about 50 lakhs, out of which 4.7 lakhs (or 9.4 percent) were unemployed, most probably in the technical sense of the term as being out of a job or seeking a job as in the more advanced countries. It must be remembered in this connexion that in 1955 just over 4 lakhs of candidates passed the matriculation examination, and the number is rising from year to year. *There is already about 10 percent unemployed among the educated class. The proportion is likely to increase considerably in future which would have grave social and political implications.*

General and Professional Education

27. I shall now briefly consider the question of trained personnel. Some information regarding the number of persons passing the matriculation examination and acquiring other general or professional qualifications every year from 1950 to 1955 is given in Appendix Table A.3.4. Much interesting information can be obtained from this table. I shall make only a few brief observations.

28. There has been fairly rapid all round progress in numbers. The number of matriculates increased roughly from 1.89 lakhs in 1950 to just over 4 lakhs in 1955 or has doubled in 5 years. The rate of increase is about the same at other levels. It is also seen that the number of candidates passing the intermediate examination is roughly 40 percent of the number who passed the matriculation examination two years earlier; the number taking the first degree is roughly 60 percent of the number who passed the intermediate examination two years earlier; and the number taking the master's degree is roughly one-fourth of the number who took the first degree, two years earlier. These are approximate statistical proportions which would vary considerably from year to year but can give some idea of the structure of general education. As a very rough rule, out of 100 matriculates in any given year about 40 would pass the intermediate two years later; 24 would take the first degree after two more years; and 6 would take the master's degree two years later.

29. It is of interest to make some comparisons on the basis of the number of literates in India which was about 63 million in 1955. The number of matriculates was thus about 5300 per million literates; and the number of first graduates about 900 per million literates in India. In contrast, the number of first graduates in UK is 450 per million literates or proportionately only half that of India.

30. One gets a general impression that the number of students in the university stage is increasing quite fast and is roughly doubling every five years. The rate of increase in the number of science students is, however, much smaller at all stages and the rate of increase of science students is also appreciably smaller than arts students at the intermediate and degree levels and is roughly the same at the stage of the master's degree. The position is thus not satisfactory from the point of view of scientific and technical man-power.

31. The fact that the "proportion of graduates to literates" in India seems to be roughly double that of the UK makes it possible that education at the university level in India is expanding in quantity at the cost of quality. This, I believe, is also the general impression among my scientific colleagues. It raises some serious questions. It is true that when there is a large increase in the number of students, the average quality would usually decrease. It is doubtful, however, whether this has been the only reason. We are aware that a very large number of natural and social scientists were appointed during World War II, and are still being appointed in Government posts at salaries much higher than those that can be offered by universities and scientific institutions. In consequence there is a great shortage of competent and experienced teachers in the universities. The expenditure on laboratories and scientific equipment has not kept pace with the expansion in the number of students and is extremely small in comparison with needs. The syllabus and courses of instruction are in many cases out of date. All this requires to be changed.

Science Teaching

32. It is clear there cannot be any broad-based advance of science and scientific research in India without making university teaching more efficient and more oriented to present needs than at present. With this problem is linked the question of efficiency of science education in the top classes of secondary schools, to which I shall merely draw your attention but which I have no time to consider. It is necessary indeed to formulate a comprehensive scheme of science teaching, from the upper classes of secondary schools upto post-graduate teaching in the universities, and implement the same, in order to lay a sound foundation for science in India. The scientists have a very special responsibility in this matter. It is true, of course, that it would be necessary for Government to make important decisions of policy and to provide adequate funds. But, on the technical side, improvements in science teaching and research can be brought about only through vigorous and untiring efforts of scientists themselves. They have a triple task. They must take the initiative in formulating, at a concrete level and step by step, programme for the improvement of science teaching and research; and, secondly, persuade Government to take appropriate action in financial and policy matters. Thirdly, scientists should start doing whatever they can on their own; and then, as and to the extent Government support begins to be available, make the best use of such support for the promotion of science in India.

SCIENTIFIC AND TECHNICAL MAN-POWER

33. It is generally agreed that India would require a rapidly increasing number of scientists, engineers, and technologists in future. It is necessary therefore to attract a sufficient number of young men of ability to take up science as a career. The only way is to offer adequate economic and social incentives. Consider the position in the advanced countries of the world. USSR has established a definite lead over all other countries in scientific and technical personnel. Professors and research scientists, as a group, get the highest salary and have the highest status in USSR. The Academicians (members of the Academy of Sciences) have a life pension of 5000 roubles (half of which would accrue to a surviving widow) in addition to the salary of the post. It is being increasingly realized all over the world that it is this high social appreciation of scientists which is the real secret of the rapid advancement of science in USSR. In USA, UK and other countries of Europe, professors and scientists have a high social status but the position is not as satisfactory as in USSR, which has become a matter of serious concern to these countries.

34. The position of science professors and research scientists in India is most unsatisfactory compared to advanced countries. Scientists working in universities and in scientific institutions receive much less salary than scientists working under Government. Scientists in Government employment also are in an unsatisfactory position. As a group (with a few exceptions) scientists receive less pay and have lower status than administrative officers. Also, scientists have very little say in the making of decisions in Government. An urgent requirement for the advancement of science in India is to remove such disparities.

Scientific societies and planning

35. I should now like to draw attention to another problem which is likely to become increasingly serious in future. In the Western countries scientific research and science teaching had developed at first in the universities, and later, in connexion with research in industry independently of Government control. From the 17th century many scientific societies and institutions were established in the countries of the West for the promotion of science and scientific research. More recently Government began to sanction large grants for scientific research. In most countries the largest share of research funds now comes from Government.[1] This has raised important questions of policy in regard to Government control over scientific research.

36. It is interesting to observe that in USSR an Academy of Sciences was established by the Communist Government at a very early date as an autonomous institution independent of the executive control of Government. The Academy has been given great responsibilities and supplied with adequate funds for a wide range of functional activities in scientific research and the promotion of science. It maintains over one hundred scientific institutes spread over the country, and in 1957 had a total staff of 50,000, of whom 12,000 were professional scientists and 4,000 professors. The point to be emphasized is that in all advanced countries of the world, in the West as well as in USSR, there are well established scientific societies with a great tradition of scientific thinking and criticism which are outside Government and which can be relied upon to supply Government with independent advice in scientific matters.

37. It seems to me that there is need in India of functional scientific institutions which would be outside Government but which would take up, by agreement with Government, such scientific work or research or promotion of science or the coordination of scientific activities as can be done conveniently and efficiently by a non-official agency with the help of a whole-time staff of competent and high level scientists. Scientists engaged on such "decentralized" research or scientific activities, on a whole-time salary basis, would be independent of Government. In this way it would be possible to build up an organization or system of scientific thinking and criticisms which would be able to render great service to Government by offering unbiased and independent views in scientific matters. There is great need of such advice in connexion with planning and in the appraisal of the progress of plan projects.

38. To speak quite frankly, some of these ideas have come to mind, because I am not satisfied with the present activities of the National Institute of Sciences. I feel scientists must shoulder greater responsibilities in connexion with national planning. Coming together for occasional meetings is not enough. I should, therefore, like to see the National Institute of Sciences undertake assignments relating to planning for national

[1] In USSR, China, and other socialized economies all expenses for research are provided by Government. In other countries also, scientific research is being increasingly financed by Government. Even in the USA, out of the total expenditure of $ 5.4 billion dollars (= Rs. 2550 crore) in 1953, the share of Government was highest and 52 percent. Industry came next with a contribution of 44 percent. The share of universities was only 3 percent and that of institutes only one percent. Of the total expenditure, the biggest portion (72 percent) was spent by industrial concerns, 18 percent by Government agencies, and only 9 percent by universities. It is interesting to note that of the money spent on research by industry, 60 percent came from industry itself and 40 percent from Government. (*Scientific American*, November 1957, p. 47).

development which would be done in a systematic and painstaking way by a whole-time or part-time paid staff. I have a feeling that it is only through work at a concrete level that we shall be able to develop seriousness of purpose and a sense of responsibility in scientific matters of importance for national development.

STRATEGY OF PLANNING IN INDIA

39. The task of planning must be to improve continually the level of living, especially, of the 95 percent of the population who are poor, and to create enough new employments to get rid of the fear of unemployment. It has been recognized for a long time that this can be done only through rapid industrial development. As India has plenty of iron ore, coal, bauxite, etc., the key to industrialization lies in establishing the manufacture of heavy machinery, heavy electrical equipment (turbines, generators, switch and transmission gear), and machine tools. Once this is done, everything else can be gradually manufactured in India mostly out of domestic resources. As more and more machinery becomes available, it would be possible to create more and more employment and continually to construct more machinery and expand the production of coal and electricity; steel and aluminium ; fertilizers, cement and heavy chemicals; equipment for transport and communications; scientific instruments, etc.; and, in this way, produce more and more consumer goods and improve the level of living.

40. It has to be accepted, in principle, that until sufficient machinery and tools become available, it is essential to utilize idle hands for the production of cloth, household utensils and other consumer goods. This is for two reasons. Our greatest shortage is of machinery, while we have millions of unemployed persons sitting idle. Whatever machinery we can afford to import or manufacture within the country should be used to build up the basic industries which would produce more machinery, more steel, cement, fertilizers, electricity, etc. That is, we must not waste our meagre resources of foreign exchange to import non-essential consumer goods, or machinery for the manufacture of consumer goods which can be produced within the country by putting idle hands to work. Expansion of small scale and village industries would create employment all over the country, increase the supply of cloth and other consumer goods made by hand labour, and improve the level of living without hampering the expansion of basic industries.

41. A third point requires to be recognized. Agriculture and industry are closely interlocked in India. Industrial development is not possible without an increasing supply of cheap food and raw materials. On the other hand, in India, owing to scarcity of land, basic improvements in agriculture can be brought about only through the use of more fertilizers, more irrigation, and better methods of cultivation, all of which would have to depend on large scale industrial development. However, in the short run, a good deal can and must be achieved by intensive cultivation of land by hand and by improving conditions of living in rural areas through community projects, land reform, consolidation of holdings, village cooperatives, etc.

42. This brings us to the fourth point, namely, that planning in India must proceed at two different and clearly distinguishable levels or spheres. One is concerned with questions of large scale industrial development which can be, and are, decided in every country by a small group of persons at the top. For example, the decision in 1949

to instal a million-ton steel plant, its reversal in 1950, and fresh decisions in 1953 and 1954 to expand steel production by 3 or 4 million tons were all taken by the Government of India without any consultations with the general public. It is proper for Government to make such decisions. It is also possible to implement the decisions without any difficulty as it would involve only a small number of persons.

43. The position is entirely different in agriculture or in small scale and hand production which involve millions of households scattered over a very big country. Consider consolidation of holdings or village cooperatives. It is necessary, of course for Government to make policy decisions; but this by itself would not be sufficient because the implementation would depend on securing the willing cooperation or at least the concurrence of millions of persons in the villages. In the beginning, the organization of agriculture and small scale production, which may be called the "diffuse" sector, would be far more difficult than establishing large scale industries. The approach must be through institutional changes, spread of education, improvement of communication, etc., and, above everything else, by carrying conviction to the masses that Government is doing its best for national development. Success in establishing the basic industries would give Government increasing control over the national economy, and thus place Government in a strong position to make steady improvements in the diffuse sector and to secure the active support of the masses for national development.

44. Basic industries are thus of crucial importance in two different ways. Firstly, these alone can give us economic independence. Secondly, these alone can place Government in a position to make steady advance in the diffuse sector. The strategy of planning, therefore, requires the highest priority being given to the basic industries, namely, heavy machine building, heavy electrical equipment, machine tools, fertilizers, steel, cement, etc.

The Question of Foreign Exchange

45. It is true that, in the beginning, it is necessary for us to have both technical and financial help from outside India. Professor P. M. S. Blackett, in his Presidential Address to the British Association for the Advancement of Science in September 1957 has pointed out the importance of outside help to an underdeveloped country in getting it off on its way to economic development. He has also given an inspiring lead by stressing the responsibility of the industrially advanced country in this matter from the world point of view. I fully appreciate the need of external aid.

46. I am also aware that grave difficulties have been created by the shortage of foreign exchange. A new approach was adopted in the Second Five Year Plan, and the size of the Second Plan was intentionally made much bigger than that of the First. It is not surprising that mistakes have been made at the stage of transition from a small to a much bigger scale of planned economy. Techniques and tools of planning are not yet adequate and would have to be improved; and these questions are receiving the attention of Government and the Planning Commission. It would be appropriate, however, to examine the question of foreign exchange from the point of view of long-term planning.

47. I shall give a numerical example. Consider the question of foodgrains about which India is in a precarious position. From 1948 to 1953 we imported 19.3 million

tons of cereals at a cost of about Rs. 867 crore in 6 years, that is, at the average rate of about 3.2 million tons at a cost of Rs. 145 crore per year.[1] The average price paid was about Rs. 450 per ton.

48. The population of India is growing at the rate of, possibly, 5 million persons per year.[2] It takes roughly one ton of cereals to feed 7 persons. At this rate, an additional supply of 700,000 tons of foodgrains *every year* would be required to keep pace with the growth of population. If we decide to purchase this quantity from abroad, we would require *every year* an additional Rs. 30 crore of foreign exchange which would amount to Rs. 150 crore in the course of one five-year plan (and this, also, only at the present rate of growth of population).

49. Consider the alternative method of using imported fertilizers to increase the production of cereals. One ton of ammonium sulphate, at a cost of about Rs. 250 per ton, should normally give an additional yield of 2 or 2.2 tons of foodgrains. To give 700,000 tons more of foodgrains, the quantity of ammonium sulphate required would be 350,000 tons, of which the price would be Rs. 8.75 crore or say Rs. 9 crore. This would be the additional amount required *every year;* in the course of 5 years the total amount required would be Rs. 135 crore.

50. A still better way would be to instal *every year* a new fertilizer factory to produce 350,000 tons of ammonium sulphate (roughly, like the factory at Sindri). The fixed investment would be about Rs. 25 crore, of which the foreign exchange component would be only Rs. 10 crore. After the period of construction is over, each such factory would supply enough fertilizer to take care of the increase of population of one year. The total expenditure in five years would be Rs. 125 crore with, however, a total foreign exchange component of only Rs. 50 crore.[3]

51. It is possible to go one step further, and establish immediately a heavy machine building factory in India, and, when this plant is constructed, to manufacture in India the machinery required, to set up a fertilizer factory. Of course, it is neither possible nor necessary to set up a machine building plant exclusively for the manufacture of big machinery for fertilizer factories; the work can be done in plants which would manufacture machinery for other industries as well. It is, however, possible to make rough calculations of cost, because in the case of heavy machine building plants the value of output is roughly equal to the value of the fixed investment. To produce machinery worth Rs. 10 crore (the value of imports required to set up a Sindri-type plant) would thus call for an investment of about Rs. 10 or, say, 15 crore with a foreign exchange component of

[1] Imports fell below one million ton in 1954 and 1955 but we have again started importing foodgrains heavily from 1956.

[2] There is some evidence to indicate that the rate of growth may be appreciably greater and as high as 6 or even 7 million per year. Although registration of births and deaths is known to be extremely defective, the fall in the recorded death-rate is probably real. Population estimates based on the National Sample Survey show high rates of growth in some of the rural areas.

[3] Besides this, there will, of course, be current costs of intermediate products used up and wages paid. But when the intermediate products are available within the country and the output of wage goods industries is sufficient to meet the demand, such costs could be met entirely out of domestic resources. This would, no doubt, call for an expansion of the economy and would require organizational efforts; but similar and even greater organizational efforts would be needed to produce the goods to be exported to meet the larger requirements of foreign exchange in the other cases.

possibly Rs. 8 or 10 crore. This would be the (apportioned) cost in the first instance. The actual cost of setting up a fertilizer factory would be Rs. 25 crore per year or Rs. 125 crore in 5 years ; but this would not involve any expenditure of foreign exchange.

52. To sum up, in order to feed the fresh additions to the population at the rate of 5 million persons per year, it would be necessary to provide an additional quantity of 700,000 tons of foodgrains *every year* which would require Rs. 450 crore of foreign exchange over a period of five years. The cost can be reduced to Rs. 135 crore of foreign exchange in a 5-year period, if an additional quantity of 350,000 tons of ammonium sulphate is ordered from abroad *every year*, at least two years in advance of the crop season. The cost can be further reduced to Rs. 125 crore (out of which the foreign exchange component would be Rs. 50 crore) over a five-year period, if a new fertilizer factory of 350,000 ton capacity is started *every year*; this would call for decision 4 or 5 years ahead of the crop season concerned. The apportioned cost of a heavy machine building factory which would manufacture machinery in India to instal *every year* a new fertilizer factory of 350,000 ton capacity[1] would be, however, so small as Rs. 12 or 15 crore with a foreign exchange component of perhaps Rs. 8 or 10 crore. Such a decision would have to be made only once but 8 or 10 years in advance of the season in which the fertilizer would be used.

53. The above account is, no doubt, over-simplified ; but it brings out clearly one important point In India it is of the greatest importance to take a long view of planning. Additional requirements of foodgrains to cope with the growth of population can be met with an (apportioned) investment of only Rs. 15 or 20 crore and of foreign exchange of Rs. 8 or 10 crore, provided a decision can be made 8 or 10 years in advance of the year in which the food would be consumed. If the decision is made 4 or 5 years in advance, the cost would increase to Rs. 125 crore with a foreign exchange component of Rs. 50 crore. If the decision is made a couple of years ahead, the cost would increase to Rs. 135 crore in foreign exchange to import fertilizers; and if the decision to import foodgrains is made only from year to year the cost would go upto Rs. 450 crore in foreign exchange. *Wise utilization of Rs. 10 crore of foreign exchange once for all can lead, in time, to a saving of Rs. 450 crore of foreign exchange in imports of foodgrains over a period of 5 years.*

54. Similar considerations hold good in other crucial sectors. An investment of Rs. 150 crore, including Rs. 80 crore of imported machinery, would be required to instal a million-ton steel plant with a product value of Rs. 40 or 45 crore. A heavy machine building factory with an investment of Rs. 80 crore, with foreign imports worth about Rs. 50 crore, would produce every year machinery worth roughly Rs. 80 crore or the equivalent of imported machinery needed to set up a million-ton steel plant. Once such a heavy machinery factory gets into production, it would be possible to start a new million-ton steel plant *every year* out of our own resources. An investment of Rs. 30 crore in a plant to manufacture mining machinery would produce goods worth about Rs. 30 crore per year. An investment of Rs. 100 crore in heavy electrical equipment (generators, switchgear, heavy motors, rectifiers, transformers, etc.) would give products of the value of about Rs. 70 crore per year; and so on.

[1] There is great scope for the use of fertilizers in India ; some relevant information is given in Statistical Notes on the Use of Fertilizers.

Need of Long-term Planning

55. From the point of view of industrial development over a period of 15 or 20 years there cannot be any doubt that the correct policy would be to establish the heavy machinery industries. Consider, purely for purposes of illustration, the following programme of investments with a rough value of the product given within brackets in each case :—heavy machinery Rs. 150 crore (150 crore), heavy electrical equipment Rs. 100 crore (70 crore), turbines Rs. 20 crore (12 crore), mining machinery and drilling equipment Rs. 30 crore (30 crore), machinery for chemical engineering Rs. 25 crore (25 crore), machine tools[1] Rs. 30 crore (20 crore), aluminium Rs. 25 crore (5 crore), and, say, another Rs. 70 crore for other basic industries giving a total investment of about Rs. 450 crore with foreign exchange requirements of the order of Rs. 300 crore over a period of five years. I am aware that foreign exchange would also be needed to expand transport and other facilities but provision has been already made for this and for steel and other investments in the Second Plan.

56. The point I am emphasizing is that Rs. 300 crore of foreign exchange invested in suitable basic industries over a period of 5 years would establish a sound foundation for future industrial development and would enable us to manufacture essential capital goods within the country. (I am not suggesting that we should reduce our imports. On the contrary, we should try continually to expand our foreign trade. But we must attain as soon as possible a position in which, if necessary, we shall be able to manage on our own in an emergency). We have made some real advance during the First Five Year Plan. It has been a very wise and farsighted decision to develop atomic energy, for which we have much natural resources. Dr. H. Bhabha has shown in a recent article[2] how great would be the benefit of atomic power electricity to Indian economy. Good progress is being made with steel. It is now necessary to make similar farsighted decisions to establish the basic heavy industries.

57. I should like to refer in this connexion to some recent trade statistics. Indian exports f.o.b. amounted to Rs. 597 crore in 1954-55; Rs. 641 crore in 1955-56; and Rs. 637 crore in 1956-57. Imports c.i.f. in these three years were respectively Rs. 684 crore, Rs. 757 crore, and Rs. 1077 crore. It would be noticed that the increase in imports in 1956-57 over 1955-56, that is, in one year was Rs. 326 crore; and in 1956-57 over 1955-54, that is, in two years was Rs. 393 crore, out of which the increase on private account was Rs. 272 crore. I may also mention that the Government outlay on the First Five Year Plan was nearly Rs. 2400 crore; and the outlay on the Second FYP is expected to be roughly double. It is in the context of the above figures that one must view the proposal to invest Rs. 450 crore and utilize Rs. 300 crore of foreign exchange to build up the basic industries. After the factories come into operation, there would be a saving of Rs. 300 or Rs. 350 crore of foreign exchange in the import of capital goods. This is the crucial issue of planning in India.

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[1] To give one example, it is worth mentioning that machine tools formed roughly 3 percent of industrial equipment (in value) over a long period in the USA. On this basis Rs. 20 crore worth of machine tools would suffice for the manufacture in India of about Rs. 600 crore worth of industrial equipment which, in its turn, would enable industrial investments being made to the extent of *at least* Rs. 1000 crore per year basically out of our own resources. (*The Machine Tool Industry*, New York, Clark, Dodge & Co., May 1948).

[2] *Science and Culture*, October and November, 1957.

58. Finance and balance of payments are important aspects of planning; and there is no conflict between financial planning and physical planning. But it must be kept in mind that, in an underdeveloped country, the physical view is of basic importance. In one single year, 1956-57, our imports suddenly exceeded exports by Rs. 440 crore. If by some happy chance, Rs. 300 crore out of this amount had been utilized to purchase capital goods required to establish the basic industries, then in five year's time we would have won our economic independence and would have overcome difficulties of foreign exchange permanently. Although the accounting position would have been the same, the real position would have been entirely different and ever so much better.

Planning in China

59. It is instructive to consider what happened in China. Mr. Li Hsien-nien, Vice-Premier and Minister of Finance of China, in his speech to the First National People's Congress in Peking on 29 June 1957 (supplement to *Hsinhua News Agency Release, Peking*) stated that China has received foreign loans amounting to 2,174 million yuan (= Rs. 435 crore) before 1953, and 3120 yuan (= Rs. 624 crore) for China's First Five Year Plan from 1953 to 1957. The total amount of the loan was thus Rs. 1059 crore. A good part of this was used for rehabilitation after the present Government came into power (as stated by the Finance Minister); and a part, no doubt, was used for military expenses during the war in Korea. However, with the whole of the second loan of Rs. 624 crore and a part of the first loan China rapidly developed the basic industries (heavy machinery, heavy electricals, machine tools, steel, fertilizers, trucks, etc.). The Finance Minister of China appreciated the help received from USSR, but stated "*we may say that we are now in a better position to rely on our own accumulation* [i.e., investment] *to carry on national construction.*" (P. 5, col. 1).

60. It is important to note that foreign credit had tapered off rapidly. In the same speech the Finance Minister stated that foreign loans constituted 117 million yuan or Rs. 23.4 crore in 1956, and 23.3 million yuan or only Rs. 4.7 crore in 1957. China has a foreign trade which is roughly of the same size as India on a per capita basis. Although foreign loans would be of help and would make the task lighter, it seems that China will not have to worry about foreign exchange for essential requirements in future, and would be able to manage, if necessary, on the trading surplus. It may be mentioned that India received about Rs. 200 crore of foreign assistance, roughly half in grants and half in loans, during the First Five Year Plan; and has fairly firm authorization of receiving at least Rs. 600 crore of foreign assistance during the Second Five Year Plan. India also had foreign assets (held by the Reserve Bank) to the extent of Rs. 723 crore in 1951-52 and Rs. 746 crore in 1955-56 at the end of the First Five Year Plan which China had lacked. The foreign exchange position in India was thus much more favourable.

61. In Chinese planning the highest priority was given to develop those basic industries which would enable China to manufacture, within the country, essential capital goods required for rapid industrial development in future. Remembering that the Chinese economy is bigger than ours, it is of interest to note that China has "got off" on the way to industrialization out of its own resources with comparatively less foreign exchange

than India. In contrast, India may continue to have foreign exchange difficulties for some considerable time to come in the absence of wise planning.[1]

62. The Chinese example merely corroborates what an objective scientific analysis had brought out, namely, that India could have built up, and can still build up, with the help of only a few hundred crores of foreign exchange those basic industries which would give her economic independence.

Selfconfidence and Economic Independence

63. It is our responsibility, as scientists, to work out the logic and techniques of planning suited to India. It is our responsibility, as scientists, to educate and convince our countrymen that India is a great country with vast resources, natural and human. We have the responsibility to use these resources to improve the level of living of our countrymen and to promote science and culture. We should welcome foreign help and cooperation, especially, in science and technology and in cultural matters. Also, we must realize that it is not necessary continually to depend upon help from abroad. We must overcome the defeatist attitude which would make us continually ask for foreign loans. We must realize that political independence is not enongh; we must win economic independence. We have the ability and the responsibility to make rapid economic advance with our own resources, and with hard labour, scientific thinking, wise decisions, and seriousness of purpose. We must have faith in ourselves.

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[1] The Indian Industrial Delegation which visited USA, Canada, UK, West Germany and other countries in Europe in September–November 1957, referring to foreign investments in Canada in its Report to the Federation of Indian Chambers of Commerce and Industry, stated :

> "Eight hundred dollars per capita foreign investment means nearly Rs. 4,000 in Indian currency and at that rate and for such high development India should require Rs. 1,60,000 crore (Rupees one lakh sixty thousand crore) of investment in India, of which at least one-third, viz., nearly Rs. 50,000 crore would have to be in foreign currency! This can only be a dream. The conclusion to draw is that India cannot be developed without foreign capital which we shall continue to need for at least the next 25 years and in substantially large amounts" (p. 27).

This attitude of mind is in sharp contrast to the outlook in China where, with a fifty percent bigger population than India, the national economy got off on the way to rapid economic development with the help of foreign loans of only Rs. 1059 crore spread over 7 or 8 years.

Statistical Notes

Notes on Table 1 : In Table 1 figures have been given in metric tons. The Chinese official estimate of population in 1955 has been given instead of the UN estimate. Electricity production in China and India excludes generation in enterprises for their own use. Figures of energy (all forms) presented in col. (7) refer to the gross inland consumption of commercial fuels and water power, expressed in terms of coal equivalent. Production data include chiefly coal and lignite, gasoline, kerosene and fuel oils, natural gas, and hydro-electric power; electricity produced by using the above fuels has been excluded. No account has been taken of fuel wood and other vegetable fuels and peat for want of adequate data. These possibly provide a major share of the energy supply in all but a few countries. In India, for example, a United Nations source (*World Energy Supplies in Selected Years*, 1929-50) gives a figure for 1949 of about 84 million tons in coal equivalent of energy from such sources (mostly dung and fuel wood) compared to a figure of 35 million tons in coal equivalent for all commercial sources of energy quoted in Table 1. Thus we get a ratio between 2 and 3 to 1 between non-commercial and commercial sources in India. The corresponding figure for USA is only 1 is to 20. For India, the percentage distribution of all energy may be given as : commercial energy (19%); non-commercial sources such as fuel wood, dung, etc. (44%); animal effort (33%); and human effort (4%) with total (= 100%). The UN publication used above did not include the last two sources.

Notes on Table 2. In Table 2 the national income figure for USSR is calculated from an estimate given in the *Economic Bulletin for Europe*, May, 1957 on the assumption that one-third of the gross savings comprise depreciation. Other figures have been taken from sources referred to in the footnote to the table and have been rounded off. Also, all the figures have been expressed in national currencies. The conversion factors between the various currencies used are 1 $ = 4.75 Rs.; 1 £ = 13.3 Rs.; 1 rouble = 1.2 Rs. and 1 Yuan = 2 Rs., at current official exchange rates. The exchange rates and the figures in col. (3) would give some indication of the wide difference in the level of living between advanced and underdeveloped countries; any finer comparison between per capita incomes is fraught with grave dangers of error because of structural dissimilarities in prices.

The per capita figures in Table 2, col. (4) are obtained by using the output and population data in Table 1, and figures in col. (5) are directly derived from *UN Statistical Year Book* 1956 in terms of coal equivalents (p. 308—10); the conversion factor used being 1 ton of coal = 1667 kwh of energy.

Greater difficulties are associated with the derivation of the expenditure on research given in col. (6) because of inadequacy of information. The figure of $ 5.4 billion dollars used for USA relates to 1953 and is on the basis of a report on *Funds for Basic Research in the United States* 1953 published by the National Science Foundation, USA; and also briefly reported in the *Business Week*, 23 November 1957. It was noted that only about 8 percent of the amount is devoted to fundamental research. The percentage for USA given in col. (7) is computed on the basis of national income for 1953.

The expenditure on scientific research in USSR is taken as 18.2 billion roubles on the basis of a report in the *Times of India* of a message dated Moscow, 20 December 1957, which was later confirmed in other communications.

The expenditure on scientific research in the UK is taken to be £325 million on the basis of an article, "Highly trained technical man-power in Western Europe," *Economic Bulletin for Europe*, May 1957.

The figure used for scientific research in China is 327 million yuan (= Rs. 65.4 crore approximately) on the basis of the Finance Minister's speech on the budget for 1957 (July 1957). It should be noted that this expenditure is on scientific research proper and excludes a considerably larger figure (637 million yuan = Rs. 127.4 crore) for higher education. However, we have to take cognizance of the fact that in China and USSR the definition of 'science' is wider and includes some of the social sciences (economics, linguistics, history, etc., which are not reckoned as science in Western countries) but excludes art, literature, etc. This would give a higher total figure for research in socialist countries. On the other hand, much of developmental research in engineering and technology is probably included under industries in socialist countries.

The figure for expenditure on scientific research in India has been arrived at on the basis of Government budget accounts and financial statements. Attempts have been made to exclude expenditure on higher education and certain promotional outlays ; but expenditure on research in social sciences, such as economics and statistics has been included. No account, however, has been taken of research met exclusively by bodies other than Government; but its magnitude is small in India. The figure of Rs. 15 crore used is, at best, a dimensional estimate.

Exact comparisons are not possible because the definition of "scientific research" for budget and accounting purposes varies from one country to another. It is, in any case, difficult to demarcate research in applied science, in a precise and comparable way, from developmental work in engineering and technology. The figures given, however, give a broad idea of the position in the different countries.

Notes on Table 3. *USA :* Data on available number of engineers and doctors as well as the figure of annual out-turn of doctors are taken from the *Statistical Abstract of USA*, 1957. The figure for annual out-turn of engineers is quoted from "Trained Man-power, USA *vs.* USSR," *Monthly Review*, New York, April 1957.

USSR : Regarding engineers, both the figures are based on Soviet official statistics (in Russian). The figure of number of doctors available is taken from the English language publication, *National Economy of USSR : Statistical Returns*, while the out-turn figure is from the *USSR Reference Book*, November 1957.

UK : Both the figures for engineers are taken from "Highly trained technical man-power in Western Europe," *Economic Bulletin for Europe*, May 1957. The Annual Report of the British Medical Association, 1955-56 (Supplement to the *British Medical Journal*, April 7, 1956) gives the total membership of the Association as 68,306 in March 1956 and states that this number represents 80% of the total number in the profession ; the available number of doctors is estimated on this basis. The figure of annual output is obtained from G.D.H. Cole : *Post-War Condition in Britain*, 1956.

China : All the figures are based on the statistical returns for the People's Republic of China prepared by the State Statistical Bureau (in Chinese). However, a base figure of the available number of engineers in 1952 has been taken from Solomon Adler : *Chinese Economy.*

India : The out-turn figures are based on the *Educational Statistics of India.* The available number of engineers is taken from *Man-power Studies No. 5 : Engineers in India : Number and Distribution 1955*, (Planning Commission, October 1957). The number of doctors is based on information available in the Planning Commission.

Notes on the Use of Fertilizers : In a review by the Indian Council of Agricultural Research on "The Use of Fertilizers on Foodgrains"[1] the response, standardized to 20 lbs. N (= 100 lbs. of sulphate of ammonia) per acre, was given as 3.4 maunds (or 274 lbs.) of rice per acre, 2.8 maunds (or 230 lbs.) of wheat per acre, and between 1.7 and 3.1 maunds (140 lbs. and 255 lbs.) of other cereals per acre . For paddy the water supply was presumably adequate. Experiments were reported for wheat from both irrigated and unirrigated crops; the response on unirrigated land was 1.7 maunds (140 lbs.) per acre compared to 2.8 maunds (230 lbs.) per acre on irrigated land. The authors pointed out that

> "when the total supply of fertilizer is severely limited, the greatest natural benefit will accrue if small dressings are used on a large area of crop rather than heavy dressings on a small part of the area. ....The first step....is to ensure that available supplies are distributed over a large area of potentially responsive land; the second step is to increase supplies so that all areas likely to benefit considerably can have a small dressing; only thirdly does the increase of dressings to optimal levels become a desirable national policy" (p. 14).

The authors concluded that nitrogen response of 2.5 maunds (= 206 lbs.) of grains per acre from 20 lbs. N per acre (= 100 lbs.sulphate of ammonia) was "a reasonably representative figure for all cereals" (p. 15).

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[1] By F. Yates, D. Finney and V. G. Panse : I.C.A.R. Research Series No. 1, 1953.

From information supplied by I.C.A.R. for a later (T.C.M.) series of field trials on rice and irrigated wheat conducted during the three years 1953-54 to 1955-56 at community project centres distributed over the whole country, it appears that the nitrogen response for a first dose of 20 lbs. of nitrogen per acre was about 3 maunds (247 lbs.) of both rice and wheat per acre; and for a dose of 40 lbs. of nitrogen per acre the response was 4.5 maunds (370 lbs.) of rice per acre and 4.7 maunds (380 lbs.) of wheat per acre.

There is a gradual falling off in the response with higher doses of nitrogen; but from the results given above it is clear that upto about 20 lbs. of nitrogen (100 lbs. of sulphate of ammonia) a response of 200 lbs. or twice by weight of foodgrains can be expected on an average with confidence.

The net area sown in India was 313 million acres and the gross area sown including double cropped land was over 351 million acres in 1953–54.[1] The gross area irrigated was about 60 million acres. The total area under rice is about 78 million acres, out of which about 26 million acres are irrigated leaving a balance of about 52 million acre of unirrigated rice land, much of which would normally have adequate rainfall. We thus have about 34 million acres of irrigated land under crops other than rice, 26 million acres of irrigated rice land, and 52 million acres of unirrigated land under rice giving a total of 112 million acres of land, for which the water supply is likely to be fairly adequate for the use of fertilizers. At a rate of application of 20 lbs. of nitrogen per acre there should not be any difficulty in using upto one million tons of nitrogen or 5 million tons of sulphate of ammonia for this type of land alone. This is a safe estimate of minimum requirements. For the remaining 200 million acres of land if we accept a comparatively small doze of 10 lbs. of nitrogen per acre on an average, we could use nearly the same quantity again at the second stage. This would raise the requirement to about 10 million tons of sulphate of ammonia per year. For 112 million acres of land with good supply of water it would be possible to increase the doze upto 40 lbs. of nitrogen per acre which would require nearly another 5 million tons of sulphate of ammonia. These very rough calculations indicate that India may be able to use without any difficulty upto 15 or 16 million tons of sulphate of ammonia per year, that is, can afford to instal 40 or 45 factories of the Sindri capacity of about 350,000 tons per year.

We may also consider the question from the point of view of rainfall. There are about 50 million acres of land under cultivation which get more than 50 inches of rainfall per year; and about 87 million acre under cultivation with an annual rainfall of roughly between 40 and 50 inches. Out of these 137 million acres about 36 million acres are irrigated leaving a balance of about 100 million acres of unirrigated land with annual rainfall of about 40 inches or more. The balance of irrigated land is about another 30 million acres giving a total of about 130 million of acres under cultivation which is likely to have enough water for the profitable use of good doses of fertilizers. On the other hand, only about 50 million acres of land under cultivation in India receive less than 30 inches of rainfall per year; and of this about 12 million acres are irrigated. This would leave something like 38 million acres of land which may be really unsuitable for the use of fertilizers.

I may further mention that the rate of application of nitrogen in many countries is very high.[2] For example, the natural average doze of nitrogen in lbs. per acre over all cultivated area in 1955-56 was as follows: Belgium 73, East Germany 42, West Germany 48, Netherlands 156, Norway 38, U.K. 37, Japan 98 and Egypt 38 compared to 0.86 lbs. per acre with a total consumption of 145,000 tons of nitrogen or 725,000 tons of sulphate of ammonia in India. These figures also indicate that there is great scope for the use of fertilizers in India. The proposal made in my Address of installing only one fertilizer factory of the same capacity as Sindri per year is thus quite modest. It is worth mentioning in the present connexion that there is some evidence to suggest that the actual rate of growth of population may be appreciably greater than 5 million per year and may be 6 or 7 or even more per year. It would be wise to instal two such factories per year and this can be done without any fear of the saturation limit of utilization being reached in 15 or 20 years.

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[1] *Agricultural Statistics of Reorganised States*, Government of India, 1956–57.

[2] Year Book of Food & Agricultural Statistics: Production, Vol. 10, Part I (FAO), 1956.

TABLE A.1.1. INDEX NUMBER OF CONSUMER EXPENDITURE PER PERSON FOR A PERIOD OF 30 DAYS BY ITEMS OF CONSUMPTION : ALL INDIA (RURAL AND URBAN) : 1955-56

items	expenditure classes in rupees per person per month												
	0–8	8–11	11–13	13–15	15–18	18–21	21–24	24–28	28–34	34–43	43–55	55 & above	all classes
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Index number of average expenditure per month													
1. foodgrains	53	71	89	96	105	115	125	129	132	141	152	211	100
2. sugar	18	39	49	71	82	102	127	151	206	222	286	473	100
3. milk & products	9	25	38	53	63	102	123	154	211	269	570	489	100
4. other food	36	55	69	81	97	104	127	142	167	177	219	364	100
5. total food	40	58	75	85	96	109	125	137	156	173	236	304	100
6. clothing	12	30	45	58	81	108	124	147	218	279	245	579	100
7. medical	2	21	26	44	63	86	107	119	195	281	402	907	100
8. others	25	38	45	56	71	89	105	138	160	243	286	744	100
9. non-food total	20	35	44	56	73	94	110	139	178	255	282	710	100
10. total (all items)	33	50	64	74	88	104	120	138	164	201	252	444	100
Index number of percentage of total expenditure													
11. foodgrains	158	141	139	129	120	110	104	94	80	70	61	48	100
12. sugar	53	78	77	95	94	98	106	110	126	110	114	106	100
13. milk & products	26	49	59	71	72	98	102	112	129	134	226	110	100
14. other food	108	109	108	108	110	100	106	103	102	88	87	82	100
15. food total	121	116	117	113	109	105	104	100	95	86	94	68	100
16. clothing	35	60	70	78	92	104	103	107	133	138	97	130	100
17. medical	7	42	40	59	72	83	89	86	120	140	160	204	100
18. others	76	75	71	75	81	86	87	100	98	121	113	168	100
19. non-food total	61	69	69	75	83	91	92	101	109	127	112	160	100
20. total	100	100	100	100	100	100	100	100	100	100	100	100	100
21. percentage of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
22. cumulative percentage	14.01	31.32	43.06	52.20	63.75	71.96	79.00	84.53	89.70	94.55	71.14	100.00	—
23. size of households (persons)	112	111	118	104	100	95	93	91	84	93	68	70	100
24. no. of households	12.53	15.59	9.92	8.83	11.51	8.68	7.59	6.08	6.16	5.22	3.79	4.10	100
25. no. of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100
Index number of total expenditure													
26. on 'food' items	5.65	10.13	8.75	7.73	11.07	8.99	8.83	7.58	8.06	8.38	6.12	8.71	100
27. on 'non-food' items	2.89	5.99	5.15	5.07	8.47	7.75	7.76	7.69	9.22	12.37	7.32	20.32	100
28. on 'all' items	4.70	8.70	7.51	6.81	10.16	8.56	8.46	7.62	8.46	9.76	6.54	12.72	100
29. no. of sample households	260	369	240	217	305	244	197	207	193	187	138	197	2754

no. of sample villages = 1544, no. of sample urban blocks = 1220

Based on the National Sample Survey (NSS) : 10th Round, December 1955—May 1956, All-India (rural and urban) excluding Jammu & Kashmir.

TABLE A.1.1. INDEX NUMBER OF CONSUMER EXPENDITURE PER PERSON FOR A PERIOD OF 30 DAYS BY ITEMS OF CONSUMPTION : ALL INDIA (RURAL AND URBAN) : 1955-56

items	expenditure classes in rupees per person per month												
	0–8	8–11	11–13	13–15	15–18	18–21	21–24	24–28	28–34	34–43	43–55	55 & above	all classes
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Index number of average expenditure per month													
1. foodgrains	53	71	89	96	105	115	125	129	132	141	152	211	100
2. sugar	18	39	49	71	82	102	127	151	206	222	286	473	100
3. milk & products	9	25	38	53	63	102	123	154	211	269	570	489	100
4. other food	36	55	69	81	97	104	127	142	167	177	219	364	100
5. total food	40	58	75	85	96	109	125	137	156	173	236	304	100
6. clothing	12	30	45	58	81	108	124	147	218	279	245	579	100
7. medical	2	21	26	44	63	86	107	119	195	281	402	907	100
8. others	25	38	45	56	71	89	105	138	160	243	286	744	100
9. non-food total	20	35	44	56	73	94	110	139	178	255	282	710	100
10. total (all items)	33	50	64	74	88	104	120	138	164	201	252	444	100
Index number of percentage of total expenditure													
11. foodgrains	158	141	139	129	120	110	104	94	80	70	61	48	100
12. sugar	53	78	77	95	94	98	106	110	126	110	114	106	100
13. milk & products	26	49	59	71	72	98	102	112	129	134	226	110	100
14. other food	108	109	108	108	110	100	106	103	102	88	87	82	100
15. food total	121	116	117	113	109	105	104	100	95	86	94	68	100
16. clothing	35	60	70	78	92	104	103	107	133	138	97	130	100
17. medical	7	42	40	59	72	83	89	86	120	140	160	204	100
18. others	76	75	71	75	81	86	87	100	98	121	113	168	100
19. non-food total	61	69	69	75	83	91	92	101	109	127	112	160	100
20. total	100	100	100	100	100	100	100	100	100	100	100	100	100
21. percentage of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
22. cumulative percentage	14.01	31.32	43.06	52.20	63.75	71.96	79.00	84.53	89.70	94.55	71.14	100.00	—
23. size of households (persons)	112	111	118	104	100	95	93	91	84	93	68	70	100
24. no. of households	12.53	15.59	9.92	8.83	11.51	8.68	7.59	6.08	6.16	5.22	3.79	4.10	100
25. no. of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100
Index number of total expenditure													
26. on 'food' items	5.65	10.13	8.75	7.73	11.07	8.99	8.83	7.58	8.06	8.38	6.12	8.71	100
27. on 'non-food' items	2.89	5.99	5.15	5.07	8.47	7.75	7.76	7.69	9.22	12.37	7.32	20.32	100
28. on 'all' items	4.70	8.70	7.51	6.81	10.16	8.56	8.46	7.62	8.46	9.76	6.54	12.72	100
29. no. of sample households	260	369	240	217	305	244	197	207	193	187	138	197	2754

no. of sample villages = 1544, no. of sample urban blocks = 1220

Based on the National Sample Survey (NSS) : 10th Round, December 1955—May 1956, All-India (rural and urban) excluding Jammu & Kashmir.

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items	expenditure classes in rupees per person per month												
	0–8	8–11	11–13	13–15	15–18	18–21	21–24	24–28	28–34	34–43	43–55	55 & above	all classes
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Index number of average expenditure per month													
1. foodgrains	53	71	89	96	105	115	125	129	132	141	152	211	100
2. sugar	18	39	49	71	82	102	127	151	206	222	286	473	100
3. milk & products	9	25	38	53	63	102	123	154	211	269	570	489	100
4. other food	36	55	69	81	97	104	127	142	167	177	219	364	100
5. total food	40	58	75	85	96	109	125	137	156	173	236	304	100
6. clothing	12	30	45	58	81	108	124	147	218	279	245	579	100
7. medical	2	21	26	44	63	86	107	119	195	281	402	907	100
8. others	25	38	45	56	71	89	105	138	160	243	286	744	100
9. non-food total	20	35	44	56	73	94	110	139	178	255	282	710	100
10. total (all items)	33	50	64	74	88	104	120	138	164	201	252	444	100
Index number of percentage of total expenditure													
11. foodgrains	158	141	139	129	120	110	104	94	80	70	61	48	100
12. sugar	53	78	77	95	94	98	106	110	126	110	114	106	100
13. milk & products	26	49	59	71	72	98	102	112	129	134	226	110	100
14. other food	108	109	108	108	110	100	106	103	102	88	87	82	100
15. food total	121	116	117	113	109	105	104	100	95	86	94	68	100
16. clothing	35	60	70	78	92	104	103	107	133	138	97	130	100
17. medical	7	42	40	59	72	83	89	86	120	140	160	204	100
18. others	76	75	71	75	81	86	87	100	98	121	113	168	100
19. non-food total	61	69	69	75	83	91	92	101	109	127	112	160	100
20. total	100	100	100	100	100	100	100	100	100	100	100	100	100
21. percentage of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
22. cumulative percentage	14.01	31.32	43.06	52.20	63.75	71.96	79.00	84.53	89.70	94.55	71.14	100.00	—
23. size of households (persons)	112	111	118	104	100	95	93	91	84	93	68	70	100
24. no. of households	12.53	15.59	9.92	8.83	11.51	8.68	7.59	6.08	6.16	5.22	3.79	4.10	100
25. no. of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100
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28. on 'all' items	4.70	8.70	7.51	6.81	10.16	8.56	8.46	7.62	8.46	9.76	6.54	12.72	100
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(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Index number of average expenditure per month													
1. foodgrains	53	71	89	96	105	115	125	129	132	141	152	211	100
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5. total food	40	58	75	85	96	109	125	137	156	173	236	304	100
6. clothing	12	30	45	58	81	108	124	147	218	279	245	579	100
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8. others	25	38	45	56	71	89	105	138	160	243	286	744	100
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10. total (all items)	33	50	64	74	88	104	120	138	164	201	252	444	100
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11. foodgrains	158	141	139	129	120	110	104	94	80	70	61	48	100
12. sugar	53	78	77	95	94	98	106	110	126	110	114	106	100
13. milk & products	26	49	59	71	72	98	102	112	129	134	226	110	100
14. other food	108	109	108	108	110	100	106	103	102	88	87	82	100
15. food total	121	116	117	113	109	105	104	100	95	86	94	68	100
16. clothing	35	60	70	78	92	104	103	107	133	138	97	130	100
17. medical	7	42	40	59	72	83	89	86	120	140	160	204	100
18. others	76	75	71	75	81	86	87	100	98	121	113	168	100
19. non-food total	61	69	69	75	83	91	92	101	109	127	112	160	100
20. total	100	100	100	100	100	100	100	100	100	100	100	100	100
21. percentage of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
22. cumulative percentage	14.01	31.32	43.06	52.20	63.75	71.96	79.00	84.53	89.70	94.55	71.14	100.00	—
23. size of households (persons)	112	111	118	104	100	95	93	91	84	93	68	70	100
24. no. of households	12.53	15.59	9.92	8.83	11.51	8.68	7.59	6.08	6.16	5.22	3.79	4.10	100
25. no. of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100
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27. on 'non-food' items	2.89	5.99	5.15	5.07	8.47	7.75	7.76	7.69	9.22	12.37	7.32	20.32	100
28. on 'all' items	4.70	8.70	7.51	6.81	10.16	8.56	8.46	7.62	8.46	9.76	6.54	12.72	100
29. no. of sample households	260	369	240	217	305	244	197	207	193	187	138	197	2754

no. of sample villages = 1544, no. of sample urban blocks = 1220

Based on the National Sample Survey (NSS) : 10th Round, December 1955—May 1956, All-India (rural and urban) excluding Jammu & Kashmir.

TABLE A.1.2. CUMULATIVE PERCENTAGE OF EXPENDITURE ON 'FOOD', 'NON-FOOD' AND 'ALL' ITEMS: ALL INDIA (RURAL AND URBAN): 1955-56

per capita expenditure classes in Rs.	actual number of sample households		cumulative percentage of total number of persons		cumulative percentage of expenditure on 'food' items		cumulative percentage of expenditure on 'non-food' items		cumulative percentage of expenditure on 'all' items	
	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
					cumulative percentage					
0—8	135	125	13.84	14.18	5.64	5.66	2.82	2.96	4.67	4.73
8—11	181	188	31.52	31.12	16.15	15.43	8.60	9.15	13.55	13.26
11—13	122	118	43.62	42.50	25.37	23.74	13.80	14.25	21.38	20.45
13—15	115	102	52.65	51.74	33.16	31.41	18.89	19.31	28.23	27.21
15—18	153	152	64.17	63.33	44.38	42.30	27.56	27.59	38 57	37.20
18—21	131	113	73.61	70.32	55.06	49.66	36.32	34.37	48.59	44.36
21—24	89	108	79.36	78.63	62.29	60.03	42.97	43.19	55.62	54.19
24—28	104	103	85.93	83.14	71.32	66.22	52.37	49.24	64.78	60.33
28—34	91	102	90.28	89.12	77.81	75.80	60.63	59.37	71.88	70.10
34—43	98	89	95.31	93.79	86.66	83.73	73.64	71.14	82.17	79.36
43—55	60	78	97.08	97.19	90.83	91.73	79.27	80.07	86.85	87.69
55 & above	98	99	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
all classes	1377	1377								

no. of sample villages : S.S.1 = 772, S.S.2 = 772. no. of sample blocks : S.S.1 = 610, S.S.2 = 610.

Based on National Sample Survey (NSS): 10th Round, December 1955—May 1956, All India (rural and urban) excluding Jammu & Kashmir.

TABLE A.1.2. CUMULATIVE PERCENTAGE OF EXPENDITURE ON 'FOOD', 'NON-FOOD' AND 'ALL' ITEMS: ALL INDIA (RURAL AND URBAN) : 1955-56

per capita expenditure classes in Rs.	actual number of sample households		cumulative percentage of total number of persons		cumulative percentage of expenditure on					
					'food' items		'non-food' items		'all' items	
	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
					cumulative percentage					
0—8	135	125	13.84	14.18	5.64	5.66	2.82	2.96	4.67	4.73
8—11	181	188	31.52	31.12	16.15	15.43	8.60	9.15	13.55	13.26
1—13	122	118	43.62	42.50	25.37	23.74	13.80	14.25	21.38	20.45
13—15	115	102	52.65	51.74	33.16	31.41	18.89	19.31	28.23	27.21
15—18	153	152	64.17	63.33	44.38	42.30	27.56	27.59	38 57	37.20
18—21	131	113	73.61	70.32	55.06	49.66	36.32	34.37	48.59	44.36
21—24	89	108	79.36	78.63	62.29	60.03	42.97	43.19	55.62	54.19
24—28	104	103	85.93	83.14	71.32	66.22	52.37	49.24	64.78	60.33
28—34	91	102	90.28	89.12	77.81	75.80	60.63	59.37	71.88	70.10
34—43	98	89	95.31	93.79	86.66	83.73	73.64	71.14	82.17	79.36
43—55	60	78	97.08	97.19	90.83	91.73	79.27	80.07	86.85	87.69
55 & above	98	99	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
all classes	1377	1377								

no. of sample villages : S.S.1 = 772, S.S.2 = 772. no. of sample blocks : S.S.1 = 610, S.S.2 = 610.

Based on National Sample Survey (NSS) : 10th Round, December 1955—May 1956, All India (rural and urban) excluding Jammu & Kashmir.

14. The number of sample households in the two sub-samples are given in cols. (2) and (3) to show the size of samples but are not used in drawing the concentration curves. Col. (4) gives the accumulated percentages of persons in sub-sample 1, similar to the figures given in line 22 of Table A.1.0. Percentages for sub-sample 2 are given in col. (5). The expenditure on, say, food items (or non-food items, or all items) is known for each expenditure group shown in col. (1) ; and the total expenditure on food items for all expenditure groups taken together is also known. It is, therefore, possible to express the expenditure incurred in any particular group as a percentage of the expenditure incurred by all the groups. In this way, each expenditure group, in each line of Table A.1.2 would have a figure giving its percentage share of the total expenditure on food (or non-food, or all) items. These percentages can then be added successively from the bottom up, and would supply the 'cumulative percentage of expenditure,' say, on food items shown in col. (6). For example, the expenditure group '0–Rs. 8' accounts for 5.64 percent of the total expenditure on food items. The two groups '0–Rs. 8' and 'Rs. 8–11' together account for 16.15 percent of the total expenditure on food items and so on.

15. The cumulative percentages of persons in col. (4) can be represented on the horizontal scale (at the bottom of the chart); and the corresponding cumulative percentage of expenditure can be represented on the vertical scale (on the right of the chart). The values given in the same line in cols. (4) and (6) are plotted on the chart and is shown by the graph for sub-sample 1 of concentration curve B for expenditure on food items. A similar graph can be drawn for sub-sample 2 on the basis of each pair of figures given in the same line of cols. (5) and (7). The two graphs for concentration curve B were drawn in this way. The same procedure was followed in the case of expenditure on non-food items by plotting the figures given in cols. (4) and (8) for sub-sample 1, and the figures in cols. (5) and (9) for sub-sample 2; these are shown in the two graphs of concentration curve C. For expenditure on all items, the figures in cols. (4) and (10) for sub-sample 1, and figures in cols. (5) and (11) for sub-sample 2 are plotted to give the two graphs of concentration curve D.

16. It is of interest to examine the three sets of double graphs of B, C, and D. Consider the two graphs of curve B, each of which gives an equally valid sample representation of the concentration curve for expenditure on food. They diverge to some extent but not too much. We may, therefore, infer that the 'true' concentration curve B for expenditure on food items lies somewhere in the neighbourhood of the pair of graphs for sub-samples 1 and 2. Also, the divergence between this pair of graphs supplies some idea of the margin of errors of sampling. In the same way, we can locate approximately (and always subject to some margin of errors of sampling) the position of concentration curve C for expenditure on non-food items; and the position of concentration curve D for expenditure on all items of consumption.

17. The divergence between the concentration curve B, on one hand, and the concentration curve D, on the other hand, can be directly seen on the chart to be much greater than the divergence between the pair of graphs for the two sub-samples of curve B or of curve D. From this we may infer that the two concentration curves B and D are significantly different in the statistical sense. Looking at all the three pairs of graphs it can be inferred that the three concentration curves B, C and

TABLE A.2.0. PERCENTAGE OF HOUSEHOLDS (EXCLUDING THOSE OF SIZE LESS THAN 0.10 ACRE) BELOW SPECIFIED SIZE OF OWNERSHIP HOLDING AND THE CORRESPONDING PERCENTAGE OF AREA OWNED : ALL INDIA (RURAL) : 1953-54

	specified size of ownership holdings	number of sample households			cumulative percentage of total number of households			cumulative percentage of area owned		
		Central	State I	State II	Central	State I	State II	Central	State I	State II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	0.10–0.50 acre	1107	1210	1043	9.49	10.94	9.47	0.37	0.40	0.33
2.	upto 1.00 „	1099	1095	1075	18.95	20.58	18.82	1.29	1.37	1.23
3.	„ 1.50 „	1060	996	1012	27.38	28.90	27.34	2.70	2.80	2.61
4.	„ 2.50 „	1656	1578	1596	40.21	41.33	40.75	6.17	6.20	6.10
5.	„ 5.00 „	2856	2805	2622	61.24	61.97	60.68	16.53	16.65	15.54
6.	„ 7.50 „	1825	1848	1722	73.73	73.51	72.60	26.99	26.55	25.20
7.	„ 10.00 „	1164	1265	1241	80.77	80.60	80.05	35.34	35.17	33.73
8.	„ 15.00 „	2311	2495	2486	88.25	88.69	87.71	47.93	48.93	46.06
9.	„ 20.00 „	1368	1337	1337	92.42	92.56	91.78	57.83	58.28	55.36
10.	„ 25.00 „	1038	964	1021	94.56	94.80	94.11	64.38	65.23	62.18
11.	„ 30.00 „	675	629	740	96.13	96.15	95.76	70.29	70.38	68.18
12.	„ 40.00 „	757	693	847	97.77	97.77	97.56	77.98	78.19	76.32
13.	„ 50.00 „	396	392	414	98.61	98.64	98.48	83.10	83.58	81.39
14.	„ 75.00 „	413	395	464	99.48	99.44	99.44	90.16	90.37	89.48
15.	„ 100.00 „	127	134	136	99.73	99.71	99.70	92.98	93.64	92.40
16.	„ 250.00 „	131	134	128	99.97	99.99	99.97	97.60	99.10	97.69
17.	„ 500.00 „	14	6	18	99.99	100.00	100.00	98.62	99.68	99.01
18.	above 500.00 „	6	1	4	100.00	100.00	100.00	100.00	100.00	100.00
19.	total	18,003	17,977	17,906						
20.	sample villages	1,410	1,422	1,383						

Based on the National Sample Survey : 8th Round, July 1954—March 1955. Information for the Central sample was collected by an agency of the Government of India and for the State samples by the respective State Governments. The Central, State-I, and State-II samples are each based on four interpenetrating samples; and all 12 samples also form, of course, an interpenetrating net work of samples covering the rural area.

D are all different. It has been possible to make this inference in this very simple manner, because we have been able to use a pair of graphs (based respectively on sub-samples 1 and 2) for each of the three concentration curves B, C and D.[1]

18. We may now examine the concentration curve or the figures given in Table A.1.2 to understand the implications. For sub-sample 1, the lowest group '0 to Rs. 8' has a percentage share of population of 13.84 percent, in col. (4); but its share of expenditure on food items is only 5.64 percent, in col. (6); and the share of non-food expenditure is still less and only 2.82 percent, in col. (8); the share of expenditure on all items is 4.67 percent, in col. (10), and naturally falls between the other two. The position can be ascertained for other groups or for any percentage of the population directly from the graph. It would be seen the lower the concentration curve at the beginning, the lower will be the share of the poorer households.

19. It will be noticed that expenditure on food is more egalitarian than the expenditure on all items, while expenditure on non-food items deviates most from equality. This can be seen clearly from the curves B, C and D on the chart. The further a concentration curve lies towards the lower right-hand corner of the chart, the greater is its deviation from the egalitarian distribution shown by the straight line inclined at 45° to the axis. The more intense the concentration, the greater would be the advantage enjoyed by a few rich men over a very large number of poor people. Concentration curves thus give a simple visual picture of the non-equality of the distribution.

CONCENTRATION CURVE FOR LAND HOLDINGS

20. It is, of course, possible to draw concentration curves for distributions other than that of expenditure. The case of holdings of land by households is of great interest. Some relevant data are given in Table A. 2.0 based on a special survey of land-holdings carried out in the NSS : 8th round : July 1954–March 1955 covering the whole rural area of India. In this survey 12 interpenetrating sub-samples were used, information for 4 of which was collected by the NSS (which is a Central agency) and information for the remaining 8 sub-samples was collected by respective State Governments in the form of two groups of samples called State-I and State-II, each consisting of 4 sub-samples. The information is given in Table A. 2.0 separately for 3 groups of samples : Central, State-I and State-II.

21. Information was obtained about the size in acres of the total holdings of land owned by each household. The households were then classified in groups by size of holding, such as, owning '0.10 to 0.50 acre;' owning '0.50 to 1.00 acre' and so on. The number of households in each group and also the total area of land held by each group were then calculated; and these were expressed as percentage of the total number of households and of the total area of land owned by all households. The next step was adding up the percentages by successive groups to give the 'cumulative percentage of

[1]When a particular number or quantity (as distinguished from a curve, as in the present case) is estimated, the margin of error can be calculated with considerable accuracy on results based on two or more interpenetrating samples. The rule is extremely simple: for a set of 2, 3, 4, 5, 6, ... k interpenetrating samples the probability would be respectively

$$1/2,\ 3/4,\ 7/8,\ 15/16,\ 31/32\ \ldots\ (2^{k-1}-1)/2^{k-1}$$

and the 'true' value of the parameter lies between the two extreme estimates based on the interpenetrating samples. This method is being used in the Indian Statistical Institute since 1937.

household' and the 'cumulative percentage of total area of land owned by households.' These figures are given for the Central sample in cols. (5) and (8) respectively of Table A.2.0; for State-I sample in cols. (6) and (9) respectively; and for State-II sample in cols. (7) and (10) respectively. These three sets of values were then drawn on the chart in the form of the three graphs of concentration curve E, at the extreme lower right-hand corner of the chart.

22. The number of sample households is given in cols. (2), (3) and (4) which show that the size of the sample was much larger in the case of the survey of land-holdings compared to the survey of household expenditure. Each of the Central, State-I and State-II samples had about 18,000 sample households compared to only 1377 sample households in sub-samples 1 and 2 in the case of household expenditure. It is of interest to note that the three graphs of curve E lie very close to one another (and are almost indistinguishable), no doubt, due to the large size of the samples. Comparing the graphs of curve E with the graphs of B, C and D, it is seen that the margin of errors of sampling is much smaller in the case of curve E. The size of samples in the case of land-holdings would seem to be quite adequate.

23. It should be mentioned that in the present case only those households have been included which own more than 0.10 acre of land in order to exclude landless labour and households who practically do not own any land. The most important point to be noted is that the concentration of land-holdings is far greater than the concentration of expenditure on non-food items of consumption. The distribution of land-holdings is thus far more unequal than the distribution of consumer expenditure. The curves B, C, D and E give a clear idea of the inequality in the level of living and in the ownership of land in India at the present time.

Employment and unemployment

24. Table A.3.1 shows the position regarding the labour force, employment and unemployment based on the 9th Round of the National Sample Survey (NSS) : May–August 1955. Estimated numbers in million are given for each category in cols. (2), (3) and (4) for rural and urban areas, and all-India respectively. The corresponding percentage of the total are shown in cols. (5), (6) and (7). The first portion A gives the basic information. Consider the all-India figures given in col. (4) and corresponding percentages in col. (7). It is seen from line 1 that the total estimated population (on the basis of the National Sample Survey) was 382.4 million in 1955, and from line 3 that the labour force consisted of 162.6 million persons [or 42.5 percent of the population, as shown in col. (7), line 3] who were at work or seeking work at the time of the survey. Within the labour-force itself 160.4 million were gainfully occupied (line 5) and 2.24 million were "unemployed" (line 4) in accordance with the concept of "unemployment" used in industrially advanced countries.

25. For various reasons, it is known that the concept of unemployment used in the advanced countries is not suitable in the case of under-developed countries in which most of the people work in household enterprises and agriculture. They are never "unemployed" in the technical sense, but may often have to sit idle for lack of gainful work. The figures for "unemployed" given in line 4 are not, therefore, adequate. A better picture can be obtained, if consideration is given to the amount of time a person

is available for work or is actually engaged in gainful work. This has been sought to be done in Part B of the table. Three different approaches were used.

26. Information was collected on how many more hours a person was available for work per week and the replies were classified in groups of "available from 1 to 8 hours per week," "from 8 to 14 hours per week," etc., (that is, by units of 1 hour per day per week), shown in lines 6 to 13. Those who are available for work for more than 29 hours per week (that is, who can accept work for more than 4 hours per day for 7 days) are either practically unemployed or are sitting idle for half the week or more. Their number would come to 11.7 million [col. (4), line 9]. This is perhaps a lower limit of effective unemployment.

27. Information about hours of work per week is given (in an accumulated form) in lines 14 to 20. It would be seen that the number of persons working less than 8 hours per week was 20.9 million and their position was practically the same as that of the unemployed. The number of persons working less than 29 hours per week or 4 hours per day was as large as 44.8 million [col. (4), line 16].

28. A third approach was to enquire how many days a person was engaged in gainful work during 30 days preceding the day of interview. The information is given in the form of accumulated totals in lines 21 to 26. The number of persons working less than 10 days out of 30 days, or less than one-third of the month, was 39.2 million [col. (4), line 22]. This is broadly consistent with the figure 44.8 million given in the previous paragraph.

29. There is, however, a big gap between estimates of the number of unemployed persons based on B.(1) the hours per week available for additional work and B.(2) the hours of work per week. A special enquiry carried out in the NSS: 7th Round, October 1953–March 1954 had given some interesting information on this point. The number of persons working part-time was obtained as 47.2 million corresponding roughly to 44.8 million persons who worked 28 hours or less per week as given in col. (4), line 16 of Table A.3.1. The enquiry in the 7th Round brought out that among them 10.4 million (22 percent of the total) were working part-time partly on account of ill-health of the worker and partly because of illness in his household. Also, 23.4 million persons (or roughly half) were working a part of the time for reasons of an economic nature, such as lack of demand for their labour, lack of tools and raw materials, slack and off season, etc.; and 13.4 million persons gave other reasons. It would seem from the above discussion that at least 23 million persons, who were working part-time for reasons of an economic nature, can be considered as severely "underemployed."

30. It is clear that the volume of underemployment is very great indeed in India. It is, however, difficult to set up precise definitions and standards for unemployment and underemployment especially in rural areas and in household and small scale enterprises and in the case of self-employed persons. The actual number would depend entirely on where the line is to be drawn between employment and underemployment.

31. Table 3.2 gives information on the distribution of gainfully employed persons by industries and by economic sectors (public, large scale, private household, etc.). From col. (9) it is seen that out of a total number of gainfully employed persons of 160.38 million, 119.76 or nearly 120 million work in agriculture, forestry, livestock, etc. The total number engaged in manufacturing industries is only 17.54 million, out

TABLE A.3.1. STATUS OF ECONOMIC ACTIVITY AND GAINFUL EMPLOYMENT : RURAL, URBAN & ALL INDIA

		estimated number of persons in million			percentage of total		
		rural	urban	all-India	rural	urban	all-India
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	A. Distribution of population by status of economic activity[1]						
1.	total population	316.1	66.3	382.4	100.0	100.0	100.0
2.	outside labour force	176.4	43.4	219.8	55.8	65.6	57.5
3.	in labour force	139.7	22.9	162.6	44.2	34.5	42.5
4.	unemployed	0.92	1.32	2.24	0.29	1.99	0.59
5.	gainfully employed	138.8	21.6	160.4	43.9	32.6	41.9
	B. Distribution of gainfully employed persons by period of work						
	(1) *hours available for additional work per week*[2]						
6.	above 70 hours	0.38	0.04	0.42	0.28	0.20	0.26
7.	„ 56 „	1.2	0.11	1.3	0.85	0.51	0.81
8.	„ 42 „	6.1	0.7	6.8	4.4	3.3	4.2
9.	„ 28 „	10.4	1.3	11.7	7.5	6.2	7.3
10.	„ 14 „	17.6	2.5	20.1	12.7	11.6	12.5
11.	„ 7 „	22.1	3.2	25.3	15.9	15.0	15.8
12.	„ 1 hour	24.3	3.4	27.7	17.5	15.7	17.3
13.	nil	138.8	21.6	160.4	100.0	100.0	100.0
	(2) *hours of work per week*[2]						
14.	7 hours or less	18.9	2.0	20.9	13.6	9.2	13.0
15.	14 „	24.3	2.6	26.9	17.5	12.1	16.8
16.	28 „	40.2	4.6	44.8	29.0	21.5	27.9
17.	42 „	64.3	8.5	72.8	46.3	39.5	45.4
18.	56 „	109.7	17.2	126.9	79.0	79.4	79.1
19.	70 „	133.4	20.3	153.7	96.1	93.9	95.8
20.	all	138.8	21.6	160.4	100.0	100.0	100.0
	(3) *days of work per 30 days*[3]						
21.	less than 5 days	28.2	1.6	29.8	30.2	7.2	18.6
22.	„ „ 10 „	37.2	2.1	39.2	26.7	9.6	24.4
23.	„ „ 15 „	50.1	3.2	53.3	36.1	14.6	33.2
24.	„ „ 20 „	62.5	4.6	67.1	45.0	21.1	41.8
25.	„ „ 25 „	78.3	8.2	86.5	56.4	38.0	53.9
26.	„ „ 30 „	138.8	21.6	160.4	100.0	100.0	100.0

[1] Based on the National Sample Survey (NSS): 9th Round, May-August 1955; growth of population calculated on the Census 1941-1951 rate of 1.32 percent per annum.

[2] Percentages in cols. (5) to (7) and lines (1) to (20) based on NSS: 9th Round, May-August 1955, sub-samples 1 and 2 only, consisting of 8,037 rural and 16,703 urban sample households.

[3] Percentages in cols. (5) to (7) and lines (21) to (26) based on NSS: 5th and 6th Rounds, December 1952-August 1953, consisting of 12,976 rural and 5,670 urban sample households.

of which also only 3.47 million are engaged in modern large scale industries. Trade and commerce with 5.84 million and service with 5.13 million come next in order of importance.

32. From col. (2), bottom line, it is seen that 7.26 million persons are employed in the public sector, that is, under the Central and State Governments, Municipalities, and other public authorities; and from the total of col. (3) that 5.65 million are employed in private large scale enterprises. These two taken together, 12.91 million persons have employment of the type familiar in industrially advanced countries; and in their case it is probably possible to specify fairly well whether a person is employed or unemployed in the sense in which "unemployment" is defined in advanced countries.

33. The private small scale sector has 146.61 million [col. (7), bottom line], out of which 115.23 million are household labour (col. 4). They may be fully or only partly engaged in work but can almost never be "unemployed" in the technical sense. The structure of employment clearly shows the backwardness of the Indian economy.

TABLE A.3.2. GAINFULLY EMPLOYED PERSONS BY INDUSTRIES : ALL INDIA : 1955

industry	public	private large-scale	private small-scale				not recorded	total
			household labour	hired labour	domestic service	sub-total (4)+(5)+(6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				million persons				
1. agriculture, forestry, livestock, fishing and hunting	0.41	0.93	93.23	24.76	0.00	117.99	0.51	119.84
2. mining and quarrying	0.04	0.39	0.01	0.08	—	0.09	0.00	0.52
3. manufacturing	0.44	3.47	11.38	2.10	0.00	13.48	0.16	17.55
4. construction	0.26	0.22	0.66	0.85	0.00	1.51	0.01	2.00
5. electricity, gas, water, sanitation	0.16	0.01	0.09	0.00	—	0.09	0.01	0.27
6. trade and commerce	0.10	0.22	4.78	0.72	0.00	5.50	0.02	5.84
7. service	2.65	0.14	1.07	0.49	0.77	2.33	0.01	5.13
8. transport and communication	1.47	0.14	1.03	0.24	0.00	1.27	0.03	2.91
9. not specified above and not recorded	1.73	0.13	2.98	0.67	0.70	4.35	0.11	6.32
10. total	7.26	5.65	115.23	29.91	1.47	146.61	0.86	160.38

Based on the National Sample Survey (NSS) : 9th Round : May—August 1955, sub-samples 1 and 2 only consisting of 8,027 rural and 16,703 urban households.

34. Table A.3.3 shows the incidence of "unemployment" among educated persons defined as matriculates or having higher educational qualifications. The concept of "unemployment" used is the same as that used in the advanced countries and is known to be much too restricted and hence unsuitable for underdeveloped countries. However,

using this strict definition of unemployment, it is of interest to observe [from col. (7), line 5] that there were about 0.47 million or 4.7 lakhs unemployed in 1955 out of a total of 5 million or 50 lakhs of educated persons altogether. Taking into consideration the facts that about 4 lakhs of candidates matriculated in 1955 and that the number is steadily increasing, it can be easily imagined how very difficult the problem of unemployment among educated persons would become in future, unless there is rapid economic development.

TABLE A.3.3. DISTRIBUTION OF TOTAL POPULATION AND UNEMPLOYED PERSONS BY EDUCATION CLASS: RURAL, URBAN & ALL INDIA : 1955

education class	rural		urban		all-India		percentage of unemployed		
	total	unemployed	total	unemployed	total	unemployed	rural	urban	all-India
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	..... million persons						....percentage....		
1. below matriculate	314.70	0.76	62.70	1.01	377.40	1.77	0.24	1.60	0.47
2. matriculate	1.10		2.40		3.50				
3. intermediate	0.19		0.65		0.84				
4. graduate and above	0.13		0.57		0.70				
5. sub-total (2–4)	1.42	0.16	3.62	0.31	5.04	0.47	11.42	8.59	9.40
6. total	316.12	0.92	66.32	1.32	382.44	2.24	0.29	1.99	0.59

Based on the National Sample Survey : 9th Round, May–August 1955, sub-samples 1 and 2 only, consisting of 8,037 rural and 16,703 urban sample households. Growth of population calculated on the basis of the Census 1941–51 rate of 1.32 percent per annum.

General and professional education

35. Table A.3.4 shows the number of persons passing different examinations in India each year from 1950 to 1955 based on information collected by the Planning Commission. There is no doubt that general education is increasing quite fast. In most cases numbers have more than doubled in five years since 1950. The number of matriculates was over 4 lakhs in 1955 which represented about 1050 matriculates per million of the population. The number of first graduates was about 57,000 or about 150 per million which is comparable with an out-turn of about 20,000 graduates in the UK with a population of 51 million or 392 per million. A comparison can also be made on the basis of literate persons. The number of literates in India in 1955 was about 63.2 million (all ages below 5 are omitted in calculations relating to literacy). The number of matriculates in 1955 was thus about 5300 per million literates; and the number of first graduates was about 900 per million literates. In the UK the number of persons of age 5 years or more was about 44 million and this would be also the number of literates (because of universal literacy) and is comparable to 63 million literates in India. On the basis of an out-turn of about 20,000 graduates per year in the UK, the number would work out at about 450 graduates per million literates. The proportion of graduates in India in relation to literates (900) would thus seem to be double that of the UK (450). This supplies some interesting information on social differentials in education.

TABLE A.3.4. GENERAL AND PROFESSIONAL EDUCATION : ALL INDIA 1950–1955

qualification	number of persons qualifying in						index-number: 1951=100
	1950	1951	1952	1953	1954	1955	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General education							
1. Matriculation	1,89,184	2,41,143	2,61,059	3,34,760	3,97,005	4,00,014	166
2. Intermediate	59,283	72,685	77,836	89,021	1,04,851	1,26,476	174
.1 Arts	41,652	47,013	52,373	59,703	71,640	86,741	185
.2 Science	17,631	25,672	25,463	29,318	33,211	39,735	155
3. First degree	28,745	32,238	36,136	40,033	50,178	57,051	177
.1 Arts	19,212	21,251	24,965	27,491	35,773	40,444	190
.2 Science	9,533	10,987	11,171	12,542	14,405	16,607	151
4. Master's degree	5,581	7,138	7,734	7,855	9,777	11,013	154
.1 Arts	4,503	5,729	6,054	6,161	7,709	8,802	154
.2 Science	1,078	1,409	1,680	1,694	2,068	2,211	157
5. Doctorate	115	146	164	123	280	324	222
.1 D.Phil.(junior)	56	136	159	115	269	n.a.	(198)
.2 D.Sc.(senior)	59	10	5	8	11	n.a.	(110)
6. total	2,82,908	3,53,350	3,82,929	4,71,792	5,62,091	5,94,878	168
Engineering and technology							
7. Certificate	566	14,189	13,604	17,418	15,718	18,588	131
8. Diploma	784	1,547	2,871	2,575	3,148	3,774	244
9. First degree	1,923	2,189	2,510	3,046	3,520	3,583	164
10. Master's degree	50	66	82	69	211	144	218
11. total	3,323	17,991	19,067	23,108	22,597	26,089	145
Medical science							
12. Diploma	50	117	120	267	—	—	—
13. First degree	2,017	1,624	1,985	2,146	3,131	—	(193)
14. Master's degree	19	256	261	350	693	—	(271)
15. Doctorate	52	54	55	63	48	—	(89)
16. total	2,138	2,051	2,421	2,826	3,872	—	(200)
Agriculture							
17. Certificates	459	783	1,120	982	999	1,510	193
18. Diploma	585	661	352	691	563	778	118
19. First degree	1,067	1,118	984	914	1,004	971	87
20. Master's degree	146	151	209	190	198	193	128
21. total	2,257	2,713	2,665	2,777	2,764	3,452	127
Veterinary science							
22. Diploma	62	34	37	—	—	—	—
23. First degree	112	242	237	252	298	300	124
24. Master's degree	—	—	—	—	135	147	—
25. total	174	276	274	252	433	447	124

Notes : (1) Index-numbers within brackets are for year 1954.

(2) Source of information : Division of Perspective Planning, Planning Commission.

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