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CLASSIFICATION AND ANALYSIS OF INDUSTRIES BASED ON KNOW-HOW AND SKILLS

by

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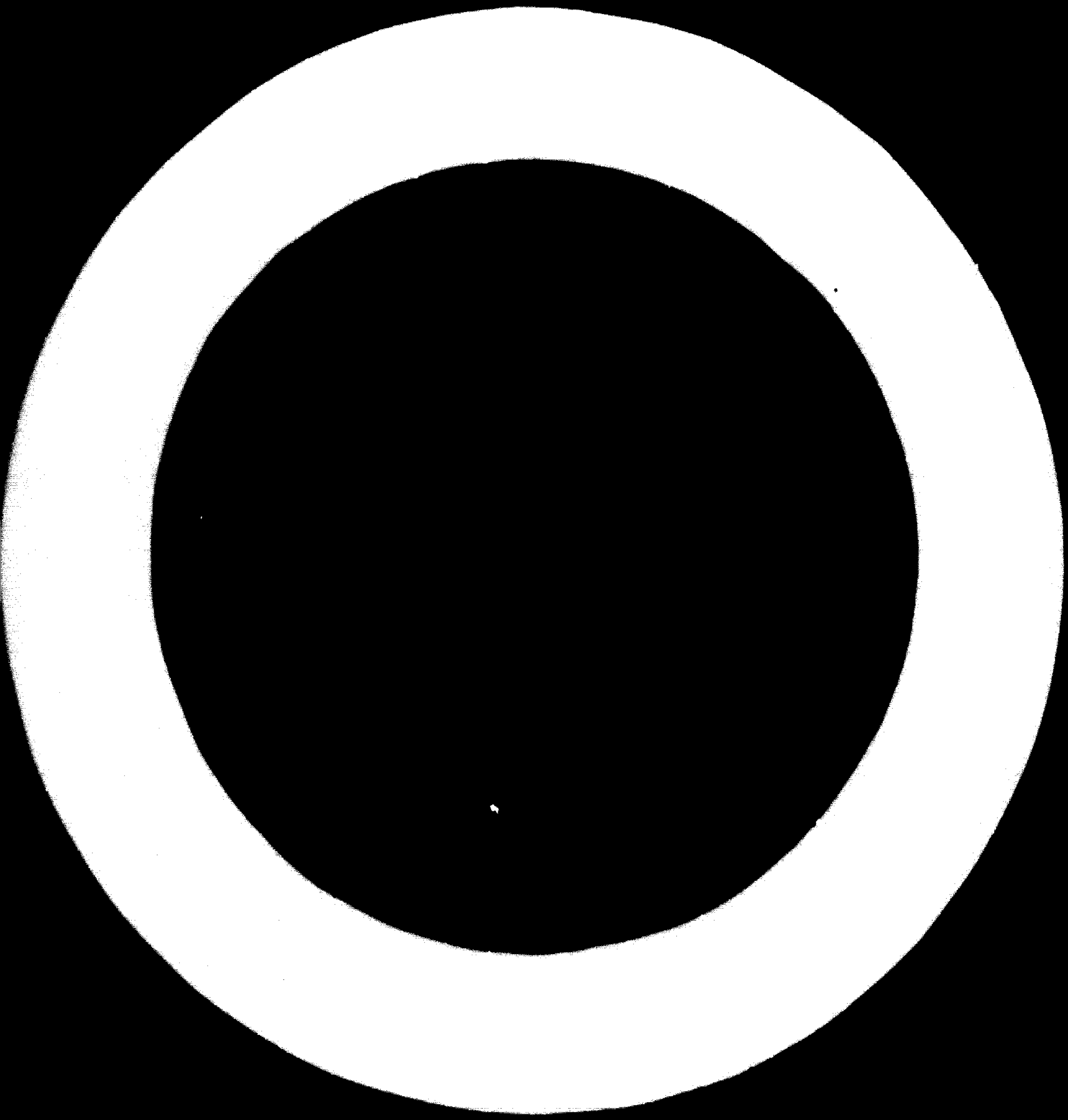

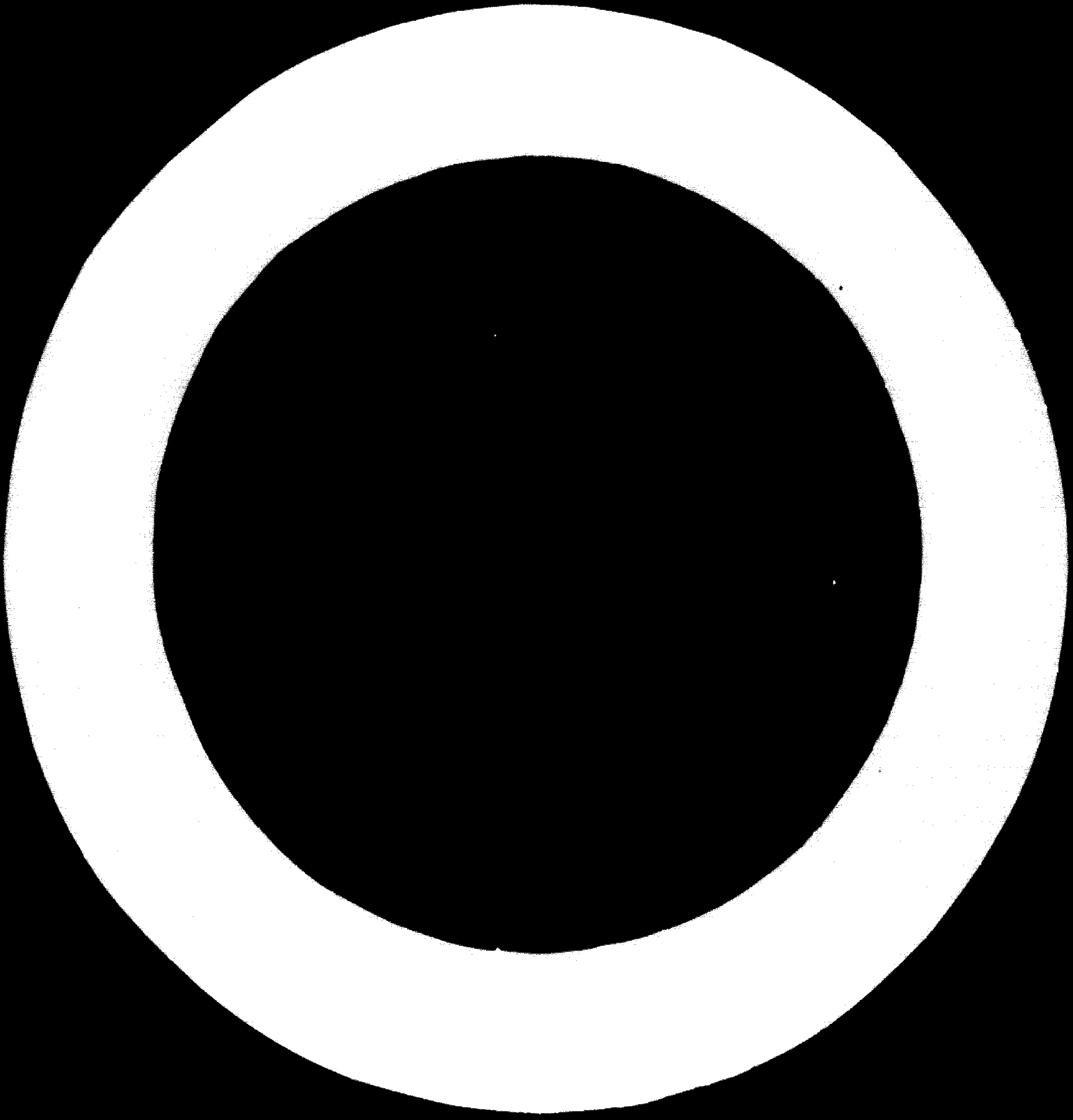

1. Introduction

Industrial development is in the center of modern economic development. The development of up-to-date large-scale industrial production requires a long time and important investments. Some time ago it seemed that the main difference between the developing and the industrially developed countries consisted of the modern machinery, equipment, factory-buildings existing in the latter. More comprehensive investigation, as well as practical experience proved, however, that although the creation of the material basis, (the scarcity of capital) certainly hampers rapid development, the lack of engineers, technicians, skilled workers and other qualified personnel, who are able to use the modern technical methods is an even more important hindrance to development. Machinery and equipment, and for a certain time also leading personnel and instructors, can be imported; the masses of the productive man-power can be composed only of the nationals of the country and it is an exigence of the national interest to form and employ nationals also as leading specialists.

The training and education of the industrial man-power takes a long time. This creates - because of the rapid scientific and technical development - increasing problems even in the developed countries. The problems are even greater in the developing countries. These situations have been recognized by the governments of the developed countries which make - also because of other social and cultural reasons - great efforts for the development of education. Appreciable help is given in this by the UN, UNESCO, other international organizations and also by the developed countries.

The preparation of the labour force for industrial development and the acceleration of this development require a clear view concerning the structural changes of the labour force, which are a precondition as well as a consequence of industrial development. This is particularly important for the developing countries, which can import industrial machinery, equipment and technologies, but cannot take over without changes in either the structure of the labour force or their education - and training - systems.

The aim of this study is to give information on the structural change of the labour force which goes together with industrial development, on the possible

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classification of industries based on the quality and structure of the labour force, as well as on the change of this latter, and on some main conclusions which can be based on the analysis of the changing man-power structures.

2. Industrial Development and Structural Change of the Labour Force

Industry is in the heart of contemporary social and economic development. The developed countries, that is the majority of the European countries, the U.S. and some other countries all have developed industries. The rest of the world, and in particular, the previously colonial countries are just beginning to build modern industries, which are considered essential to economic and social development. It is generally admitted, that one of the crucial problems of industrialization and perhaps even the most crucial one is the development of industrial man-power; such development takes place within the framework of the overall structural change of the whole working population.

Industrial development can certainly be accelerated if the interconnections between industrialization and the structural change of the labor force are recognized. The basic aspects of these interconnections are well known (and developed in detail in studies of Colin Clark, Jean Fourastier and others). A brief survey of the whole development seems, however, useful in order to place the more special man-power problems of the industry into the proper perspectives.

At the beginning of the era of modern economic development, in the now industrially developed countries, or perhaps more exactly at the beginning of the (first) industrial revolution, 80-90 percent of the total working population was occupied in agriculture. The rest of the labor force belonged to industry (and construction) and the other service type sectors. Small-scale enterprise connected with the family type of work organization was predominant.

This type of production, with mostly simple technologies, was mainly manual. The rate of illiteracy was very high. Skills were acquired by practical experience.

Industrial development and its impact on the labor force can be characterized by the following main features:

The productivity of agriculture increased faster than agricultural production. Employment in agriculture decreased. Unemployed and under employed persons migrated from agriculture to the non-agricultural sectors.

Large-scale enterprises based on the use of machinery and mechanical equipment appeared and became predominant in the industrial sector. The role of small-scale and domestic industry decreased within total industrial production (but conserved and even partly increased its activity in the field of services). Industrial production increased rapidly, the main source of the increase being for a long time the increase of industrial employment. Towards the end of this extensive-type of industrial development, the share of industrial employment increased to about 30-40 percent, while agricultural employment decreased to about 25-35 percent of the total. At the same time, the rapid development of agricultural and industrial production also generated the development of transports, of trade and of other service-type sectors; the employment in these reached about 30 to 40 percent of the total.

Industrial development generated the structural change of total employment: man-power shifted from agriculture to industry and services. The sex-composition of the labor-force (or more exactly of the labor force in non-family type enterprises) also changed, with women leaving households and taking jobs. The increase of female man-power was, together with the increase of the population, the main source of the increase of total employment. The educational level of the labor force increased substantially. This was required mainly by the technological development of production and resulted in the elimination of illiteracy through general primary education. As it will be discussed later, more in detail, the importance of all of forms of schooling increased in the development of the labor force.

With the disappearance of the formerly prevailing abundancy of the labor force the extensive-type industrial development came to an end. Less man-power became available out of the traditional sources, namely agriculture and households, and the service (tertiary) sectors absorbed a larger part of the total increase. As a consequence, the increase of industrial production became more and more a result of the increase of productivity, instead of the increase of employment. This characterizes a new stage of economic development.

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In this new "intensive type" development period, machinery and new scientific production methods are introduced also into agricultural production faster than previously. The share of agricultural employment continued to decrease to (in the most developed countries) 4 to 14 percent. In this period, with large-scale production already predominant in industry, automation is beginning. The role of domestic and small-scale industrial production is insignificant, and the increase of the industrial labor-force is being determined by the increase of the population (disregarding the case of foreign labor-force in some countries), its share within total employment is already even decreasing in the most industrially developed countries. Employment in some industrial sectors is stagnating or even regressing, furnishing one of the sources of man-power for the dynamic, rapidly increasing industries. Regional development with regard to man-power resources is acquiring more and more importance in total industrial development.

The further increase of material-goods production naturally also generates the further development of transportation and trade. Up-to-date technical and organizational methods also increase their role in these sectors. Education and health services, as well as public administration, also absorb an increasing share of the labor force. The number of employed in these sectors increases more rapidly than previously and their share in total employment surpasses that of industrial employment; in the actually most developed countries, even the share of employment in industry and agriculture are taken together.

Modern technological methods are becoming predominant in every field of human activity. Automation is gradually expanding, and science appears as a direct productive force. Organized formal education is acquiring the leading role in the formation of the skills necessary for production. The previously not fully recognized interconnections between education and the economy are becoming more and more apparent. It is more and more admitted that the rate of economic development is determined directly and largely by the educational level of the labor-force.

This structural change of the labor force within the three main economic sectors is shown in Table 1, with the help of statistical data covering 24 countries and the period from the end of the last or the beginning of this

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century to up to the years 1960-1965. It is easy to recognize the clear tendency of the decrease of agricultural and the increase of the share of employment in services, as well as the connexion of these changes with the general level of economic development. Table 2 covers more countries, also including the developing countries and gives figures for a more recent year. This distribution of the labor force into the main economic sectors, and in particular, the low participation in industrial activities in the developing countries is - as it is well known - a very characteristic feature. The distribution according to occupational groups is showing the higher share of highly qualified specialists, as well as of clerical, and sales workers, at higher levels of development. Finally, the increased share of salaried employees and wage earners in the total labor force demonstrates the increased importance of large-scale enterprises in the more developed countries.

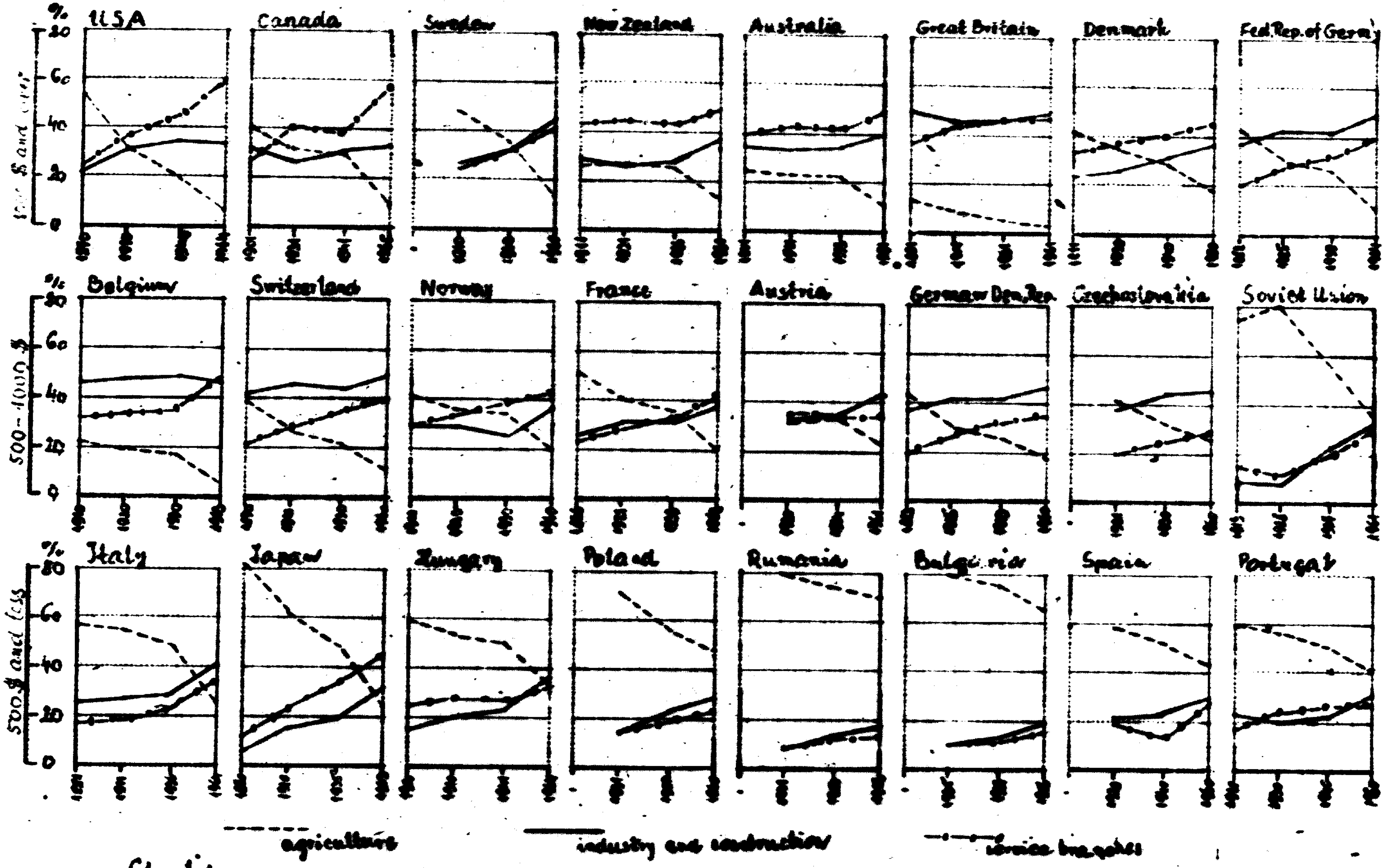

Chart 4. Structure of employment in the main economic sectors in per cent of total employment, in selected countries.

Table 1.

Structure of employment in the main economic sectors in per cent of total employment. Selected countries

Country	Year I	Year II	Year III	Year IV	Agriculture I	Agriculture II	Agriculture III	Agriculture IV	Industry and construction I	Industry and construction II	Industry and construction III	Industry and construction IV	Services I	Services II	Services III	Services IV
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Annual per capita national income above $ 1,000																
1. United States	1870	1910	1940	1964	53	32	19	7	22	31	35	34	25	37	46	59
2. Canada	1901	1931	1941	1965	40	32	30	9	32	27	31	34	28	41	39	57
3. Sweden	.	1910	1930	1960	.	48	36	14	.	27	32	45	.	25	32	41
4. New Zealand	1911	1921	1936	1961	27	28	26	14	29	26	28	37	44	46	46	49
5. Australia	1901	1921	1933	1961	25	23	22	11	35	33	35	40	40	43	43	49
6. Great Britain	1881	1901	1931	1961	13	9	6	4	50	47	47	49	37	44	47	47
7. Denmark	1911	1930	1940	1960	42	35	29	18	28	26	31	37	30	38	40	46
8. Federal Republic of Germany	1882	1925	1939	1964	45	31	26	11	37	42	42	49	20	27	32	40
Annual per capita national income $ 500 to $ 1,000																
9. Belgium	1910	1920	1930	1963	22	19	17	6	46	47	48	46	32	34	35	48
10. Switzerland	1890	1910	1930	1960	38	27	21	12	41	46	44	49	21	28	35	39
11. Norway	1900	1920	1930	1960	42	37	35	20	29	29	26	37	29	34	39	43
12. France	1866	1921	1936	1962	51	41	35	20	28	31	31	38	23	28	33	42
13. Austria	.	1920	1934	1961	.	32	32	23	.	33	34	43	.	35	33	34
14. German Democratic Republic	1882	1925	1939	1960	43	31	26	18	37	42	42	47	20	27	32	35
15. Czechoslovakia	.	1921	1930	1960	.	42	30	26	.	38	46	46	.	20	25	28
16. Soviet Union	1913	1928	1937	1961	75	80	56	37	9	8	26	33	16	12	20	30
Annual per capita national income below $ 500																
17. Italy	1881	1911	1936	1964	57	55	48	25	26	27	29	41	17	18	23	34
18. Japan	1890	1910	1936	1963	82	63	48	24	6	15	19	32	12	22	33	44
19. Hungary	1900	1910	1941	1964	59	53	50	33	16	20	23	35	25	27	27	31
20. Poland	.	1921	1950	1960	.	71	56	48	.	15	23	28	.	14	19	24
21. Rumania	.	1931	1950	1966	.	81	74	70	.	8	14	17	.	9	12	13
22. Bulgaria	.	1935	1957	1956	.	80	76	65	.	10	13	19	.	10	11	16
23. Spain	.	1920	1940	1960	.	59	52	44	.	22	25	29	.	19	15	27
24. Portugal	1910	1930	1940	1960	59	56	51	42	25	20	22	31	16	24	27	27

Source: J. Timár: Planning the Labor Force in Hungary. International Arts and Sciences Press, White Plains, New York, 1966.

Table [illegible].

[illegible] IN PERCENT, [illegible] BY MAIN ECONOMIC SECTORS, BY OCCUPATIONAL GROUPS AND BY STATUS

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Country	Year	Agriculture	Manufacturing and construction	Others	Highly qualified [illegible]	Clerical and sales workers	Non agricultural workers	Agricultural employment	Salaried and wage earners economy as a whole	employees manufacturing
United States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Canada	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sweden	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Switzerland	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
United Kingdom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Australia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
New Zealand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
France	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Germany /Federal Republic/	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Norway	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Belgium	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venezuela	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Netherlands	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
U.S.S.R.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Austria	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Czechoslovakia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Germany /Democratic Republic/	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Italy	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Hungary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Poland	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rumania	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bulgaria	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cyprus	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Yugoslavia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Spain	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Greece	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Portugal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Trinidad and Tobago	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jamaica	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Panama	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ecuador	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chile	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nicaragua	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Honduras	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dominican Republic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Philippines	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Turkey	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Peru	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Syria	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Morocco	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
United Arab Republic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ghana	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Liberia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Republic of Korea /South/	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
India	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pakistan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Thailand	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: Yearbook of Labour Statistics, International Labour Office, Geneva, [illegible].

The development of the labor force of the individual industries - both from the point of view of the number of employed and of the level of skills - takes place and can be properly understood within this broad framework. However, in order to recognize the main causes for the differences in the skill-pattern of the different industries, a brief survey of the different technologies used in the different industrial sectors seems to be necessary.

3. Industrial Technologies as the Basis of Skill Requirements and their Impact on the Professional Structure

The different technologies used in individual industrial sectors, obviously, largely determine the character of the required man-power. Investigated in full detail, the different industrial technologies are very diverse. However, from a more general point of view, the industrial sectors can be classified according to the main characteristics of their technologies. These characteristics are connected on the one hand with the product itself, and on the other hand with the particular production techniques; the latter being of course largely determined by the chemical, physical, etc. characteristics of the products.
(Table 3)

One part of the products serving final consumption or further industrial use can be considered as homogeneous, having uniform physical and chemical qualities. The overwhelming part of basic and auxiliary materials, the products of mining, chemical and metallurgical products, textiles - in general the products of most of the industrial sectors - belong to this group. The products of some - and very important - industries are composed of parts having different physical and chemical qualities. These products which are fitted together by assembly processes can be called heterogeneous. The most important of such products are manufactured by the engineering industries like electrical machinery, vehicles, instruments, etc., but clothing, shoes, furniture also belong to this group. (Of course the above criterion - as well as the other criteria which will be discussed below - do not permit a very exact and unequivocal classification in every case. In the case of printing, for example, it is not easy to decide whether its products, namely books, newspapers, or reviews, should be considered homogeneous, or heterogeneous. The material itself, namely paper, has of course the same qualities. However, considering that the

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Table 3.

Characterisation of industrial technology of individual industries

Industry	Product				Production process				
	Product type	Product mix diversification	Product change	Product development	Production development	Production process-basic principle	Production process-batch size	Main process	
								type of labour skills needed	amount of preparatory work
1. Mining	homogenious	narrow	none	low	homogenious	mechanical	mass	traditional	medium
2. Metallurgy	homogenious	medium	slow	medium	homogenious	mechanical-chemical	mass	traditional scientific	medium
3. Engineering industries	heterogenious	wide	rapid	high	heterogenious	mechanical	individual serial mass	traditional scientific	high
4. Electricity	homogenious	narrow	none	low	homogenious		mass	scientific	low
5. Building materials industry	homogenious	narrow	none	low	homogenious	mechanical-chemical	mass	traditional	low
6. Chemical and rubber industry	homogenious	medium	slow	high	homogenious	chemical	mass	scientific	medium
7. Wood processing /furniture/	heterogenious	wide	rapid	medium	heterogenious	mechanical	serial	traditional	medium
8. Paper industry	homogenious	medium	slow	medium	homogenious	mechanical-chemical	mass	traditional	low
9. Printing	heterogenious	wide	rapid	low	heterogenious	mechanical	serial	traditional	medium
10. Textile industry	homogenious	medium	slow	low	homogenious	mechanical	mass	traditional	low
11. Leather and fur industry	homogenious	medium	slow	low	homogenious	mechanical	serial	traditional	low
12. Clothing industry	heterogenious	wide	rapid	low	heterogenious	mechanical	serial	traditional	medium
13. Food industry	homogenious	narrow	slow	low	homogenious	mechanical-chemical	mass	traditional	low

products are diversified and that bookbinding is an assembly-type operation, it seems appropriate to consider printing as an industry producing heterogeneous products.)

The production process is determined by the diversification of the product mix of the industry in question, or more exactly of the single plant belonging to the industry. There is certainly some connection between technology and the fact as to whether the plant produces a larger variety of products or a narrower one. In the case of homogeneous products, the diversification is generally narrower and with heterogeneous products usually wider; this, however, is only the general tendency and not the absolute rule. If we disregard by-products and less important products only one product is produced by (electrical) power plants, by the plants of the building materials and (in most cases) by the plants of the food industries, as well as by single mines for which, as already mentioned, the character of the products is homogeneous. A wide diversification of products characterizes in general the engineering and the clothing industries, although there are some plants belonging to the engineering industries which produce only a few, or in some cases, even only one product. (For example in the case of radio receivers, TV-sets, or passenger cars.) However, there are some industries, for example, the chemical industry and in particular the production of drugs, with which, although the product itself is homogeneous, the variety of the products to be considered is at least moderately wide.

The variety of the products (diversification) is also important because this fact will largely determine whether the products manufactured are changing and with what frequency. This fact is closely connected with product development and therefore with the requirement of highly qualified technical man-power. It can be observed in this respect that there is no change or only a very slow change in industries where the product is homogeneous and the diversification rather narrow; for example, in the case of electricity or of building materials. In the case of heterogeneous products and wide product diversification - for example in the clothing industry or in several sectors of the engineering industries - the change of products is very frequent. The rate of change of the products has an impact on the amount of work to be devoted to product

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development, but it is not the only decisive factor. There are industries in which, although there is a high frequency of change (for example the clothing industry and in the production of furniture), the amount of work going into development is not particularly important because the new products are similar to the old and change takes place rather to suit changing fashions. In addition, these products are not particularly complicated. Of course, it may happen that some changes require a more important development-work, for example some new procedure of glueing (fastening) in the shoe industry. However, in these cases the change is mostly affecting the production process and only secondarily the product itself. The most important changes affecting the product are primarily connected with the material used (for example, the introduction of synthetic fibres in the clothing industry or of the Corfam artificial leather in the shoe industry); the actual development is concentrated in these cases into the industry producing the basic materials in question.

The characteristics of the products mentioned above largely determine the characteristics of the main technological processes. We consider "main process" to be such operations which contribute to shaping the product itself, distinguishing them from the auxiliary processes, like material handling and maintenance. The main production processes can be classified - like the products - into homogeneous and heterogeneous types. In the case of the homogeneous processes, the same operation is continuously performed with the help of the same machinery or equipment; in the heterogeneous case, operations are changing with more or less frequency. There is a rather close connection between the character of the products and the production processes. Industries having homogeneous products have also homogeneous technologies. The case is similar with the heterogeneous products fitted together by assembly operations; here the main production processes are usually heterogeneous. For example, the machine tools of the engineering industries usually serve to produce parts having different shapes and being of different material.

It seems appropriate to distinguish also the scientific - technological principles of the technological processes. The process is either changing only the shape of the material applying mechanical technology or performing chemical changes applying chemical technologies. The character of the technology

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influences the requirements in the highly qualified technical labor and, of course, also the basic knowledge necessary for manual workers. Chemical technologies are obviously utilized in the chemical industries, both chemical and mechanical technologies are utilized in metallurgy, in the building materials industries and in some sectors of the food industries and mainly mechanical technologies in the other industrial sectors. Technological processes and, in particular, their organization is different according to the batch-size. In this respect, we distinguish individual, serial and mass-production. As a rule there is mass-production in the case of homogeneous products and processes and serial production in the heterogeneous case. In the engineering industries, all three cases, namely individual, serial and mass production can be found.

The skill requirements - mainly form the point of view of the skilled workers - can be "traditional" or "scientific". The skills which require mainly practical experience and know-how, and in the case of which the skills of the large-scale industries are the organic continuation of the artisan skills can be considered "traditional". In the case of the "scientific" skills, manual dexterity has less importance. The essential thing is the control of the processes with the help of instruments and regulation based on the observation of these instruments. Long practical experience is not so important to perform these jobs as is a higher educational level, the comprehension of the production processes, and of written instructions and the aptitude to make the required written reports. Now, if we classify the individual industries from the point of view of this last criterion, and if we disregard the cases of the total automation which are rather exceptional, even in the most developed countries, the traditional skills are predominant in the light industries (except perhaps paper production), and in the food industries. Scientific skills are predominant in the chemical industries and in electricity. The skills of the engineering industries and of metallurgy are partly traditional and partly scientific.

From the point of view of the relationships of men performing the job and of the machinery the technological processes can be classified into the following categories:

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1) Manual work performed without tools or with the simplest tools;
2) Manual work performed with the help of mechanical (power-driven) tools;
3) Work performed with the help of machinery with a predominance of manual work (for example the feeding of production machinery with material, the feeding of material handling equipment;
4) Work performed with the help of machinery with the predominance of the mechanical work, the operations performed concerning mostly (but not exclusively) the direct control and regulating of the equipment;
5) Control of more complex equipment, the whole process taking place in principle without interference of the worker, the task of whom concerns mainly some corrections in the process or trouble-shooting.

Actually the types of jobs characterized under 3) and 4) above are the most important in the majority of industries. Of course, manual work is still necessary at least for maintenance. Automated processes mentioned under 5) are important mainly in some chemical industries and in electricity production. If we consider the cases listed under 1) - 5) as successive steps of mechanization and automation, we can state that the introduction of the higher technological stages is facilitated by increasing homogenity of the products, increasing batch-sizes and decreasing frequency of product-changes. The tendency of technical development is to increase the role played by the higher technological stages and the regression of the lower stages in the main technological processes and in material handling. (The situation is different in the case of maintenance.) The above stages - if we disregard maintenance - require different types of skills. Lower skill levels, that is unskilled or semi-skilled workers, are required by manual work and by the work on machinery with a predominance of manual tasks. The characteristic skilled worker of large-scale industries, for example, the turners in the engineering industries, perform the task described under 4). The control of the equipment mentioned under 5) requires a new type of skilled worker. In this case, aptitudes like attention, thoroughness and reliability, as well as appropriate schooling is more important than special professional skills. This type of skilled worker can therefore shift more easily from one industry to the other in his particular field, while such changes are much more difficult for the actually more characteristic type of skilled workers in large-scale industry.

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Material handling and maintenance form, of course, an integral part of the total technological process. The jobs connected with these are characterized by the fact that the skill requirements are not or not only connected with the main technologies. To maintain buildings we need skills of the building industry and to maintain machinery mainly skills which characterize the engineering industries. Of course, the maintenance of textile-producing equipment or of machinery in the food industry will also require special experience in these industries. Skill requirements in material handling are generally not very high and connected mostly to the character of the material. (For example, liquids or solids, large and heavy or small and light pieces, etc.) The influence of these different technologies on manpower, in the case of individual industries, will be discussed in the following chapters more in detail.

4. Classification of Industries Based on the Quality of the Labour Force

Before the present era of large-scale industries, the production of industrial goods took place in artisanal and small-scale shops. Here the same person generally performed the whole production process without division of labor into intellectual or manual work or into simple or more complex operations. Mechanization and large-scale production, to the contrary, is characterized by detailed division of labor. Management, organization and control of the production are now the main task of technical and scientific, but also of other highly qualified personnel.

The tasks of these highly qualified specialists are being differentiated further by technical development. This differentiation is taking place concerning both: a) the special field of science or technology, (e.g., mechanical, chemical, etc. engineers), and b) the educational level. In this latter respect there are in most countries technical specialists with full university (academic) curricula and technicians having completed secondary type education. In some countries there is a third type of technical education, intermediate between the secondary and university level with two or three years courses based on a previous secondary level curriculum.

The tasks of the manual workers are also differentiated by technical development. From the point of view of skill requirements there are three

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main levels. The more sophisticated operations are performed by skilled workers, the education of whom requires a longer period (generally several years), organized apprenticeship and education. A second group of workers perform simpler tasks for which training periods of some weeks or at most of some months are sufficient. This group - for example, machine operators or personnel on some assembly lines - are called semi-skilled workers. The group of non-skilled workers performs tasks not requiring any previous organized training, e.g., material handling and other auxiliary type jobs.

Manual work is also differentiated as to its technical content. A rather important part of the artisanal skills is losing ground or even disappearing. Other crafts acquired new content conserving the old name. New technologies, in particular electronics, gave birth to practically completely new skills.

As a result of the division of labour briefly described above on the one hand and the special technologies characterizing individual industrial sectors and discussed more in detail in Chapter 2 on the other hand, certain skill-patterns became typical for the different industries. These skill-patterns can be described from two different aspects, emphasizing either the level of education of the labour force or its skill structure.

The particular industrial sectors are characterized by one or more of the following three conditions: a) the use of the same (or of a similar) materials, b) production of the same (or similar) type of products, and c) as a result of the foregoing, the same or similar technology of production. It can be argued on purely logical ground that these similarities should require similar skill patterns for plants belonging to the same industrial sector and similar skill patterns for the same industrial sector even in different countries. Now, if there really are such similarities in the skill inputs of the individual industries, the clear recognition of the relevant interrelationships will be helpful in planning and promoting industrial development, providing a better possibility to gear industrial development to the existing (or forseeable) labour force, on the one hand, and to develop a labour force according to existing (or possible) industries.

However, some remarks seem to be necessary in this respect.

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1) The labour force or more exactly its skill pattern - which is one of the most important or even the most important input of industrial production - is more flexible than other types of inputs, the possibilities of substitution being much wider. To produce one given product, the materials to be used should usually be exactly the same. In some cases a few different material mixes are possible. As to the skill content of the labour force, there are always more possibilities of substitution between adjoining categories, for example, between engineers and technicians, skilled and semi-skilled or semi-skilled and unskilled workers. The same is largely true concerning the special crafts, identical operations being performed, for example, by mechanicians or fitters, etc.

2) The effective skill-content of the same profession or craft is not always identical in different countries, or sometimes even in one and the same country. Professional denominations are largely traditional and by no means rational or based on scientific analysis. For example, engineers and technicians can have formal schooling of very different levels in different countries. In one and the same country, skilled workers in different industries can have different effective qualifications, having undergone different types of training. (In Hungary, for example, practically all of the skilled workers of the engineering industries completed at least three years of organized apprenticeship after leaving primary school. In the clothing industry, on the other hand, as well as in the production of construction materials, about fifty percent of the skilled workers are considered, as such, on the basis of practical experience and have no formal school-type certificate.)

3) Data on the qualification of the labour force in national statistics are very often scarce, especially concerning the subdivision into the different industrial sectors. Such data are even often contradictory. In the United Kingdom, for example, 1961 and 1965 data on the proportion of the skilled workers in the clothing industry varied between 12 and 74 percent. Similar variations are found for leather production, namely between 21 and 79 percent and for wood products and furniture between 52 and 78 percent. One part of this difference is of course explained by a difference of coverage, but even the

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differences between statistics having apparently the same coverage seem to be quite large.[1]

4) The international comparability of labour statistics concerning qualifications is, in spite of some efforts made by international organisations, very restricted.

Bearing in mind the foregoing, and within the limits of the available information, it will be attempted in the following to investigate the differences in the skill requirements of individual industries in three respects, namely concerning:

(A) the average skill content (or quality) of the labour force;
(B) the requirements of the highly qualified technical labour force (engineers, scientists and technicians);
(C) the requirements of manual workers, mainly skilled and semi-skilled workers.

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[1] Computed on the basis of:

	Clothing	Leather	Wood processing
a) 1961 Census, Industry Table Part I. Table 5	30	79	78
b) 1965 Annual Abstracts of Statistics No. 102. Table 131	74	53	60
c) 1965 Industries in G.B. Ministry of Labour Gazette. Jan. 1966. Table 23	77	57	63
d) 1965 Industries in G.B. Ministry of Labour Gazette. Jan. 1966. Table 1-20.	12	21	52

The difference between c) and d) is caused by a different interpretation of the "skilled worker" level; d) refers to "Skilled operatives" covering also semi-skilled workers, while c) only to workers having undergone apprenticeship or equivalent training.

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A) Classification of industries based on the average skill content of the labour force

As already mentioned above, the principal method of transmitting the knowledge and skills necessary for production was, before the industrial era, the direct passing on of working experience. Formal education in schools did not play a major role as far as the training for production was concerned. The knowledge necessary to perform certain operations - at times even complex operations and accordingly requiring sophisticated knowledge - was transmitted orally and by practical experience from generation to generation. As a contrast in the now industrially developed societies the, by far, overwhelming part of technical knowledge and experience is laid down in written form. Formal education in schools plays the central role in the training and development of skills. This of course does not mean that the direct handing over of working experience, in general on-the-job training does not have an important role in industrial societies, but it is rather a continuation and completion of formal schooling and very largely based on this latter.

The quality of the labour force is therefore largely determined by the levels of schooling. There is, however, no exact and internationally accepted method to measure and compare the quality and complexity of labour. Several methods have been proposed in this respect, based essentially on three types of consideration.

Some economists suggest measuring the quality and complexity of labour on the basis of the wages earned by the given category of man-power. This method presupposes a perfect market mechanism under which every good - including labour - will be bought and sold at the most "rational" price. As it is necessary to have more schooling in order to perform more complex tasks the investment in schooling is repaid, even with a certain rate of interest, by the higher wages earned by labour of higher quality. Although this type of reasoning may have some justification, it does not seem to be appropriate to measure the differences in the quality of labour according to this method. As it is well known occupational wage differences are also influenced by various factors other than the effective skill content, as occasional scarcities, traditional status, the physical effort required, working conditions, etc. It can even be observed, in industrial countries, that the wage-differentials between the simple and the more complex tasks have a tendency to decrease, while the differences in the required qualification are rather increasing.

Another method of measuring the quality of labour is based on the length the educational curriculum (number of years spent in school or in formal training). This method eliminates the distortions due to accidental wage differentials. However, the costs of education, both from the point of view of the society and the individual, are very different on the different stages of schooling; lower at the beginning and higher later on. This is so, not only because the costs of education are higher at the secondary than at the primary level and even higher at the university or post graduate level, but also becaus the "opportunity cost" of keeping a person away from the working population, th loss of national income for the society and the loss of earnings for the individual being higher for persons more aged and having more education.

The method which is proposed here for the measure of the quality and complexity of labour takes into account not only the time spent in school (or in other formal training), but also the total costs of education at the different educational levels. These costs comprise (1) investment, personnel and materia cost of educational institutions, (2) costs of living of the students; (mainly borne by the families); (3) other costs connected with the students, borne by the society (grants, scholarships, etc.), and (4) the opportunity cost of education for the society, namely the loss in national income because of the delay to enter the working population.

The relative levels of the quality and complexity of labour based on this reasoning and on actual Hungarian data are the following:

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Occupation	number of years	ending level	Level of complexity of labour
	of schooling		
Unskilled worker	8	elementary	1.00
Skilled worker	11	apprenticeship	1.33
Technician	12	secondary	1.92
Engineer	17	university	3.81

Source: J. Kovács: Education and investment.
Review Economique, No. 7-8. 1966.

On the basis of this or some other appropriate system of weights, the average level of qualification of the labour force can be computed for the individual industrial sectors, provided that the scholarity level or more exactly the number of years spent in school be known. This method will give better results than taking into account only the number of years spent in school, because the importance of the more highly qualified man-power will be more appropriately reflected. Sufficiently detailed data were available only for two countries, namely for the United States and Hungary. Consequently, the comparison and analysis was worked out for these countries and based on effective length of education and training, but on Hungarian costs.

(It has to be noted, that international comparisons are never accurate from every point of view. In the present case the weights are based on the relative costs of education of the Hungarian school-system, as well as on Hungarian costs of living. American costs would be of course different. However, as the aim of the comparison is only to demonstrate general tendencies, this system of coefficients can be accepted.

Table 4 shows the average complexity of labour in individual Hungarian and American industries, as well as the deviation of the industrial average in both cases. Some important conclusions can be drawn from these data.

The comparison deals with countries being on very different levels of economic and industrial development. Accordingly, the resulting coefficients

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Table 4.

The level of complexity of labour in selected industrial sectors in the U.S. in 1960 and in Hungary in 1960

Industry	Average level of complexity of labour		Industry total = 100	
	USA	Hungary	USA	Hungary
1. Mining	1,79	1,06	110	98
2. Metallurgy	1,49	1,05	92	97
3. Engineering industries	1,70	1,24	104	115
3.1 Machinery except electrical	1,70	1,17	104	109
3.2 Electric machinery and appliences	1,71	1,23	105	114
3.3 Precision engineering	1,71	1,46	105	136
3.4 Iron and metal mass products	1,63	1,09	100	101
4. Building materials industry	1,47	0,91	90	84
5. Chemical and rubber industry	1,89	1,16	116	108
6. Wood processing industry	1,32	0,99	81	92
7. Paper industry	1,50	1,02	92	95
8. Printing	1,74	1,20	107	111
9. Textile industry	1,47	1,03	90	96
10. Leather and fur industry	1,50	1,03	92	95
11. Clothing industry	1,50	1,01	92	94
12. Food industry	1,47	1,00	90	93
Total	1,63	1,08	100	100

Computed on the basis of
R.S. Eckaus: Economic Criteria for Education
and Training, The Review of Economics
and Statistics, May 1964 and
Hungarian 1960 Population Census

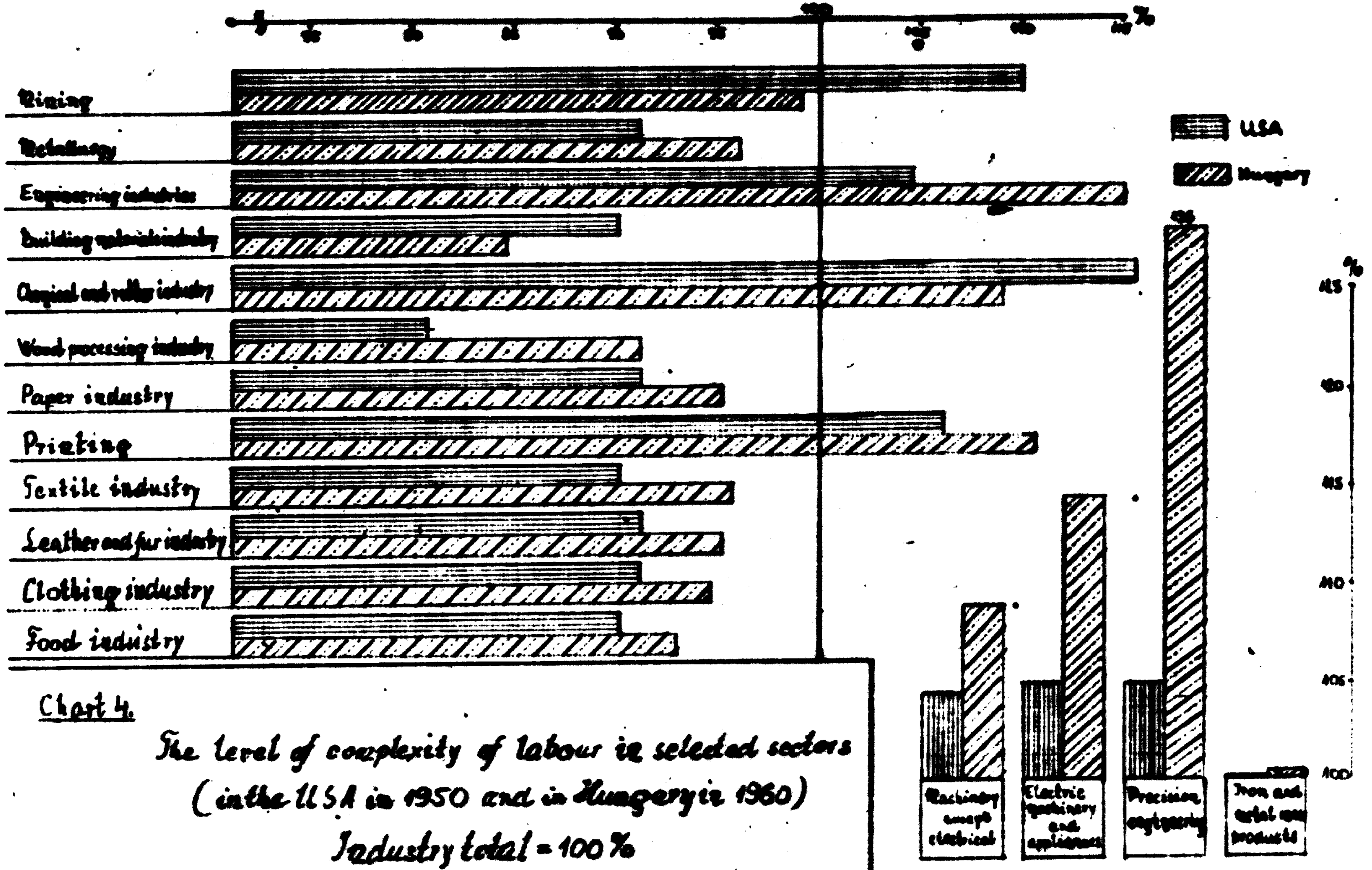

Chart 4.

The level of complexity of labour in selected sectors
(in the USA in 1950 and in Hungary in 1960)
Industry total = 100 %

are higher in the American industry both for the individual sectors and for the industry as a whole. However, in spite of this difference and in spite of the difference in the size and other circumstances of the two industries, the deviations of the individual sectors from the industrial average are similar in the two countries. The differences in the distance from this average are of 30 points in one case (precision engineering) and of 8-12 points in 4 further cases (chemical industry, mining, electric machinery, wood processing) with no appreciable difference being shown with the 10 other sectors. It is even more characteristic, that - with two exceptions - the complexity of labour can be classified as high, medium or low in the case of the same industrial sectors, compared to the average of the industry as a whole. As it is shown on Table 5, this coefficient is medium, for both countries that is within ± 3 percent of the industrial average, in the case of the iron and metal mass production. We have an average complexity level in mining and metallurgy in Hungary, while according to the data the level is high in mining and low in metallurgy for the United States. The difference for mining can probably be explained by the fact that share of less qualified labour decreased in the United States because of the favourable geological conditions and the high level of mechanisation. In Hungary, to the contrary, geological conditions in mining and, in particular, in coal mining are much less favourable and production is - partly also because of the former reason - considerably less mechanized, the share of less qualified labour being therefore higher. It is more difficult to find an explanation for the difference in metallurgy. (Long term statistics show that the absolute number of skilled workers decreased in the United States since 1920. This is perhaps connected with a type of technical development reducing particularly the number of skilled workers.)

At any rate the conclusion can be drawn that the relative qualification-level of the labour force employed in individual industries is determined basically by the industrial technology, more or less independently from the size of the country or from the actual level of development of the industry.

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Table 5

Comparison of Industries in the U.S. and Hungary According to the Average Complexity of Labor

United States	Both countries	Hungary
	I. High	
Mining	Chemical & rubber industry	
	Engineering industries	
	Machinery except electrical	
	Electrical machinery and appliances	
	Precision engineering	
	Printing	
	II. Medium	
	Iron and metal mass products	Mining
		Metallurgy
	III. Low	
Metallurgy	Building materials industry	
	Wood processing industry	
	Paper industry	
	Textile industry	
	Leather and fur industry	
	Food industry	

B) Classification of Industrial Sectors Based on the Share of Highly Qualified Technical Man-Power (Engineers, Scientists, Technicians)

The increase of the number of white collar workers, in particular the increase of the number of highly qualified technical specialists, is a well known phenomenon going with economic and technical development. It is less known how the share of this highly qualified man-power compared to the total labour force is distributed among the main sectors of the economy and among the individual sectors of the industry. We are interested here in this last aspect of the problem. Appropriately detailed data are available for the United States and Hungary and contained in Table 6. As can be expected, the number of technical specialists per 1,000 of employed is substantially higher in the industry of the U.S., namely, 70 against 40 in the Hungarian industry.[2]

The deviations of individual sectors from the industrial average can be very important. The range is between 11 and 257 per cent in the U.S. and between 33 and 205 per cent in the case of Hungary. Compared with this wide range, the difference between the technical skill-intensities concerning the same individual industries of the two countries are not very considerable. If we group the individual industries in three categories, having high, medium and low skill-intensities (shares of highly qualified technical man-power) - as it was done in Table 7 - we find a difference only for metallurgy, which shows high intensity in Hungary and low intensity in the U.S. Consequently, industrial technology again is found dominant in determining the relative requirements in highly qualified technical man-power.

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[2] The real difference is probably less important. Hungarian data refer to the number of persons having obtained the appropriate diplomas while the American data concern persons working as engineers, technicians or as scientists. Now, according to the U.S. Census of Population 1960, only a little more than 50 per cent of persons working as engineers and only about 75 per cent of persons working as scientists had completed university education of 4 years or more, and only 80 per cent of persons working as technicians had at least 12 years of schooling. Adequate corrections would bring the U.S. figure substantially down, or alternatively raise somewhat the Hungarian figures.

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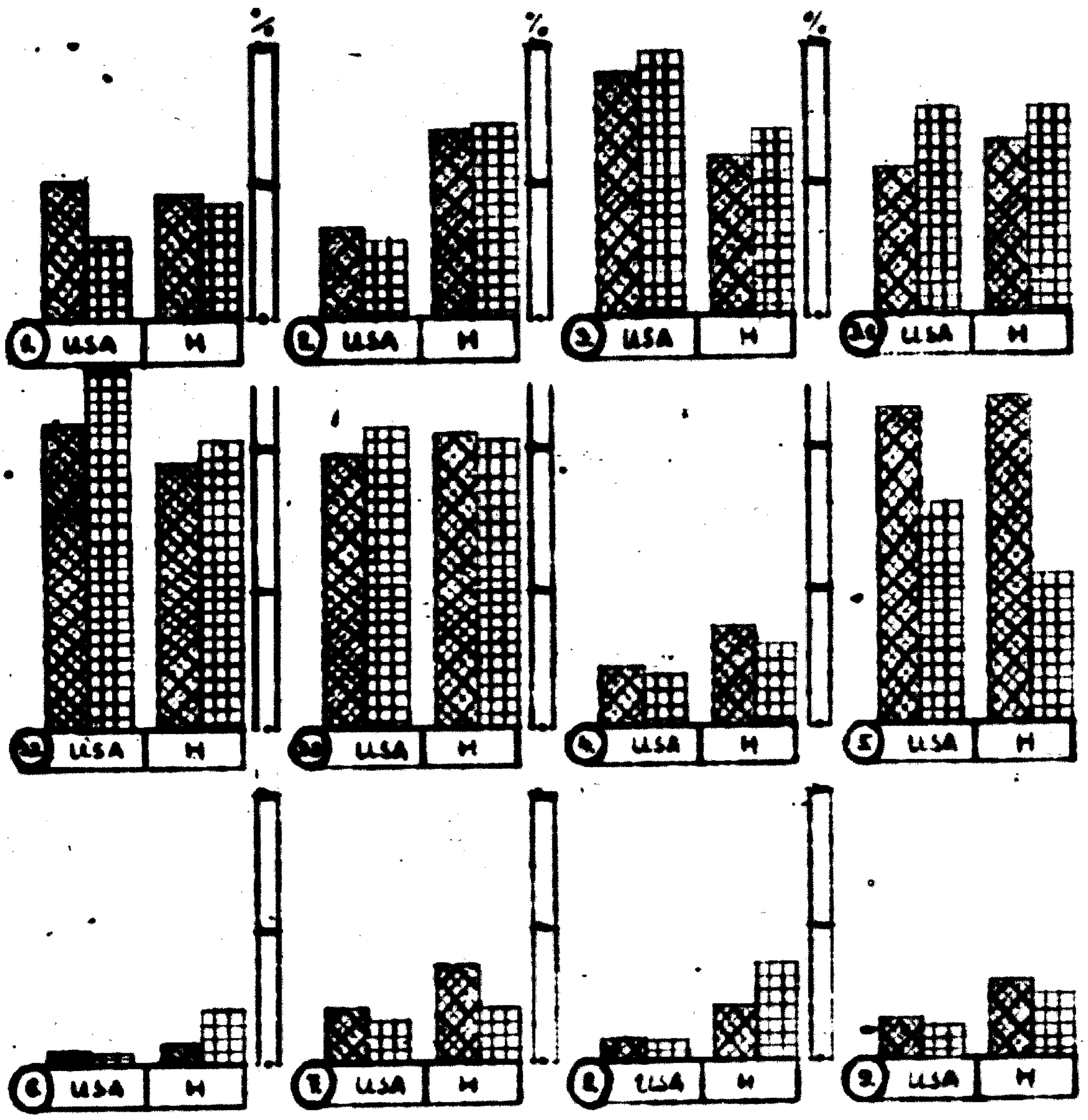

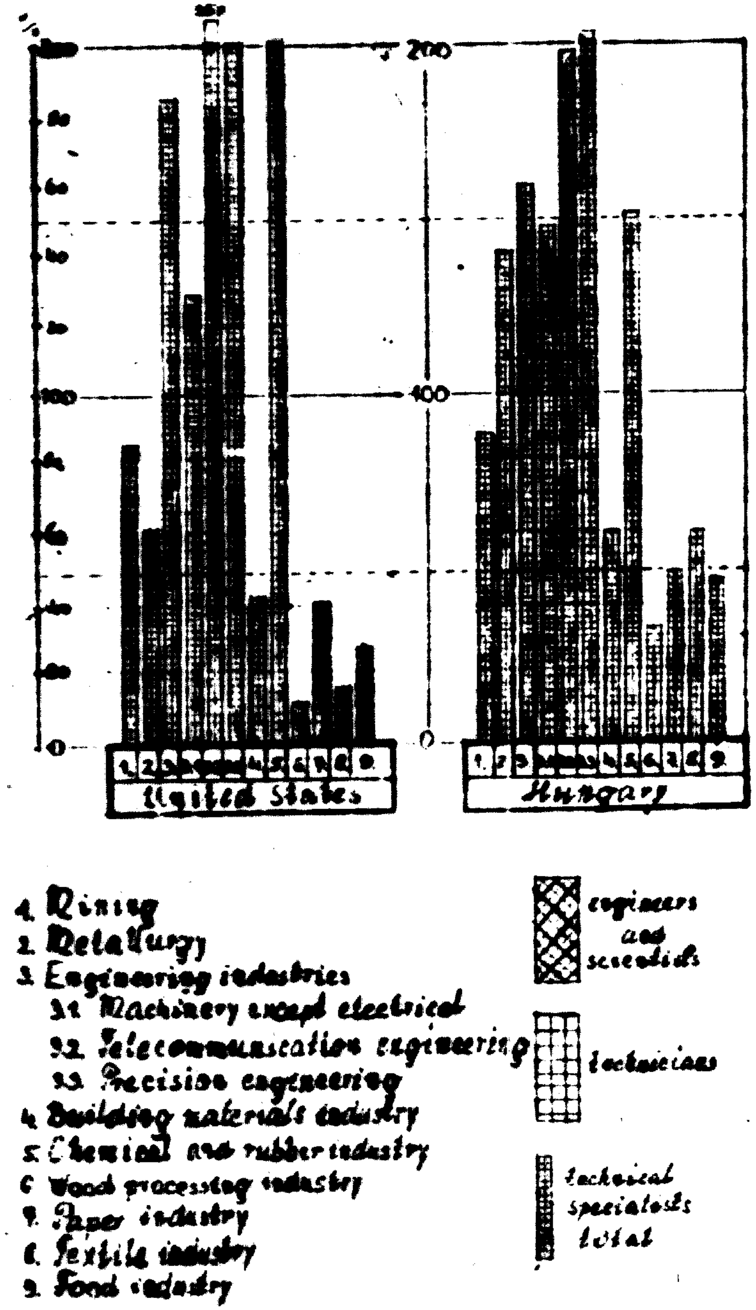

Chart 6 Engineers, scientists and technicians in selected industrial sectors.
(relativ levels, total industry = 100%)

Table 6.

Engineers, scientists and technicians in selected industrial sectors, United States and Hungary 1961

Industry	Technical specialists per 1000 of employed						Relative levels. Total industry = 100					
	Engineers and scientists		Technicians		Technical specialists total		Engineers and scientists		Technicians		Technical specialists total	
	US	H	US	H	US	H	US	H	US	H	US	H
1. Mining	44	12	16	23	60	35	102	92	59	85	84	88
2. Metallurgy	28	18	15	38	43	56	65	139	56	141	61	140
3. Engineering industries	77	19	53	45	130	64	179	146	197	167	186	160
3.1 Machinery except electrical	48	17	42	42	90	59	109	131	156	155	129	148
3.2 Telecommunication engineering	105	24	75	55	180	79	244	193	278	204	257	198
3.3 Precision engineering	83	27	58	55	141	82	193	208	215	204	201	205
4. Building materials industry	20	9	10	15	30	24	42	69	37	56	43	60
5. Chemical and rubber industry	98	31	44	30	142	61	228	238	163	111	203	152
6. Wood processing industry	5	2	3	11	8	13	12	15	11	41	11	33
7. Paper industry	20	9	9	11	29	20	42	69	33	41	41	50
8. Textile industry	7	5	4	19	11	24	16	38	15	70	16	60
9. Food industry	12	7	7	12	19	19	28	54	26	45	27	48
10. Total industry	43	13	27	27	70	40	100	100	100	100	100	100

Comparison of selected industries in the U.S. and Hungary according to the share of highly qualified technical manpower in total employment

United States	Both countries	Hungary
	I. High	
	Telecommunication engineering Precision engineering Machinery except electrical Chemical industry	Metallurgy
	II. Medium	
	Mining	
	III. Low	
Metallurgy	Building materials Textiles Paper industry Wood processing Food industry	

We can go one step further in the analysis. As technical specialists belong to different categories, concerning the narrower professions, it can be investigated which kind of professionals are working in the individual industries. Some aggregation is indicated at the outset because the number of specialities is very great. As about 70-80 per cent of engineers belong to the categories of mechanical, electrical or chemical engineers - at least in the industrially developed countries - we can narrow down the closer investigation to these professions. In some industrial sectors the characteristic professions of the sector play an important role, for example, mining engineers or metallurgical engineers. Table 8 was worked out based on Hungarian data to show the distribution of engineers according to these professions and according to the individual industries.

As the table shows clearly - with the exception of 3 sectors - at least 75 per cent, but in some cases even 90 per cent of the engineers belong to the three leading categories already mentioned, namely to the categories of mechanical, electrical or chemical engineers. The special professions of the sector play an important role only in mining and in metallurgy. The dominant profession is determined by the character of the industrial technology, which can be mainly mechanical or mainly chemical technology. Accordingly, chemical engineers form the leading professional group in the chemical industry, in the leather and fur industry, as well as in food processing, while the importance of chemical and mechanical engineers is about the same in the building materials industry. The importance of mechanical engineers is appreciable in every industry, this is even the leading profession in 7 out of 14 industrial sectors. Exceptions are - in addition to the sectors already mentioned - telecomunication engineering and electricity production, where electrical engineers play the domanant role.

The intensity of highly qualified technical man-power utilisation is highest in the engineering and the chemical industries. This circumstance is also connected with the characteristics of industrial technologies used in these sectors, which have, as shown in Table 3, particularly important amount of product development. As it is well known, highly qualified technical specialists are particularly needed for this type of work. In addition, the preparation of

Table 8.

Distribution of engineers and scientists in selected sectorsof the Hungarian industry

1.	2.	3.	4.	5.	6.	7.	8.
Industry	Mechanical	Electrical	Chemical	2+3+4 together	Special profession of the sector	Others	Total
	engineers						
Mining	20,3	4,5	9,0	33,8	54,7 1/	11,5	100,0
Metallurgy	33,6	4,5	14,4	52,5	37,6 2/	9,9	100,0
Machinery	67,5	10,8	7,0	85,3	-	14,7	100,0
Telecommunication engineering	29,4	46,6	10,7	86,7	-	13,3	100,0
Precision engineering	49,9	29,5	4,3	83,7	-	16,3	100,0
Electricity	40,7	46,7	3,4	90,8	-	9,2	100,0
Building materials industry	35,6	2,6	35,1	73,3	20,5 3/	6,2	100,0
Chemical and rubber industry	20,0	5,0	59,5	84,5	-	15,5	100,0
Wood processing	73,5	2,7	16,5	92,7	-	7,3	100,0
Paper industry	52,5	6,1	31,4	90,0	-	10,0	100,0
Textile industry	54,8	3,9	29,8	88,5	-	11,5	100,0
Leather and fur industry	17,5	0,8	74,8	93,1	-	6,9	100,0
Clothing industry	85,7	1,1	3,3	90,1	-	9,9	100,0
Food industry	37,2	4,2	46,8	88,2	-	11,9	100,0
Industry total	43,3	13,8	19,7	76,8	-	23,2	100,0

1/ Mining engineers 2/ Metallurgical engineers 3/ Building engineers the production process is also important in the engineering industries, requiring a great amount of technical work.

C) Classification of Industrial Sectors According to the Requirements of Skilled Workers

Because of the lack of detailed and internationally comparable labour statistics, a realistic comparison is particularly difficult in the field of blue-collar workers of different skills. It is hardly possible to distinguish the real differences in the man-power structure from the differences in the statistical system or in the denomination of the different categories.

Table 9 shows the share of skilled workers in the industrial labour force of four countries, namely of the United States, the United Kingdom, France and Hungary. The pattern is less uniform here than in the case of the previous comparisons. In order to facilitate the comparison, we distinguished only two groups of industrial sectors in Table 10. The share of the skilled workers in the first group is higher and in the second group lower than the industrial average. As it can be seen in Table 10, industries are ranked in the same group only in the case of 8 sectors for all countries, even from the point of view of this not very narrow condition. There are differences in the case of metallurgy, wood processing and the clothing industry which belong to different groups for the different countries.

The clothing industry belongs to the group of low skill intensity in the U.S. and U.K., while to the group of high skill intensity in France and Hungary. For this, the following tentative explanation can be given. Large-scale clothing industry has been developed out of small-scale industry, the latter being successively absorbed and replaced by large plants. In this process, workers who acquired skills in small-scale industry, for example, tailors, dressmakers, and seamstresses, are entering large-scale enterprises where the work, of at least part of them, is more a semi-skilled than a skilled job. Because of reasons connected with this artisanal tradition, workers coming from small-scale industries, and even newly trained workers, can be considered as skilled although the level of the job is mpre likely to be on the semi-skilled level. It can be clearly established, that the high proportion of skilled workers in the

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Table 9.

The share of skilled workers in the total number of /blue collar/ workers

1.	2.	3.	4.	5.	6.	7.	8.	9.
I n d u s t r y	Number of skilled workers per 100 of /blue collar/ workers				Industry total = 100			
	United States /1960/	United Kingdom /1966/	France /1962/	Hungary /1961/	United States /1960/ a/	United Kingdom /1966/ b/	France /1962/ c/	Hungary /1961/ d/
Metallurgy	35	23	31	38	126	77	79	95
Engineering industries	35	40	47	50	130	130	122	126
Building materials industry	21	16	20	20	78	55	61	50
Chemical and rubber industry	25	17	23	34	92	78	59	85
Wood processing industry	20	32	32	30	74	105	81	75
Paper industry	20	32	27	24	69	40	69	60
Printing	40	36	39	44	150	108	130	110
Textile industry	30	9	23	31	112	32	59	77
Leather and fur industry	19	21	31	28	[illegible]	70	79	70
Clothing industry	6	12	72	50	22	40	124	125
Food industry	30	11	23	27	[illegible]	35	73	68
Industry total	27	30	30	40	100	100	100	100

Sources: a/ United States. Census of Population 1960. Occupation by Industry PC/2/-7C.
b/ United Kingdom. Ministry of Labour Gazette, January 1966.
c/ France. Recensement Général de la Population de 1962. Population active. I.N.S.E.E. 1966.
d/ Hungary. Skills and Income of Workers. Statistical Periodical Publications, 1963/8.

Share of skilled workers of total number of /blue collar/ workers in selected industries

Same in the four countries	Different in the four countries			
	United States	United Kingdom	France	Hungary
I. Higher than the industrial average				
Engineering industries Printing	Metallurgy	Wood processing	Clothing industry	Clothing industry
II. Lower than the industrial average				
Building materials Chemical industry Paper industry Textile industry Leather and fur industry Food industry	Wood processing Clothing industry	Metallurgy Clothing industry	Metallurgy Wood processing	Metallurgy Wood processing

Hungarian clothing industry can be linked to this circumstance and not to technology. It can be supposed that the situation is similar in the French clothing industry. In addition, in this latter, the great importance of the "haute couture" can play a part. In the United Kingdom and particularly in the United States, on the other hand, large-scale clothing industry has been developed for a long time and the importance of traditions mentioned earlier is less important. (However, we were not able to find a convincing reason for the differences concerning metallurgy where the share of skilled labour is high in the United States and low in the other countries and for wood processing where this share is high only in the United Kingdom.)

The engineering industries employ a high proportion (36-48 per cent) of skilled labour in the countries we consider here. As it is shown in Table 9 the proportion of skilled labour is in every country higher in the engineering sector than the industrial average. The engineering sectors therefore strongly influence the industrial average and compared to engineering the skill intensity is low - except for printing - in other sectors.

Because of the above circumstances, it is rather difficult to discover the direct connections between skill composition and technologies. It seems, however, that the skill intensity is high or at least near the average in sectors with heterogeneous products, high product diversification, and with a high rate of change of the products. To the contrary, the skill intensity is low in sectors having homogeneous products and production processes, less product diversification, and a low rate of product change.

There is a clear tendency concerning the structural change of the skill composition within the group of skilled workers. This tendency consists in the increase of such trades which are closely connected to mechanisation and automation, in general, to new techniques and to large-scale production, while the share of trades connected to small-scale and domestic industry decreases. Data showing this tendency are contained in Table 11 for the United States in 1900-1960 and on Table 12 for Hungary in 1930-1965. The American data covering more than half a century show that skills connected with the operation and particularly with maintenance of machinery and equipment, the number of

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Table 11.

The change of the occupational structure of skilled industrial workers in the United States from 1900 to 1960 a/

Detailed occupation	1960	1950	1940	1930	1920	1910	1900
Craftsmen, foremen and kindred workers - total b/	100,0	100,0	100,0	100,0	100,0	100,0	100,0
I. Occupations characteristic for large scale production							
Mechanics, repairmen and kindred workers	44,4	45,6	40,7	36,7	34,9	23,0	20,9
Skilled workers of metallurgy	1,8	2,2	3,4	3,9	5,0	6,4	6,2
Electricians	5,1	5,4	5,1	6,0	5,1	4,0	2,7
Foremen for metal manufacturing	4,9	3,6	2,6	2,6	2,9	2,2	2,0
Total I.	56,2	56,8	51,8	49,2	47,9	35,6	31,8
II. Occupations based on small-scale production							
Bakers, millers, etc.	1,7	2,3	3,6	3,7	3,3	4,2	5,0
Tailors and shoemakers	1,1	2,4	4,4	5,8	7,2	10,2	12,5
Upholsterers and cabinet-makers	1,9	2,4	2,4	2,5	1,9	2,3	3,2
Opticians, lens grinders and polishers, jewellers, watchmakers, gold- and silversmiths	0,8	1,1	1,1	1,2	1,3	1,5	1,5
Printers and bookbinders	4,9	5,2	6,2	6,5	5,5	7,0	8,7
Plumbers and pipe fitters	4,8	5,0	4,9	5,7	5,5	5,6	4,9
Total II.	15,2	18,4	22,6	25,4	24,7	30,8	35,8
Sum total	71,4	75,2	74,4	74,6	72,6	66,4	67,6

a/ Source: Occupation Trends in the USA, 1950, Department of Commerce and US Census of Population, 1960, Occupation by Industry PC/2/-7 C.

b/ Without skilled workers of construction.

Table 12

The change of the occupational structure of skilled industrial workers in Hungary from 1930 to 1965

Occupation	1965	1960	1949	1930
Skilled industrial workers total	100.0	100.0	100.0	100.0
I. Occupations characteristic for large-scale production				
Fitters, tool makers etc.	18,3	17,3	13,2	13,4
Mechanics	5,4	3,5	3,0	1,8
Electricians	6,5	5,4	3,0	2,3
Skilled workers of metallurgy	1,4	1,3	1,2	0,6x/
Turners and other skilled machine tool operators	6.5	5.2	3.5	0.4
Total I.	38.1	32.7	23.9	18.5
II. Occupations based on small scale production				
Skilled workers of the food industry	3,6	4,5	6,9x/	12,3
Tailors, shoe makers, and kindred skilled workers	13,8	16,2	27,8	35,7
Skilled workers of the wood-processing industry	6,5	6,8	10,4	15,5
Printers and book-binders	0,8	0,7	1,1	2,2
Plumbers and pipe fitters	2.2	1.8	0.7x/	0.4
Total II.	26.9	30.0	46.9	56.1
Sum total	65,0	62,7	70,8	84,6

Source: Population Censuses of 1930, 1949 and 1960, current statistics for 1965 /x/ in part, estimated/.

electricians, foremen and machine-operators in the engineering industries increased within the total skilled industrial labour force to more than the double. The share of the second group, with skills based on traditional small-scale production decreased. The decrease was most important for the trades of tailors and shoemakers, here not only the percentage in the whole but also the absolute number of skilled workers consistently decreased from the beginning of the century. Hungarian data in Table 12 show the same tendency which can be found also for France. In the latter case, the skills connected with the engineering and chemical industries and with metallurgy increased from 42 to 48 per cent of the total in the period 1954-1962, while the share of the other skills connected mainly with the light industries decreased from 58 to 52 per cent.

D) Composition of the Skilled Labour Force by Industrial Sectors

The skill composition of the industrial labour force can be differentiated not only according to the skilled, semi-skilled and non-skilled categories, but also according to the different trades. These trades can have very different denominations and skill-content in individual countries depending on traditions, the system of education and the level of development of the industry. In Hungary, for example, there is actually regular apprenticeship of three years for 315 different trades. The majority of skilled workers is, however, concentrated into much less categories. More than 2/3 of the skilled labour force belong to 35 professions out of the total 315 and 42 per cent of the skilled industrial labour force is concentrated into only six professions. As the manpower statistics broken down by industries and by skills were available again only for Hungary, the analysis of the skill composition is being made on the statistical data of only one country.

Table 13 contains the share of skilled workers for these six trades, and, in addition, for the trades characteristic of some of the sectors given in detail in footnotes of the table. The six trades in question appear in every industrial sector and account for more than 50 per cent in 5 out of the 13 sectors and for 11-31 per cent in 4 additional sectors. The basic trades of the engineering industry, namely fitters, mechanics, skilled machine tool operators electricians give four out of the six leading skills. This fact is

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Table 13.

The occupational structure of skilled workers in the Hungarian industry in 1963 a/

I n d u s t r y	Fitters, tool-makers etc.	Mechanics	Turners and other skilled machine tool operators	Electricians	Bricklayers	Cabinet makers, joiners	Total 1-6	Special occupation of the sector	Sum total 7+8
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Mining a/	13,3	0,5	1,3	6,6	2,5	3,5	27,7	63,6	91,3
Metallurgy b/	29,1	2,2	7,0	3,7	4,0	3,3	53,3	29,5	82,8
Machinery	40,0	6,2	17,4	4,6	2,1	5,8	76,1	-	76,1
Precision engineering	18,1	37,9	12,1	4,0	3,5	3,9	81,1	-	81,1
Electricity	35,7	7,1	1,6	36,7	6,3	3,1	90,5	-	90,5
Building materials	25,2	0,1	3,5	5,5	12,7	7,2	57,2	16,4	73,6
Chemical industry c/	15,6	0,9	3,9	4,5	3,1	3,3	31,3	50,0	81,3
Wood processing industry	8,2	0,1	2,5	1,6	2,5	57,0	72,7	-	72,7
Paper industry d/	3,3	0,1	2,6	3,3	2,6	0,4	10,0	90,0	100,0
Printing e/	2,1	0,1	1,0	2,1	1,0	1,0	7,3	77,1	84,4
Textile industry f/	7,5	0,2	1,2	0,9	0,9	0,7	11,4	38,6	50,0
Leather and fur industry g/	1,8	0,3	0,4	0,6	0,4	0,1	3,6	96,1	99,7
Food industry h/	2,7	0,8	1,2	1,6	1,4	2,1	10,0	77,2	86,2
Industry total	20,3	3,6	6,5	5,3	2,6	5,0	43,1	47,2	90,3

Special occupations /column 8/:
a/ Miners
b/ Skilled workers of metallurgy
c/ Skilled workers of the chemical industry
d/ Skilled workers of the paper industry
e/ Printers
f/ Skilled workers of the textile industry /mainly weavers and spinners/
g/ Skilled workers of the leather industry
h/ Skilled workers of the food industry /millers, bakers, butchers, soap makers etc./

Source: Work conditions and wages of industrial workers. Statistical Periodical Publications 1964/3. and Census of 1963.

a/ According to the computations of the Planning Office obviously connected with repair and maintenance of machinery. The same holds for bricklayers and joiners (cabinetmakers) who are also needed for repair jobs in every sector. According to the Hungarian data 48 per cent of the skilled labour force belong to some special trade of the individual sectors. Such trades are for example that of miners, printers, etc.

As it can be seen the characteristic trades of the engineering industry play an important role in every industrial sector.

5. Summary, Conclusions, Recommendations

1. Economic and social development is going together with a structural change of the labour-force and consequently there is a characteristic structure of the labour force corresponding to a given level of economic development. The main feature of this structural change in the course of development is a shift in the sectoral distribution of the labour force and, in particular, a decrease of agricultural man-power. There is, first, a substantial increase of employment in industry, which is slowing down or even stabilizing, later to give way to a more accelerated expansion of the share of employment in the service sectors. In addition, the share of white-collar workers increases to the expense of blue-collar worker; there is an accentuated growth in the first category mainly of technical specialists and in the second mainly of well-qualified skilled workers. The educational levels are generally growing, school education is playing an increasing role in training and skill-formation for practical jobs.

2. Man-power employed in industry, or more exactly, in individual industrial sectors, is in the center of interest of this study. The most important characteristics of man-power are its educational level, the share of technical specialists (engineers, scientists, technicians) and of skilled workers in the total and the occupational composition of the qualified labour-force. Man-power of the individual industrial sectors has a characteristic structure as to the educational levels and the occupational composition. This structure is mainly determined by the industrial technology used in the sector, more closely by the homogeneous or heterogeneous character of the products and production processes, by the diversity of the product mix and the rate of change of the

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products, the batch sizes of production, the amount of work necessary for product development and by the mechanical or chemical character of the technology in the main production process.

The average complexity (educational level) of labour can be appropriately measured by a system of coefficients, which also takes into account, in addition to the length of time necessary to attain the different levels, the direct and indirect costs of education and training. This method makes perceptible the importance of the more highly qualified labour-force. The complexity of labour measured with such a method (or with any other method) is higher in countries with more developed industries. The complexity of labour in the individual industrial sectors differs from the industrial average, and the difference is characteristic for the sectors, having the same tendency in industries on very dissemblable levels of development. This fact can be traced back to the circumstance mentioned above, namely to the influence of technology on the composition of labour in the industrial sectors.

3. The flow of the labour-force among sectors and occupations shows some fairly regular characteristics. Non-skilled agricultural man-power is transferred mainly to non-skilled occupations of the industry and of other economic sectors. Part of it then goes over rather slowly into occupations requiring semi-skilled and skilled workers. Sectoral and regional mobility can be relatively high, particularly for the non-skilled labour force. Occupational mobility towards work places requiring higher qualifications is on the other hand rather slow because of the problems of training and education; both in the case of the up-grading of adults and in the case of the training of the new generation. Man-power planning and the prevision of requirements to be expected is important because it can facilitate the slow and difficult process in question through planning and preparing formal education and other methods of training and through harmonizing the structure of the educational and training output with the structure of real requirements. There are losses connected with the non-concordance of these structures and also with educational outputs which are higher than what is needed, especially in developing countries where relatively important resources have to be devoted to education.

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4. As the skill and educational structure of the labour-force can be modified only slowly, it is very important to take into account appropriately the existing resources of man-power. In this respect, small-scale industries can represent an important basis foreman-power development, in particular when skills required in small-scale industries can be well utilized in large-scale plants, as in the case of the clothing, leather and fur industries, printing etc. Engineering industries, which play a particularly important role in development and which employ about 1/3 of the industrial labour-force in developed countries deserve special attention in this respect. Man-power of the mechanical maintenance and repair workshops, which are established earlier or are already existing in developing countries, can be used as a nucleus to form the man-power of the engineering industries proper. On the other hand, as the typical skills of the engineering industries are also necessary in every other industrial sector, the former can be used as a basis in forming the repair and maintenance labour force of the other sectors.

5. The comparison and analysis of international man-power data is likely to give valuable information for man-power planning and development and is therefore essential to solve the problems in this field, in particular, of developing countries. Lessons drawn from international data can reflect, however, only the main interconnexions and tendencies. The hopes seem to be exaggerated, according to which there are possibilities to build on the basis of such data general and universal mathematical models for man-power planning or to establish man-power utilization coefficients, which would permit to transpose - taking into account the relative productivity levels - the proportions prevailing in one country into the plans of some other. This is hardly possible, on the one hand, because of the fact that actual man-power utilization is influence, in addition to technology, by historical and social circumstances, which - reinforced by the substitutability of different labour inputs - can produce man-power structures in one country which are by far not appropriate in some other, and on the other hand, because of the very restricted international comparability of labour statistics.

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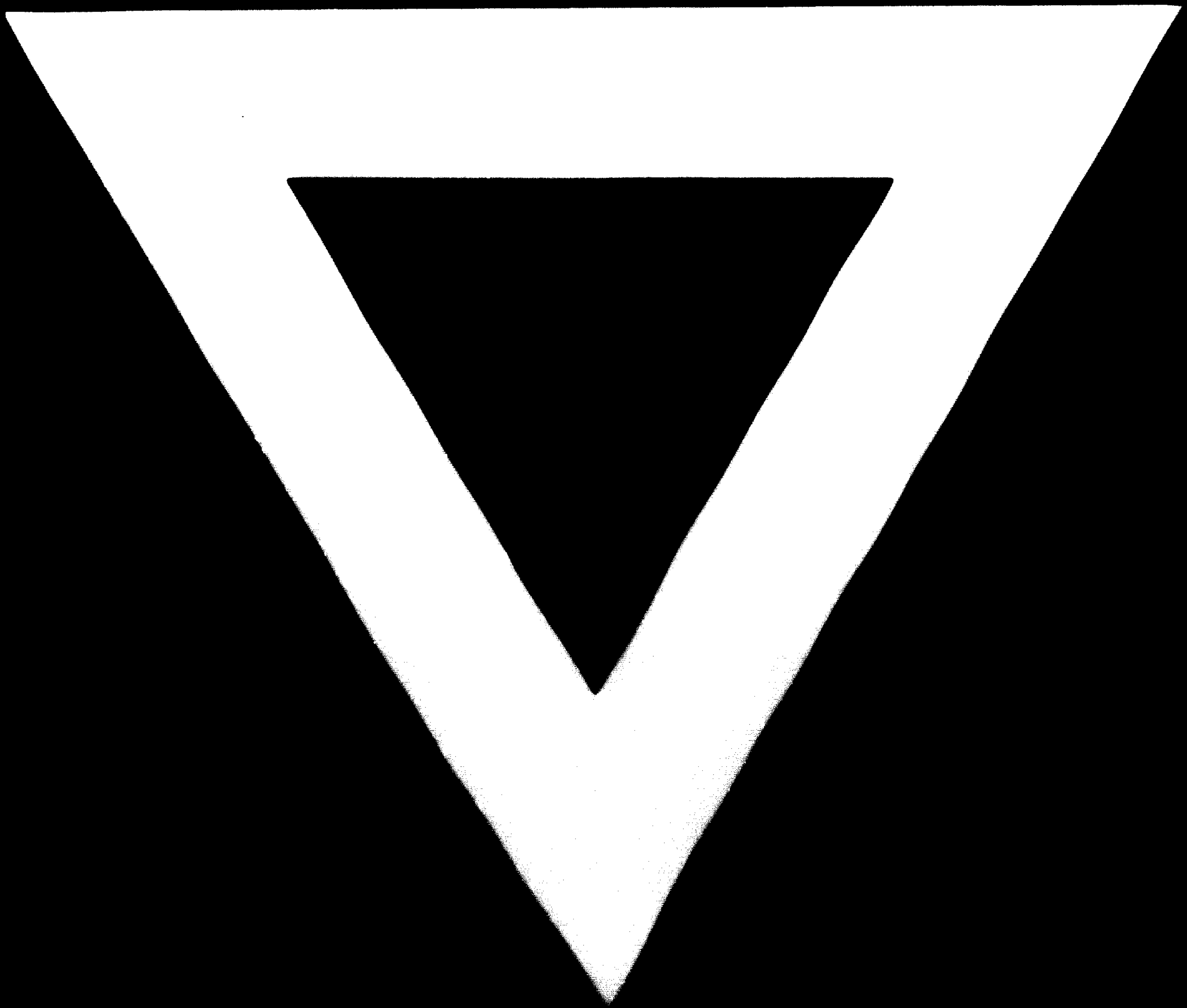
This, of course, does not mean that international man-power statistics are useless; on the contrary, that steps should be taken to improve the data and increase their comparability. This mainly means the improvement of occupational statistics. Efforts are being made in this direction by the International Labour Organisation, with the help of experts and some other international organizations, principally in order to modernize the International Standard Classification of Occupations. In this latter respect, there is actually some conflict between the requirements of historical statistics (comparability with previous censuses) and the requirements of planning. In the present statistical system the points of view of occupations, spheres of activity, skills and educational achievements are intermingled. For man-power planning the number of persons working "as..." (for example engineers) and the number of persons educated for these occupations are the most important aspects. The knowledge of these data is also necessary in order to know the number of persons educated for and employed in individual occupations and the social loss resulting from the possible differences. It has to be taken into account that school-type formal education has an increasing role, especially for more highly qualified man-power.

Statistics should therefore be directed to report mainly the levels and main types of skills and education, as well as the actual requirements of jobs in those respects. From the practical point of view of collecting statistical data, experience seems to prove that only census data can be sufficiently complete, taken at regular intervals and on the basis of the same or at least similar methodology, to really permit international comparison. The International Standard Classification of Occupations is also used mainly in censuses, which should be considered as the main source of internationally comparable data. Special surveys can, of course, play an auxiliary role. It should therefore be attempted to reconcile the traditional requirements of censuses and the new requirement of man-power planning. The United Nations could play an important role in ensuring that these new requirements, which are important in particular for the developing countries, be taken into account at the occasion of the world census of 1970.



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