

ECONOMICS AND TECHNOLOGY

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ECONOMICS AND TECHNOLOGY

BY

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PREFACE

We live in an epoch that reminds us in many respects of the times of some one hundred years ago, that is the beginning of the nineteenth century. For what we experience to-day is not only a revolution in the sphere of morality and politics, but also a revolution on a large scale in industrial technique. What was a hundred years ago the steam-engine is to-day electricity and the internal combustion engine ; what was then the railway and the steamship is to-day the motor-car and the aeroplane ; what were then the rising textile and metal industries are to-day the growing ramifications of the giant chemical and electro-technical industries.

The literature of that period brings back to our minds the numerous complaints that were made against technical development and the introduction of machinery as becoming more and more the cause of poverty and unemployment. Such objections appeared to us in pre-War days, when technological development was slowing down, as unjustifiable and reactionary. We were at a loss to understand them ; we regarded them as a sign of ignorance and narrow-mindedness. "Who," we asked, "could blame the progress in industrial technique for the unemployment and poverty of the people ?" We maintained that technological progress reduces our physical efforts, lowers the cost of production, contributes to the general welfare and enhances economic development. Unemployment due to technological development is only a passing phase, and hands that have temporarily become idle will soon be absorbed by the turning wheel of the economic machine.

All this is, of course, true, but how much time will it take ? We know to-day that between the appearance of unemployment and its subsequent absorption, not only

years but decades may elapse, as indeed happened at the beginning of the nineteenth century; and time is an essential element that cannot be overlooked by the economist.

We are, therefore, much more able to understand to-day the objections of the nineteenth-century economists than we were before the War. For to-day the same kind of problem has emerged. We hear to-day that social progress does not keep pace with technological progress, that we have not succeeded in utilizing all the potentialities of technical science, that we cannot consume all that we can produce, while vast masses of people live on the verge of starvation and millions are unable to find employment and earn their livelihood.

The problems of poverty and unemployment become especially acute at a time when capitalism is passing through a process of important change caused by technological progress, which in our days has been accelerated by the late War and its consequences. Liberal capitalism is giving way more and more to monopolistic capitalism. It is within this monopolistic and autarchic capitalist system that rapid technological development takes place. Under such a system the possibility of absorption of unemployment is very limited, and adjustment between technological and social progress under these circumstances much more difficult.

With increasing frequency we hear the question: Does not technical progress under such circumstances miss its object, does it not lose sight of the very purpose which it is supposed to serve? The very aim and purpose of technical progress is being questioned, as it was a century ago. John Stuart Mill took a very critical view of the benefits that *man, as an individual*, derives from mechanical inventions: "It is questionable if all the mechanical inventions yet made have lightened the day's toil of any human being. They have enabled a greater population to live the same life of drudgery and imprisonment, and an increased number of manufacturers and others to make fortunes. They have increased the comforts of the

middle class. But they have not yet begun to effect the great changes in human destiny which it is in their nature and in their futurity to accomplish."¹

This scepticism of John Stuart Mill does not appear to us to be justified to-day to the same extent as it might have been a century ago, when the birth-rate was fairly high. To-day the revolution in industrial technique goes hand in hand with a revolution in moral standards and, as a result of the latter, the birth-rate is continually falling. The fear of Mill, therefore, that the only benefit derived from mechanical inventions will consist in the fact that a greater population will be able to live "the same life of drudgery" seems to-day less justifiable.

To-day, we are faced with a number of other factors that make us doubt whether technological progress bestows any actual advantage not only on man as an individual, but *on man as a species*. It is to be feared that all the advantages derived from the development of technology will be utilized for the purpose of financing military, social and economic warfare, and that industrial development will make such warfare only the more cruel, ruthless and devastating. To perfect the machinery of destruction seems to have become the aim of technological progress. Its avowed purpose appears to be to help men in their conquest of men, whether such conquest be military, economic or otherwise. Such dangers are by no means illusory. The sociologist, the economist and the politician, each in his own sphere, have to take notice of them. But the question to be dealt with is: To what extent are these dangers real?

Readers will not find in my work any rough and ready answers to these vital questions. Notwithstanding, the material of thought and fact collected in my book ought to prepare the ground for a better understanding and a wider treatment of the subject, while the interrelation between technology and economics may enable us to arrive at certain conclusions.

¹ *Principles of Political Economy*, Book 4, ch. vi., § 2.

The book consists of an analytical part (Analysis of Technological Progress), a theoretical part (Problems of Compensation for Technological Unemployment), a sociological part (Sources and Limits of Technological Progress), and finally of a practical part (Remedies for Technological Unemployment).

I wish to lay stress on the analytical part of my work. In it I endeavour to show that what we call "technological progress" is really a complicated set of phenomena, that differ not only in form and scope, but also in their cause and effect, and the importance to be attributed to them. What I call "progress in novelty" (development in the production of novelties) is a matter which is different, both in nature and extent, from "progress in productivity" (an advance in industrial output). "Qualitative progress" must be distinguished from "quantitative progress." Mechanization creates a different set of problems from rationalization, industrial organization or industrial psychology. Progress resulting in saving of capital has a different economic significance from progress resulting in a saving of labour. Development that aims at the production of goods that are positively productive must be measured and valued from a different angle from the production of goods that are of a destructive character. All these distinctions have to be kept well in mind, for if we do not take into account the vast and essential differences between such factors, the conclusions that we arrive at will be lacking in perspective and miss the essential point.

Previous attempts at a complete analysis of the subject have not succeeded in getting at the root of the problem and discovering the causes and effects of technological progress. They contained too many generalizations and had too narrow a scope. I am afraid that I shall be unable to make my analysis as thorough and detailed as the problem requires. But it is better to sacrifice certain details and save the work from an excessive casuistry, for nothing could be more dangerous in such a work than to lose sight of the wood for the trees.

Preface

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I feel obliged to thank the Economic Society in Cracow and its President, Professor Adam Krzyżanowski of the University of Cracow, for their assistance in publishing this work—and also Mr. I. Hake for his translation of my book from Polish into English.

FERDYNAND ZWEIG.

CRACOW, *February* 1936.

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PART I
**ECONOMIC AND TECHNOLOGICAL
PROGRESS**

CHAPTER I

THE ECONOMIC WORLD AND THE TECHNICAL WORLD

§ I. ECONOMIC AND NON-ECONOMIC PHENOMENA

THE economic phenomena which form the subject-matter of economics can be divided into two groups :

1. The first group consists of phenomena which are part and parcel of what we call the exchange system, such as goods, prices, wages, rent, interest, money, profit, credit, savings, employment, production, etc. All these phenomena, being the product of economic co-operation or exchange, form the economic system. We inquire into the elements of this system, their mutual relations and interdependence, and especially their quantitative and qualitative relation in a state of equilibrium, by which we mean a state of things that shows no tendency to further change.

2. The second group of phenomena which form the subject-matter of economics are those which are outside the economic system, but nevertheless influence it, such as an increase in population, progress in technology, changes in the law and constitution, or changes in human wants and desires. These factors, although not part of the exchange system, nevertheless influence the economic system to a great extent. Technological progress or the natural increase in population affect prices, wages, rent, profits, employment, savings—in short they affect the production, exchange and distribution of incomes. These non-economic factors, influencing and shaping the economic system, have therefore to be taken into account and to be dealt with by the science of economics.

The first group of phenomena which are part of the economic system creates a set of problems which are primarily problems of the exchange system or of the

relationship and interdependence between economic quantities. They are in essence the static forces of economics. They deal with the problems of production, distribution and exchange of goods in a state of equilibrium when the economic system is not exposed to outside changes and influences, such as technological progress, increase in population, etc.

The second group of phenomena, consists of non-economic factors, yet they, too, create problems of economic change and development. They form as a whole the dynamic forces of economics. This set of problems deals with the development and changes which take place within the exchange system, but which are brought about by non-economic factors outside the economic system.

The above short introduction aims at indicating with which part of economic theory we shall be mostly concerned. In dealing with the question of the influence of technology on economics we shall be mostly in the sphere of what is often termed "the dynamics of economics." The dynamics, as opposed to the statics of economics, is, as a theory, less precise, solid and clear. Quantitative problems are here almost non-existent, and the most we can do is to trace the nature and tendency of the phenomena, but not their quantitative proportions. Hence the deficiencies in the dynamic theory of economics and the difficulties therein must be realized at the outset.

The non-economic factors which have to be taken into account by the science of economics fall under four heads:—

- (a) Demographic, (b) psychological, (c) legal, (d) technological.

These four groups of non-economic factors are at the root of all economic activity. We can hardly visualize a form of economic activity without a population, without psychological motives actuating economic activity, without a legal system regulating relations between men, or finally without technical equipment, however primitive, to create the physical conditions for economic activity.

Changes in the nature of such factors, *e.g.* an increase or a change in the distribution of the population as regards sex, age and ethnical characteristics, bring about corresponding changes in the supply of labour, employment, production, savings, incomes, demand and so on.

Psychological changes alter the motives behind economic activity, and the motives, in turn, change the nature and forms, the aims and methods of economic activity. For it is clear that economic activity takes on a particular form when its main object is to satisfy the demands of a person or a family on a constant or a customary scale. This form of economic activity was in existence under the feudal and guild system in the Middle Ages, when the satisfaction of customary demands and not profit-making was the end in view. But economic activity necessarily takes quite different forms when at the root of the system are motives of profit-making pure and simple, as happens under capitalism. Or to take the example of Russia, where economic motives are confined to satisfying the demands of the State and where the bureaucratic administration is actuated by a desire to govern effectively and boast about their success. All these motives, the satisfaction of customary demands, or profit-making, or ambitions to govern—rationalism or traditional activity—change, influence and shape the economic system.

Similarly, legal and constitutional changes have their share in shaping the economic system. Economic activity under a legal system which fully recognizes and protects the rights of private ownership and the liberty to contract and inherit is different from that under a system where there is no recognition of such rights. A system under which the relations between employer and employee are regulated by free agreement is different from a system under which such relations are regulated by force or compulsion, as in slavery or serfdom. Again, economic activity which is controlled and regulated by the State differs from a state of affairs which is controlled and regulated by cartels and trusts.

Technology belongs to the fourth group of non-economic phenomena, which influence and shape the economic system. Economic activity is different under a system in which the only form of labour consists of the use of one's own hands (as was the case in the days of primitive production), when tools or implements (such as a plough or a chopper) are the instruments of labour, when steam-engines or electric machines are in use, or again when, hand in hand with the use of machinery and electricity, there goes on a process of rationalization and organization which affects industrial efficiency and output.

The advent of the steam-engine wrought the most revolutionary changes in the history of economic activity. Economic changes caused by mechanical inventions at the end of the eighteenth and the beginning of the nineteenth century were deeper and more extensive than any change that had taken place in the course of the preceding eighteen centuries. The period was, therefore, rightly called the "Industrial Revolution." Similarly, to-day, after the Great War has given an enormous stimulus to mechanical inventions, and, by a rise in real wages and an increase in social legislation, favourable conditions have been created for the application of new technical methods in industry, we are faced again with the far-reaching changes brought about by a second "Industrial Revolution," which is no less important than the Industrial Revolution of the nineteenth century.

The following analysis will be mainly devoted to this fourth group of non-economic phenomena, *i.e.* technology. We shall inquire into the connection and mutual relations that exist between technology and economics, both in the sphere of theory and of fact. The range of problems that arise out of such an inquiry is very extensive. It is one of the most interesting and at the same time most important parts of economic theory, but it is also the most complicated and the least elucidated.

§ 2. DEFINITIONS OF ECONOMICS AND TECHNOLOGY

It is necessary, first of all, to determine certain basic principles of economics and technology. What is the nature and scope of economics, and what that of technology? Which phenomena belong to the world of economics and which to the world of technology? What are their common characteristics and what are the differences between them?

There have been many attempts at segregating technology from economics, and most of them date back to the time when the psychological theory was first formulated. The Classical School knew nothing of such segregation between economics and technology. The Classical School approached economics from a social point of view, as a sociological science, and such an approach meant, by implication, that economics, as a social science, is distinct from technology as a natural science. But the psychological school in economics abandoned the social approach of the classical theory and found itself, in consequence, faced with the necessity of making an express distinction between economics and technology.

To-day, the prevailing psychological theory of economics is Crusoe economics, applying the psychological analysis. It maintains that the science of economics deals chiefly with phenomena governed by the law of least effort. It is just at this point that difficulties in the delimitation of the fields of economics and technology arise. For both economics and technology are subject to the law of least effort, and at the root of both is the same object, namely, the attainment of the greatest results at the least cost. Hence the attempts of some writers to fix, within the framework of the economic law of least effort, a dividing line between economics and technology.¹ But, in my opinion, these attempts have shown rather a definite relation between them than a divergence, and have

¹ Such attempts are also to be found in some recent works on economics by Polish writers. Adam Krzyzanowski: *The Assumptions of Economics*, Cracow, 1919. A. Heydel: *Fundamentals of Economics*, Cracow, 1925.

certainly not shown that one set of problems belongs to the subject-matter of economics and another to that of technology.

Let us cite just three of the most characteristic instances of such attempts. Although they do not contain the whole truth, they nevertheless contain some truth and are certainly instructive.

1. According to one view, both economics and technology deal with factors emanating from the law of least effort, but while the former deals with these factors in general, the latter deals with these factors in particular. While economics concentrates on the general characteristics common to all of them, technology is concerned rather with particular characteristics and concentrates on certain peculiarities of economic phenomena.¹ According to this view, we can speak of a technique in building, painting, sculpture, agriculture and machinery, but we cannot speak of technology in general. Economics, therefore, would embrace technology in the abstract, *i.e.* as a general principle, while technology would be a branch of applied economics.

Such a close relation between economics and technology would resemble the relation that exists between a general statement of a law and its detailed exposition. This conception of their relationship fails, however, to show which are the phenomena of a general character that are dealt with by economics; neither does it point out any definite problems of economics as distinct from the problems of technology.

2. Another view regards the difference between technology and economics as consisting in the fact that, while the object of the former is to attain the greatest possible material result, the object of the latter is to attain the greatest possible satisfaction of demands. Consequently,

¹ Dietzel: *Theoretische Sozialökonomik*, p. 189. "This technological science, in its history and principles, deals with the special forms of wealth and the special means used by man to extract goods from Nature. The theory of economics, on the other hand, is the science of wealth in the abstract. It deals with the general forms and the means by which the products of Nature can be won, and then distributed between individuals."

the means and ends of technology are approached from a material and objective angle, while those of economics from a psychological and subjective angle. One and the same economic activity may be considered fruitful from the objective and material aspect, but may be of no consequence from the psychological and subjective point of view; for it is clear that, while in technology we aim at the attainment of a maximum of material results with a minimum of material effort, in economic activity we strive to achieve the highest utility at least sacrifice. According to this view, therefore, technology is the science dealing with phenomena produced under a system of least effort taken objectively and materially; while economics is the science dealing with phenomena produced under a system of least effort viewed from the psychological and subjective aspect.¹

But this theory of viewing economic phenomena as being governed by the all-powerful principle of least effort fails to explain the real issue. The law of least effort is not peculiar to the science of economics, but pervades every branch of human activity and is the basis of every rational human activity. For who is not doing his best to obtain in every sphere of rational activity the highest utility at the least effort and expense? Such an analysis cannot, therefore, be accepted as drawing a valid distinction between economics and technology. No distinction can be drawn on the basis of a psychological viewpoint as against a material viewpoint, for the psychological and the material exist in both economics and technology. Since the law of least effort is applied in every sphere of rational activity, writers representing the

¹ Robert Liefmann: *Grundsätze der Volkswirtschaftslehre*, vol. 1, part 3, chap. v., p. 333. "The close resemblance to economic problems which technology bears appears only in technology in the narrow sense, which can be termed 'comparative technology.' Here the point is not so much the means as such and their most efficient application that characterizes technology in the wider sense, but rather a problem of decision and choice. Unlike economics, however, there is always a given end, and the different means are weighed in the light of achieving that purpose in the most effective way, and, therefore, consideration is given to obtaining and to using such means to the best possible advantage. Alternatively there are given means, and the problem is to choose the best possible results."

above view try to explain it away by introducing a number of new notions, such as technology in a wide sense and technology in a narrow sense, comparative technology, etc.¹

3. The third conception sees the distinction between technology and economics in the fact that while economics deals with the choice of ends given certain means, technology deals with the choice of means given certain ends. Economics deals with the problem of whether to choose a certain end (*e.g.* whether to build a house or not), and technology deals with the problem how to attain his end (how to build, from what materials, etc.). In other words, technology is a system of the selection of the best means for the achievement of a given object.² It simply weighs the means, without considering the merits of the object. It is the latter task that falls within the domain of economics, for there we weigh the ends, having been given certain means.

But this distinction, too, is not clear, because a differentiation between means and ends is in itself very indefinite. The end in one case may constitute the means to some further end, and both ends and means are just different links in one and the same chain. Coal is the means in the production of iron, which in this connection is the end, but iron again is only the means in the production of agricultural machines, which are again the means in some other association.

¹ Liefmann: *Ibid.*, p. 337. "The above leads, therefore, to the following differences between economics and technology:—

" 1. The broad application of rationalization is the law of least effort. The study of means and the process of production is technology in the wide sense.

" 2. The narrow application of rationalization is the problem of distribution. The comparison of ends or means either

" (a) given the end, to choose the means, or

" (b) given the means, to choose the end,

is comparative technology. The end is an external affair.

" 3. The narrow but more specialized application of rationalization is the comparison of ends and means."

² Max Weber: *Wirtschaft und Gesellschaft*, p. 31. "Economics is concerned with the fulfilment of the end. Technology is concerned with the application of means, given the end." See also Andreas Voigt: *Dictionary of Political Science*, under "Technology and Economics."

All these distinctions with which we have dealt approach the problem from too narrow a point of view. Here and there they touch upon some indisputable facts, but they miss the vital points and do not give us the essence of the problem.

The definition of economics as merely a science dealing with "economic activity" must be rejected. Economics is a social science, which approaches certain phenomena from a certain point of view, namely from the social, exchange point of view. It deals with problems of exchange in a very wide sense, problems of price, interest, wages, profits, money and credit and the problems of production, the latter being a constituent part of the exchange system. In other words, economics deals with the relationship between man and man in respect of goods, but not with the relation between man and the goods. Economic factors are really social exchange factors, factors of the exchange system. Economics belong to the sphere of social sciences, while technology belongs to the sphere of the natural sciences.

Technology is not concerned with the relation between man and man in respect of goods, but solely with the mutual relation between the commodities as such. It deals with the relation of their physical and natural characteristics as viewed from the angle of the maximum and the optimum of results. "Homo technicus" aims at the attainment of an optimum in the sense of obtaining the best possible results out of physical, chemical or biological quantities. From a given quantity of timber, iron, tiles and cement, to erect the most solid, beautiful and spacious building, is a technological problem aiming at the achievement of the best results from these materials. "Homo economicus," on the other hand, aims at an optimum in the sense of achieving the best results out of existing economic quantities.

How to get the maximum production and an optimum in distribution, how to increase the productive forces of a given country, how to increase exports, to what branches of activity to apply most effectively the capital, labour

and land at our disposal—all these are problems of economics, and not of technology. In all these cases we aim at an optimum in social exchange relations—and this is the main problem of political economy, as distinguished from the main problem of technology. Consequently, the calculations of the economist are made in exchange media, or in units of economic value (generally money), while the calculations of the technologist are in physical, chemical or biological terms.

§ 3. CO-OPERATION BETWEEN ECONOMICS AND TECHNOLOGY

The proposition at which we have arrived, namely, that technological motives are directed towards the attainment of the best results from physical, chemical or biological entities, while economic motives are directed towards the attainment of best results from exchange entities, leads us to the further conclusion that results which are best from the economic aspect need not be the best from the technological aspect, and vice versa. Thus, a building erected with a certain technical skill may be a masterpiece from the technological point of view, but an utter failure from the economic point of view; or, on the contrary, it may be a success economically, but clumsy and unimpressive from the technical point of view. We see, therefore, that the criteria applied by the economist differ from those applied by the technologist.

Under the present organization of society, the economist applies, as a general rule, the criterion of profitability, *i.e.* he is concerned with the achievement of the greatest profits. The technologist applies the criterion of the achievement of the best results with the least effort and sacrifice. The motives and aims of the technologist and the economist are very often conflicting. The economist aims, as a rule, at the cheapest production, while the technologist aims at the best production. Consequently, we find that in industry the technologist and

the economist are usually in conflict, and, as a rule, it is the economist who has the last word, for under the present economic system it is the task of an industrial undertaking, however, it is the technologist who is very often victorious, because here efficiency and quality of output plays a greater part than mere profit-making.

But if the aims of the technologist and the economist are often conflicting, they are at the same time complementary, in the same sense that the provinces of a manager and his employees are complementary. In economic activities, the technologist has the task of performance, the economist the task of making decisions. Consequently, we see co-operation between them in economic activity, for if economics has to achieve its aim of securing the best results in economic relations, it must use the services of technology, which aims at the best results with physical, chemical or biological matter.

Economics appears, therefore, to be paramount, while technology plays a subordinate part, the part of performance. The economist deals with the question: whether and what? The technologist has to answer the question: how and by what means? Thus, in the carrying out of any economic activity the latter plays the role of a guide, but the economist retains the last and decisive word.

Devoid of technology, however, economics would be only a meaningless abstraction, for the mere creation by an idea and a decision does not constitute actual performance. On the other hand, technology without economics would mean the execution of work without a proper purpose or direction. Only harmonious co-operation between technology and economics can lead to sound economic activity.

It is of great importance to an economist to be proficient in the field of technology. Abstract economic principles, rigidly separated from technology as such, have only a formal character and are of little practical use. Economics without technology may be compared

to a soul without a body. Without a knowledge of economic technology, the economist would, as a rule, arrive at false conclusions, for in deciding on economic matters, questions as to the method of carrying them out must be taken into account. What is economically advisable under one set of circumstances, when a particular technique is applied to the execution of some piece of work, may be inadvisable when a different technique is applied; or, again, the whole plan may fall to the ground owing to the impossibility of carrying it out due to the encountering of some insuperable obstacles.

It is only in the close co-operation between economics and technology that the former becomes really effective. Not infrequently, what we call "applied economics" is just a combination of economic and technological principles. For instance, in agricultural economics nine-tenths of the problems involved are really technological. Similarly, in those parts of economic science which deal with mining, communications, transport, or even with commerce and the stock exchange, technology plays an important part. Even in that part of economics which deals with general and abstract principles, such technological factors as appear in the law of decreasing returns, or in the law of rent, or in the law of increasing returns, etc., cannot be left out of account.

§ 4. TECHNOLOGY IN PARTICULAR BRANCHES OF ECONOMICS

The science of economics can be divided into two principal parts: (1) the science of production and (2) the science of exchange and distribution.

In the first part the connection between economics and technology is absolute. In production, economic and technological factors are closely linked together and, therefore, when we deal with production we find ourselves almost continually on the borderland between economics and technology.

In the sphere of exchange and distribution this close

co-operation between economics and technology disappears. Here we enter into a field that is purely social, dealing with the relations between man and man, where relations between physical, chemical or biological entities pass into the background and where the tool plays a subordinate part. It ought also to be noticed that in the sphere of production we are faced with natural and technological conditions, which are less dependent upon social and legal institutions. On the other hand, the exchange and the distribution of incomes is more independent of natural and technological conditions.

Nevertheless, in the science of exchange the elements of economics and technology are still partly interconnected. The form and extent of exchange depends in a large measure on the means of transport and communication, the latter being, as a matter of fact, on the borderline between production and exchange. Some knowledge of the technique of transport is essential to a full and proper study of commerce.

But the study of the distribution of incomes is entirely free from any technological terms. Knowledge of technology is not necessary for the understanding of the process of the distribution of incomes. The branch of economics dealing with the distribution of incomes has, therefore, comparatively little connection with technology. Technological terms or problems are here reduced to a minimum. This does not mean, of course, that in the sphere of the distribution of incomes technological progress does not exert its influence. On the contrary, as we shall see later, the influence which technology exerts here is considerable. But the real point is, that in this branch of economics technological problems are not linked up with economic problems, and a knowledge of technological principles is not necessary for the appreciation of the theory of the distribution of incomes.

We can see from the above that co-operation between economics and technology is in many ways very close. It is chiefly so in the sphere of production, but least so in the field of the distribution of incomes.

CHAPTER II

TECHNOLOGY AND PROGRESS

§ 5. PRIMITIVE, QUALITATIVE AND QUANTITATIVE TECHNOLOGY

LET us now pass to the problem of technological progress, for that, indeed, is the purpose of this work. Consideration of the problems of technology and economics leads us, first of all, to the question of technological progress, for technology in itself implies technological progress. Let us then inquire why it is so.

Technology is one of the few branches of our civilization in which the line of development is always on the upgrade. It is progress in the sense that man's control over Nature is increasing, while his dependence on Nature is decreasing, and he is becoming more and more capable of overcoming obstacles and performing greater and more difficult tasks. Unlike other branches of civilization, the results of technological progress are cumulative. Every stage in technological development is in itself a source of further development, for every tool or machine made facilitates the construction of a still better and more efficient tool or machine. The construction of one tool paves the way for another and more efficient tool; and that is why technological development is so difficult at the beginning, but much easier in the later stages, when the tools are of a higher standard.

This progressive tendency, this upward march, is inherent in the nature of technology. It is true, as we shall see later, that this upward march is often interrupted by long halts and even retrogression, *i.e.* by a backward movement within one and the same economic structure. This upward march takes place at a different speed in different economic structures. In some, techno-

logy is traditional and develops at a slow rate. Sons run their business in the same way as did their fathers and grandfathers before them. In other economic structures, technology wears seven-league boots.

If we retrace the development of technology throughout the centuries, we can distinguish a powerful and continuous influence of technology and economics upon one another. We could also, in my view, distinguish three stages in the development of technology:—

1. Primitive technology—the stage of primitive tools.
2. Qualitative technology—the stage of workshop tools and implements.
3. Quantitative technology—the stage of the machine.

In *primitive technology* the tools consist of stones, sticks and clubs, and these develop later into hammers, hatchets and weapons. The primitive tool is not a labour-saving instrument, but one that stimulates and encourages systematic work. There can be no systematic work without a suitable tool. In this stage of technical development the tool has for its purpose neither the qualitative improvement of production (as in the second stage), nor the quantitative increase (as in the third stage), but merely the starting and facilitating of production itself.¹ It is the tool that teaches early man how to produce, *i.e.* how to work continuously and systematically. This stage of technology is, of course, bare of interest to an economist, for here there are no economic problems. Technology exists here before economics, and so the former creates the latter. It is a period of simple tools, a period of primitive technology.

The second stage of technological development is *qualitative technology*, the stage of workshop tools and implements. There the first workshop tools appear: spinning and weaving looms, grinding mills, the anvil, the turning-lathe, and the first improved agricultural

¹ Friedrich von Gottl-Ottliensfeld: *Wirtschaft und Technik*, "The Fundamentals of Social Economy," Part II, p. 229: "Primitive Technology is the technology of an evolving production."

implements, such as the plough. There is already some production, but it needs improvement. The improvement of tools serves, in this stage, the purpose, not of a quantitative multiplication of output, or a substitution for labour, but of improving the product and the labour. Hand in hand with the development of qualitative technology, there takes place an improvement in the man himself; for a better tool makes a better man, it educates him and makes him more skilful and efficient. Man's part in production is not diminished with the development in qualitative technology. As before, man here accounts for—to express it in figures—90 per cent of production, and the tool 10 per cent. The tool does not push the man out of the workshop, for its purpose is quality and not quantity. This stage of technology corresponds to production by craftsmen, and to the city and guild economy. In other words, it is production of goods at the request of the consumer, and not production of goods for an impersonal market. Such production is personal, and not impersonal as in the stage of quantitative technology.

The third stage of technological development is *quantitative technology*. It is no more the technology of the craftsman but technology of manufacture. The tool has developed into a machine, *i.e.* is a compounded tool, which with the help and co-operation of man carries out a number of interconnected functions. It is the machine that does the work and the man that controls it.

The purpose of the machine is to save time and labour. Its object is a quantitative maximum, and not a qualitative optimum.¹ Man's part in production diminishes, while the importance of the tool increases. Man no longer represents 90 per cent of production and the

¹ "A machine is an active instrument of labour, but serves the purpose of replacing human labour, as opposed to a tool, which has for its purpose the assistance of human labour." Werner Sombart: *Das Wirtschaftsleben im Zeitalter des Hochkapitalismus*, vol. I, p. 103. "The machine is a mechanically operated system of tools; its essence is the substitution of labour." Schultze-Gävernitz: *Die Maschine in der kapitalistischen Wirtschaftsordnung. Archiv für Sozialwissenschaft und Sozialpolitik*, Tübingen, 1930, vol. 63, No. 2, p. 225.

machine 10 per cent, as in the case of qualitative technology. His share falls as low as 40 or 30 per cent, or even less. The machine, as a rule, does not improve the man; on the contrary, it makes him stereotyped and mechanical, and lowers his general personal standard. The type of economic life is changing, its speed is increasing. Production develops extensively, but not intensively. Time becomes a precious factor, for on this factor of time is based interest on capital. The machine becomes man's rival, not his assistant. Mass production, and not quality, comes to the foreground.

Production becomes impersonal, there is less and less contact between the producer and the consumer. No longer is production for immediate orders, but for an impersonal market, exposed to the play of external forces of demand and supply.

It is the stage of the machine, the epoch of capitalism.

§ 6. TECHNOLOGY OF THE ISOLATED, THE FAMILY AND THE COMMUNITY

Primitive technology was primarily an affair of the individual. It was *the technology of the isolated man* and not of the group. The stick, club, stone or knife were the implements that he used in his solitary work.

But the stage of qualitative technology, when workshop and more complicated tools have been in use, was, in effect, technology of a small group, working together and carrying out a certain division of labour. We can term this *family technology*, technology of the household economy, in its broad sense. Man no longer carries out his work solitarily, but in a small group. Of course we speak here about work in its mass-application as typical phenomenon because there are always, even in qualitative and quantitative technology, many branches of activity in which work of the individual and isolated man plays an important part.

Quantitative or machine technology is communal technology, in the sense that it collects in one workshop

hundreds, thousands and sometimes tens of thousands of workmen, all participating in a system of division of labour. The machine renders work collective, and makes the man a mere cog in the great social machine. Man's work ceases to be a whole, and becomes just a tiny particle in a colossal rhythm of work, with which he must comply, if he is not to fall by the way.

This social side of technology (the development of which we have traced through the three stages of technology) is of the utmost importance in the course of economic development.

§ 7. TECHNOLOGY IN ECONOMIC DEVELOPMENT

Technology is, without doubt, the greatest dynamic force in economic development. Economic development is shaped and influenced by the progress of technology in the sphere of production and communication. Such elements as production, exchange, distribution, type and speed of economic activity and also the relation between men, all vary in the three stages of technology, primitive, qualitative and quantitative, respectively. The technological outlook which is inherent in the materialistic interpretation of history is well founded on actual fact. I do not approve, however, of this conception in its absolute form, for technology is not supreme; its course is dependent on the economy and mentality of different communities.

The whole course of development of economic and social life could be regarded as a product of technological development. Whatever the criteria which we apply in the classification of economic development, we must come ultimately to the question of technological progress. Let us illustrate the point with a few examples and see what are the criteria of economic development.

Let us take the criterion of production. We can then say that the characteristic feature of economic development is the continuous expansion in the scale of production. Primitive production was based on the occupation and

appropriation of Nature's riches ; then came hunting and fishing and later land cultivation and cattle-breeding ;¹ later still, handicrafts in an improved form, and finally mining and industry, the number of industries continually growing and developing on the lines of specialization and rationalization. Economic development can be, therefore, described in terms of the number of industries and the continual expansion in the scale of production. Needless to say, economic development approached from this standpoint is just a reflection of technological progress. Technological progress in production has opened out new avenues of production, and has facilitated the performance of more difficult and complicated tasks by labour.

Let us take another criterion of economic development. Let us describe economic development from the point of view of exchange, as an extension in the scale of exchange. We can then say that the characteristic feature of economic development consists in the fact that the field of exchange is continually widening and embracing greater areas. At first, exchange took place within the family and not between families, but, at a later stage, exchange extended to the whole clan or the village ; later still, it embraced the adjoining township, then the whole province, the whole state, a whole continent and finally the whole world. Local, rural exchange was replaced by urban exchange, urban exchange by national exchange, and finally international exchange. But this criterion of economic development also brings us back to technological development. Without the development of the means of communication, without the substitution of the draught horse by steam-power and the railway, without the motor-car and the aeroplane, the telephone, telegraph and wireless, the system exchange would not be in a position to become international and embrace the whole world. Development of technology in communication is at the root of economic development, according to this conception.

¹ Naturally the historical sequence differs according to climate and race.

Let us now describe economic development, using the criterion of the form of production, *i.e.* as a development from household tools to workshop tools, and from workshop tools to factory plant. Here, again, at the root of this industrial evolution lies technological development, which, by increasing output and extending the scale of consumption, facilitates specialization and rationalization in production.

Now let us describe economic development, applying the criterion of the accumulation of wealth. In the course of economic development, wealth per head increases, and the standard of living becomes higher. The United States has a several thousand times higher income per head of the population than have the Eskimos or the Bantus, and the American can therefore satisfy his demands to a greater extent than the Eskimo. It is clear that, in this case too, we come in the end to technological development, for technology, increasing the output of labour, increases the income from production.

We shall arrive at a similar conclusion, if we analyse development by applying the principle of the division of labour. In a primitive economy, the principle of division of labour is limited in its application, but in time, its application becomes wider and deeper. But an extensive application of the principle of division of labour presupposes, in fact, technological progress, for it is as a result of the development in technology that a more extensive division of labour takes place in industrial institutions and in the social economy in general.

We could quote further examples endlessly, but the few cited above prove the conclusion that the development of technology is the most powerful, dynamic factor in every branch of economic activity.

We find this dynamic factor in the sphere of production, as well as in the sphere of exchange and distribution of incomes; it is, of course, more powerful in the sphere of production than in the sphere of exchange, and more powerful still in the sphere of exchange than in distribution of incomes.

Each stage in the development of technology leads to development in the sphere of production and exchange, but we can trace no such development in the sphere of the distribution of incomes.

Whatever the criteria of development we apply in the sphere of production and exchange, whether the increase of wealth, the increase of man's power of control over Nature, the expansion in the scale of exchange or in the division of labour, the specialization and rationalization in industry, the raising of the standard of living, we can see clearly in every case that technological development is identical with economic development in the *sphere of production and exchange*.

In the sphere of the distribution of incomes, the criterion of progress is closely connected with the principles of elimination of poverty and the wide extremes in the distribution of incomes, as well as the most extensive employment of labour. But here the development in technology does not run parallel with progress in the distribution of incomes. Far-reaching progress in technology may be coupled with increasing poverty and unemployment, with the increase of poverty on the one hand and excessive luxury on the other. Technological development does not necessarily lead to a more equitable distribution of incomes; or, in other words, social progress does not go hand in hand with technological progress.¹

As a hundred years ago, so to-day, we are faced with the calamity of unemployment and poverty. Far and wide we hear the cry for a readjustment between technological and social progress, for the use of technological progress for the furtherance of social progress, to the benefit of vast masses of people.

¹ "An examination of the capitalist system to-day presents a gloomy picture. The mad speed of technological changes is uprooting the whole structure of production. Change is not only development, but also destruction. Workers keep the machinery in motion and become at the same time its victims." Emil Lederer: *Technischer Fortschritt und Arbeitslosigkeit*, Preface, p. 6. Tübingen, 1931.

CHAPTER III

CLASSIFICATION OF TECHNOLOGICAL PROGRESS

§ 8. PROGRESS IN PRODUCTIVITY, IN QUALITY AND IN NOVELTY

THE methodology of technological progress is far from being easy. The economist has to approach technological progress from the point of view of economic, and not of technological, criteria. The classification of the different forms, types and characteristics of technological progress must be so construed as to provide the economist with the widest scope in which to work. He has to single out such forms of technological development as create a specific set of problems. It is here that difficulties arise. The different problems of the labour market, of the distribution of incomes, of structural changes in the capitalist system, of the speed of technological development and of a practical valuation of progress, all require a different classification of the elements of technological progress. They also necessitate the application of different criteria, which cannot always be reconciled and adopted in their simple form. Accordingly, every classification is, in effect, the result of a compromise, for what is most important is not to lose sight of the criteria that are most essential. Needless to say, the methodology of political economy does not provide us with any hard and fast divisions, but mainly gives us a division into categories that are elastic and flexible, such as a division into production goods and consumption goods, durable goods and usable goods, or a division into the different branches of production.

With these qualifications before us, we can begin an examination of technological development at the present day. Let us start with the widest classification, taking

into account the different forms of technological progress.

It is as well to give a number of instances of how technological development works out in practice. The method of work has been improved or a new and more efficient machine has been invented, or the use made hitherto of the given sources of energy has been greatly enlarged, or man's productive capacity has been increased, or the industrial organization has been improved—and thereby a *general increase in productivity has been achieved*. Or, due to some scientific discovery, a better and improved product has been created, or new applications in the use of raw material have been found by which the production of new goods for consumption is facilitated, and thereby entirely new forms of demand are satisfied.

The above examples cover almost the whole range of technological development. These can be divided into three main groups, corresponding to the three principal kinds of technological development, and serving three different objects.

In one group fall all the cases of an increase in the productivity of labour, by the use of different means and methods, by the improvement in the instruments of labour, by an improvement in the method of labour, or by the increase in man's efficiency, or again by a better industrial organization. Such development could be termed "progress in productivity," for it increases the intensity and the productivity of labour. The same product has been turned out with less effort and difficulty, and consequently the same amount of labour can create a greater volume of production. It is, therefore, in essence a quantitative progress.

In the second group come the cases of a qualitative improvement in goods already produced and on the market, irrespective of the means and methods used in the achievement of this improvement. Due to scientific invention, cloth has become more hard-wearing and hygienic; the fragility of glass has lessened; tanning of leather has given a better product; some instrument

has been made more precise; musical instruments have been improved, etc. This group could be termed "qualitative progress," for its main characteristic is the improvement of the product, and not its numerical multiplication. At same cost a better, but not a larger, product has been created.

The third group of cases consist of inventions which bring into existence new and hitherto unknown goods for consumption, that satisfy new demands or new forms of demand. Here belong the wireless, gramophone, motor-car, aeroplane, electrical apparatus, etc. This type of technological development could be termed "progress in novelty."

The differentiation between these three categories of technological development is of utmost importance, for they are different branches of progress, resulting, as a rule, in varying economic consequences.

1. *Progress in productivity* is based upon a saving in the cost of production per unit of output. For the economist, progress in productivity consists only in such an improvement in the system of production as is expressed in the decrease in the cost of production per unit of output. A machine that works more quickly and productively, but does not reduce the cost of production, due to the disproportionately high cost of the machine itself, is not recognized by the economist as contributing to technological progress. What is progress in productivity for the technician, is not always such for the economist. The views of the economist and the technician with regard to what is progress in productivity are frequently at variance.

For the economist, the measure of progress is only the amount of the saving in costs. By a saving in costs per unit of output, one of two things are understood. Either the turning out of quantitatively greater production at the same cost, or, what amounts to the same thing, the turning out of the same amount at less cost, *i.e.* with a reduction in the quantity of labour or capital expenditure (*e.g.* saving in the use of machines).

In this category comes not only the quantitative reduction in labour, but also the replacement of skilled by unskilled labour. If technological progress consists in using the same amount of labour for the production of an article as was necessary before, but in the place of skilled labour cheaper and unskilled labour is being used, then, of course, the costs of production are in this way reduced. For skilled labour may be regarded as unskilled labour multiplied many-fold.

Similarly, the stimulation of human effort and the increased use of man's energy and his capacity to labour, falls within this category; it results, in effect, in a saving of costs. If, for instance, the time taken in the production of a certain article has not been reduced, but by some psychological stimulus the energy of the worker has been increased so that he does his work more efficiently, then technological progress in this case consists not in the fact that a lesser effort is used for the production of an article, but rather in the fact that the worker finds that it is easier to increase his efforts; in other words, to turn out, in a given unit of time, a greater quantity of articles. This, in effect, reduces the cost of production.

A reduction in the time necessary for the placing of the article on the market also comes into this first category. It does not mean a reduction in effort or in working time, but solely a reduction in the period of time required for the realization of the value of the product. This makes the capital necessary for production available for further use, and results in a saving of interest. A decline in the risks of production, or a reduction in accidents in industry, comes into this same category.

This first category of technological progress, which we termed "progress in productivity," consists in turning out the same product at the same cost, but in multiplied numbers, while the quality of the product, as such, remains unchanged. Progress of this kind increases the supply of the article on the market, and, consequently,

supply, we are faced with what is called "technological unemployment," *i.e.* unemployment caused by an increase in output.

2. *Progress in quality* is of a different nature. Here the product increases not in quantity, but in quality. The results attained are not greater, but better. It is not that a new article has been produced, but that the same article has been improved, however slightly, whether in appearance, durability or otherwise. Such progress can be brought about in different ways; either by the introduction of a new and more precise machine or by an increase in the skill of the worker, or again, by an improvement in the materials by the use of special processes. Progress of this type does not, as a rule, save capital or labour. Neither does it create technological unemployment. It does not, as a rule, increase the supply of the article on the market; on the contrary, it increases the demand, for it offers a better article at the same, or slightly different, price. Progress in quality may not create new employment, but it certainly does not cause technological unemployment. The measure of such progress is its capacity to increase the demand for an improved article.

3. The third category is *progress in novelty*. This is progress consisting in the production of new consumption goods, either entirely new types of articles satisfying new demands or goods satisfying different types of demand. New articles created by such progress must have the character of consumption goods, not production goods. The measure of progress is here the value of the novelty, *i.e.* the capacity to create new lines of production. Synthetic petrol, although important from the technical point of view, is for the economist only of slight value, so long as the productive value of the invention is limited, and the number of new workmen it can employ remains small. The motor-car, on the other hand, which has created employment for several millions of people in the United States, in its different stages of production, is of the utmost importance from the point of view of

technological progress. The additional employment created by progress in novelty can be termed "technological employment," as opposed to technological unemployment, which is created by progress in productivity.

These three categories of technological progress, though different in their nature, are yet not divided by any rigid dividing-line, but overlap in many cases.

Such overlapping takes place when, for instance, the production of a better article can be regarded as multiplied production of the same article. A shoe that is twice as good and is produced at the same cost, can be regarded as having the value of two shoes of the former lower quality. A pair of shoes of a quality twice as good gives the service of two pairs of shoes of former quality. It may be that, in this way, the demand for the better quality shoes will fall. It may occur, therefore, that in certain cases the progress in quality will be from the economic point of view, equal in result to progress in productivity. But these are exceptional cases, and, as a rule, progress in quality must be distinguished from progress in productivity.

Progress in quality also often overlaps progress in novelty. An article of a better quality amounts, in fact, to a new article, and from the economic point of view in many cases cannot be distinguished from it. The distinction between a new article and an old article which has been improved in quality, is frequently negligible. These are, of course, marginal cases, but they do not alter the fact that progress in quality and progress in novelty on a large scale are different.

Similarly, progress in productivity often overlaps progress in novelty. In many cases one and the same scientific invention can be utilized for the furtherance of both progress in novelty and in productivity, just as coal can be either a production good or a consumption good. The motor vehicle, which may be considered as the typical novelty invention, may be at the same time assisting progress in productivity; for the motor vehicle, too, can be either a production good or a consumption

good. The motor lorry has speeded up goods transport, and has also made such transport cheaper and more convenient, thereby ensuring progress in productivity; the motor-car, on the other hand, used for the transport of persons, is progress in novelty, as it meets new demands or new types of demands, such as pleasure motoring, touring, etc.

Similarly, wireless in communication is progress in productivity, and wireless in broadcasting is progress in novelty. The discovery of petroleum and its application as a fuel for motor vehicles was a very important event in the progress of productivity, but the same petroleum used for household lighting is progress in novelty. The same applies to electricity, but not to the cinema and the gramophone; the latter are solely forms of progress in novelty, for these make no contribution to progress in productivity. Nevertheless, in spite of all these overlapping cases, the broad distinction holds good.

Progress in quality, in productivity and in novelty, each in their own sphere, have a different effect upon the specialization of the product, the employment of labour and capital, demand and supply, the method of production, the mentality of the worker and the type of management. Each of them influences the increase in the social income and its distribution.

Let us now classify these three categories of progress, according to their importance. First of all comes progress in productivity. Progress in productivity shapes the whole technical structure of capitalism, and has created the most important set of problems connected with technological unemployment.

Second in importance is progress in novelty. Its importance fluctuates with time; in certain periods it becomes of the utmost importance; in others it disappears altogether for a time. It also creates important problems of technological employment, but they are not so important as those caused by progress in productivity.

Progress in quality is the least important. The period of progress in qualitative technology on a large scale has

passed, although, of course, even to-day one can still speak of the qualitative improvement in certain articles. Progress in quality creates problems of qualitative and quantitative changes in demand, and consequently of employment.

Progress in quality is the intermediate stage between progress in novelty and progress in productivity. Its nature resembles sometimes the one and sometimes the other. As a rule, it neither results in any increase in technological unemployment, nor does it create new employment.

The three categories of technological progress are complementary and it is the aim of technological development to secure the mutual co-operation between them. Very often, however, progress in quality is only achieved at the cost of quantity, and, as a rule, serves the interests of the upper classes, while progress in productivity is often achieved at the price of quality, and serves the interests of the masses. Progress in novelty, too, is frequently achieved at the expense of the older branches of production and deprives them of such instruments of production as capital and labour. Progress in novelty needs, therefore, supplementing with progress in productivity, and vice versa.

§ 9. PROGRESS IN QUALITY

The problems of progress in quality are perhaps the most complicated of all three types of progress. A clear and precise classification of qualitative characteristics is more difficult than the mere classification of quantitative characteristics. Quantitative elements are measurable and comparable, but qualitative elements present very often a mosaic of almost incomprehensible changes.

In progress in productivity we get a quantitatively greater product at the same cost. We can, accordingly, calculate the amount of the product per unit of cost. In qualitative productivity, however, such calculation is generally impossible. This can be done to a certain

extent, but only in the case where progress in quality results in an increased durability of the article. For, in such a case, progress in quality approaches progress in quantity.

Besides durability, the utility of an article is of great importance. Progress in quality can be based on improvement in the quality of the goods, their dimensions, type, appearance and their respective capacity to satisfy demand. Thus, in articles of food, such progress can improve the product as regards taste, nutritive and health value; in clothes, as regards colour, shape, texture, style, etc.; in musical instruments, as regards precision, richness, tone, etc.

The wealth of qualities is here enormous, but it does not create any quantitative and measurable basis of economic problems. All we can say with certainty is that it does not, as a rule, create technological unemployment. If, at the same cost, a better article has been produced, this will usually raise demand, for people will be able to get a better product than formerly. Since such progress is not based on a saving in costs or labour, and, as a rule, it increases demand, it consequently creates additional employment. Even where the progress in quality consists in an increase in durability, it will not create technological unemployment. Although, in the example given above, the one pair of shoes of a quality twice as good does the service of two pairs of shoes of ordinary quality, demand will nevertheless be affected. Normally the consumer wants shoes for different occasions (ordinary wear, sport wear, evening wear, etc.), and the improvement in the quality of the shoes raises his taste and, therefore, his demand for shoes of better quality.

Progress in quality educates the worker and raises the standard of living of the consumer. It increases the demand for better articles and indirectly creates employment. Generally, therefore, it does not upset the system of distribution. The valuation of progress in quality depends in each particular case upon its influence on the amount and nature of demand, upon the competitive power of

the improved article, upon whether the article is of a destructive or constructive type, and whether it is a luxury or for popular consumption. The influence of progress in quality is different when an article of higher quality replaces a lower one, from when a high quality article appears side by side with the article of inferior quality. In the former case there may come about a complete depreciation of the existing stock of goods, which can, therefore, result in great losses of capital. In the latter case, however, there can be no losses. In the two cases the advantages and disadvantages of technological progress are distinct.

§ 10. PROGRESS IN NOVELTY

We have noticed before that progress in novelty consists in the production of new consumption goods which satisfy new demands or new forms of demand. It widens and enriches the scale of man's demands, thereby contributing to the advance of civilization.

Under this category falls electrical inventions, which have given rise to an entirely new branch of industry, satisfying new demands. Here belongs the discovery of such new materials as aluminium and platinum, which have opened the way for the production of new articles; here belong also such essentially new articles as the motor-car, the wireless, the gramophone and the film.

Since progress in novelty consists in the production of consumption goods, it cannot include novelty in the sphere of production goods such as new machines and tools. The object of the latter is, as a rule, the increase in the output of existing consumption goods, and, as such, they come within the category of progress in productivity. This is the basic difference between progress in novelty and progress in productivity. The former influences not only the supply of goods, but also the nature of the demand. The latter, however, influences directly only the supply of goods, by facilitating production and reducing its costs.

Progress in novelty creates a new demand for goods and thus for capital and labour, due to the fact that it brings into existence new branches of industry. It opens for capital new possibilities of profitable investment, for labour new employment, for the consumer new possibilities of consumption. The productive effort of the community is increased in order to satisfy new demands. In this way a new branch of production comes into being.

It could be claimed that even new production goods create a new branch of production, *e.g.* the invention of new machines brings into existence a new branch of industry producing such machines. But there is a fundamental distinction between a machine and a consumption article. Whereas the machine increases the supply of goods which it produces, it does not shape or create a new demand, but the consumption article, on the other hand, does create a new demand. The machine may, therefore, bring about technological unemployment, while the consumption article will create technological employment.

When qualitatively new consumption goods are placed on the market, the purchasing power of the community increases, due to the fact that the production and consumption of such goods necessarily give employment to workmen, who would otherwise be unemployed. The national income increases as a whole, owing to the new employment of workmen in this branch of industry, while other branches of production incur thereby no loss. At the same time the capacity of the community to satisfy demands increases and the scale of demand becomes wider.

In many epochs progress in novelty was of vital importance in increasing a country's prosperity. The motor vehicle was, after the Great War, especially in the years 1920-29, such a factor in shaping the prosperity of the United States. It brought into existence an enormous new industry, causing thereby no loss to other branches of production. It gave employment (in all its stages of production) to several millions of workers, whom the progress in productivity had turned into the street.

Progress in novelty smoothes out the economic disturbances caused by progress in productivity. *Consequently, the object to be aimed at by technological progress is to keep progress in novelty and progress in productivity in step, for they are complementary and have a comparatory influence on the labour market.*

Whenever technological progress inclines mainly towards progress in productivity, a certain amount of labour becomes superfluous. This tends to increase unemployment and poverty, owing to maladjustment in the distribution of incomes. On the other hand, whenever technological progress leans towards progress in novelty, then production of new consumption goods draws on the reservoir of productive forces, which, in the absence of any progress in productivity, remain unchanged. In this case, it is the production of existing consumption goods that suffers, unless the general effort of the community is increased. Where, however, progress in productivity keeps pace with progress in novelty, then labour which has been released from other branches of industry, due to mechanization, can be diverted into new avenues of production of consumption goods.

Hence the importance of securing as the ideal of technological progress the proper adjustment of progress in productivity to progress in novelty.

The characteristics of progress in novelty are not uniform. They differ in importance, and depend upon the nature of the goods they create. These characteristics have, therefore, to be taken into consideration when dealing with progress in novelty.

1. The intensity of demand is the first thing to be considered. Whenever demand is only slight, the importance of the invention, from the point of view of economic activity, is also slight. On the other hand, when the new article meets with a great demand, which, in effect, results in a demand for capital and labour, such an invention is of the utmost importance in economic

development. It can go so far as entirely to reconstruct the economic life of the country, change the whole structure of demand, advance the industrialization of the country and substantially increase the national income.

2. The second point to be considered is the question whether the new article is an internal consumption good or for export. A novelty thrown on a foreign market is usually a source of great profit and of additional employment. The export of cars from America was for the United States an important source of income and paved the way for America's world economic supremacy.

3. The degree of competition between the new articles and the old ones, *i.e.* the extent of substitution, has also to be considered. New articles can so satisfy new demands as not to curtail the demand for existing goods, but it can also push out of the market existing articles. In the latter case, the new branch of production grows at the expense of the existing branches, but in the former no dislocation whatsoever is occasioned. In the one case there is a transformation of production, in the other a variation and enrichment.

It is important to emphasize that this distinction is based upon the degree of competition, for, in effect, all the new articles oust existing articles from the market, to a greater or lesser degree. The cinema, has, to some extent, ousted the theatre, the wireless and the gramophone has ousted the musical instrument, the motor vehicle the horse and the railway, the cigarette-lighter the match, electric light paraffin and the candle, gas ousts coal, photography ousts painting. The demand which is being satisfied by the new article can be less or more different from the existing article. What the theatre provides is not the same as that provided by the cinema, and vice versa. Let us suppose that the cinema has displaced the theatre to the extent of one-third, and to that extent it curtails the development of the theatre. But, at the same time, it creates an enormous sphere where competition is absent and in which development breaks new ground. The motor vehicle can supplant the

railway to the extent of one-tenth of its activities, and the horse to the extent of one-third ; but, on the other hand, there is a wide range of non-competitive activity, in which the demand met by the motor vehicle is different from the demand met by the railway or the horse.

Consequently, in considering the degree of progress, it is important to take into account the extent of competition between the new goods and the old, since only goods of small competitive power have a beneficial effect on the labour market, as will be observed from what has been said above. On the other hand, goods of a high competitive power bring about less beneficial results, and progress in novelty approaches here in its character progress in productivity.

4. The form of competition, too, and not only its extent, has to be taken into account. The question is, not only whether the new articles compete with existing articles to a greater or lesser degree, but also whether the new goods are capable of replacing the old ones in the sense of the inferior-quality substitutes, or whether they are competitive goods in the sense of being goods of a higher standard.

In the first case, we have a substitution article of inferior quality meeting the demand, but in an inferior way. Such substitution article will never be in a position to oust completely the main article, *e.g.* the gramophone will never be able to replace completely the piano or the violin. In the second case, there is a definite improvement and upgrading of demand, contributing to an advance in civilization. The motor vehicle is a better mode of transport than the horse-cart, and can in no way be considered an inferior substitution of it. It contributes to the material enrichment of civilization, which an inferior substitute makes no further contribution.

The differentiation between an inferior substitute and an article of higher quality is also important in considering the influence of technological progress on the distribution of incomes. The inferior substitute is mainly

for popular consumption, and has for its object the facilitating of the acquisition by the masses of goods which were formerly available only to the richer classes.

Of course, the question of in what direction the progress in novelty proceeds, whether towards better-quality articles or towards inferior-quality substitutes, depends not merely upon the development of technological thought, but first and foremost upon the structure of the distribution of incomes. If, in a given community, the upper classes retain in their hands a greater and greater share of the national income, they must be given an increasing amount of higher-quality articles and an opportunity of reserving to themselves, both quantitatively and qualitatively, a greater variety of goods. If, on the other hand, the share of the masses increases, then it is necessary to provide them with an opportunity of acquiring goods of a quality approaching that which was a monopoly of the upper classes. In this way, inferior substitutes bring popular consumption nearer to the consumption of the upper classes.

We can say here that, as a result of fluctuations in the distribution of the national income, the object of technological progress ought to be in the direction of securing both inferior substitutes for the masses and better-quality articles for the upper classes. Whenever progress tends to be one-sided and leans towards popular demand, the upper classes are not stimulated towards increased demand for superior-quality goods; when the opposite takes place, the masses in their turn are deprived of any such stimulus.

5. The positive and negative value of new goods has now to be considered. New goods, created by progress in novelty, may have both a positive and a negative value from the economic point of view.

One of the leading American economists, Edwin Seligman,¹ divides, from this point of view, goods produced by man into four classes:—

(1) Positive. (2) Neutral. (3) Wasteful. (4) Destructive.

¹ Edwin R. A. Seligman: *The Economics of Instalment Selling*, New York, 1927.

Thus the production of foodstuffs, clothes, houses, motor vehicles, and scientific tools is of a positive character, since it increases the productive efficiency of the community. A community which produces and consumes more goods of such character will show a higher productive efficiency.

But the above cannot be said of goods of a neutral character, such as tea or coffee. A community producing and consuming a greater amount of goods of this kind will not increase its productive efficiency, although there can be no decrease either.

In the third class of goods, *i.e.* goods of a wasteful character, the productive efficiency of a community is exposed to a danger if the production and consumption of such goods becomes excessive. This happens with the production of luxuries, silk, embroidery, carpets, diamonds, etc. The production of such novelties on a large scale can result in a general diminution in the productive power of the community.

Lastly, there come goods of a destructive character, the production and consumption of which destroys the economic forces of the community. The production of narcotics, liqueurs, opium, poison gas, guns, etc., is of a destructive character.

This classification can be usefully employed in considering progress in novelty. Here it is of importance to distinguish the character of goods so produced, *i.e.* whether they are positive or destructive goods.

New discoveries in building or clothes differ in importance, from the economic point of view, from discoveries in the sphere of diamonds, embroidery, narcotics or liqueurs, and finally, what is most important, from new inventions in the sphere of the destructive technique of warfare.

Of course, the ideal of progress in novelty is that it should be directed only towards the production of positive goods. It would thus ensure an increase in the standard of living of the masses and a general increase in the national income. If, on the other hand, as is the case

to-day, progress in novelty is being utilized mainly for the production of destructive goods of the armament industry, then such technological progress is only an element of poverty and destruction in both national and international economic life. Such progress only increases the cost of armaments, which bears heavily upon the standard of living of the population.

§ II. PROGRESS IN PRODUCTIVITY AND ITS FORMS

Progress in productivity is the largest and the most important section of technological progress. A great part of this work will, therefore, be devoted to it. We have already dealt with its nature. The problems it creates and its influence on employment and the distribution of incomes will be dealt with in Part II of this book.

Here we shall be concerned only with an analysis of the different forms of progress in productivity. As stated above, its essence is a saving in costs. It is important for the economist to realize how much saving in costs is brought about, whether by the introduction of a new machine, by a new system of work, by stimulating human effort, or finally by industrial organization. It is equally important for the economist to know where such saving in costs takes place, in labour or in capital.

The first problem we shall term "the problem of the form" (the method of progress), and the second problem "the problem of the direction" of progress. These problems play only a small part in the other types of progress, *i.e.* in quality and in novelty, and we shall, therefore, deal with the problem of the form of progress only in relation to progress in productivity.

An analysis of all the forms of progress in productivity brings us to a division into four main heads. These are:—

- (1) Mechanization. (2) Rationalization. (3) Industrial Psychology. (4) Industrial Organization.

The range of their causes and effects does not always coincide, and therefore a closer examination is necessary.

The terminology used here does not correspond to popular usage, and this fact has to be kept well in mind.

1. *Mechanization.*—By mechanization is understood all technological improvement in the instruments of labour. It therefore comprises every improvement in tools, of whatever form, and not merely the introduction or improvement of machines.

Obviously, at the present stage in the development of technology, the introduction or improvement of a machine is a most important factor. All technological improvements consisting in the replacement of human labour by mechanical power, or the replacement of human skill by the use of improved tools and automatic machines, fall under this head. An example of the former is the steam-engine or the Diesel motor, while an example of the latter is the typewriter or the linotype. In many cases there is, of course, a combination between a power-producing and a labour-producing machine. It can even be said that, as a general rule, the machine is, to some extent, the combination of power and labour. But frequently the machines are only power-producing, *i.e.* are motors; in other cases, however, they perform their work by being set into motion by human labour and are a substitution of human skill.

Machines of the first kind serve the purpose of utilizing superhuman energy, such as wind, water, electricity, steam, etc.; under this head come the steam-engine, the petrol motor and the electric motor. Machines of the second kind serve the purpose of achieving greater efficiency in performance or relieving human labour; under this head come the typewriter and the linotype. The early machines of the first kind were the water-mill, the windmill and the piston; early machines of the second type were simply improvements of tools.

Naturally, there is no hard and fast distinction between the machine and the tool. Such a distinction is only clear where there is a simple tool on the one hand and a machine on the other. The knife, the scissors, the hammer, the saw, the screw and the lever are not machines;

but when the tools become complicated, as, for instance, in the weaving-loom or the turning-lathe, the distinction between the machine and the tool becomes less marked. A machine is usually a compounded tool, which, in co-operation with man, performs a number of interconnected functions. The performance of such functions is usually automatic and is controlled and set into motion by man.

Mechanization of production is found in early times,¹ but it was only in the second quarter of the eighteenth century that it developed on a large scale. At first, mechanization embraced the weaving and spinning sections of the textile industry, due to the inventions of Kay (1733), Wyatt (1738), Paul (1748), Hargreaves (1768), Arkwright (1769-71), and Cartwright (1784). Later on, it embraced the iron industry, introduced the steam-engine, the railway, the steamship, and later still it revolutionized in turn almost all branches of industry, which, at different periods, were in the forefront of economic development. Such a leading industry was spinning and weaving at the end of the eighteenth century, but later the metal industry came to the fore, and later still the chemical industry, and in our times the motor vehicle and the electrical engineering industry.²

The mechanization of production has brought about many far-reaching transformations in the system of production, in its processes, in the psychology of the worker and his relation to his employer. It has also resulted in a concentration of production, for the increasingly com-

¹ "Our age is called 'the machine age.' This is quite wrong if it is meant to express that formerly there were no machines in existence and that they have only now been invented and put into operation. The machine, in point of fact, is as old as the tool." Werner Sombart: *Das Wirtschaftsleben im Zeitalter des Hochkapitalismus*, 1928, vol. I, p. 104.

² Walther Hoffmann, *Stadien und Typen der Industrialisierung*, Jena, 1931, p. 94, distinguishes four periods of industrialization. The first, from 1770 to 1820, *i.e.* the industrialization of England and its influence on Switzerland and the United States. The second, from 1821 to 1860, *i.e.* the industrialization of continental countries, especially of Belgium, France, Germany, Austria, Russia and Sweden. The third, from 1861 to 1900, *i.e.* the industrialization of Italy, Holland, Denmark, Greece, Canada and Japan. The fourth period brought industrialization to overseas countries.

plicated and expensive machines necessitate greater capital and larger productive units. This has resulted, in turn, in a specialization of production, for the machine, in a way, compels a man to limit himself to a certain branch of production. A further consequence is mass production, which has destroyed the individual character of production, thereby creating a uniformity both in production and in the demands of the consumer. Mechanization has enlarged the market enormously, both extensively and intensively, since it has made transport easier and prices lower, and thus made goods more accessible to the general consumer.

Mechanization of production has, nevertheless, extended the period of production, by bringing into existence new branches of industry which turn out the new tools and machines. The number of intermediate stages is increasing, and these serve as the preparation for the last stage, *i.e.* the production of consumption goods. This increases the proportion of production goods, or "capital goods," in the economic structure, and this, in fact, is the essence of industrialization. In this way, important changes in the tempo of production take place, since the extended period of production increases the range of economic fluctuations. Lastly, mechanization increases the overhead costs of production, which are independent of the size of production, and decreases the variable costs. This, in turn, brings about far-reaching economic changes, *e.g.* monopoly and cartels in production and inelasticity in the play of economic forces.

2. *Rationalization.*—By rationalization of production is understood an improvement in the system of labour or the process of production, which takes place without the introduction of new or old, but improved, tools. The increase in the productivity of labour (or reduction in production costs) is here brought about without any corresponding progress in mechanization, *e.g.* where the method of production has been improved, so as to achieve a saving in raw material or in labour, or where a better division of work has been introduced, with the result that

the worker, who carries on the work of another, does not have to wait for his fellow ; or where a stricter control has been exercised, or again, where some superfluous movements of the worker or of materials has been eliminated ; or where the cost of operating a machine, due to its better use, has been decreased, on account of its continuous operation ; or again, where the time necessary for placing the product on the market has been shortened. In all these cases, a rationalization of production has been achieved without any improvement in the instruments of labour, but, of course, rationalization often goes hand in hand with mechanization, in the same way as mechanization is often connected with rationalization. But these two forms of technological progress must be distinguished, since they are brought about in different ways and give different results.

Let us now give a few examples of rationalization of labour. Frank Gilbreth, a follower of Frederick W. Taylor, made a film time-study, in which he observed which of the motions of the worker are necessary for a certain piece of work, which movements are the most essential and which involve the least effort and the greatest saving in time. In this way he fixed certain standards of movement for the worker, showing which are the most essential, which the quickest and which are time- and energy-saving. Gilbreth observed from many years study of building operatives that in setting the bricks thirteen out of eighteen movements are completely unnecessary, and by limiting them to five, on Gilbreth's scheme, 350 bricks can be set per hour against a previous record of 120. By dispensing with superfluous movements, a building operative, working according to Gilbreth's system, achieves greater results in the same time, at a considerable saving of energy. This is a typical example of rationalization of labour.

In addition to the examples cited above, what is known as "scientific management" comes under the head of rationalization. Here belong all improvements in the labour system which are based on a strict

division of function between the management and the employees, as well as highly developed specialization and the execution of preliminary work by the management.¹ The labourer receives from the foreman an instruction card, which contains exact details of the method of carrying out his work, the materials to be used, the tools to be employed, etc. All preliminary activities and the examination of the most efficient method of work are the function of the management.² Part of the labour previously performed manually is, under a system of rationalization, taken over by clerical workers, who, by their direction and control, statistics and schemes, make part of the manual work unnecessary.

Rationalization also includes the so-called "conveyer belts," by which the worker performs highly automatic tasks on a moving belt in a strictly defined time. Should he not carry out his work in the prescribed time, then all his fellow-workers, who have to do their work on the same moving belt, would come to a halt and dislocate the whole system. This kind of rationalization creates a need for highly skilled workers capable of concentration, otherwise damage will be caused, and this would increase, and not reduce, costs.

Rationalization of production is the most recent step forward in progress, whereas formerly technological progress consisted largely of mechanical inventions.

The influence of rationalization is distinct from that of mechanization. Mechanization brings into existence new branches of the engineering industry, which does not, of course, apply to rationalization. Mechanization extends the period of production, thereby increasing the number of its stages, since in the production of a given article

¹ "There is an almost equal division of the work and the responsibility between the management and the workmen. The management take over all work for which they are better fitted than the workman, while in the past almost all the work and the greater part of the responsibility were thrown upon the men." Frederick Winslow Taylor: *The Principles of Scientific Management*, 1911, p. 22.

² *Ibid.*, p. 16. "This close, intimate, personal co-operation between the management and the men is of the essence of modern scientific or task management."

another stage is added, viz. the construction of the machine. This does not take place in rationalization.

Mechanization changes the character of production costs, by increasing overheads. This does not always occur in rationalization.

The new division of labour which mechanization brings in its train is quite distinct from that brought about by rationalization. Mechanization introduces a division of labour between the inventor of the machine, the workers producing it and the workers operating it. Rationalization, on the other hand, places most of the work in the hands of clerical staff supervising labour, and increases the participation of mental workers in the factory. Moreover, rationalization creates a class of well-paid and highly qualified workers, while mechanization very often leads to the replacement of skilled by unskilled workers.

3. *Industrial Psychology*.—Industrial psychology is a form of technological progress consisting of such technological improvements as increases the productivity of the worker by stimulating his capacity for additional effort, and his ability and readiness to use such additional energy. These are really methods of improvement in the "human machine," the betterment of the man himself as a producing or operating agent.

If the factory is well aired, is bright and clean, and is well decorated, all this will increase a man's capacity for additional effort.

If the hours of work are suitably shortened, a relative increase, and not a reduction, in output can be achieved.

If the mental and physical health of the worker is cared for, and he is guarded from bad habits, such as excessive drinking, an increase in his productive power will result.

If a better factory discipline is introduced, then, to a certain extent, better results can also be obtained.

If psychological tests are applied to gauge the worker's capacity to perform certain functions, and thus are selected those with the best qualifications, an increase in

output will be achieved. Appropriate selection of labour brings about an increase in productivity. If studies in industrial psychology are made to include the factor of fatigue,¹ by endeavouring to spread it over time and distance in such a way as to conserve the energy of the worker and to derive the maximum amount of labour from him, then here, too, productivity will be increased. (In England there is in existence an Industrial Fatigue Research Board.)²

Similarly, the productivity of the worker can be increased by the application of suitable incentives. These may consist of a better level of wages, *e.g.* piece-work combined with bonuses, which aim at increasing the efforts of the worker as far as is physiologically and hygienically possible. Such a system may be termed a "system of initiative," for the worker, in his own interest, shows the highest initiative.³ It can also be called the "system of incentives," for its aim is to stimulate the worker to the greatest productivity by offering a number of incentives.⁴

Also the factor of collective work, by creating a latent element of emulation and a common tempo of labour, necessarily brings about good results. In this way, record results are obtained from workers.

All these technological improvements can be described as the application of industrial psychology to labour, since their object is the increase in the productivity of

¹ An improvement in lighting results in an increase in productivity. In U.S.A., tests have shown an increase of 42 per cent in productivity. See *Les Aspects sociaux de la Rationalization*, Geneva, 1931, p. 56.

² *Ibid.*, p. 31.

³ "Broadly speaking, the best type of management in ordinary use may be defined as management in which the workmen give their best initiative, and in return receive some special incentive from their employers. This type of management will be referred to as the management of 'initiative and incentive,' in contradistinction to scientific management, with which it is to be compared." F. W. Taylor, p. 20.

⁴ An American author, C. W. Lytle, head of the Department of Industrial Co-operation in New York University, says that "it has been shown by a number of experiments that a good system of remuneration very often increases the productivity of the unskilled workers by 100 per cent, of machine workers by 150 per cent, of skilled mechanics by 200 per cent, and in the case of higher qualified workers the percentage was as high as 300."

human labour by influencing the psychology of the worker. The most important application of this method is the Taylor system, although it is also partly a system of rationalization of production.

Progress in industrial psychology is in practice as old as production itself. Taylor was the first to place it on a scientific basis, by introducing the factor of initiative and incentive in extracting the maximum effort. The present machine production and the rationalization of labour demand an active and willing worker, who will show a certain keenness in his work and will not be merely a passive slave.

As was stated above, vocational guidance is an important branch of industrial psychology. We owe its beginnings to F. Parsons, who, in 1908, opened in America a Vocational Guidance Agency. To-day, experiments in industrial psychology and bureaux giving vocational guidance are in existence in almost every country. Such experiments are of great importance in responsible vocations, in which there is a risk of accidents to the public, such as motor-drivers and engine-drivers. Industrial psychology is a prime factor in reducing the number of accidents in industry, which is important, not only from the humanitarian point of view, but also from the point of view of reducing costs of production. (Here belongs education in protective measures, aiming at a reduction in fatalities in industry.)

Let us now consider the difference between rationalization and industrial psychology. This consists in the fact that while the former aims at a rationalization of the system of labour by the application of purely external factors, the latter aims at an increase in productivity by the application of psychological incentives to human labour. Rationalization brings about an increase in productivity in particular stages, but industrial psychology increases the productivity of human labour as a whole, in all its stages. This difference could also be described by saying that whereas rationalization is an improvement in the system of labour or the rationalization of certain

definite activities in production, industrial psychology is really *rationalization of the man himself*.

Of course, there are many cases which are on the border line between rationalization and industrial psychology. Many technological improvements belong at one and the same time to both rationalization and industrial psychology. Such is the conveyer belt, which, on the one hand, by simplifying labour belongs to the class of rationalization, and on the other hand, by compelling the workers to perform certain tasks in a prescribed time, acts as a psychological stimulus, and falls, therefore, within the category of industrial psychology.

Industrial psychology and rationalization each create a different set of problems. These problems embrace discipline, the mentality of the worker, choice of vocation, hygienic conditions of work and finally the vast field of the problem of wages. Again, industrial psychology brings about different results from rationalization. Thus, industrial psychology results, as a rule, in higher wages, while this result is not usually brought about by rationalization.

4. *Industrial Organization* is the fourth form of technological development which advances productivity. Here, the increase in productivity takes place in relation to the whole collective apparatus of labour, and not in a single unit. It is brought about either by convention or by legislation, and can generally be referred to as "industrial organization."

Included under this head is the simplification of models, *i.e.* the working according to fixed standards, patterns and types. Here, too, belongs the specialization in industry which, in its broadest sense, consists in the transfer of the location of the industry to the most advantageous spot and the allocation of the work of production to the best organized workshop, together with the amalgamation of industrial concerns, or a close co-operation between them, in order to secure a saving in costs and so on.

Working according to fixed standards consists in a

uniformity of quality. For instance, instead of having ten different qualities of zinc only three or four set qualities are produced.

Working according to fixed patterns consists in a uniformity of the size of different products. For instance, instead of having fifty different sizes of beds or windows, only five fixed sizes are produced.

Working according to fixed types consists in a uniformity of certain complicated kinds of goods, such as machines, buildings, etc. For instance, in working-class buildings, a uniformity in type, materials used, measurements, appearance, etc., of the houses are introduced.

Such working according to fixed standards, patterns and types is brought about either by the conventions of the industrialists themselves or by State legislation, *i.e.*, by legal compulsion.¹ It can also be brought about as a result of a single producer holding a monopoly or a quasi-monopoly, who has captured the market in respect of certain articles.

Simplification of models facilitates mass-production and leads, in turn, to great savings in costs. Thus, the number of the machines and tools employed may be considerably reduced, for uniform production requires

¹ "The movement towards standardization, scarcely in being before the War, has since expanded in an extraordinary manner. In the United States, the report of the Federated American Engineering Societies on the subject of *Waste in Industry* (published in 1921) gave it a great impetus. There existed at that time in that country quite a collection of important institutions or organizations charged with the task of ensuring that standardization was put into practice (National Bureau of Standards, Division of Simplified Practice, Commercial Standards Unit, American Marine Standards Committee, Central Committee on Lumber Standards, American Standards Association, etc.). On the other hand, more than 240 industrial concerns worked for the establishment of their own standards or co-operated with other organizations for the establishment of trade association standards.

"The movement has developed similarly in a number of other countries. Where a single national standards organization existed before the War, there were twenty at the end of 1928. The number of standards drawn up by these different organizations is already important and is continually increasing." "Social Aspects of Rationalization," International Labour Office, Geneva. Series B, No. 18, 1931, p. 66.

In 1930 Germany possessed 2952 standards which had been adopted and 1924 pending, or a total of nearly 5000; Russia had 603 adopted and 4000 pending; France approximately 400 adopted or pending; Czechoslovakia 732 adopted; Switzerland 655; Austria 549. *Ibid.*, p. 67.

uniform machinery. Simplification of models brings about also a reduction in the stock of goods kept by factories or trade in general, thereby freeing capital itself. Thus, if out of one hundred existing sizes of a certain article the business man has to keep in stock at least twenty of each size, then if the number of sizes is reduced to fifty he will now need for the same volume of business only half of his former stock.¹

Under this head of technological progress in industrial organization falls also industrial specialization in a broad sense, resulting in an increase of output. If by convention, legal compulsion or a decision of an individual industrialist, work in a factory giving unsatisfactory results is restricted or suspended and transferred to a factory that works better, or if specialization is introduced by means of a division of labour between the different factories, so that a particular factory devotes itself to the production of a particular type of product—the problems of such progress in industrial organization are similar in nature to those of simplification of models. To this section belongs also saving in costs as a result of industrial concentration, amalgamation or conventions leading up to rationalization.

Industrial organization either results in direct concentration or leads to concentration and monopoly in industry. Its main feature, distinguishing it from other forms of progress in productivity, is the freeing of fixed capital in industry and commerce. It is, as a rule, progress resulting in the saving of capital.

§ 12. DIRECTION OF TECHNOLOGICAL PROGRESS

An analysis of progress in productivity necessitates the consideration, not only of the forms it takes, but also of the direction in which it lies. Does it lie in the direction of saving in wages, or in the saving of interest,

¹ In the United States the number of electric bulbs has, owing to standardization, been reduced from 55,000 in 1900 to 342 in 1923. *Ibid.*, p. 68.

or again in the saving of rent? We shall deal here with the problem of the influence that technological progress exerts on the composition of the factors of production and their quantitative relations. Accordingly, we shall have to take into account not only the amount by which costs as a whole have been reduced, but also the fluctuation in the apportionment of costs between the different factors of production.

It is of importance to the economist to observe what are the items of expenditure in which a reduction has been attained. Did the saving affect overhead costs or variable costs? Is it a labour-saving or a capital-saving cut in expenditure? Is the labour so affected manual or clerical, skilled or unskilled?

We shall apply here the traditional division of the factors of production (applicable equally in distribution of incomes) into the three main groups of capital, labour and land. We shall therefore distinguish between capital-saving, labour-saving and land-saving progress.

Capital-saving progress consists of such development as results in a saving of interest, *i.e.* the reduction in interest charges in relation to the costs per unit of production. *Labour-saving progress* consists of such development as results in saving of wages and similar costs (such as health and unemployment insurance), *i.e.* a reduction in wages in relation to general expenses. *Land-saving progress* consists of such development as reduces the rent or other land charge in relation to costs per unit of production.

This distinction is of great importance with regard to problems of the distribution of incomes. Labour-saving progress diminishes, as a rule, the income of the labouring classes. Capital-saving progress, as a rule, reduces the income of the capitalist class, and land-saving progress diminishes, as a rule, the income of the land-owning class.

Mechanization, rationalization, and industrial psychology usually result in labour-saving progress. Industrial organization which, owing to standardization, saves a considerable amount of capital, results, as a rule, in capital-saving progress. Technological development in

agriculture, which facilitates the output of the same product from a smaller area of land, is land-saving progress.

There is no doubt that labour-saving progress is of the greatest importance. Modern development goes mainly in the direction of labour-saving, both directly and indirectly in other stages of production.

Amongst the problems of the direction of technological progress the problem of duality of such direction is most important ;¹ this problem is concerned with the question whether technological progress tends to promote saving in labour or whether it tends to promote saving in capital in a wide sense, including the factor of land.

It is only labour-saving progress that creates technological unemployment. Capital-saving progress in a broad sense does not, as a rule, result in technological unemployment. Labour-saving in capital (or land) usually means the liberation of capital for some other industrial enterprise, and this is equivalent to new demand for labour made by the liberated production-capital.

It is, therefore, the ideal that technological progress should not tend towards saving in labour only, but that it should also embrace the factor of capital.

§ 13. SUBSTITUTION OF THE FACTORS OF PRODUCTION

Changes brought about by technological progress in the items of costs of production can appear not only as saving in certain factors of production, but also as substitution of certain factors by others. A decrease in certain items of cost may go parallel with an increase in others. Technological development may, for instance, lead not

¹ " If we concentrate on two groups of factors, 'labour' and 'capital,' and suppose them to exhaust the list, then we can classify inventions according as their initial effects are to increase, leave unchanged, or diminish the ratio of the marginal product of capital to that of labour. We may call these inventions 'labour-saving,' 'neutral,' and 'capital-saving' respectively. Labour-saving inventions increase the marginal product of capital more than they increase the marginal product of labour ; capital-saving inventions increase the marginal product more than that of capital ; neutral inventions increase both in the same proportion." J. R. Hicks, M.A., B.Litt. : *The Theory of Wages*, p. 121. Macmillan & Co., London, 1932.

merely to a decrease in the labour costs, but it may, at one and the same time, lead to an absolute increase in the cost of capital. Where, for instance, the costs per unit of product amounted formally to £100, being apportioned as to £70 for labour costs and £30 in interest charges, as a result of new technological methods the costs may amount to £40 on labour (a decrease by £30 and £40 on interest charges (an increase by £10). Thus, the net saving attained per unit of production amounts in the case stated to £20, in spite of the fact that the costs of labour have been decreased by £30, for in respect of the £10 substitution has taken place.

In the above case a certain item in the cost of production has been substituted by another. This is not a process of saving in costs, but the process of substitution resulting from technological progress.

Development in technology affects the profitability of the factors of production in industry and consequently causes a different employment of such factors. At one stage of technology it may be more profitable to employ skilled labour, at another stage of technological development it may pay better to employ unskilled labour. Or, again, at one stage of technological development the introduction of a machine and the dismissal of a number of employees may be profitable, at another it may be more profitable to take on an increased number of clerical and supervisory workers. At a certain stage of technology it may pay to increase the land area at the expense of capital and labour, at another time it may pay to increase labour and capital at the expense of the land area.¹

Of course, the influence of technological progress in these factors of production is not absolute and unilateral, for technology too is a variable depending on the ratio of the particular factors of production on the market.²

¹ "The variableness of technology . . . exert an influence on the degree of employment of the particular factors of production." Hans Neisser: *Lohnhöhe und Beschäftigungsgrad im Marktgleichgewicht. Weltwirtschaftliches. Archiv* 1932. 36 Bd., Heft 2, p. 422.

² "The ratio capital-labour is not rigidly fixed by technology, for technology itself is variable and dependent to a certain extent on such economic factors as the rate of exchange." *Ibidem*.

Technological development may be compensated by contrary movements that change the conditions of profitability in the opposite direction. If, *e.g.*, a new invention facilitates the substitution of capital by labour, but at the same time the rate of interest increases and labour becomes cheaper, substitution may not take place since it may become no more profitable, due to the changed market ratio of interest and labour.

The substitution of factors of production took place so far mostly at the expense of labour. Within the factor of labour itself it took place in different stages of history, either at the expense of skilled labour (*e.g.* at the expense of handicraft) or at the expense of unskilled labour. The complicated machine as well as rationalization of labour has created a new demand for skilled labour necessary for the production and control of the machine, thus pushing out of employment unskilled labour.

Substitution is an important element in the influence that technological progress exerts on the pay for the different factors of production. It lowers, as a rule, the pay of the substituted factor.

In the substitution of one factor by another, the cost of substitution is the marginal value of remuneration of the other factor. Thus, *e.g.*, the cost of substitution of human labour by machinery, or in other words the cost of the machine calculated per unit of dismissed human labour, is the marginal value of the workers' wage. If, *e.g.*, at the cost of £50,000 a new machine has been introduced, guaranteed to be in good working order for the period of seven years and substitutes in that period of time 100,000 working hours (that is 5 workmen, 8 hours daily, in 7 years), then the cost of one working hour (including the upkeep of the machine, amortization of capital and interest) will amount to 6d. This will, then, be the maximum wage for workers of this class, and it will not exceed 6d. per hour. If such process took place, not at once but gradually, then by the way of increasing substitution of human labour through mechan-

ization the wage level will be sooner or later brought down to the marginal point.

In such a way, substitution is an important factor shaping the level of wages of workers employed in industries, influenced by technological progress.

§ 14. CONCENTRATING AND DECONCENTRATING PROGRESS

In a discussion of technological progress, the influence of such progress on the amount of fixed capital in industry (*i.e.* machinery, plant and buildings) must be specially considered. Approached from this point of view, technological progress can be divided into two main groups :—

- (1) Progress increasing the ratio of fixed capital in industry ; and
- (2) Progress decreasing the ratio of such capital.

We may term the former *concentrating* progress and the latter *deconcentrating* progress, since this distinction is of utmost importance in the problem of concentration in production. It creates a set of valuable problems and opens wide avenues of valuation of future technological progress.

Thus, when a new machine of £100,000 capital value has been invented and will replace an old one of the value of £10,000, then such progress in technology increases the fixed capital in industry. Such tendencies are very important as elements of economic development.

When, on the other hand, the machine invented is of the capital value of £10,000 and replaces one that was of £100,000 capital value, while the productive result is the same, then such progress in technology diminishes the amount of fixed capital in industry. Such tendency would, clearly, amount to a revolution in the conditions of industrial development.

Progress in productivity appeared, so far, mostly in the form of a concentrating progress, as was already observed

by Carl Marx.¹ Such developments lead to concentration in ownership, causing thereby far-reaching social and constitutional transformations. It was the main factor in the process of monopolization and cartelization of industries, autarchization of markets and beaurocratization of economic institutions. Such development was the main factor in the process of proletarianization of the middle classes. It brought the element of rigidity into the economic structure and extremity in fluctuations. But this latter point will be dealt with at a later stage.

Deconcentrating progress comes also to the surface from time to time. Its existence and influence is strongly felt in our own time. Within the class of inventions of this nature comes the wireless, since in comparison with the telegram it tends to decrease the amount of fixed capital. The same applies to the motor-car when compared with the railway. Number of discoveries in the sphere of chemical industry show the same tendency, facilitating modern production in small units. Electric current and the internal combustion engine lead also towards a deconcentrating progress. Even a workshop using electric power can without a large fixed capital carry on production of a high technical standard, or be able to compete with large factories run by colossal machinery.

If future technological progress came to pass from the stage of concentration to that of deconcentration and a diminution of fixed capital ensued—its natural result would be deconcentration in industry, and in turn deconcentration in ownership. Factories with a colossal plant and machinery would stop in their development and disappear in time, and their place would be taken by workshops of a small or medium size. The whole economic structure would undergo a fundamental change. The process of proletarianization and gradual annihilation

¹ "This law that the proportion of constant capital steadily grows in comparison with the proportion of variable capital is confirmed at every step by a comparative analysis of the prices of commodities, no matter whether we compare successive economic epochs in one particular country, or different countries at one and the same time." Karl Marx: *Capital. A Critique of Political Economy*. Translated from the fourth German edition by Eden and Cedar Paul, London, 1928, p. 687.

of the middle classes would come to a halt. Monopolization, State relementation and autarchization of markets would give way to a contrary process. The great discrepancy between rich and poor would tend to lessen. Work would be more easily available to the poor, for work would not require the large capital necessitated to-day.

It is the ideal of technological progress that it should enter the road of deconcentrating progress. Deconcentrating progress of great intensity would solve, or at least diminish, the acuteness of many grave defects attributed to technological progress, which are, in fact, connected with "concentrating progress."

Technological progress showed hitherto a tendency to increase fixed capital. But it does not follow from this that it must be so necessarily in future too. Sooner or later a saturation point in the increase of fixed capital will be arrived at, and it will consequently give rise to many difficulties. Advantages derived formerly from the increase in fixed capital, will step by step give way to disadvantages. Inelasticity, brought about by the excess of fixed capital, will lead to intense economic fluctuations, the first victim of which will be fixed capital itself. The increasing difficulties of acquiring new capital and the burden of interest will have similar results.

This process will, in turn, give rise to a recurrent wave, a tendency towards reduction in fixed capital and contraction of capital, the amortization of which would not be fully effected. The inventor of the future will, accordingly, direct his research in the way of replacing the gigantic machinery by smaller and simpler machinery, of lower capital value, so that it may be available for the small and medium producer.

Deconcentrating progress can appear in different forms. It can take the form of mechanization (the replacement of big by small machinery is, to our regret, so far only a rare occurrence), or it can take the form of improvements in industrial organization. (Improvements in industrial organization such as, *e.g.*, standardization, simplification

of models, etc., lead to saving in fixed-capital.) On the other hand, even rationalization and industrial psychology do not, as a rule, exclude the possibility of fixed-capital saving, since such saving can be brought about by the use of rationalized methods of work.

§ 15. THE TIME FACTOR IN TECHNOLOGY

The time factor is of the utmost importance in technological progress. The problem of the rate of technological progress is really the problem of time. When the rate is slow, the results of technological progress are different from what they are when the rate is quick. The problem of compensation or absorption of technological unemployment is also, in fact, the problem of time. Compensation that takes place after five years will be different in its effects from compensation that ensues after fifty years.

The results of technological progress in relation to the factor of time pass through several stages. In some of its forms, technological progress can, in the first stage, create technological employment, and in the next it can result in unemployment. In the first stage the community may sustain a considerable loss, and in the second stage it may derive additional benefit.

A few examples will make the point clear. Progress in quality, which resulted in the production of a better-quality article and ousted from the market the inferior quality, will cause, in the first stage, a depreciation in value of the existing stock of goods. The tradesman or manufacturer who has a stock of the inferior-quality goods will sustain a heavy capital loss. Thus, the first stage of technological progress leads to a considerable loss of capital.

But in the next stage, as the production of the higher-quality goods is continued and the first profits are reaped, the new profits compensate and show a surplus over the loss in the first stage of progress. Thus, the loss in the first stage is being adjusted by profits in the second stage.

Let us take, again, mechanization in industry. In the first stage the invented machine has to be produced. The production of a certain number of the newly invented machine requires a number of new hands. Thus, an increased demand for labour, caused by new employment in the production of the invented machine, is evident on the labour market. But the next stage brings in its train different results. When the new machines are already produced and put into operation in industry, they replace to a certain extent human labour, and thus give rise to technological unemployment.

But in mechanization other stages of development are conceivable. What will be the effect of increased output in industry in which the new machine has been made use of? As a rule a reduction in costs will cause a fall in prices, increase in demand and additional employment in the given industry. This will be, therefore, the third stage: the stage of compensation of technological unemployment.

But the matter does not end even here. Further effects and transformation in the economic structure itself come to the fore in different branches of production at different periods of time. Increase in productivity in one branch of industry will not remain without effect on the increase in productivity or demand in other branches of industry. Finally, the world economy will be affected, and developments in the latter will, in turn, have their repercussions on the national economy.

Generally speaking, the following can be stated: Every technological progress is a charge on the present for the benefits of the future. The statement remains none the less true, even if the charge on the present is slight and the benefits of the future considerable. In its very nature technological progress is a charge on the capital resources of the present for the sake of capital profits to be reaped in future. Thus, it is a process that causes economic fluctuations in time, and such fluctuations may, within the period of all the stages of a given technological improvement, change their nature and direction.

A direction that is positive in one stage may be negative in another, and vice versa. The economist must follow up the cycle to its very end, he must go all the way till the journey's end. But at the same time he must not lose sight of the different stages of the journey which, in their turn, may bring about changes that are detrimental in their nature and different in their intensity.

PART II

**TECHNOLOGICAL PROGRESS AND ITS
INFLUENCE ON EMPLOYMENT AND
DISTRIBUTION OF INCOMES**

CHAPTER I

THE PROBLEM OF COMPENSATION

§ 1. THE PROBLEM OF COMPENSATION IN ECONOMIC LITERATURE

BEFORE we enter into an inquiry of the problem of compensation in its entirety, that is, the problem whether and to what an extent technological unemployment can be absorbed, we shall have to retrace the history of this problem in economic literature and, especially so, in the literature of the Classical economists.

The problem of compensation is known in economic literature as the conflict of two theories: the theory of compensation (*Kompensations-Theorie*) and the theory of technological unemployment (*Freisetzungs-Theorie*).¹ The former is represented by the optimists, mainly by the Liberal school. It is represented by such writers as Say, MacCulloch, Senior, and later by Böhm-Bawerk. The machine, in the view of these writers, was a source of new income and new possibilities of labour. Fluctuations and disturbances caused by machinery are accordingly only of a passing nature. These theorists based their argument on Say's law of markets (*Théorie des débouchés*), which does not recognize the possibility of a general over-production.

This school is really divided into two sections. One maintains that compensation is brought about mainly by liberation of the consumers' purchasing power, due to the fall in prices, the other section holds the view that compensation is brought about mainly by the accumulation of profits derived from technological progress.

The most outstanding representative of the compensa-

¹ Dr. Alfred Kähler: *Die Theorie der Arbeiterfreisetzung durch die Maschine*, Leipzig, 1933.

tion theory is Böhm-Bawerk who, in his theory of circulation of goods, gives also an outline of the changes brought about by mechanical inventions. Compensation, as it is illustrated by Böhm-Bawerk, is based either on the decrease in wages or on the increase of profits, or, again, on a reduction in the production period.

The theory of technological unemployment was formulated first of all by Sismondi, who stated it most concisely and connected it with the theory of a general over-production. A similar view is also taken by Malthus. Ricardo is also a supporter, to a certain extent, of the theory of technological unemployment. To the third edition of his *Principles of Political Economy*, in 1821, he added a special chapter "On Machinery." This chapter is, to a certain extent, at variance with the general construction of Ricardo's economic system. In that chapter he recognizes quite clearly the possibility of permanent unemployment resulting from the introduction of machinery: "I am convinced," writes Ricardo, "that the substitution of machinery for human labour is often very injurious to the interests of the class of labourers." According to Ricardo the working class does not always share equally with other classes in the benefits derived from technological progress. Accordingly, Ricardo declares in the third edition of his *Principles* that his opinion on the subject has undergone a considerable change.

"My mistake," Ricardo writes, "arose from the supposition that whenever the net income of a society increased its gross income would also increase; I now, however, see a reason to be satisfied that the one fund from which landlords and capitalists derive their revenue may increase, while the other, that upon which the labouring class mainly depend, may diminish, and therefore it follows, if I am right, that the same course which may increase the net revenue of the country may at the same time render the population redundant, and deteriorate the condition of the labourer." "As the power of supporting the population, and employing labour, depends

always on the gross produce of a nation, and not on its net produce, there will necessarily be a diminution in the demand for labour, population will become redundant, and the situation of the labouring classes will be that of distress and poverty."

Ricardo comes, therefore, to the conclusion that "the opinion entertained by the labouring class, that employment of machinery is frequently detrimental to their interests, is not founded on prejudice or error, but is conformable to the correct principles of political economy."

In the above quotation the word "frequently" is to be emphasized, for, according to Ricardo, there are many cases when compensation really takes place. Such compensation takes place specially in cases when the persons who derive the profits from technological progress spent these profits on the upkeep of servants or in the form of wages of all kinds; in such a case the profits increase in a direct way the demand for labour.

John Stuart Mill is also, with certain restrictions, a supporter of the theory of technological unemployment. Mill based his opinion to a great extent on the argument of Ricardo, and considers that the main source of unemployment is, first of all, the increase of fixed at the expense of variable capital, the latter being mainly the wage fund. This train of thought was very widely developed by Karl Marx, who is the most important representative of the theory of technological unemployment.

Marx paid great attention to the theory of compensation. His theory of technological unemployment is based on many principles of a relative character, but the conclusions he arrives at are nevertheless of an absolute character. Marx formulated the problem of compensation slightly differently from the Liberal economists such as, for instance, James Mill, MacCulloch, Torrens, Senior, and John Stuart Mill, whose arguments he tried to disprove. He represented their view as being that compensation always takes place simultaneously and com-

pletely.¹ Marx disagreed with such a formulation of compensation, but he admitted at the same time that mechanization frequently causes employment in other branches of industry as a result of an increased demand for machines or raw materials; but in his view this fact has nothing to do with compensation.² Marx's view in the matter can be briefly set out as follows: Production-capital is divided in two parts, fixed capital and variable capital. The latter is really the fund of workers' wages, while every other kind of capital is fixed, especially so capital invested in buildings, machinery, plant, raw materials, etc.

The relation between the two sections of production-capital is known as the organic composition of capital and is determined by the stage of technological development. Technological progress, which for Marx is identical with the development of capitalism, brings about a change in the organic composition of capital, so that fixed-capital increases while variable-capital decreases. He calls this the law of accelerated increase of fixed-capital. Since variable-capital is that part of the fund which employs the worker, it follows from the above law that the fund available for paying the workers is permanently decreasing.

But this does not settle the problem. On the contrary, it is the starting-point for a number of new questions. Marx maintains that the decrease takes place only in the relative share of the variable capital in relation to the whole production-capital. He does not mention, however, whether or not variable-capital increases absolutely with the increase of the whole production-capital as a result of accumulation, since only changes in the absolute magni-

¹ "Many bourgeois economists, such as James Mill, MacCulloch, Torrens, Senior, Stuart Mill, etc., maintained that, whenever machinery displaces workers, there is always and necessarily a simultaneous liberation of sufficiency of capital for the employment of an equal number of workers." Karl Marx: *Capital: Critique of Political Economy*. English Translation by Eden and Cedar Paul, p. 469.

² "Although machinery necessarily displaces workers in the branches of industry into which it is introduced, it may none the less lead to an increase of employment in other branches of industry. But this effect has nothing to do with the so-called theory of compensation." *Ibid.*, p. 496.

tude of the variable-capital would be of importance in the problem of compensation. In this respect his argument is defective. Generally speaking, however, his train of thought is the following: The decrease of the relative share of the variable-capital does not exclude the possibility of an absolute increase of such capital.¹ But if there is a possibility of an absolute increase of the variable-capital, technological unemployment is not a necessary consequence.

The question may be raised as to when variable-capital will increase in its absolute magnitude. The whole problem is really reduced to the question of at what a rate the entire production-capital increases, and at what a rate the relative share of the variable-capital decreases. If the entire production-capital increases, say by 20 per cent., and the variable-capital as a result of technological progress falls at the same time by 40 per cent., then variable-capital will thereby be reduced in its absolute magnitude and a number of workers will be deprived of employment. But if the entire production-capital increases by 20 per cent. and the relative share of the variable-capital falls only by 10 per cent. then a contrary effect will be produced; variable-capital will increase absolutely and a number of workers will find additional employment.

The purpose of this inquiry is simply to state what is the rate at which accumulation (which increases production-capital) takes place, and what is the rate at which technological progress (which decreases the share of variable-capital) proceeds. Marx considered the rate of

¹ "Furthermore, if the progress of accumulation lessens the relative magnitude of the variable part of capital, this by no means implies that the possibility of a rise in the absolute magnitude is excluded. Let us suppose that a capital value is at first divided into 50 per cent. fixed and 50 per cent. variable-capital, and to that subsequently the division becomes 80 per cent. fixed and 20 per cent. variable. If meanwhile the capital, from being £6000, has grown to become £18,000, then its variable constituent, which was £3000, will have become £3600, and will therefore undergo an absolute growth to the extent of one-fifth. But whereas formerly an increase of capital to the extent of 20 per cent. would have sufficed to have raised the demand for labour by 20 per cent., this now requires a tripling of the original capital." *Ibid.*, p. 688.

technological progress to be in general higher than the rate of accumulation. He maintains that accumulation takes the form of centralization of capital, which in turn results in increased technological development and thereby causes increased unemployment.¹ His conclusion is, therefore, the following: "With the growth of the total capital, its variable constituent, or the labour incorporated in it, does also increase; but in a constantly diminishing proportion."²

This proposition is not sufficient for the determination of the problem of compensation, for it does not settle the main question, namely, whether in spite of the constantly diminishing proportion of variable-capital such capital increases in its absolute magnitude or not.

If we say that variable-capital increases in its absolute magnitude—and this is what Marx maintained—then there would be no basis for the theory of technological unemployment. If variable-capital increases in its absolute magnitude, then the number of workers can be increased. Marx therefore introduces into the discussion a new factor, namely, that of population.

The law of population of the capitalist system is really a law of over-population; the law which brings into existence a permanent working-class reserve army.³ This working-class army is artificially augmented as a result

¹ "Centralization supplements the work of accumulation, inasmuch as it enables the industrial capitalists to extend the scale of their operations." *Ibid.*, p. 692.

"It is obvious, however, that accumulation, the gradual increase of capital by spiral form, is a slow process when compared with centralization, which needs but to alter the quantitative grouping of the integral parts of social capital." *Ibid.*, p. 693.

"While centralization thus increases and accelerates the effects of accumulation, it simultaneously increases and accelerates changes in the technical composition of capital, the constant part of which grows at the expense of its variable part, so that the relative demand for labour diminishes." *Ibid.*, p. 693.

² "In its turn an increasing accumulation of centralization leads to new changes in the compensation of capital, to a more accumulated reduction in its variable as compared with its fixed constituent." *Ibid.*, p. 695.

³ "It is the working population which, while effecting the accumulation of capital, also produces the means whereby it is itself rendered relatively superfluous, is turned into the relative surplus population." *Ibid.*, p. 697.

of the impoverishment of wide masses of population, impoverishment of the lower middle class, and by the employment of women and children in industry.

As we can see a quantitatively formulated problem has been brought to the fore : namely, the problem of the rate of the rise in population and absolute increase of variable-capital.

Finally, Marx comes to a proposition of a relative character that the rise in the organic composition of capital finds its expression first of all in the difficulty of absorbing the increased population.¹ "In some spheres, a change in the composition of capital occurs without any increase in its absolute magnitude, it occurs as an outcome of simple concentration; in other spheres, the absolute growth in the capital is associated with the decline in its variable constituent, in the amount of labour power absorbed by it; in others the capital grows for a time upon its extant technical basis, and attracts additional labour power in proportion to its increase; and yet in others, it undergoes organic change, its variable constituent diminishing: in all spheres, the increase in the number of workers employed is invariably associated with violent fluctuations and with the transient production of surplus population, which may take the conspicuous form of the dismissal of workers already employed, or the less-evident but equally real form of increasing difficulty in the absorption of the supplementary working population through the usual channels."

As we see, Marx introduces into the problem of compensation the problem of the general growth of the economic system, the problem of the increase of capital and increase in population. Compensation has ceased to be for him a separate problem and has become a part of the dynamics of capitalism. The problem of compensation thus conceived, has become the main problem of the future of capitalism, and the problem of population in capitalism. The problem of compensation as such has

¹ *Ibid.*, p. 696.

lost its peculiar characteristics. Marx's statements on these subjects are hardly well founded, as for instance, the following statement :¹ "The production of a relative surplus population, or the setting of workers at liberty, therefore proceeds more rapidly than the corresponding relative decline in the variable portion of capital as compared with the fixed."

Such statements regarding absolute and relative changes in the particular elements of the economic system, from a quantitative point of view, are lacking the necessary statistical figures or the different data for a mathematical analysis.

The way itself in which I have reviewed the problem of compensation in economic literature indicates clearly that I am in no way in favour of solutions that are absolute. I shall not formulate the problem of compensation in an alternative form: compensation or technological unemployment. My formulations will be rather methodological: when compensation takes place, under what circumstances it is a greater and quicker, and under what circumstances it is smaller and slower?

My answers will not be absolute and applicable in all cases and under all circumstances. They will be rather relative in their nature, and will take into account the entirety of conditions and elements or, at least, conditions and elements that are most important in the circumstances. We shall thus achieve results relatively true, which will be of a practical value only when we can observe the entirety of the conditions in which technological unemployment really appears. Solutions submitted without consideration of a definite economic structure and its specific conditions have to be, in my view, rejected as being methodologically inaccurate.

¹ *Ibid.*, p. 702.

§ 2. PERIOD OF COMPENSATION

Let us begin with an analysis of the process of compensation. Compensation consists in the subsequent absorption of technological unemployment, *i.e.* unemployment caused by technological progress, namely, by way of consequential changes which are brought about by technological progress in its further stages.

It follows from the above that every compensation requires a certain period of time. We shall call it "the period of compensation," that is, the time in which full compensation of technological unemployment takes place.

Such full compensation will take place when production in a certain branch of industry rises to such an extent that the whole technological unemployment caused by some mechanical invention will be again absorbed. On the other hand, when only a portion of such unemployment is absorbed, then we shall speak of a partial compensation. Again, when the rise in production caused by the fall in the cost of production is so considerable that the number of workers employed exceeds the number of those previously dismissed, then we shall say that an over-compensation takes place. The problem of compensation is really a problem of the dimensions of production in time, since the degree of compensation depends on the magnitude and rate of the rise in production, which will make the absorption of technological unemployment possible.

In this problem two factors come to the fore :

1. The time in which production rises.
2. The magnitude of the rise in production.

The greater the rise in production as a result of consequential changes brought about by technological progress and the quicker the rate at which it proceeds, the fuller will be the compensation.

The period of compensation may differ in its length. In one case full compensation of technological unemploy-

ment can take place after a year, in another case after ten years. It is quite clear that the effect of compensation on the labour market will be in the first case different from the second.

Economists who represented the theory of full compensation have frequently left the problem of time out of consideration. It is not enough to state that compensation of technological unemployment always takes place—it is necessary to add when it will take place, whether in a year, ten years, or fifty years. If such compensation takes place in fifty years' time, this will hardly be any consolation for the present generation, who suffers as a result of technological unemployment. It will be otherwise, however, if such compensation takes place in the course of a year or two.

The period of compensation is reckoned from the time when technological unemployment first appears, until the time of its absorption, so that it embraces the stage of the growth of technological unemployment as well as the stage of its subsequent absorption or liquidation. We shall call these two stages "the period of compensation." These two stages will run partly concurrently, if the industrialist does not dismiss workers soon after the introduction of some technological improvement, but will at once increase the size of production correspondingly. As a rule, however, the two stages run consecutively.

Obviously, the repercussions on the labour market will depend on the length of the first and second stage of compensation. If, for instance, the first stage is extended over a period of four years and the second over a period of six years, then for ten years the labour market will suffer from unemployment. Such unemployment will be usually greater than would have been the case if, all other things being equal, the first stage extended over six years and the second over four years. As a rule, the situation on the labour market will be more favourable when the first stage is shorter than the second.

There are a number of factors which affect the length of the period of compensation. From amongst the factors

that contribute to shortening the period of compensation we shall single out the free economy, or in other words, the system of liberal economic policy. Where the free exchange in the world economy is at work to the fullest extent, and where the elements of national economy are free and easily adaptable, the process of compensation will proceed at a faster rate. Where, however, economy is stiffened internally and externally, and the whole economic structure is rigidly linked up by a chain of monopolies, cartels and trusts, national relementation, tariffs, quotas and prohibitive decrees—compensation will, in similar circumstances, proceed at a slower rate and will be extended over a longer period of time. Elasticity, mobility and economic freedom are the most important factors that accelerate the process of compensation, which is, in fact, nothing else than an incident in the process of economic automatism.

The period of compensation is the most important co-factor of technological unemployment. Where the period is prolonged, unemployment is augmented.

In this connection the problem of the rate at which technological progress proceeds, that is, the rate at which new technological improvements are introduced in industry, becomes of importance. Very frequently one technological improvement is followed within a short space of time by other improvements. For instance, rationalization introduced to-day can be in three or four years supplemented by a further process of rationalization which will push labour out of employment. In this way, one improvement can be followed by the second, third, or fourth, etc. By the rate of technological progress we understand that period of time which will elapse between one invention made and the second one. We shall term it "the period of inventions." Whenever such period is short, the rate of technological progress is fast; when the period of inventions is long, the rate is slow.

Whenever the period of inventions is shorter than the period of compensation, the labour market gets no time to adjust the fluctuations. Before even the compensation

of technological unemployment created by invention No. 1 has taken place, there already appears technological unemployment created by invention No. 2. Thus the rate of technological progress is an important factor in shaping technological unemployment.

Obviously, the rate of technological progress (the period of inventions) must be compared with the length of the period of compensation. If the period of compensation is long, then the rate of technological progress must be slowed down in order not to be too heavy a burden on the labour market.

It is the ideal of technological progress that the period of inventions should run concurrently with the period of compensation, or even be slightly shorter than the latter. It is of importance that only after the labour market has had sufficient time to adjust the fluctuations caused by the previous invention, the second invention, which will burden the labour market, should appear.

§ 3. THREE ASPECTS OF THE PROBLEM OF COMPENSATION

The problem of compensation can be viewed from three aspects. It can be considered (1) from the aspect of the particular branch of production in which the invention has been introduced; (2) from the aspect of national economy, that is, the repercussions on other branches of industry; and (3) from the aspect of world economy. Technological unemployment can be absorbed in the very same branch of production in which the technological improvement has been introduced (we shall term this branch of production the "progressive industry"), or it can take place in other branches of production within the national economy, or, again, the absorption can take place within the world economy.

The question where such compensation takes place is not irrelevant. If compensation occurs within the same branch of production, the disadvantages of technological progress are not so serious. Working men in more or less

corresponding numbers or categories, will find employment in the same industry or even in the same locality.

But if compensation takes place only within the national economy, the disadvantages of technological progress become more serious. At the expense of the previously employed workers, different classes of workers and different localities will be favoured as a result of technological progress. In such a case compensation will take a longer time than usual. It may be that compensation will only take effect as a result of the diminution of the share of the working class in the national dividend.

If compensation occurs only within the world economy, the disadvantages of technological progress are still more serious. It may happen that compensation of technological unemployment in England will take place only in the United States or Germany. National conditions are here of utmost importance. Problems of international exchange, which to-day is very difficult, become involved.

As a rule, complete compensation takes place only within the world economy. Compensation within the national economy is usually less complete. It is still less complete within the "progressive industry."

The process of compensation in these three aspects are complementary and cumulative. Compensation in the "progressive industry" creates favourable conditions for compensation within the national and the world economy. Compensation within the national economy creates in turn favourable conditions for compensation within the "progressive industry."

These consequential changes appear in different stages and are hardly intelligible even to the expert statistician and economist. In the first stage, it may be partial compensation within the "progressive industry"; in the second stage, compensation may be completed within the national economy; in the third stage, a further completion within the world economy may take place; and in further stages new repercussions can appear in the form of a recurrent influence of former compensations on the "progressive industry," etc.

§ 4. COMPENSATION IN THE "PROGRESSIVE INDUSTRY"

The problem of the dimensions of production is fundamental so far as the degree of compensation is concerned. If we leave aside the period of compensation, the rate of growth of the dimensions of production will decide the degree of compensation. Let us deal first of all with the problem of compensation in the "progressive industry," in order to discuss at a later stage compensation within the national and world economy.

Every invention that decreases the costs of production gives rise to a tendency towards enlarging the dimensions of production. Where the costs of production are falling, and production itself thereby becomes cheaper, in a state of free competition a tendency to extend production on a larger scale will arise.

This can be explained graphically in the following way : We have the curve of demand which shows the prices offered by consumers and the quantities which they demand at the given prices. We call these prices the prices of demand. We have, again, the curve of production, which shows at what price and in what quantity producers are ready to deliver the goods on the market. We call these prices the prices of cost.

The point at which the two curves intersect gives us the price and the dimensions of production and consumption. Accordingly, if the costs of production are falling, then, as a rule, the market prices will fall and production will increase. The question is, however, how far production will increase and on what factors it depends.

These factors can be set out as follows :—

1. *Elasticity of Demand.*—The most important factor of compensation is the elasticity of demand, that is, the capacity of increase in the quantities of demand, caused as a result of the fall in prices.

We can illustrate the demand on the market by a curve, showing the quantity of goods demanded at a given price. The demand curve generally takes the form of a sloping curve, if on the *X* axis we mark the quantities, and the

Y axis the prices. This means that the demand increases when prices fall and falls when prices increase. For it is clear that dearer goods (of the same utility) have always less purchasers than cheaper goods. But the degree of slope of the demand curve is different in the case of different categories of articles. There are curves with a high degree of slope as, for instance, when they run almost parallel to the Y axis, and curves with a low degree of slope, running almost parallel to the X axis. This degree of slope of the curve gives us the elasticity of the curve. Elasticity of demand is nothing else than the relation between the proportional change in the quantities demanded and the proportional change in the price.¹

Elasticity is the relation between the changes in quantity and changes in price. This relation can be from 0 to infinity. Elasticity will be 0 when demand is absolutely inelastic—but this is, of course, an ideal case. It would mean that even the greatest fall in prices could not increase the quantities demanded on the market. This curve would run parallel to Y axis. Elasticity will be near infinity when even the slightest fall in prices would lead to a maximum increase of the quantities demanded. This curve would run parallel to the X axis. Obviously, these are ideal and extreme cases, since no curve of demand is ever parallel to the X axis or to the Y axis.

In practice the elasticity of the curve of demand is above or below unity. We are assuming that elasticity will be 1 when the proportional change in prices leads to the proportional change in quantity, *i.e.*, for instance, the fall in prices by 15 per cent. leads to a corresponding increase in quantity by 15 per cent. Elasticity will be below 1 when the increase in quantity is less than 15 per cent.²

¹ "Elasticity of demand at any price or at any output is the proportional change of the amount purchased in response to a small change in price, divided by the proportional change of price." J. H. Robinson: *Economics of Imperfect Competition*, p. 18, Macmillan, London, 1933.

² Similarly, Robinson on p. 18: "The curve of elasticity numerically less than unity is described as inelastic, and a curve of elasticity is equal to zero; the curve is said to be perfectly inelastic, and when the elasticity is equal to infinity the curve is said to be perfectly elastic."

We have stated above that different categories of goods have a curve of a different elasticity. Thus, for instance, corn has a slight elasticity, certainly below 1. This means that if, *e.g.*, the price of bread falls by 10 per cent., the rise in consumption will be less than by 10 per cent. If the price will fall by a further 20 per cent., the rise in consumption will be proportionally still smaller. People cannot consume indefinitely more bread, for here the capacity of the stomach comes into the question. An even greater inelasticity is evident in a number of other articles as, for instance, salt.

On the other hand, articles of luxury and fashion show a great elasticity. In the case of such articles the quantity demanded depends to a large extent on the price.

Let us now go back to the problem of technological progress. We can say that the greater the elasticity of demand (the quantities demanded as a result of the fall in prices), the greater also will be the compensation. In such a case, all other things being equal, the output will be greater, as a result of the fall in prices caused by technological progress will be greater.

In cases in which elasticity is greater than unity, *i.e.* when the quantities demanded exceed in proportion the fall in price, then over-compensation may occur, that is, the number of workers employed as a result of technological progress may increase out of all proportion as a result of the great rise in production. In many branches of industry in which the demand was very elastic and expanding, this has actually happened. We could not observe, however, such an occurrence in agriculture, due to the inelasticity of the demand.

Of course, the curves of demand show in different fields different degrees of elasticity. If, for instance, we lower the price of bread from 4d. to 3d., elasticity may be 0.9 per cent. When, however, the reduction in price will be from 3d. to 2d., elasticity may be 0.5 per cent., etc. From the point of view of compensation, elasticity will be important only within that part of the curve of demand in which the influence of technological progress

is noticeable (that is, near the point of intersection of the curve of demand and the curve of supply).

2. *Elasticity of Output.*—Elasticity of output, in the sense of capacity to reduce the output as a result of a fall in profitability, is an important factor of compensation. Such capacity to curtail the output as a result of a fall in profitability differs in some branches of industry. When prices fall, farmers are, for instance, not able to curtail production as quickly and efficiently as can be done by coal or chocolate producers. Agricultural produce is, to a great extent, independent of the amount of work which man puts into it, or, at any rate, the independence is greater than in industry.

Similarly, also in industries in which overhead costs, independent of the size of production, form a considerable proportion of the general costs of production, the capacity to curtail production is slight, since the reduction in output brings about an increase in costs per unit of product; this, of course, leads in many cases to an increase in losses.

Elasticity of output, described as the capacity of reducing the dimension of production as a result of the fall of profitability, is nothing else than the relation between the change in the size of output and the change in profitability. If, for instance, the fall in profitability by 10 per cent. corresponds to a curtailment of output by 10 per cent., then elasticity is equal to unity; if, however, the curtailment in output is less than 10 per cent., elasticity will be less than unity; and, again, if the output will be curtailed by more than 10 per cent., elasticity will be greater than unity.

Let us now come back to the problem of compensation. As a rule, the smaller the elasticity of output the greater is compensation, and, on the contrary, the greater the elasticity of output the smaller the compensation.

If the capacity to curtail output as a consequence of the fall in profitability is small, as, for instance, in the case of agricultural production, then technological progress will lead to a greater extent to an increase in the

dimension of production than would have been the case in industries with an elastic production. In some places agricultural production may increase as a result of the application of technological improvements, in others it will not be reduced, in spite of its unprofitability. Such an increase in the dimensions of production will save part of the workers from becoming unemployed.

Inelasticity of output is a factor which promotes compensation within short periods of time; for, in the long run, the dimensions of production adjust themselves sooner or later to the changes in profitability. Production, even if it is inelastic, will be curtailed after a long period of time if it is permanently run at a loss. In such a way, the inelasticity of production protects the workers employed from technological unemployment—but only during a short transitional period. After a time, this factor ceases to be operative.

3. *The Stage of Industrial Development.*—Technological progress may take place either in industries which consist entirely of factories and are run on very advanced lines, or in industries run on less advanced lines and consisting partly of factories and partly of handicraft workshops. An improvement in the machinery used by factories competing with handicrafts will produce different results in the labour market from an improvement in machinery used by factories competing with other factories. In the former case, competition will be easier than in the latter. In the former case, the result will be the decline of the handicraft, which need not mean an increase in technological unemployment, but simply the impoverishment of craftsmen, or a reduction in their incomes. This impoverishment will correspond to an increase in the incomes of the factory owners and the additional employment of industrial workers. In the former case, the additional employment of industrial workers will take place to a greater extent than in the latter case.

Mechanization of industries, which takes place within the sphere of handicrafts, brings about compensation more easily than mechanization in industries which consist

mostly of factories. This problem was considered by Marx in his *Capital*.¹

4. *The Absolute Magnitude of the Fall in Production.*—The greater the absolute fall in the cost of production, then, all other things being equal, the greater also will be the increase in the size of production. If, for instance, the costs of production of shoes fall by 50 per cent., the result will be a rise in production by, say, 20 per cent. ; on the other hand, if the costs fall by 25 per cent., production may rise only by, say, 5 per cent.

Of course a vast set of problems has here to be taken into consideration, especially such questions as whether the fall in costs has taken place in marginal productivity or not, whether it has taken place in all factories or workshops, or only in some of them, etc. If the reduction in costs has taken place in factories or workshops run at high costs and not in marginal productivity, *i.e.* not in respect of marginal producers whose costs are decisive for the shaping of prices on the market, then the tendency towards the enlarging of the size of production will be less extensive than in the case of the reduction in costs in marginal production. We shall refrain from entering into details of these cases, since it would lead to a jungle of casuistry.

It can be stated, however, as a general rule, that, all other things being equal, the greater the fall in costs the greater will be also the tendency to increase the dimensions of production.

¹ "As long as machinafacture is extending in any branch of industry at the expense of the old-time handicrafts or manufacturing system, its victorious progress is no less certain than is the victorious progress of an army equipped with modern breech-loading rifles when matched against an army equipped only with bows and arrows. This opening period, in which the machine is achieving the conquest of its sphere of activity, is of decisive importance owing to the extraordinarily high profits which can be made at such a time. These profits do not only form a source of accelerated accumulation ; for they also attract into the favoured sphere of production a large part of the additional social capital which is constantly being created, and is ever on the look-out for new investments. The peculiar advantages of this opening period of storm and stress are continually being renewed in the branches of production into which machinery is freshly introduced." Karl Marx : *Capital: a Critique of Political Economy*. English Translation by Eden and Cedar Paul, p. 484.

5. *The Rate of Profit and the Rate of Saving in Wages.*—An invention which causes a fall in the cost of production reduces the gross costs and increases the net profits of the producer. The reduction in gross costs (X) is a reduction in the expenditure on labour dismissed as a result of the introduction of the invention. Accordingly, the rise in the rate of net profit (Y) takes place. This reduction in X and the rise in Y can take place in a different ratio. The invention can reduce X by $\frac{1}{2}$ and increase Y by $\frac{1}{10}$. The machine may replace 50 workers out of the total number of 100 workers employed in the factory, but the net profit of the factory owners may increase only, say, from 5 per cent. to 5.5 per cent. In this case the ratio is unfavourable for compensation. Sometimes a mechanical invention or technological improvement is introduced by the factory owner, even for a small net profit, although the invention may mean a considerable reduction in the gross costs. This problem has already been dealt with by Ricardo in his chapter, "On Machinery," in the third edition of his *Principles*. He gives there expression to the opinion formulated by us above, that the machine may reduce the gross income considerably, but increase the net income only slightly, and for the situation of the working class the gross income is decisive. The consideration of the influence of factors which are dealt with here brings us again to considerable casuistry. The increase in the rate of profit will have a different influence on a factory which was formally run at a loss from that of a factory which has already produced considerable profits. The former will show a greater tendency towards an increase in the size of production, that is, of compensation, than the latter.

6. *Composition of Reduced Costs.*—Compensation will be influenced by the fact of where the reduction in costs has taken place; whether in overhead costs, that is, costs which have to be defrayed irrespective of the size of production, or in variable costs, the magnitude of which is proportionate to the size of production.

If the reduction in the cost of production appears in

variable costs, so that the relation between variable and overhead costs has changed, and the latter have risen per unit of product, then a greater tendency towards enlarging the size of production will appear, in order to reduce the cost of production per unit of product by an increase in the size of production. If, for instance, rationalization has reduced factory costs and increased administrative costs, which are independent of the size of production, then a tendency will arise to divide such costs over a larger number of products. The tendency to increase in the dimensions of production will in this case be greater than in the case of a reduction in overhead costs.

7. *The Relation between the Invention and the Dimensions of Production.*—Another factor influencing the process of compensation consists in the circumstances whether the reduction in costs has been conditioned by an increase in output or not. Very often the application and introduction of a certain invention depends on an increase in the size of production, so that the application of the invention is closely connected with an increase in the dimensions of production. Very often the application of a certain machine is possible only at an output of, say, 10,000 tons, while at an output of 5000 tons the introduction of the machine would not pay. In such a case a tendency arises towards a greater increase in output. Thus, the rise in production is closely connected with the very nature of the improvement.

8. *Structure of the Market.*—The structure of the market is an important factor of compensation. If production is carried on within the sphere of free competition, then there would be no necessity to add anything at all to the above statement. When, however, production is monopolistic, then the desire of the monopolist to attain the maximum of profit will stand in the way of the growth of production. A monopolist will agree to an increase in the dimensions of production and the reduction of price only when his total profit will be greater than formerly, and only within the limits prescribed by the

rule of the maximum of profit. Since this does not always take place, monopolization of the given branch of industry is a factor obstructing compensation.

If the structure of the market is monopolistic, then an entire casuistry of the problem of monopoly has to be considered. Compensation will be one thing in the case of an absolute monopoly, another thing in the case of a limited monopoly (*e.g.* where the sphere of substitution of the monopolized article is extensive); it will be one thing in the case of pure monopoly, and another in the case of a duopoly (*e.g.* where there is a monopolistic competition); it will be one thing in the case of a one-sided monopoly, that is, on the side of production only, and another thing in the case of a bilateral monopoly (*e.g.* a monopoly of *entrepreneurs* against a monopoly of consumers). Compensation will be different in all these cases in which the form of the curve of production and of the curve of demand differs.

Without entering into complex casuistry of the problem, it can be stated that all forms of monopolies and semi-monopolies are characterized by the tendency to raise the prices to above the level of free competition, towards the point of Cournot; and thus it is, as a rule, a factor which curtails the dimensions of production.

Accordingly, a monopolistic structure of the market is less favourable towards compensation than a system of free competition.

Amongst the many factors of compensation which have been mentioned above, precedence must be given—next to the liberalization of the market, which is the general and permanent condition of a quicker compensation, in all its aspects—to the most important factor of elasticity of demand. The problem of compensation of the “progressive industry” is, primarily, the problem of the elasticity of demand. When technological development takes place in an industry which shows a greatly elastic and easily expanding demand, then compensation will

proceed easily. When, however, technological development affects a production, the expansion of which is greatly limited by an inflexible demand, as, for instance, the *provision* industry, then compensation is made difficult.

Obviously, the importance of other factors is not to be under-estimated, especially of such factors as elasticity of output and the stage of industrial development. But, in my opinion, emphasis ought to be laid on elasticity of demand.

§ 5. COMPENSATION WITHIN THE FIELD OF THE NATIONAL ECONOMY

We have dealt so far with the problem of compensation within the field of the "progressive industry." We shall now enter the field of the national economy. Compensation within the national economy depends on many factors which are not entirely identical with those which we have mentioned in a former section, while discussing compensation in the "progressive industry."

It is clear that compensation within the field of national economy is closely connected with compensation within the "progressive industry." The greater the degree of the latter, the greater will be also the degree of the former compensation. An increased production in the "progressive industry" means an increased demand for raw materials, semi-manufactured goods and machines used in the "progressive industry." Compensation within the "progressive industry" puts into operation new workshops, and by an equal measure it increases the output within the whole field of the national economy. Increased employment in the "progressive industry" is, as a rule, a factor which increases employment within the whole field of the national economy. This, however, does not always take place. If, for instance, employment within the "progressive industry" was increased as a result of the handicraft being replaced by factories, then increased compensation within the "progressive industry" will

usually result in a smaller compensation in other branches of the national economy, that is, strictly speaking, in the field of the handicraft. There will be a rise in the number of industrial labourers employed, but at the same time there will be a fall in the number of employed craftsmen. But compensation of this type, replacing craftsmen labour by labour in the "progressive industry," is only a fictitious compensation, based on the fact that the labour of the craftsmen in the same branch of production is reckoned as belonging to the "progressive industry." This exception, therefore, only confirms the above-stated rule.

We shall now proceed with an analysis of the factors of compensation within the field of the national economy as a whole.

1. *The Magnitude of Profits produced by Technological Progress.*—Technological progress creates sources of permanent or temporary profits, either for the producer who applies the given invention, or for the consumers who purchase the article at a lower price. The profits can be directed either for consumption or for capitalization. In the first case, an increase in the production of consumption goods takes place and creates a source of additional employment in consumption industries; in the second case, the production of capital goods increases, creating a source of additional employment in investments. The greater the profitability of the inventions for the producers or the consumers, the greater also will be the compensation.

2. *The Degree of Capitalization of these Profits.*—When the profits, or the savings, resulting from technological progress are capitalized, that is, transformed into production-capital, then compensation will thereby increase. The new production-capital will create a source of greater and more permanent employment than the new consumption expenses of the population. For production-capital is being used and renewed over and over again, without a stop, giving at the same time a certain surplus; this, however, does not take place in the case of consumption expenditure.

The higher the rate of accumulation, the greater will be

compensation. If, however, the profits or the savings of the consumer are used indirectly for consumption, compensation will not be so great and permanent as in the case of the accumulation of profits.

It is clear that not only is the accumulation of profits of importance, but also the transformation of profits into production-capital in profitable investments, which create a new source of income for the population.

When profits are being hoarded or sent abroad, or put into unsound investments, then compensation will be slight or temporary.

When the profits, or the savings of the consumer are being used for the purpose of financing consumption, then the question has to be considered whether an increase in luxury consumption or an increase in the consumption of necessaries takes place.

In the first case, compensation will be smaller than in the second.

There must also be considered whether the increase in consumption is in respect of imported goods, or in goods manufactured in the country. Only in the second case will compensation be brought about.

Another point to be taken into account is whether or not an increase in indirect consumption will take place in service of all kinds, as, for instance, domestic servants, chauffeurs, hotel servants, etc. In the first case, compensation within the national economy will be of a greater extent than in the case when the profits are expended on the consumption of goods. Ricardo dealt with this point in his chapter "On Machinery."¹

¹ "If a landlord, or a capitalist, expends his revenue in the manner of an ancient baron, in the support of a great number of retainers, or menial servants, he will give employment to much more labour than if he expended it on fine clothes, or costly furniture, on carriages, or horses, or in the purchase of any other luxuries.

"In both cases the net revenue would be the same, and so would be the gross revenue, but the former would be realized in different commodities. If my revenue were £10,000, the same quantity nearly of productive labour would be employed whether I realized it in fine clothes and costly furniture, etc., or in a quantity of food and clothing of the same value. If, however, I realized my revenue in the first set of commodities, no more labour would be consequently employed: I should enjoy my furniture and my clothes, and there would be an end of them;

3. *The Degree of Elasticity in Demand for Human Labour.*—Technological unemployment causes a fall in wages. This creates a source of additional profits for the capitalist, a source of additional profitability. The employment of workers which formerly did not pay, pays now. But in different branches of industry, and under different market conditions and in different countries, the elasticity of demand for labour differs. In certain places, the fall in wages influences the demand for labour to a great extent, in some other places the influence on the labour market is slight. Where the fall in wages influences the demand for labour to a great extent, compensation will take place to a considerable degree. When wages fall, the wages-fund is able to employ a greater number of workers.

4. *Elasticity in the Economic Structure.*—The greater the elasticity of the economic structure, the easier it will be for the economic system to adjust itself to the changes brought about by technological progress, and the quicker also will be the reactions. If the national economy is free internally and externally, then the process of compensation will proceed more easily and quickly, and also to a greater extent. When, however, the economic structure is tightened up or autarchized, then the process of compensation will proceed with more difficulty, more slowly and to a smaller extent.

As was stated above, compensation is nothing else than a process of economic automatization. But this automatization operates only when the economic system is free, when there are no obstacles in the form of monopolies, cartels and syndicates, or in the form of export and import restrictions; since they all hamper the growth of production. Monopolies exclude, as a rule, a fall in prices, or make the possibility of a fall in prices very

but if I realized my revenue in food and clothing, and my desire was to employ menial servants, all those whom I could so employ with my revenue of £10,000, or with the food and clothing which it would purchase, would be added to the former demand for labourers, and this addition would take place only because I chose this mode of expending my revenue." David Ricardo: *Principles of Political Economy*, third edition, 1846, chapter on "Machinery," p. 239.

slight. The saving in purchasing power which can be brought about as a result of the fall in prices is being limited to a minimum. The more monopolistic the economic system, the more difficult and the less extensive will be the process of compensation. The same applies, not only to monopolies, but to all kinds of economic restrictions operating internally and externally, since any amount of restriction hampers the process of automatization which forms the basis of compensation.

In the problem of general compensation (that is, within the sphere of the national economy), besides the factor of *laissez-faire* in the economic system, the factor of capitalization has to be singled out as outstanding and most important. Compensation within the "progressive industry" is primarily "compensation of demand" (*i.e.* depending on the elasticity of demand). Compensation within the national economy, on the other hand, is primarily "compensation of capital" (depending on the degree of the accumulation of profits resulting from technological progress). The latter depends, first of all, on the question whether the "progressive industry" has created a source of sufficient profits for the *entrepreneurs*, or for the consumers, and also whether the profits have been transformed into production-capital.

When profits of the producers, or the savings of the consumers, are quite considerable and have been sufficiently accumulated, that is, transformed into capital, then compensation within the national economy will be considerable. When, however, the rate of accumulation is low, then compensation within the national economy will be slight. Compensation within the national economy depends on the general process of growth of the national economy, in which the accumulation of profits arising from technological progress plays an important part.

§ 6. COMPENSATION WITHIN THE WORLD ECONOMY

Compensation can take place either within the sphere of the national economy itself, or within the sphere of some other national economies, in other words, within the world economy.

In fact, the complete consequences of compensation appear, as a rule, only within the sphere of the world economy, and not within the sphere of one national economy. A machine which has been introduced in Germany may have been produced in England. In this case, a partial compensation of German technological unemployment takes place in England. Or, to give another instance, a Hollywood talkie supplants English musicians. Compensation resulting from a fall in the prices of export goods in England may be of advantage to American industries, so that labour dismissed in England may be compensated in the United States.

Assuming, however, a free world economic system, then the increase in production and investment in the United States will also show beneficial result in England, since it will facilitate the mutual export between English and American goods or a profitable export of capital, or, at least, of English labour to the United States. Of course, this is only possible when the world economic system is free and undivided by tariff walls. The greater the degree of freedom in the world economy, the greater also will be the compensation.

Compensation within the world economic system assumes a free economy and a free exchange of goods, labour and capital. If, however, industries are more rigidly organized, and the dismissed labourer has no possibility of emigration, or if the exchange of capital is difficult, then compensation will also be more difficult, more slow and less extensive. An easy and speedy compensation requires therefore a free export of goods and capital, and free immigration to countries in which labour and capital could be utilized for the new possibilities created by technological progress.

§ 7. THE CASE OF MECHANIZATION

The problem of compensation, from the point of view of mechanization in production, has to be specially analysed. This case will be different in certain respects ; here the problem of the period of compensation, as well as the problem of the size of production, are modified to a certain extent.

As a rule, compensation of technological unemployment resulting from mechanization is greater than compensation of unemployment resulting from other forms of the progress in productivity, such as rationalization, industrial psychology and industrial organization.

Mechanization ousts from employment, as a rule, fewer workers than other forms of progress in productivity. In the case of mechanization the new machines that replace the workers have to be produced. Thus mechanization leads to the foundation of a new branch of industry for the production of the new machine ; but this does not take place either in the case of rationalization or industrial psychology, or industrial organization.

The fall in employment caused by mechanization appears only after the new machines have been produced ; in other forms of the progress in productivity the saving in labour is usually brought about sooner.

In the case of mechanization, there is a preliminary stage of production of new machines in which time the new branches of production come into existence or develop. In this preliminary stage there is no fall in employment ; on the contrary, there is, as a rule, an increase in employment.

The rise in employment results from a longer period of amortization of the machines, that is, from the fact that the machine, as a rule, serves not for the production of one economic period but for the production of many years. The production of such a machine necessitates, *eo ipso*, the performance of additional work within the whole period of amortization.

An example will make the point clear :—

Let us assume that the new machine has a durability of ten years, and within that period of time it substitutes the labour of 50 working units per year. Thus the constructed machine represents the power of 500 working units within ten years. The new machine is produced, let us say, in the course of a year, at a cost of 300 working units—in other words, it represents the saving of under 200 working units in the course of ten years, that is, of 20 working units per year, leaving out of account the question of time and interest. In such a way, a yearly saving amounts to 20 working units, while the saving of the machine within ten years will amount to 200 working units. Accordingly, in order to produce such a machine, 300 working units must be at once expended.

In the first year the construction of the new machine creates a demand for 300 working units, and therefore the necessity arises to employ additional labour (300 working units) since, as we stated, the machine will be operative in production only after a year.

Additional employment in this preliminary stage is caused by the fact that a machine with a long period of amortization has to be produced, and that the whole amount of labour for the whole period of amortization has to be at once expended.

Let us go a step further. What will happen in later years when the machine is already in operation in the factory? In the first year the machine will oust from employment, in the case stated above, 50 units, and in later years a further 50 working units yearly. In other words, the 300 working units which represent the cost of the machine will be replaced only after a period of six years (the work done by the machine in the last four years will represent the surplus or saving, for which purpose the machine has been, in fact, constructed).

The above brings us to the conclusion that during the period of seven years, that is, one year of the production of the machine and six years of the application of the machine, *per saldo*, there is not, as yet, a fall in employment. The diminution in employment will

appear in the latter four years of the operation of the machine.

There has also to be taken into account the fact that, at the time when the production of the new machine comes first into existence, the number of machines produced will be greater than the number of machines applied. Thus if, for instance, a new industry produces 150 machines, out of that number 100 may be used and 50 may remain in stock for use at some future date. In such a case the saving of labour will be still smaller.

It is evident, from the above example, that mechanization does not lead in the first years to a fall in employment ; on the contrary, it leads to a rise in employment. The extent of such a rise in employment will depend on the period of amortization of the machine, *i.e.* whether the machine produced has a durability of five, ten, or twenty years. The longer the period of amortization and the greater the durability of the machines, the greater will be also the rise in employment in the first period.

If, for instance, the construction of a machine to be in working order for twenty years necessitates a greater outlay of labour, the equivalent value of which will be adjusted only after ten years ; then, during the balance-period of ten years the labour market will not be affected by unemployment. We say "during the balance-period," since in course of time the position will be different ; at the time of construction of the machine a sudden rise in employment will occur, but later, once the machine is introduced and set into operation, a fall in employment will take place.

Sufficient attention has not been paid by investigators of the cyclical fluctuations to the period of amortization as being an important factor. This factor widens to a great extent the scale of market fluctuations ; and it is important to add that the greater the period of amortization, the greater also is the influence of this factor. If the machines introduced have a long period of amortization, then employment will at first rise considerably, as a result of great capital investment ; but later on,

when the new machines are already in operation, not only is there no more investment of capital, but also an important labour-saving factor (the new machine) is now operative. Accordingly, the longer the period of amortization, the greater also the fluctuations.

In the case of mechanization in production, the problem of the rate of technological progress will not be the same as is the case in the other forms of the progress in productivity.

Let us go back to our former example:—

The net saving of the machines was 200 working units. As we stated, the saving appeared only in the last four years of the working of the machines; or, in other words, the full saving took place only if the machines were in operation during the whole of the ten years and thus had been fully amortized. If, however, technological progress proceeds at a quicker rate, then even after only five years a new machine may appear and replace the old one. In such a case the saving of labour power by the first machine entirely disappears: on the contrary, the saving in our example is transformed into a loss. The first machine has been produced by the labour of 300 working units and had to replace 500 working units in the course of ten years (50 units per year). But, in fact, it has replaced only 250 working units, since after five years the machine has been supplanted by new and better machines. In such a case, 50 working units have, in effect, been wasted.

Accordingly, if the rate of mechanization (not of rationalization) is much quicker, then the saving in labour becomes smaller, or even disappears or is turned into a loss. This depends on the rate of mechanization, on the period of amortization of the machine and on the amount of saving in labour brought about by the machine.

If we term the durable goods which serve the purpose of production "capital," then mechanization creates, but

at the same time also destroys, capital. By the construction of new machines and new plant, capital is created. The amount of capital increases at the expense of the consumption goods, which are consumed by the workers who produce the capital (machines).

But mechanization wastes capital, since the machines and plant are replaced before their full term has expired, and as a result of the new development remain idle and in time become valueless. The amount of capital created by mechanization can exceed the amount of capital wasted by it, or vice versa.

For instance, the new machine gives an additional profit of £300 per year, which at a rate of 6 per cent. means an increase in capital of £5000, but at the same time it replaces an old machine of an existing value of £10,000, which has not yet become amortized; and as this becomes valueless, in the first year capital has in this way been wasted to the extent of £5000.

If the rate of mechanization is very high, then the waste of capital may exceed the amount of the new capital created, and the capital loss which arises therefrom may, in such a way, cause considerable damage to the national economy.

It is here that an important modification of the general principles concerning the period of compensation appears. In this case of technological progress, the higher rate of such progress, as a rule, causes a considerable increase in technological unemployment; in the case of mechanization, however, the contrary is the fact. The higher rate of mechanization postpones the process of the increase of technological unemployment. Considerable unemployment will appear only when the rate of mechanization slows down. An industry which is kept busy by the construction of new machines, with a long period of amortization, usually employs a great number of new workers. The workers will be dismissed only when such machines are put into operation and the rate of the further progress of mechanization slows down, that is, when the given industry will no more be busy to such

an extent with the construction of new machines for future use.

Thus, in the case of mechanization, when technological progress proceeds more quickly, the growth of employment is postponed for some time. Technological unemployment is being divided in time in a different way. It will be greater not when the rate of mechanization is higher, but only when the rate has slowed down.

In the above considerations, we have not taken into account the field in which mechanization takes place. The question to be dealt with, first of all, is whether the country in which the new machines are introduced is the same as the country which produces such machines. In this connection, three situations are possible.

In the first case, the producing country is the country in which the machines are used. Here nothing need be added to what has been said above.

In the second case, the country which introduces the machines not only produces all the machines, but it also exports a number of new machines to other countries. In other words, the new mechanical invention brings into existence a new export of machines. The given country will, of course, increase employment above its former level, as a result of its supply of machines to other countries.

Lastly, in the third case, the country in which the machines are introduced have to import the machines from abroad, replacing in this way its own labour power by the imported machines. In such a case, the mechanization of production leads indirectly to a diminution in employment.

As we have observed, compensation within the sphere of the national economy is different in the case of mechanization from that in the case of the other forms of the progress in productivity.

In the case of rationalization, industrial psychology, or industrial organization, the replacement of labour starts

at a far earlier stage, without providing any compensation that is usually created by the new work of the production of the machines.

§ 8. COMPENSATION IN THE DIFFERENT BRANCHES OF PRODUCTION

Compensation differs in the different branches of production. It is different in the production of gold, in the production of goods, different again in industry and in agriculture ; it is different in industry producing consumption goods, and different again in industries making production goods ; it is different in transport and communication, and different in trade or banking.

1. Technological progress in the production of gold leads, as a rule, to over-compensation. Such over-compensation occurs partly in the production of the gold itself and partly in the production of goods, which develops as a result of cheaper gold and the increased circulation of currency. When gold becomes cheaper as a result of some technological improvement in its production, then the price level rises, a general boom in production and trade follows, and consequently employment also goes up. The production of gold is the creation of money and of purchasing power ; consequently every increase in the production of gold brought about as a result of technological progress in gold mines is a stimulating factor on the production of goods.

Technological improvements in the production of gold leads, as a rule, to over-compensation ; at any rate, they lead to a greater compensation than in the case of the production of commodities.

2. Technological progress in the production of consumption goods leads to compensation more easily and quickly than technological progress in production goods industries. An increase in demand as a result of falling prices follows more quickly in the case of consumption articles than in the case of production articles. In the case of production goods, the rise in demand comes in a

roundabout way through the fall in prices of manufactured goods, for the manufacture of which the production goods have to be used. Hence compensation is greater and quicker in the case of technological progress in the consumption goods industries than in the case of production goods industries.

3. So far as technological progress in agriculture is concerned, two conflicting forces are at work. Agricultural production is characterized by inelasticity of demand and inelasticity of production. The first factor is an anti-compensation factor (leading to an increase of technological unemployment), while the second is a pro-compensation factor (decreasing unemployment).

The first factor (small elasticity in demand for agricultural products) causes a fall in prices, reduces profitability in agriculture, brings about a considerable waste in capital and a reduction in the wages-fund at the disposal of agriculture. It is a factor making for unemployment.

The second factor (small elasticity in production) makes it hardly possible for agriculture, even if it proves itself unprofitable, to curtail production; consequently the worker does not lose employment, but only part of his wages.

Technological unemployment in agriculture is the result of the conflicting influence of these two forces. The first factor restricts the rise in the number of workers employed in agriculture, the second factor protects the workers employed from unemployment. Generally speaking, the following proposition could be laid down in respect of technological unemployment in agriculture:—

Technological progress in agriculture does not lead to a swelling of technological unemployment within agriculture itself; as a rule, however, it restricts the growth of employment, and consequently the number of agricultural workers in relation to the population as a whole is constantly decreasing.

Instead of technological unemployment in agriculture, there appear impoverishment and decapitalization in agriculture, insolvency, a fall in wages and in the number of agricultural workers and their general consumption,

which in turn leads to serious disturbances within the whole economic system. Concentrated technological progress in agriculture is usually connected with vehement economic fluctuations and goes hand in hand with a considerable technological unemployment within the whole field of social economy, although it is least within agriculture itself. A high rate of technological progress in agriculture constantly reduces the number employed in agriculture in relation to other branches of employment.

4. Technological progress in transport and communication falls within a different class. Such progress brings about changes in the local distribution of production and leads, as a rule, to productive improvements by way of specialization and mass production, caused by the widening of the field of exchange. Technological progress in communication increases the exchange and distribution of labour within the nation and between nations. The increase in exchange and distribution of labour does not reduce employment as such; on the contrary, it increases it. On the other hand, it is true that this rise in employment takes place within the whole territory where the progress in communication takes place, while such progress may, at the same time, cause a fall in employment in local labour markets. If technological progress in communications will express itself, for instance, in a fall in the costs of transport, and enable Glasgow factories to compete with Birmingham factories, then employment in Glasgow will rise at the expense of employment in Birmingham.

Every technological improvement within the communication industry which facilitates transport brings about a corresponding reduction in costs or time of transport, widens the range of the market and leads to an increased profitability in production, as well as to a growth of production itself; thus it brings about, as a rule, over-compensation within the whole of the economic system.

5. Every technological improvement in trade which reduces the costs of its intermediaries stimulates the market, both from the point of view of the producer whose profitability increases, and from the point of view

of the consumer whose purchasing power is liberated for other purposes. Such compensation is proportionately greater than the corresponding extent of technological unemployment. Thus technological improvements in trade lead, as a rule, to over-compensation.

6. Every technological improvement in banking which reduces the number of bank employees results in a rise in the profitability of banks, and thus makes possible the lowering of the interest rate of the banks by reducing the divergence between the rate of interest of the creditors and the debtors. Since the lowering of the interest rate stimulates economic life, technological progress in banking leads, as a rule, to over-compensation. The same applies to technological progress so far as credit and currency technique is concerned.

§ 9. THE PROBLEM OF COMPENSATION IN THE LIGHT OF EXPERIENCE

It is clear from the above considerations that the problem of compensation cannot be, generally speaking, solved by way of theoretical abstraction. Theory can only give answers to such questions as where, and under what conditions, compensation is greater or smaller, which factors are favourable and which unfavourable to compensation. We shall refrain from further discussion of compensation in view of the great complexity and casuistry of this problem.

Theory itself does not provide a valid basis for a general and absolute formulation of the problem of compensation, and consequently its solution. We cannot give a valid general answer applicable in all cases and at all times, in respect of every branch of production, every invention, or every country.¹

¹ Mark Mitnitzky in "Kapitalbildung und Arbeitslosigkeit" states quite correctly: "The theory admits the possibility both of compensation and of technological unemployment; but it proves the necessity of neither. Any further extension of the validity of the theory, whether based on the proof of permanent employment of the whole labour power or on the belief in an inevitable working-class reserve-army, is unjustified." *Arch. für Sozialwissenschaft und Sozialpolitik*, vol. 66, No. 1, 1931, p. 91.

To our regret, it is also impossible, from the empirical point of view, to give valid replies to general and absolutely formulated questions. The fact that a given invention in a given branch of production, at a given time and place and under given circumstances, has led to full or even over-compensation, does not exclude the possibility that in the case of different inventions and under different circumstances the consequences will be also different.

The way of empirical research, in the problem of compensation, whether within the field of the "progressive industry," the national economy, or the world economy, is strewn with many, almost insuperable, obstacles.

If we reduce the problem of compensation, empirically viewed, to the sphere of the "progressive industry," then naturally the picture we shall get will be fragmentary and incomplete. This would mean that we leave out of consideration the changes within the whole national economy and restrict ourselves to a small portion of the whole problem. The most important factor of compensation within the "progressive industry" is the growth in demand, that is, the question whether the demand proceeds in the direction of goods that are subject to technological progress or not.

In agriculture, compensation has, as a rule, been slight, but in industry it has been considerable. The demand of a population growing in numbers and wealth is directed towards industry, and not agricultural products. Industry has absorbed an increasing number of workers, and agriculture has passed on to industry an increasing number of the population. But the growth in demand can hardly be singled out from other processes of "the growth of capitalism."

Even if we remain within the sphere of the "progressive industry," it will be very difficult in practice to single out the process of compensation from other processes of growth and structural changes, such as an increase in population, or in capital. The fact that employment within the "progressive industry" has gone

up does not necessarily mean that it was due to a process of compensation, and not to a process of structural or transient changes, independent of the process of compensation.

Similarly, the fact that additional unemployment has occurred within the "progressive industry" cannot bring us to the conclusion that compensation has not taken place. It is extremely difficult to single out compensation from other phenomena of general economic development, such as growth of capital and increase in population which are features of the capitalist system. The fact that unemployment has not increased as a result of an increase in productivity cannot lead us to the conclusion that a full compensation has taken place; neither would the fact that, in spite of the rise in productivity by 30 per cent., employment has increased by 50 per cent. justify a conclusion that over-compensation has taken place. For it is clear that other factors have to be taken into account, such as the general expansion of the capitalist system, growth of capital, increase in population, the widening of markets, the ratio of employment in handicraft and agriculture and a number of other economic changes. It is obvious that industry expands in the capitalist system irrespective of technological changes.

In an empirical approach to the problem of compensation within the national economy, it is of prime importance to notice whether compensation has been so considerable that it has absorbed the whole increase in population, or whether it has fallen short of such absorption. The economic history of capitalism so far shows that compensation within the national economy has, as a rule, absorbed the whole technological unemployment of a certain period, but this is without taking into account the increase in population. There have been, however, periods in which compensation has additionally absorbed the whole increase in population, and there have also been periods when compensation fell short of absorbing the whole increase in population. But here we enter the field of population

problems which, in practice, are closely connected with the problem of compensation.

The problem of compensation within the national economy approached empirically is closely connected with the rate of increase in capital, the growth of population and technological progress. The rate of technological progress, the rate of capital accumulation, and the rate of growth in population, are the three most important factors that decide, amongst others, whether the industry can absorb the whole increase in population or not. But such an approach to the problem of compensation is only an incident of the most complicated problem of the growth of capitalism, with which we shall deal at a later stage.

Finally, if we pass to the problem of compensation within the world economy, we have to state that within this sphere it is empirically entirely misty and undefinable, for who can state with certainty whether and to what an extent compensation of American technological unemployment took place in the world, in England, in Germany, in France, etc. ? We have no criteria by which to measure the changes brought about by technological progress in the whole world. It is, as the proverbial saying goes, "the seeking of the needle in a haystack."

If we make an attempt at a valuation of the process of compensation in capitalism in the nineteenth century, in connection with the process of the growth in capitalism, then the conclusion we shall arrive at can be thus formulated: Capitalism was the period of the most intense technological dynamics, and at the same time the period of the most intense accumulation of capital and increase in population. It enabled industries to absorb great masses of a speedily increasing population in a measure hitherto unknown in history.

In the nineteenth century, compensation, if taken jointly with the process of general growth, was excessive. The enormous progress in the productivity of labour did not result in unemployment; on the contrary, it increased employment considerably. In great capitalist countries,

such as the United States of America, England and Germany, where technological progress proceeded at a quicker rate, the number of employed increased quicker than in countries where technological progress was slower. This fact found expression in a constant wave of immigration from countries backward industrially to countries technologically advanced. Countries where machinery was constantly on the upgrade have absorbed not only the whole of their increase in population, but also a great mass of immigrants from technologically backward countries. (European immigration went Westward and not Eastward.)

The increase in productivity of labour in highly industrialized countries in no way obstructed the great increase in the number of industrial workers employed, even in excess of its own increase in population.

In England, United States and Germany productivity of labour has increased in the nineteenth century to a great extent; at the same time the figures of population were rising, the number of employed in active trade was increasing, but unemployment has in no way grown.

In England, the average of productivity of labour (*i.e.* the average for industry and agriculture) has increased in the period between 1840 and 1910 by almost 100 per cent.; in America, the same increase was evident during the period between 1850 and 1910.¹

¹ The index numbers for Productivity of Labour in the United States of America were the following in the period 1850-1910 (the average for 1900-1910 is 100) :—

<i>Year.</i>	<i>In General.</i>	<i>In Agriculture.</i>	<i>In Industry,</i>
1850	46.7	65.6-50.2	43.2
1860	57.2	68.6-53.8	61.2
1870	51.7	46.2	58.1
1880	50.3	38.9	64.9
1890	73.2	60.2	88.9
1900	92.5	84.0	101.9
1910	106.4	114.6	98.6

The index numbers for Productivity of Labour in England were the following :—

[See opposite page.

In spite of the great increase in productivity of labour, the number of employed in England and America in the course of the last century not only has not decreased but has risen to a colossal extent in a degree hitherto unknown in history.

In Europe, population has risen in the period from 1800 till 1914 from 180,000,000 to 452,000,000; in England and Wales, population has risen in the years 1801-1911 from 8,892,536 to 36,075,269; in the United States, population has risen in the period 1790-1920 from 3,929,218 to 118,000,000; in Germany, in the period 1816 till 1910 from 24,800,000 (estimate) to 64,900,000.

In spite of this great rise in population, unemployment has not increased during the nineteenth century in Europe or the United States of America. In England the number of unemployed fluctuated in the period between 1860 and 1914 in the neighbourhood of 4.5 per cent. of the number employed;¹ in the United States the percentage was estimated in the pre-War period to be about 9 per cent.²

In Germany the mechanization in industry and productivity of labour has risen to a great extent, and at the same time the number of employed has also increased; and the percentage of unemployed before the War did not increase. In the period between 1875 and 1907 the number of horse-power installed in German production-goods industries has risen from 619,000 to 6,770,000,

Year.	In General.	In Agriculture.	In Industry.
1820	—	—	—
1830	—	72.4	—
1840	57.1	66.5	49.0
1850	58.3	65.5	51.9
1860	75.1	75.6	74.4
1870	86.7	84.3	89.3
1880	94.9	84.8	106.3
1890	100.0	95.5	104.6
1900	98.6	95.6	101.7
1910	101.6	103.3	100.0

Kondratieff: "Die Preisdynamik der industriellen und landwirtschaftlichen Waren," *Archiv für Sozialwissenschaft und Sozialpolitik*, Tübingen, 1928, vol. I, pp. 25 and 84.

¹ Sir William Beveridge: *Unemployment*, p. 345, second edition, 1931.

² H. A. Hansen, *Economic Stabilization in an Unbalanced World*, New York, 1932, p. 125.

and the number of employed has risen from 1,921,000 to 5,232,100; in consumption-goods industries the number of horse-power has risen from 330,000 to 3,042,000, and the number employed from 3,543,000 to 5,572,800.¹

Thus, within the whole of the nineteenth century the existence of a huge over-compensation of technological unemployment is noticeable. The rise in productivity of labour went hand-in-hand with the rise in the number employed; this rise was specially intense in those very countries in which technological development was the strongest.

The effects of compensation within the individual industries in which mechanical inventions were introduced were similar. We know from experience that, excepting agriculture, which, due to its small elasticity of demand, did not show an increase in employment, pre-War industries are characterized not only by compensation, but also by over-compensation. Industries possessed of intense technological dynamics not only did not show a fall in the number of employed, but, on the contrary, have considerably increased the number of employed. The increase was not only absolute but also relative in relation to the entire number of employed.

Let us take as an example the American Steel Industry in the period from 1879 to 1929. Here the productivity of labour has risen 23.2 times (the productivity per worker has increased from 73.7 tons to 1710 tons), at the same time the number of workers employed in this industry has risen from 24 workers per 10,000 of population to 32 workers.² It is a well-known fact that the rise in the number of employed in a pre-War industry was usually the strongest exactly at the time of its intense technological progress. At the time of the invention of the power-loom, the employment in spinning and weaving industry had increased to a considerable extent, not only absolutely but also relatively, in proportion to the whole

¹ *Deutsche Wirtschaftskunde*. Bearbeitet im statistischen Reichsamt, Berlin, 1930, p. 111.

² Cited in Allen Raymond's *What is Technocracy?* p. 151, New York, 1933.

number of industrial workers employed. At the time of important scientific inventions in the steel industry, employment in this industry had increased enormously. Let us take, for instance, employment in English industries in the period of great technological progress, from 1841 to 1924. In this period employment in the English metal, mechanical engineering and transport industries had risen from 7.9 per cent. of the entire number of industrial workers to 26.6 per cent. ; in the chemical industry the increase was, at the same time, from 0.2 per cent. to 2.6 per cent. In the United States the number of workers employed in the mechanical engineering industry in the period from 1850 till 1927 (that is, in the period of the intense technological development) had increased from 4.2 to 10.6 per cent. ; in the transport industry it had increased from 2.7 per cent. to 11.1 per cent. of the entire number employed.¹

Obviously, there were branches of industry in which an increase in productivity of labour did not go hand-in-hand with a corresponding rise in employment. This was specially so in the case of industries which came to a static point in their development, having exceeded the saturation point of demand, or in case of industries that fell into the net of monopoly. But the "contracting" industries were in the pre-War time the exception—and the "expanding" industries the rule.

These pre-War experiences seem generally to support the theory of compensation and even of over-compensation. For industry as a whole had absorbed not only technological employment, but also a considerable increase in population.

Let us now pass on to some post-War experiences. The latter will bear evidence against the theory of compensation, although the period of time is really too short to allow any broad conclusions.

The following table, compiled on the basis of statistical figures supplied by different branches of industry in

¹ Cited in the work of Walter Hoffman : *Stadien und Typen der industrialisierung*, Jena, 1931, p. 182.

U.S.A. and covering the period 1923-7, shows the extent of technological progress and the corresponding unemployment in the post-War period :—

<i>Industries.</i>	<i>Rise or fall in Production. In per cent.</i>	<i>Rise or fall in the numbers of Employed. In per cent.</i>	<i>Increase in Productivity. In per cent.</i>
1. Refining of Petrol	+84	- 5	89
2. Tobacco	+53	-13	66
3. Meat	+20	-19	39
4. Railways (1922-6)	+30	- 1	31
5. Building industries (only in Ohio State)	+11	-15	26
6. Motor Vehicles	+69	+48	21
7. Tyres	+28	+ 7	21
8. Coal	+ 4	-15	19
9. Electricity	+70	+52	18
10. Steel	+ 8	- 9	17
11. Cotton	+ 3	-13	16
12. Electrical Installations	+10	- 6	16
13. Agriculture	+10	- 5	15
14. Timber	- 6	-21	15
15. Men's Clothing	+ 1	- 7	8
16. Paper	+ 0	- 7	7
17. Shoes	- 7	-12	5

According to statistics collected by "The Federal Reserve Board," the index numbers for production, employment and productivity of labour in U.S.A. for the period of 1919-29 were the following :—

<i>Year.</i>	<i>Industrial Output.</i>	<i>Labour Employed.</i>	<i>Production per head of Worker.</i>	<i>Amount of Wages.</i>	<i>Wage-rate per head of Workers Employed.</i>
1919	100	100	100	100	100
1920	104	101	103	120	119
1921	80	77	104	79	103
1922	104	84	124	83	99
1923	120	97	124	105	108
1924	112	90	124	98	109
1925	125	93	134	103	111
1926	129	94	137	106	113
1927	126	92	137	104	113
1928	132	91	145	104	114
1929	142	94	151	110	117

The above figures show that post-War compensation of technological unemployment in the United States was partial and insufficient.

In the case of England, the degree of compensation was more favourable though still insufficient. The number of unemployed in England was increased after the War from an average of 4.5 per cent. of the number employed in the period from 1860 to 1914 to 12 per cent. of the number employed in the period from 1914 to 1930.¹

According to the figures published by the Ministry of Labour, the total "insured population" in England increased between July 1923 and July 1935 by 17 per cent., or by about 1,900,000 persons, and the total of persons employed in all industries increased by 11.7 per cent., or by about 1,000,000 persons. So that the increase in unemployment during the twelve years amounted to about 900,000 persons.²

The "expanding" industries increased their employment in that period by 40 per cent., or by over 2,100,000 persons. The "contracting" industries decreased their employment by 26.2 per cent., or by about 1,100,000 persons.

The following tables (pp. 124, 125) give the figures of employment in "contracting" and in "expanding" industries.³

The net absorption of working population was about 1,000,000—also less by 900,000 persons than the increase of the insured population. This figure gives the rise in unemployment during the last twelve years.

In the case of Germany the degree of compensation was also small in the post-War period. Here the number of employed increased trebly in relation to the pre-War percentage, reaching at times (1931-1932) the figure of 30 per cent. of the employed.

Generally speaking, in European industrial countries unemployment has increased after the War in com-

¹ Sir William Beveridge: *Unemployment*, p. 348, second edition, 1931.

² *The Economist*, 28th December 1935, No. 4818, vol. CXXI.

³ *Ibid.*

CONTRACTING INDUSTRIES
INDEX NUMBER. EMPLOYMENT IN JUNE 1923=100

<i>Industry.</i>	<i>Number Employed in June 1935.</i>	1925	1929	1930	1931	1932	1933	1934	1935
Coal-mining	638,502	75·8	74·0	69·2	56·8	52·7	54·3	53·0	54·3
Boots and Shoes	113,751	100·6	93·1	89·9	87·7	85·6	98·1	89·4	90·6
General Engineering	460,420	103·9	105·8	98·7	81·6	77·3	78·4	87·7	91·0
Cotton	344,100	117·7	109·0	75·1	74·4	79·8	85·2	81·9	78·4
Iron and Steel	123,992	88·1	89·6	78·8	54·5	54·0	62·7	79·2	77·0
Woollen and Worsted	188,578	81·7	85·2	75·3	66·4	70·7	82·2	74·9	78·2
Shipbuilding and Ship Repairing	89,540	103·6	108·9	97·5	58·3	46·4	45·3	55·5	61·5
Dock, Harbour, etc.	113,646	92·5	87·9	83·7	79·1	83·8	82·5	86·7	85·5
Railway (non-permanent)	128,013	88·3	76·1	74·5	72·0	65·6	60·4	69·9	73·8
National Government	106,787	91·7	72·5	67·2	71·6	69·9	64·3	63·5	69·6

EXPANDING INDUSTRIES

INDEX NUMBER. EMPLOYMENT IN JUNE 1923=100

<i>Industry.</i>	<i>Number Employed in June 1935.</i>	1925	1929	1930	1931	1932	1933	1934	1935
Electric Cables	130,689	116.4	139.3	146.6	144.4	158.5	168.0	189.3	203.1
Industries not separately specified	120,114	113.6	130.4	126.8	124.4	125.8	134.4	150.0	153.8
Motors, etc.	257,029	116.4	134.4	125.2	115.5	114.4	127.9	143.2	149.9
Furniture	121,683	110.5	135.2	134.2	130.8	126.9	130.6	140.9	145.1
Metal Industries	213,541	110.1	123.2	118.6	111.4	112.6	123.2	136.6	148.7
Food Industries	110,993	108.0	122.0	120.7	119.8	120.0	130.2	131.2	131.8
Hosiery	102,198	106.0	121.2	110.7	109.1	118.9	121.3	126.1	124.2
Printing	255,711	107.9	119.7	122.2	120.1	122.1	123.0	122.5	121.9
Drink	98,701	113.4	111.7	109.3	107.7	101.7	106.8	108.8	108.4
Tailoring	186,198	106.0	109.9	107.9	109.5	107.5	110.9	107.0	107.5
Bread, etc.	152,706	90.9	96.2	97.5	97.4	100.3	104.5	106.7	108.4
Public Works	158,194	125.1	136.0	146.7	213.5	188.0	159.6	154.7	159.7
Building	843,576	112.6	126.8	121.8	117.9	106.2	118.8	132.5	141.5
Tramway and Bus	180,438	110.2	147.5	153.8	162.2	167.0	168.2	170.2	176.3
Distributive	1,799,371	116.9	136.9	140.0	144.3	149.0	153.5	155.4	155.3
Road Transport	180,202	113.2	136.0	135.3	141.7	138.5	139.7	147.0	150.6
Hotels, etc.	372,747	117.6	136.3	136.0	142.2	141.8	149.8	156.7	162.9
Professional Services	145,438	105.9	115.6	119.3	123.3	126.2	131.9	138.0	142.2
Local Government	294,903	104.7	120.1	132.2	138.2	133.9	138.2	139.6	139.8

The Problem of Compensation

parison with the last few decades before the War from 3-8 per cent. to 10-30 per cent. of the employed.¹ Thus compensation was insufficient after the War—meaning by it that the absorption of a comparatively low increase in population by the insufficiently developing industries was incomplete. A number of branches of industry fail to show an increase in the number of employed; on the contrary, an absolute fall in the employment is evident. The incomplete compensation after the War is due to a number of factors that hampered the process of compensation, making it more difficult and less extensive. Some of these factors were inherent in the very structure of the economic system, others were external, such as destruction of capital and general impoverishment caused by the Great War.

The War has caused a considerable loss of capitals. Instead of an increase of capital, a diminution of capital was brought about and it made the absorption of the increase in population difficult. The general impoverishment has increased the numbers of the proletariat, thereby increasing the supply of labour on the part of women, children and the aged. The destruction of capital has lowered the demand for labour, since such demand is measured by the magnitude of capital.

The necessity of financing the enormous costs of the War has caused an unsatisfied demand for foreign bills, and in consequence it has brought an almost universal regime of currency and trade restriction, immigration prohibitions and autarchism. This led in turn to additional loss of capital and has stimulated monopolization and autarchization. All these factors are obstructing the process of compensation.

But irrespective of the catastrophic consequences of the Great War, a number of organic changes that took place within the capitalist system (concentration, monopolization, State interference, etc.) also obstruct the process of compensation.

¹ Robert Wildbrandt: *Unsere Volkswirtschaft heute und morgen*, 1930, p. 261.

We can see from the above that experience can help us little in the solution of the problem of compensation in itself, and that it does not provide us with a basis for conclusions that are absolutely true in all cases and under all circumstances.

§ 10. COMPENSATION IN THE LIGHT OF THE GROWTH IN CAPITAL AND POPULATION

The empirical discussion of the problem of compensation has shown that the main difficulty in tracing the consequences of the process of compensation lies in the fact that it is impossible to separate the process of compensation from the general process of the growth in capitalism. It may, therefore, be of advantage to approach the problem of compensation from the point of view of its connection with the problem of the growth in capitalism.

Hitherto we have considered compensation in itself, as a sequence of changes enclosed within its own borders, and we have assumed that, except for technological progress, capitalism is in a state of equilibrium. But clearly, besides technological progress, there are at work the dynamic forces of capitalism, the growth of capital and the rise in population. Accordingly, compensation has to be dealt with in the light of these two factors.

Looking at the matter from a practical point of view, the process of compensation is woven into the general process of growth in capitalism, and technological progress is but a component part of the development in capitalism. Capitalism is the system of accumulation of capital, that is, of producing profit. The stimulus towards development and growth is part and parcel of capitalism. Technological progress itself is also the product of this stimulus towards development. Accordingly, technological unemployment, too, is a product of capitalism. In considering the problem of unemployment, therefore, we cannot leave out of account the fact that, during the time in which unemployment is in existence,

a further development in capitalism is taking place, facilitating in turn the absorption of unemployment.

Let us now proceed with a discussion of the problem of compensation as embodied in the general process of growth in capitalism. The rate of development in capitalism differs in time; there are periods of intense development and periods when development is at a standstill or even periods of temporary retrogression. The intensity of development at the time when the whole world was open to the conquest of capitalism was different from that when territories for capitalist exploitation are almost non-existent and when world economy as such is almost in a state of liquidation.

The pace of development differed again at a time when capitalism was acquiring new fields for internal exploitation (in handicraft and agriculture) from what it was in periods when such fields have been partially exploited. It is different again in periods when the growth of capital is not obstructed by heavy public burdens, due to a regime of State interference and militarism, and differs in periods when the State lays hands upon the bulk of the increase in capital, appropriating it in the form of taxes, duties and other levies.

In periods of prevailing peace, when the community is in a position to concentrate on productive and creative work, the intensity of development differs from what it is in times of war and destruction of capital and population. In periods when the motive for profit is prevalent and the rate of saving is high, the dynamics of development will be different from what they are in times when the aims and ambitions of the community lie in other directions.

Again, the intensity of development will be different in times of economic freedom from that in times of monopolies, economic planning and interference. Finally, the dynamics of development in periods of a high birth-rate will not be the same as in periods of stagnant population.

The more intense the general process of economic

development, the easier also will be the process of liquidation (we refrain from calling it here "compensation") of technological unemployment. Periods of intense economic development are usually periods of liquidation of technological unemployment, while periods of economic stagnation are usually periods of increasing unemployment.

We can formulate the problem of compensation in the light of general development in the following way: The problem of compensation loses its real importance in times of intense economic development. Intense development in capitalism creates new possibilities of employment, thus depriving the problem of compensation of its prime importance. During such intense development, the many consequential changes brought about by compensation become insignificant. The problem of compensation gains in importance, however, in times of stagnation or retrogression in capitalism.

Of course, from the practical point of view, the problem of development in capitalism is of far greater importance than the problem of compensation. The intense development of capitalism has been based on a liberal economic policy, both internally and externally, when there were still territories not yet conquered by capitalism. But to-day the problem of compensation is growing in importance.

As was observed above, in the process of development in capitalism two factors come to the fore: increase in capital and increase in population. These bring about a general increase in economic quantities and *augment the dimensions of economic life*. The productive machinery of the community becomes greater, the national dividend increases and all economic elements tend to expand.

When we consider the problem of compensation from the point of view of the increase in capital and the increase in population, then our conclusion will undoubtedly be that the increase in capital facilitates the process of compensation. A country which speedily increases its production-capital will also easily absorb its technological unemployment. The process of capital increase is almost universally considered to be a process

of the liquidation of technological unemployment in all its forms.

It is otherwise, however, with the increase in population. Economists are at variance as far as the problem of the increase in population is concerned. Some approach it from the static point of view and fall in with the conclusions of Malthus ; others approach it from a dynamic point of view and arrive at quite opposite conclusions.¹ The conflict of opinions can really be reduced to the question, which approach is the right one, the static or the dynamic.

The testimony of history does not allow us to ignore the dynamic approach to the problem of population. The periods of great rise in population were usually coupled with periods of prosperity, and not the contrary. When the numbers of the population were declining, this was an unfailing sign of economic ruin, poverty and unemployment.

From the time of the wandering of the nations until the eighteenth century, the population of Europe has only increased in a very small measure. None the less, it was not by any means a period of great employment, high wages, prosperity and wealth.

The first rise in population of any importance only appears in the eighteenth century and takes more serious forms in the nineteenth century. From the year 1350 till 1800 the population of Europe increased from 100 millions to 180 millions ; in the years 1800 to 1914 it has risen from 180 millions to 450 millions. In the United States the population increased in the period 1790 to 1920 from 3·9 millions to 118 millions. And was not the nineteenth century, from the economic point of view, the golden age of humanity, has it not raised the

¹ As the population increases in numbers, a division of labour proceeds, a more intense exchange of goods and services takes place, the standard of material and spiritual culture is raised and intense technological progress follows. A high material culture thrives in territories with a dense population and not on territories with a scanty population. In densely populated areas men find it easier to get their means of livelihood than in scantily populated territories. Similarly, the pace of technological progress is greater in the former than in the latter.

standard of life, has it not given employment to a rapidly increasing population ?

It was not an accident that this magnificent economic development of capitalism went hand in hand with a numerical rise in population. Without the rapidly increasing population, such progress would be unthinkable.

Let us see, however, what are the characteristics of the problem after the World War. Such industrial countries as England, Germany, Austria and Sweden show a considerable fall in the natural increase in population, this fall amounting in the last two decades to almost two-thirds of the former rate of increase (the natural rate of increase in population in the period 1912 to 1932 has come down in Germany from 12·9 per thousand inhabitants to 4·3 ; in England in the same period from 10·7 to 3·3 ; in Austria from 5·3 to 1·3 ; in Sweden from 10·6 to 2·9). But has unemployment diminished in these countries ? Has the labour market been eased, owing to the small rise in population ? In the United States there was another factor in operation besides the diminished rise in population, namely the entire stoppage of immigration, which ought to have eased the labour market.

It is interesting, however, to note that the relative figures of unemployment in the post-War period are highest in industrial countries, in spite of the fact that, in the last few decades, the natural increase in population is constantly falling. It is due to the acknowledgment of this fact that many economists have revised their views regarding the inter-connection between unemployment and the increase in population.¹

¹ Navratzki, in his work *Bevölkerungsstillstand als Wirtschaftsproblem* (Berlin, 1930), states that "the present decline in the number of consumers, being partly a general European occurrence and partly one to be found outside Europe too, must eventually lead to a curtailment in production for a considerable time in many branches of economy."

L. Hersch states in *Bevölkerung und Arbeitslosigkeit*: "A decline in the natural increase in population hampers the general process of economic development, and this fact must be kept well in mind, because of its bearing on production and economic prosperity. It aggravates those factors that bring about economic stagnation and unemployment." See *Probleme der Arbeitslosigkeit im Jahre 1931*, Geneva, 1931.

Accordingly, in view of past experience, and especially so after the War, the dynamic approach to the problem of the increase in population cannot be ignored. The effects of the increase in population are manifold, differing in kind and degree, and are very often of a conflicting nature. We shall, therefore, examine the problem more closely, keeping in mind both the problem of compensation and the dynamic forces of capitalism.

No doubt the growth in population on the one hand increases the supply of labour, and on the other hand it also increases the demand for labour; for it not only supplies the labour market with new workers, but also creates new economic units which produce new income.

Every increase in population which creates a new supply of labour produces incomes which create at the same time a demand for this labour (by way of increase in production, turnover and consumption). *Man is a positive and creative economic factor.* He creates his own source of support and even a surplus above it. Man's productivity, at a certain stage of technology, exceeds the cost of his support. In the capitalist system the production of the worker is in excess of his minimum necessities, and what he receives in the form of wages is only a portion of the equivalent value of his productive effort, the surplus value of it being accumulated. Existing unemployment, which, at certain periods, represents only a small percentage of the population, cannot be cited for the purpose of disproving this important fact.

In times of intense technological progress, the great increase in population offsets the social disturbances resulting from technological progress, and is a factor which contributes to the general economic growth. Intense technological progress creates a maintenance fund for the new increase in population; on the other hand, this increase in population is a factor adjusting fluctuations and disturbances resulting from technological progress, thus contributing in part to the absorption of technological unemployment. Such fluctuations are concentrated mostly in those branches of production which

work for an inelastic demand. For instance, in agriculture, in the building and clothing industries, every invention leads to technological unemployment, owing to the inelastic demand, *i.e.* the insufficient number of consumers. But when a new increase in population appears, this means new consumers. If, for instance, technological progress has lowered the cost of production and the price of bread or clothing by 35 per cent., then the head of a family can for the same amount of income purchase for his enlarged family quantitatively 50 per cent. more than before. In other words, we have at once got a ready income for the increased population. If the increase in population proceeds step by step with a corresponding technological progress, then technological unemployment will not appear. Technological progress will be compensated by the increase in population. (John Stuart Mill foresaw this consequence of technological progress, and gave expression to his apprehension that mechanical inventions may be beneficial to man as a species, but not to man as an individual.) The increase in population increases consumption in those branches of production which have an inelastic demand, and which, in the absence of this consumption, would remain unused and wasted, creating in turn unemployment. The increase in population, therefore, facilitates the absorption of technological unemployment, in spite of the superficial contradiction that may appear to be inherent in such a statement.

We can also state this in other words: that intense technological progress is a factor which does not create obstacles but, on the contrary, places additional facilities at the disposal of the population and widens the biological sphere for the expansion of the human species. Similarly, the reverse is also true, namely, that a great natural increase in population does not put obstacles in the way of technological progress, but facilitates such progress, making the disadvantages brought in its train more tolerable.

In times of great increase in population, technological

progress finds ready consumers, for whom technological progress itself has created an additional source of income and additional purchasing power.

The question may be raised as to what will be the position when technological progress comes at a time of a falling birth-rate. A falling rate in the natural increase in population is a factor which increases, but does not diminish, the disadvantages of technological progress and hinders, but does not facilitate, the absorption of technological unemployment.

In periods when the rate of the natural increase in population is falling, an instantaneous influence on the market is observable, and a diminishing demand for labour is thereby brought about; while, on the other hand, a decrease in the supply of labour will take place only after many years (it depends upon the general level of prosperity whether children will enter the labour market sooner or later). This discrepancy will be noticeable in the transitional period, as long as the fall in the natural increase in population goes on. But if the tendency towards restricting the birth-rate is prevalent in the community, then the transitional period is continually extended and finally becomes a permanent feature.

There is yet another circumstance which has to be taken into account. In periods of a fall in birth-rate, the number of persons annually entering the labour market show a relative increase in relation to the entire population, and this relative increase is evident for some fifteen or twenty years from the time when the birth-rate began to fall. This is due to the fact that people who then enter the labour market have been born in a previous period of a higher birth-rate, while the entire population now increases at a lower rate. Thus the relative number of workers increases, and this augments the productive powers of the community, thus producing effects similar to those brought about by technological

progress. In periods when there is no technological progress, this increase in productive labour is extremely desirable. But in periods of intense technological progress, this additional increase in productive power makes the disadvantages of technological progress only more serious; this causes in turn long and serious processes of adjustment, which find expression in mass unemployment.

A part of the productive powers of the community cannot be utilized and are thus being wasted. The fall in the natural increase in population increases the supply of labour, for this supply is determined, as a rule, not by the absolute number of workers but by their relative ratio to the numerical strength of the community as a whole. Thus, the natural increase in population is in the case of technological progress the best "safety valve" to protect the community from serious disturbances and long processes of adjustment.

In a discussion of the effects of a fall in birth-rate, the fact has to be well kept in mind that the property-owning classes usually reduce to a greater extent their birth-rate than the proletariat. In the same way as capitalist nations show a smaller increase in their numerical strength than proletarian nations, so also the property-owning classes increase to a lesser extent than the proletariat. This fact is of great importance as regards its influence on both the demand and the supply of labour.

If the falling birth-rate is mainly within the property-owning classes, then the relative annual increase in the number of workers supplied to the market, and also the fall in consumption, will be considerable. On the other hand, when the falling birth-rate is mainly within the working class, then the relative increase in the annual number of workers supplied to the market diminishes, and the process of falling consumption is slight.

A considerable natural increase of the property-owning class increases the demand for labour in all its forms. There is no doubt that the appreciable fall in the birth-

rate of the property-owning class has contributed in the last few decades to the increase in unemployment. The fact that the property-owning class reduced their birth-rate to a greater extent than the working class is a factor that impedes the absorption of unemployment. This factor produces results similar in nature to those brought about by the concentration of property in the hands of a few.

The above conclusions could also be formulated in a different way by stating that the biological activity of the property-owning class augments social and economic activity of this class ; it creates favourable conditions for the absorption of unemployment and maintains a balanced social structure (the middle class).

It is evident, therefore, that the natural increase in population is a dynamic factor in economic life, since it widens its dimensions and facilitates the absorption of technological unemployment in periods of intense technological progress. The working of the capitalist system is such that it cannot exclusively serve the interests of man as an individual ; it must, to a certain extent, serve the interests of man as a species. Technological progress to some extent raises the standard of life of man as an individual ; but, at the same time, it widens the field of biological expansion of man as a species. The moral revolution which has taken place in the civilized States of the world, and which would like to bestow the advantages of technological progress in a greater measure to man as an individual than to man as a species, creates additional difficulties and aggravates the effects of technological progress.

CHAPTER II

TECHNOLOGICAL PROGRESS AND THE DISTRIBUTION OF INCOMES

§ II. TECHNOLOGICAL PROGRESS AND THE NATIONAL DIVIDEND

We shall now deal with the set of problems which is usually termed "distribution of incomes." The subject of the inquiry will be the influence that technological progress or, strictly speaking, progress in productivity exerts on the wage-rate, on the rate of profit and interest, on rent, and finally on the process of proprietary and occupational changes.

It is quite clear that we cannot make an attempt at a statistical statement of all the changes that are involved in the process of the distribution of incomes, as caused by technological progress, since that would necessitate a knowledge of not only the quantities but also of the direction of the elements subject to change.

Technological progress usually increases the National Dividend, but this increase differs in time and circumstances. The increase in the National Dividend is one thing in a system of free competition and another in a complete or semi-monopoly; it differs in various branches of production, depending on the elasticity of demand and supply, on the different nature of the goods subject to technological improvement (*e.g.* positive or destructive goods, goods of mass consumption or luxury goods, etc.).

Technological progress brings about a change not only in the rate of wages but also in the rate of employment; these two factors taken together and compared with the increase in the National Dividend give us the share of the labouring class in the National Dividend. Technological progress brings about a change not only in the

rate of interest but also in the amount of credit ; and here again we have two factors which, jointly with the increase in the National Dividend, shape the share of the capitalist-creditors in the National Dividend. Again, technological progress brings about a change not only in rent, but also the area of cultivated land and the degree of the intensity of cultivation ; and here, too, a number of factors decide the share of the landowner in the National Dividend. Finally, a general balance of changes in the share of the different classes depends on the level of the prices of goods and services which are usually consumed by these classes.

The many difficulties which stand in the way of our inquiry are apparent. We shall only be able to take into account general tendencies and those elements which are essential and representative of a majority of applied cases ; after thus eliminating the non-essential cases, we shall be able to fix in broad lines the essential features of the phenomena under discussion. But even then we shall not be able to give generally binding and *a priori* solutions. We shall, however, attempt to trace the factors which determine the extent to which particular classes in the community share the advantages brought about by technological progress.

§ 12. THE INCREASE IN THE NATIONAL DIVIDEND

The National Dividend is the annual product of the community. By "annual product" is to be understood the value of goods produced annually and services rendered, apart from the production of such goods.¹ (Services rendered by civil servants, doctors, lawyers and other personal services.) By the value of goods produced in a period of time is to be understood the sum total of the products of the price and quantity of the goods, leaving the national capital unchanged, *i.e.* leaving

¹ The value of services in the production of goods is already included in the value of the goods.

aside the sum total of the products of the price and quantity of the goods which are left over from previous production periods. Goods produced in the same year, but used in the production of other goods, are not included in this total, in order to avoid double reckoning. Of course, a fixed value of money is assumed (unchanging purchasing power) as a basis for the calculation of prices.

With the above qualifications in mind, we shall identify the National Dividend with the sum total of products of the price and quantity of goods produced and services rendered in the given period of time.

If we assume an unchanging purchasing power of money, then the increase in the National Dividend is equivalent to the numerical increase in social production. Progress in productivity, which increases the productivity of labour in one branch of production, usually results in a rise in production of this branch, and thereby brings about an increase in the National Dividend. Obviously, the increase in the National Dividend must be calculated in units of purchasing power, *i.e.* in units of money, qualified by the price-index; for a fall in prices is generally brought about by technological progress.

Thus the problem of the rate of increase in the National Dividend, as affected by technological progress, is really a problem of the rate of increase in production brought about by such progress. We have dealt with this problem in the chapter on "The Problem of Compensation," where we have also enumerated the factors which influence the growth of production. We have seen there that, assuming the market to be free, a great increase in productivity, *i.e.* a considerable reduction in the costs of production of goods with an elastic demand, must necessarily lead to a considerable increase in the National Dividend. In the case of monopoly and an inelastic demand, on the other hand, a slight reduction in the cost of production may cause only a slight increase in the National Dividend.

Obviously, the nature of the industry has to be taken into account. A considerable fall in the cost of production of corn or wool will have different consequences from a fall in the cost of production of pins. Only in industries of great importance does technological progress cause a large increase in the National Dividend.

As a rule, therefore, technological progress is a factor in the growth of the National Dividend. It creates a new fund either for the maintenance of the increased population or for the raising of the standard of life.

Such a fund is not bestowed on the community at once, but usually only after a period of time, when the technological progress has been fully applied and all its different stages readjusted. Technological progress does not lead at once to an increase in the quantity of consumption goods; at first, an increase in production goods takes place, the quantity of which is usually augmented relatively by technological progress.

Technological progress, causing an increase in the National Dividend, also creates new possibilities for the accumulation of capital. The saving in the cost of production per unit of production and the total increase in the National Dividend facilitate the greater accumulation of capital. Technological progress creates a new fund of goods for distribution between the different classes and different social groups. This fund, as we shall see later, to a certain extent benefits the producers and capitalists, giving them higher profits and rates of interest, and partly benefits consumers (as well as the workers) by supplying them with goods at lower prices. It is in rare cases, however, that it bestows benefits on the working class in the form of additional wages through additional employment (*e.g.* in the case of over-compensation); in rarer cases still, in the form of a higher wage-level or bonuses (*e.g.* in the application of Industrial Psychology). *This fund may also serve for the purpose of supporting the unemployed.*

§ 13. TECHNOLOGICAL PROGRESS AND WAGES

Progress in productivity causes a fall in the wage-rate.

- (1) By reducing unemployment.
- (2) By the operation of the law of substitution.
- (3) By the substitution of skilled workers by unskilled.

1. Technological progress which increases the productivity of labour results in a saving of labour, thereby decreasing the demand on the labour market. This is the effect produced in the first stage of the introduction of a technological improvement. In later stages, however, the compensation on the labour market is brought about, which, as was stated above, can be partial, full or excessive. But even full compensation leads to an increase in unemployment in the transitional period, since a number of workers are, for some time, deprived of employment.

When the demand on the labour market falls, wages also tend to fall, so that not only the level of wages but the sum total of them decreases. The fall in wages is the result of the fall in the demand for labour, assuming, of course, free competition within the labour market. In the case of monopoly in the labour market (trade unions, regulated wages, etc.), in spite of the fall in the demand for labour, a decrease in wages need not take place; this is an anti-compensation factor which leads to unemployment, and this in turn does cause a reduction in wages.

2. A decrease in wages is brought about, not only by a fall in the demand for labour, but also as a result of the operation of the law of substitution. Mechanization of industry provides the entrepreneur with the opportunity of replacing human labour by machinery. If, for instance, the labour of a few hundred workers each earning 10s. a day and jointly £90,000 per annum can be replaced by a machine, the cost of which (including the cost of operation, interest and amortization) amounts

to only £60,000 per annum, then the sum total of wages which the entrepreneur will be in a position to offer the workers jointly will not exceed £60,000. Accordingly, he will offer a wage-rate lower by one-third, or, if the workers will not accept this rate, he will dismiss them and replace the labour by a machine which is cheaper; or, alternatively, he may demand from them a corresponding increase in the productivity of their labour, if this be possible.

The wage-rate of the worker cannot be higher than the cost of the machine which substitutes the labour of the worker. The machine reduces the remuneration of the worker in a direct manner by the operation of the law of substitution. As a result, the remuneration of the worker cannot, even with a considerable increase in the total National Dividend, exceed a definite level, determined by the cost of the machine. Accordingly, the machine is the factor which determines the marginal wage of the worker.

As a result of mechanization, the remuneration of the worker is reduced, namely by a reduction in the cost of labour performed by the substituting machine, which gives the upper marginal wage-rate. The law of substitution is the most important factor which obstructs an adequate participation of the worker in the progress of mechanization.¹

¹ J. R. Hicks (in *The Theory of Wages*, London, 1932) and Robinson (in *The Economics of Imperfect Competition*, London, 1933) approach the problem from a different point of view. They introduce the conception of elasticity of substitution of one productive factor by another (for instance, the substitution of labour by capital). "Elasticity of substitution is the proportionate change in the ratio of the amount of the factors, divided by the proportionate change in the ratio of their marginal physical productivities" (Robinson, p. 330). When it is easy to substitute labour by capital, and the marginal productivity of capital increases rapidly in relation to the marginal productivity of labour, then we speak of a great elasticity of substitution of the factor of labour. On the contrary, "when the proportions of the factors are rigidly fixed, no change in the ratio of labour to capital can be made, however great the fall in wages, and the elasticity of substitution is zero. If the smallest fall in wages (the cost of capital remaining the same) were to cause the whole output to be produced by labour alone, the elasticity of substitution would be infinite." *Ibid.*, p. 257.

J. R. Hicks gives a slightly different definition: "The case where the elasticity of substitution is unity can only be defined in words by saying

3. A fall in wages is brought about not only by a fall in the demand for labour and as a result of the law of substitution, but also by way of a lowering of the qualifications of the skilled labourer, since it influences the level of the wages.

But here the effects of mechanization on the one hand and of rationalization and industrial psychology on the other have to be differentiated. Mechanization, as a

that in this case (initially, before any consequential changes in the supply of other factors take place) the increase in one factor will raise the marginal product of all other factors taken together in the same proportion as the total product is raised." *The Theory of Wages*, p. 117.

I do not apply the conception of marginal productivity for two reasons :

1. Marginal productivity can serve no useful purpose in solving the problem of prices of the factors of production. Marginal productivity is not a factor that could be utilized for the purpose of explaining or examining economic processes, since it is a conception of an isolated and not of a social economy. The conception is extremely complicated, difficult to explain, and more confusing than helpful in solving the problem.

2. The introduction of marginal productivity as an element of a new conception (the proportionate change in the ratio of the amount of the factors divided by the proportionate change in the ratio of their marginal physical productivities) makes the problem still more complicated. The new conception of elasticity of substitution is so complicated that it contains in essence all that has to be yet explained. The statement that the share of the workers in the National Dividend was falling "when the elasticity of substitution between labour and property was greater than unity" (Hicks, p. 131) appears to be a clear and precise explanation of the changes brought about by technological progress in the distribution of incomes. In fact, however, it is mere tautology ; it is an explanation of *idem per idem*. For, if the substitution of the factor of labour is greater than unity, then it means that labour has to a great extent been replaced by capital, and the marginal productivity of capital increased to a greater extent than the marginal productivity of labour ; it is well known that the increase in marginal productivity is considered by the Psychological School as equivalent to the increase in the share in the National Dividend.

Elasticity of substitution is a conception that can be of no use in an examination of the influence that technological progress exerts on the changes in the share of the factors of production. In place of the conception of elasticity of substitution introduced by Hicks and Robinson, I apply the conception of costs of substitution. The question at what cost a unit of labour, necessary for the attainment of a certain product, can be substituted decides the share of labour in the National Dividend. If the unit of labour can be substituted at a cost of £10, then wages will be kept at a higher level than in the case when the cost of substitution is £5.

Should we decide to apply the term "elasticity of substitution," then we would define it as the proportionate change in the ratio of the amounts of the factors of production in relation to the proportionate change in the cost of substitution. The easier the substitution of labour by capital at a lower cost, the greater will be the elasticity of substitution of labour ; the more difficult such substitution of labour by capital at high cost, the smaller will be the elasticity of substitution.

general rule, lowers the standard of qualifications required from a worker, since for the operation and control of the machine an unskilled or juvenile worker is very often sufficient. Rationalization and industrial psychology, on the other hand, contribute to the raising of the standard of qualifications required from a worker, such as general intelligence, attention and alertness.

By substituting a skilled labourer by one who is less skilled, mechanization lowers the standard of wages; the effects of rationalization and industrial psychology are, however, to raise, as a rule, the standard of wages.

The above discussion brings us to the conclusion that progress in productivity as a rule lowers the standard of wages; but, as has been observed, this result is brought about only in a state of free competition. Where monopoly is at work, such a fall in wages brought about as a result of technological progress can be delayed for a long time, although it appears in an even more acute form at a later date.

When workers put up a struggle against a lowering of wages dictated by technological progress and monopolization of the labour market (by trade unions, State regulation of wages, etc.), the resultant damage to the labour market is, in the long run, still greater and the fall in wages even more considerable. When the wage-rate is not lowered, technological progress goes on, and rationalization and mechanization of industry takes place to an excessive extent. Consequently the process of ousting the worker from production is brought about; for it is clear that while wages are high, mechanization and rationalization of production continue to pay. Accordingly, compensation too is made difficult by the maintenance of a fixed level of wages. In this way, the discrepancy between demand and supply on the labour market widens more and more. The law of substitution and the process of replacement of a skilled by an unskilled worker becomes operative.

The fall in wages which eventually takes place as an unavoidable result of technological progress, has for its purpose the increase in the demand on the labour market and the impeding of further technological progress.

In the above discussion of the problem of wages, we have taken into account only nominal wages, but not real wages. The tendency to lower wages applies as a rule to nominal wages. But the question may be asked, whether the same tendency is noticeable also with regard to real wages, that is, nominal wages as qualified by the price-index, or by the cost of living.

The answer to this question depends on the direction of technological progress, *i.e.* whether the progress takes place in the production of necessaries or in the production of luxury or semi-luxury articles, or again in the armaments industry, etc.

In the first case, the loss sustained by the workers from the reduction of wages will be compensated, to a greater or lesser degree, by the fall in the prices of necessaries, such as food, clothing, rent, etc.; in the second case, the loss sustained by the workers will in no way be compensated.

Thus in considering the influence which technological progress exerts on real wages, there has to be taken into account the fact of in which branches of production technological progress takes place. Technological progress in the armaments industry (poison gas or gun manufacture) or in the production of diamonds or embroidery, champagne or caviare, will have no effect on real wages. In this sphere of production a reduction in nominal wages will be equivalent to a reduction in real wages. It is different, however, in the case of the building industry, the food and clothing industries, or agriculture. In this latter case, besides the change in nominal wages, the change in the purchasing power of such wages has to be taken into account.

To sum up the discussion of the problem of wages, our conclusions can be thus formulated: The share of the working class in the National Dividend is determined by:—

- (1) The change in the extent of employment, *i.e.* the degree of compensation.
- (2) The change in the nominal wage-rate, *i.e.* the degree of the fall in the wage-rate.
- (3) The character of the branch of production in which technological progress takes place.

If technological progress takes place in branches of production other than the production of necessities, then the share of the working class in the National Dividend will, as a general rule, tend to fall.

§ 14. TECHNOLOGICAL PROGRESS AND THE INTEREST RATE

Technological progress causes a rise in the rate of interest in three ways:—

1. Technological progress stimulates investment. The application of new mechanical inventions requires new capital. Technological progress brings into existence new branches of industry, or new industrial institutions or a new plant, all of which require to be financed. The new investments burden the capital market. The demand for long-period capital goes up, causing at the same time a rise in the rate of interest.

2. The rate of profit of the entrepreneur, who is the pioneer in the application of technological progress, shows a considerable rise. The first applications of technological progress usually give high profits, making it possible at the same time to pay a high rate of interest. The demand for credit goes up, even at the high rate of interest, and this leads in the course of time to a further raising of the rate of interest.

3. Finally, technological progress frequently leads to a considerable waste in capital, since many machines lose

their former value and factories that have not been embraced by technological progress are run at a loss. The factories that cannot thus make ends meet call for emergency credit on the money market, and are also ready to pay a high rate of interest.

These three factors contribute to the fact that intense technological progress goes hand in hand with a great rise in the rate of interest. Of course, the rise in the interest rate has a hampering effect on technological progress itself, and causes some readjustment in the rate of interest. It restricts investments, lowers the rate of profit and finally brings in its train a wave of insolvencies, leading in turn to a fall in the interest rate.

The rise in the interest rate is a factor which increases the share of the capitalist in the National Dividend. It is not, however, the only factor.

The increase in the credit-turnover resulting from technological progress has similar effects. New inventions have to be financed. An unsatisfied demand for credit appears, leading not only to a rise in the interest rate, but also to an increase in credit-turnover. Money which, in the normal course of events, would not be available for credit purposes is, owing to increased profit prospects and the general investment boom, now turned into credit money. Thus, a rise takes place not only in the rate of interest but also in the general amount of credit money available, which maintains the high rate of interest. In this way the share of money-capital in the National Dividend goes up as a result of technological progress, since the two influential factors, that is, the rate of interest and the amount of credit, exhibit a rising tendency.

The fall in prices, which goes hand in hand with technological progress, is another factor which increases the share of money-capital. The rise in the interest rate and the rise in the credit-turnover results only in an increased nominal income. But this increased nominal

income is further augmented by the increase in the purchasing power of money, which is usually coupled with technological progress.

Consequently an increase in the share of the capitalist in the National Dividend will depend on three factors:—

- (1) The rise in the rate of interest.
- (2) The rise in credit-turnover.
- (3) The fall in the prices of consumption goods.

One qualification, however, has to be observed, namely the capital loss sustained by creditors when intense technological progress results in heavy losses by some entrepreneurs. Such losses usually modify the excessive rise in the share of the capitalist.

§ 15. TECHNOLOGICAL PROGRESS AND RENT

Let us now pass to the problem of the influence that technological progress exerts on rent in all its forms: rent in agriculture, in towns, in mines, etc. We shall begin our discussion with the problem of rent in agriculture.

Technological progress in agriculture, the population remaining stationary, lowers the rent, since it makes it possible to limit cultivation to land of a better quality. If we divide the land cultivated in a given country from the point of view of quality into numbers, *e.g.* from 1 to 15, so that No. 1 produces 15 cwt. of wheat from one acre and No. 15 only 1 cwt.; and further, the qualitative difference between numbers is expressed in a difference of yield of 1 cwt. per acre, and the marginal productivity of the land necessary for the support of a given population is land No. 8, with a yield of 8 cwt., then, according to Ricardo's theory, lands Nos. 1-7 will give rent equivalent to the difference in yield. Thus land No. 7 will give rent of the value of 1 cwt. of wheat, land No. 2 of 2 cwt., etc. If, owing to an invention or other technological improvement, the output per acre is increased, the marginal productivity will shift towards

the lower numbers. Let us assume that, as a result of technological progress which increases the yield by 50 per cent. in words, the land of marginal productivity will not be No. 8, but No. 4. Then the cultivation of lands Nos. 1-4 will suffice for the support of the population, and the cultivation of additional numbers will, consumption remaining the same, be superfluous.

Thus technological progress limits cultivation to better land and eliminates, *e.g.* in our case, lands Nos. 5-8. The area of land under cultivation will, therefore, be reduced and the intensity of cultivation increased, since, by the aid of improved technological methods, it is possible, and it pays, to extract more than previously from a given unit of land. With further technological progress, cultivation can become still more intensive. Since, as a result of technological progress, cultivation becomes intensive rather than extensive, the area of land under cultivation diminishes and the share of capital invested increases; the capitalist and not the farmer assumes the leading position in agriculture. It follows, as a further consequence, that a decrease in the demand for land takes place, causing thereby a fall in rent.

Let us now inquire whether the unit of land which has remained under cultivation yields a higher or a lower rent.

Continuing with our former example, let us suppose that before any technological improvement took place, the total land under cultivation consisted of the eight numbers; we assumed that No. 1 yields 15 cwt., while No. 8, as the marginal land, yields only 8 cwt.; the difference in yield between the numbers was assumed to be 1 cwt. If the difference in yield between No. 7 and No. 8 amounted to 2 cwt. instead of 1 cwt., then the rent would be twice as high. The question therefore arises, whether technological progress increases or diminishes the difference in yield between the different qualities of land.

As far as the difference in the situation of land is concerned, technological progress in communications reduces such difference considerably. Land which is situated some twenty miles away from a town and which had a value of only one-third of a corresponding piece of land situated within one mile from the town, will as a result of improvements in communication (electric railway, frequent bus service, etc.) rise in value, and now have not one-third, but a half or even two-thirds the value of urban land. The rent of urban landowners will fall and the difference between the two types of land will diminish.

The same applies, as a rule, also to fertility. New and improved methods of fertilizing, mowing, etc., diminish the qualitative differences in land. If, before the introduction of technological improvements, the difference between land No. 7 and land No. 8 amounted to 1 cwt. of wheat, then after the introduction it will be only one-third or one-half the former quantity. The yield will not increase in the same proportion in all land; the yield of inferior land will show a relatively higher increase than the yield in better land. Consequently the costs of production in inferior land diminish as a result of technological progress to a greater extent than costs in better land. In other words, the difference between lands of different numbers diminishes. It is clear that the diminution in the difference between the various numbers is equivalent to a diminution in rent, since the rate of the latter is based on the difference in the quality of land.

If the population remains stationary,¹ then both the land area and the rent decreases. Land made more fertile as a result of technological progress gives the landowner a smaller profit; a conservative outlook is thus compatible with the landowner's interest.

The fall in rent as a result of technological progress applies not only in the case of agriculture, but to the

¹ We have assumed a stationary population. When, however, technological progress is coupled with a rise in the natural increase in the population, the effect this will have upon rent depends on the proportionate ratio between progress and the increase in population.

whole field of rent. Rent in all its forms, such as mining rent, distance rent, patent rent, or copyright rent, is affected by technological progress. Distance rent (*i.e.* land charge in respect of a more centrally situated land) falls as a result of improvements in communications; rent in respect of a patent also falls as a result of a new invention, and so on.

Technological progress is in its nature a true revolutionary; it curtails acquired rights and privileges, creating, for a time, new rights and prerogatives. It dislodges the old aristocracy and paves the way for a new.

§ 16. TECHNOLOGICAL PROGRESS AND THE RATE OF PROFIT

Technological progress raises the rate of profit. The profit of the entrepreneur, being the residuum left to the entrepreneur after the payment of wages, interest and rent, increases as a result of technological progress; for it is clear that the stimulus to the application of technological progress is the prospect of increased profitability, brought about by a reduction in the cost of production.

The greater the dynamics of technological progress, the greater also is the rate of profit of the pioneer entrepreneur; but, of course, this is only so in the first period, as long as the competition of others does not bring the profits down. Intense technological progress brings about a considerable increase in profit, this being nothing else than a remuneration for the introduction of progress.

It is clear that the above applies only to new investments and factories. The rate of profit of the institutions already established not only does not increase, but, on the contrary, shows a falling tendency. The new entrepreneurs reap profit at the expense of the old ones, new investments gain in value at the expense of the old ones.

Taken, however, as a whole, it can be stated that technological progress is a factor which increases both

the rate and the amount of profits. As a result of technological progress, the national economy is being imbued with dynamic forces. Again, every increase in the dynamics of economic life is equivalent to a widening of the field of profit and rate of profit. The scope of profit is smaller in a static economy than it is in one that is dynamic. In a static economy the profit of the entrepreneur approaches the point of zero, but with the increase of the dynamic forces, the profit of the entrepreneur rises.

We can state, therefore, that technological progress is, as a rule, a factor which increases the share of the entrepreneur in the National Dividend.

§ 17. TECHNOLOGICAL PROGRESS AND CHANGES IN OWNERSHIP

Hitherto we have been discussing the changes brought about by technological progress in the distribution of incomes. It will be necessary now to consider changes which take place in ownership, caused by technological progress.

Technological progress causes proprietary changes in capital. As a result of technological progress a number of factories lose their profitability. A factory hitherto profitable becomes unprofitable and loses its capital value. Thus, technological progress, in a way, expropriates a number of capitalists who do not participate in the progress. It acts like the most violent revolutionary, ruthlessly expropriating a number of capitalists, and apportioning their share to the pioneers of technological progress.

The elements of tradition are losing their rights for the sake of the elements of progress. The rights of the past are being limited on behalf of the rights of the future.

As a result of proprietary changes brought about by technological progress, it is, first of all, the immobile

part of capital that loses in value, namely, the fixed capital.

As a result of technological progress the share of fixed capital in production increases and at the same time the value of such fixed capital may be endangered by further technological progress. Intense technological progress may mean a depreciation in value of the whole of the fixed capital, and accordingly an expropriation of such capital. Hence the desire to find a safe-guard against a too high rate of technological progress, in the form of cartels and monopolies which may hinder, whenever it is found necessary, the free and competitive application of technological progress in industry. An association of forces endangered by technological progress is created to combat the free and competitive application of technological progress and the multiplication of fixed capital. Technological progress is fundamentally a factor of concentration of ownership. It brings great profits to those entrepreneurs who have at their disposal considerable capital resources and can afford the application of expensive technological improvements. On the other hand, the entrepreneurs with limited capital resources cannot keep pace with the progress, so that they are being out-distanced by the others, and their capital in the long run loses its value.

Technological progress enriches entrepreneurs with considerable capital resources in a greater measure than entrepreneurs with limited resources; it is consequently a factor which brings about changes in ownership, in the sense of concentration of ownership.

Technological progress is also a factor in industrial concentration; this subject will, however, be dealt with at a later stage. Industrial concentration need not go hand in hand with concentration in ownership (*e.g.*, in the case of a public company the shares may be held by a larger number of persons). But none the less the former stimulates and facilitates the latter.

To sum the matter up, technological progress is an important factor causing proprietary changes in the

direction of concentration of ownership. The same tendency towards widening the discrepancy as was evident in the case of distributions of incomes, is also evident in the distribution of ownership.

§ 18. TECHNOLOGICAL PROGRESS AND OCCUPATIONAL CHANGES

Technological progress brings about not only changes in ownership and changes in the distribution of incomes, but it also causes important occupational changes.

Technological progress, on the one hand, deprives certain occupational groups of employment and livelihood and, on the other hand, simultaneously gives additional employment and an additional source of income to other occupational groups. The power-loom has ousted hand-weavers from employment, the film has ousted musicians, electrical household apparatus has, to a certain extent, ousted domestic service, and so on. It is in this sphere that technological progress causes the most serious disturbances and disadvantages. The disadvantages are in no way less acute by reason of the fact that, at the same time, additional advantages have been bestowed on others. It is a well-known fact that communities, and likewise individuals, feel the evils of a thing to a greater extent than the benefits bestowed. The outcry that follows upon the growth of evils is usually far greater than any rejoicing due to benefits received. Besides the evils that have fallen upon one group of the community can hardly be compensated by additional benefits bestowed on another group.

Technological progress causes a re-shuffling in the occupational and social scale. The labour of highly skilled workers can, as a result of technological improvements, be replaced by less skilled labour and consequently the remuneration and the social position of the former is lowered. Master craftsmen who occupied a high social

position in the Middle Ages have been swept away by the all-invading technological progress in factories. In the course of the simplification of certain activities, the performers of such activities lose their value and importance. So, for instance, office work is to-day being mechanized to a great extent, which, in time, will reduce to the ranks of the proletariat a great proportion of mental workers.

The influence of technological progress on the social and occupational structure cannot be put in a general statement, applicable in all cases. Technological progress takes on different forms and directions in different periods and in different fields (*e.g.*, in progress in novelty, or progress in productivity or progress in quality), as also in the different branches of production.

In the nineteenth century technological progress found expression, first of all, in a permanent numerical increase of the labouring class. This increase was not only absolute, but also relative, so that the ratio of the labouring class to the whole community was constantly increasing. The class of industrial workers was of a quite uniform social character, while the differences in the earning capacity and social condition were insignificant.

With the relative numerical increase in the labouring class, a diminution in the numerical strength of the peasantry and the halt in the numerical strength in the middle class took place.

But in the twentieth century, when rationalization of labour becomes an important part of technological progress, new tendencies come to the fore. A great numerical increase of a new class, namely, that of the mental and clerical workers in industry, takes place, as a result of the many supervisory, office-routine and statistical functions necessitated by rationalization of work.

This evolution is seen quite clearly in England, in Germany and in the U.S.A. In England the number of clerical and mental workers has increased from 8 per cent. of the total number employed in 1907 to 11.5 per cent. in 1924.

In Germany¹ per 100 employed in industry and handicraft, there were :

In 1882	.	.	2	clerical and mental workers
„ 1895	.	.	3.3	„ „ „
„ 1907	.	.	5.7	„ „ „
„ 1925	.	.	11	„ „ „

In 1907 there were in Germany 5,140,000 independent and 3,187,000 clerical workers in industry. In 1925 the figures were 5,539,000 and 5,274,000 respectively.

In the United States in 1920 there were 7.5 per cent. clerical workers, and in 1930 there were 8.2 per cent.²

Thus the class of mental and clerical workers has recently shown a continuous growth. It is to be regretted, however, that this numerical increase goes hand in hand with the process of proletarianization, since technological progress has mechanized the activities of the clerical workers. Office work has been mechanized by the typewriter, comptometer and rigid office routine. Clerical work has become mass labour and poorly remunerated.

A second transformation that can be observed in this sphere is the process of commercialization *i.e.*, the increase in the functions of distribution and exchange within the community, which is coupled with the relative diminution in the number of industrial workers.

Technological progress tends permanently to increase the importance and dimensions of the machinery of distribution. An increasingly greater number of people are employed in the activities of distribution and service. This is brought about by reason of the fact that it becomes easier and easier to produce an article, but more difficult to sell it. The growing stock requires an increased distribution apparatus. On the other hand, technological progress in distribution, exchange and commerce is not so intense as progress in production. Thus, growing

¹ See Fritz Croner: "Die Angestelltenbewegung nach der Währungsstabilisierung," *Archiv für Sozialwissenschaft und Sozialpolitik*, 1928, vol. 60, No. 1.

² Svend Riemer: "Sozialer Aufstieg und Klassenschichtung," *Archiv für Sozialwissenschaft und Sozialpolitik*, July 1922.

production is served by a small number of workers, while the increasingly complicated machinery of distribution absorbs an even greater number of workers. The increasing complexity of economic life, the greater differentiation in demand, the growing travel and tourist movement, and the general bureaucratization of economic institutions, all require an increasing number of services which lie outside the process of production.

In the United States of America this change in occupations in the direction of distribution and service was as follows, in the period 1850 to 1920 :¹

Year.	Production.	Distribution and Service.
	Per cent.	Per cent.
1850	80.2	19.8
1860	75.1	24.9
1870	72.0	28.0
1880	67.2	32.8
1890	63.3	36.7
1900	59.9	40.1
1910	53.5	46.5
1920	49.6	50.4

This transformation in the occupational structure of the United States is also evident in more recent times. Between 1920 and 1930 the population of the U.S.A. increased by 7 millions. Almost the whole of this increase in population occurred in the number of persons employed in distribution and service. The number employed in transport and communication increased from 7.4 per cent. to 7.9 per cent. of the total employed; in trade it increased from 10.2 per cent. to 12.5 per cent.; in professional service from 5.2 per cent. to 7.7 per cent.; in domestic and personal service from 8.1 per cent. to 10.1 per cent.; and in clerical service from 7.5 per cent. to 8.1 per cent.²

On the other hand, the percentage of persons employed

¹ See W. G. Waffenschmidt: *Technik und Wirtschaft*, Jena, 1928.

² "Employment and Expanding Industries," *The Economist*, 28th April 1934.

in agriculture, mining and industry, that is, the percentage of the working class in relation to the whole of the employed population, has decreased. A similar transformation has taken place in other industrial countries, such as England and Germany.

In England the transfer of labour from the basic manufacturing industries to the distribution and services show the following table :¹

Industry Group.	Percentages of the Total Number of Insured Persons in Employment in different Industry Groups, at the end of June.				
	1923	1929	1932	1934	1935
Fishing	0·2	0·2	0·2	0·2	0·2
Mining and Quarrying	12·8	8·9	7·0	6·5	6·3
Manufacturing	49·3	49·4	45·9	47·0	46·9
Building and Contracting	7·2	8·2	8·2	8·7	9·1
Transport and Distributions	18·2	20·9	24·2	23·2	22·9
Gas, Water and Electricity	1·6	1·4	1·6	1·7	1·6
Miscellaneous Service	4·8	5·7	6·7	6·8	6·9
Banking, Insurance, etc.	2·1	2·0	2·3	2·3	2·3
National and Local Government	3·8	3·3	3·9	3·6	3·6
Totals	100·0	100·0	100·0	100·0	100·0

Thus, as a result of technological progress, the working class loses its numerical preponderance in relation to the whole population. Besides this numerical loss, it loses its social uniformity. Industrial progress has actually divided workers into two classes :

1. Highly-skilled workers and foremen, who are well paid and well settled in the saddle of industry, and usually co-operate loyally with the management.
2. Unskilled workers, badly paid, whose connection with the workshop is only loose and who are constantly exposed to the danger of becoming unemployed.

¹ " Britain's Expanding Industries," *The Economist*, 28th December 1935.

Technological progress, and especially so rationalization and mechanization, have caused great differentiation amongst the body of factory workers. Simple activities have become even more simple and mechanized. On the other hand, the field of difficult and complicated activities is being constantly widened. Technological progress has increased the number of highly skilled workers and mechanics, who are indispensable in industry for the control of complicated machinery, and thus for the whole process of production.

Technological progress has destroyed the unity of the working class by breaking it up into two classes: an upper class, well paid and contented, and a lower working class, comprising unskilled or partially skilled workers, whose numbers are increased by the army of unemployed, which comes into existence as a result of technological progress.

In this way technological progress has weakened the radical forces amongst industrial workers, since it has deprived them of their numerical strength and unity. (The unity of the Socialist movement has also been broken up by the division into Socialism and Communism, the two movements dissipating their energies by combating one another.) On the other hand, technological progress has increased the numerical expansion of occupational groups that belong to the middle class; but this class is, at the same time, being impoverished. The impoverishment of the middle class is also due to the fact that monopolies and cartels, which come into existence as the result of technological progress, oust the small retailer from the market.

Technological progress causes serious social disturbances. Intense technological progress is coupled with far-reaching transformations in the social structure, which in turn bring about changes in social and political movements. The important social and political changes that take place in the world of to-day have, as their root causes, the intense technological progress and the new form which it takes.

§ 19. GENERAL CONCLUSIONS

If we now attempt a summary of all the resultant changes brought about by technological progress in the distribution of incomes, then the following conclusions can be formulated :—

I. As a rule, technological progress increases the National Dividend and creates a new fund for the maintenance of the population.

II. Technological progress lowers wage-rates and rent, but it increases the rate of interest and the rate of profit.

III. In considering the share of the different classes in the National Dividend, the occupational changes which have taken place in production have to be taken into account.

Owing to the fact that technological progress decreases the number employed, it tends to diminish the share of the working class in the National Dividend.

The share of the landowner (as a receiver of rent) in the National Dividend tends also to diminish, owing to the fact that, as a result of technological progress in agriculture, not only the rent but also the area of cultivated land is decreased. (Owing to the inelasticity or very small elasticity in demand for foodstuffs, the consumption of agricultural products does not increase in proportion to the increased production.)

The share of the capitalist increases, since the rate of interest goes up and the credit-turnover necessary for the purpose of financing new investments is constantly increasing.

The share of the entrepreneur increases as a result of the increased rate of profit and a widened scope for profit, (new investments).

IV. The fall in prices, which usually takes place along with technological progress, has to be taken into account.

The rise in the purchasing power of money offsets the fall in income of the worker and the landowner, but increases the income of the entrepreneur and capitalist. Wherever technological progress causes a loss, such loss

is made relatively smaller, and wherever it increases the income, such increase is relatively greater, as a result of the fall in prices and the increased purchasing power of money.

V. We shall leave aside at present technological progress in agriculture, and consider only technological progress in industry. Let us divide all who take part in industry into two classes: the possessing class and the non-possessing class, and let us consider the extent to which the two classes participate in the effects of technological progress.

Technological progress widens the gulf between the possessing and the non-possessing class. Capitalists and entrepreneurs as a rule increase their share in the National Dividend, but the share of the workers diminishes (though, as the rule, their income increases absolutely).

Technological progress does not bring about an improvement in the distribution of wealth. It enriches the rich, adds wealth to the possessing class. Wealth adduced from technological progress becomes, initially, the share of those who have appropriated the invention and applied it for their own purposes; accordingly, every invention strengthens the economic and social position of the possessing class, since the invention has passed into their possession and power.

The machine which is a source of wealth for its owner is, at the same time, a competitor at the outset to the worker, curtailing and reducing his income by the operation of the law of substitution.

It has to be noticed, however, that the mechanism of prices and profits brings, in the long run, part of the benefits of technological progress into the hands of the non-possessing class. A part of the profits reaped from technological progress is transferred to the non-possessing class in the form of a reduction in prices, and sometimes in the form of higher wages. Otherwise the source of profit could not be constantly renewed, and the entrepreneurs would have no consumers for their goods.

Technological progress creates *in the course of its*

duration a tendency towards changes in the structure of the distribution of incomes in favour of the possessing class. When the period of changes brought about as a result of technological progress and the process of readjustment has come to an end, then the tendency disappears.

VI. We assume in our discussion a liberal economic regime, *i.e.* free competition. But when there are complete or semi-monopolies in the field, then the tendencies indicated by us will be still more strengthened.

In such a case, the changes brought about in the structure of the distribution of incomes in favour of the possessing class are even greater. Monopolies increase that part of the income bestowed on the capitalist class. The share of capital, especially so of monopolized capital, in the National Dividend increases.

But a system of monopolies in the economic structure means not only a monopolization of capital which dictates prices, but also monopolization of labour in trade unions which dictate wages; thus, on the labour market the monopoly of capital stands against the monopoly of labour, the latter seems to be offsetting the effects of the former. In practice, however, the monopolization of capital is greater, stronger and more effective than the monopolization of labour.

Monopolization of labour cannot increase to any great extent the share of the workers in the National Dividend, since a considerable increase in the wage-rate can be brought about only at the cost of reduced employment.

Monopolization of labour cannot in the long run substantially increase the amount of wages, since the wages-fund depends on the magnitude of production-capital. An increase in the wage-rate must usually be paid for by a reduction in employment, *i.e.* a reduction in the quantity of labour demanded by the entrepreneurs, which in the long run is equivalent to a net fall in the income of the workers,

The position is slightly different, however, in the case of a monopoly of capital. Although the entrepreneur has

to pay for the rise in prices by a decrease in the quantities produced, this decrease in production means a fall in the gross profit, but not in the net profit, of the entrepreneur.

If, as a result of high wages, labour of the value of £2,000,000 is not disposed of, then, generally speaking, the workers sustain a net loss of income of £2,000,000; when, however, as a result of high prices, producers are not able to dispose of goods to the value of £2,000,000, then the loss sustained by them will amount to a loss of gross income of £2,000,000 (the net loss of income may amount, for instance, to no more than £100,000).

Consequently, every curtailment of the quantities supplied (of goods or labour) produces more serious effects for the workers than for the capitalists. In the case of a monopoly of labour, the point of Cournot is nearer to the free and competitive level than in the case of a monopoly of capital.

But the point of Cournot itself has for the producers a different significance from what it has for the workers. In fact, the point of Cournot exists only in the case of a monopoly of capital. A cartel can fix his point of Cournot, in the sense that he can raise his prices and limit his production to a level at which he attains the maximum net profit (the difference between the amount of his costs and his return from sales). The point of Cournot is only a fiction in the case of monopolistic organizations of labour, since a trade union cannot actually be considered to have a real monopoly of labour, and is very frequently unable to demand the highest wages (*i.e.* the point of Cournot) owing to the divergence of interests of its different members. When wages reach the highest point, many members of the trade union will be eliminated from production, *i.e.* they will find no employment, neither will they receive any compensation from their colleagues, who obtained the higher wage at their expense.

Thus, the monopoly of capital is in its nature greater, stronger and more effective than the monopoly of labour, and increases to a greater extent the share of capital in

the National Dividend than a monopoly of labour would be in a position to increase the share of the labour element.

It can, therefore, be stated that economic monopolization increases the share of capital in the National Dividend, thus intensifying the tendencies resulting from technological progress (progress in productivity).

PART III

**LIMITED OR UNLIMITED TECHNOLOGICAL
PROGRESS ?**

CHAPTER I

THE SOURCES OF TECHNOLOGICAL PROGRESS

§ I. RECEPTION OF THE INVENTION

IN considering the sources of technological progress in industry, two stages of progress have to be distinguished. The first stage is the technological idea, the new invention, discovery or improvement. The second stage is its application in industry or the reception of the invention.

Between the first and the second stage there is a long road to be travelled. Sometimes the distance is so great that the road can never be covered, and the invention remains purely in the realm of ideas until the dust of time covers it, or until, under changed circumstances, it becomes more favourably placed for reception.

The realities of economic life exert a considerable influence on technological ideas. The sphere of invention is not determined by abstract scientific thought, but by the necessities of life. As the old saying goes: "Necessity is the mother of invention." It is by no means an accident that certain inventions are made in a certain epoch, namely, at a time when such inventions correspond to the stage of development in production or to its demands.

It is a well-known fact that a great majority of inventions is usually made by ordinary workers or mechanics employed in an industry, who, during their many years of work, are in a position to observe the intricacies of their work and improve a certain detail in the process, or a certain part of the machine. Mechanization in industry would never have taken place had it not been for the fact that the division of labour in factories prepared the ground for it. It was due to the possibility of increased production, facilitated by the development in communications, that factories were able to accommodate a

great number of workers, whose work was regulated by an intensive division of labour. Continuous progress in the division of labour has ultimately led to the automatization and simplification of labour. It was only when labour had been divided into a number of automatic and constantly repeated functions that the ground was prepared for the substitution of labour by a simple machine. Step by step, certain simple and detailed functions have been taken over by the machine; the latter being, in course of time, constantly improved on.

Mechanical inventions appear as a result of industrial activity, and only to a lesser extent as a result of abstract investigation. Especially in the case of progress in productivity is it a fact that such progress is the consequence of economic life itself. On the other hand, progress in novelty, which brings into existence new branches of production, is to a greater extent the result of scientific research.

Let us now pass to the second stage, the stage of the reception of the invention. As we observed above, the mere fact of the invention itself is not identical with its application in industry. Where there is no application of the invention, the invention itself becomes valueless. If a certain economy has no demand for inventions of a certain type, then such inventions will in time disappear. If a given economy shows no demand for inventions owing to its poverty in capital or to its undeveloped productive system being unable to make use of better machinery, then the invented activity of even the best experts will come to a halt. Thus, in the long run, the possibility of the application of inventions in industry and the demand for inventions in private and public economy decides the tempo of inventive activity.

The first fundamental condition for the reception of the invention is its profitability. An unprofitable invention, however ingenious, will find no application in industry. The greater the profitability of the invention, that is, the greater the profits it produces, the greater also will be the demand for it.

But this general statement is not sufficient. It is necessary to examine more closely all the conditions and circumstances in which profitable inventions can rely on an increased demand. Such conditions are closely connected with :—

1. The situation on the capital market.
2. The situation on the labour market.
3. The extent of competitive and military struggle.

1. The demand for inventions depends, in the first instance, on the amount of free capital seeking investment. Wherever that amount of capital is considerable, the demand for inventions is great; on the other hand, where there is a scarcity of capital, technological progress comes to a standstill.

Amongst the factors which create favourable conditions for technological progress, the most important are a high rate of saving and an accumulation of such savings. An economy which does not save, or saves only in a slight degree, does not create the necessary conditions for intense technological development.

Let us now inquire into the reason for this. Technological progress places high demands on the capital market, since it is equivalent to new investments. A period of intense technological progress is a period of boom on the money market. The realization of technological progress in all its forms continuously requires new capital. New factories for the production of new machines have to be built; new plant has to be introduced, or important changes in industrial organization or in the productive process have to be brought about.

A favourable situation on the money market and a continuous growth of savings is fundamental for technological development. Where the capital market is limited and poor, there are no favourable conditions for technological progress, since the latter finds no means necessary for its finance. It is due to this fact that the application of technological progress is easier in countries with a highly developed capitalist system, which have at their

disposal the vast resources of a rich capital market, but difficult and limited in countries which are poor in capital and are not in a position to finance their own or foreign inventions.

Technological progress necessitates a high rate of saving. In countries with a high rate of saving, the application of inventions is easier than in countries with a lower rate of saving. The hindering of the process of saving, for instance, by a superfluous public or private consumption, excessive taxation, etc., is equivalent to the hampering of technological progress.

2. The second factor which augments the demand for inventions is the scarcity and expensiveness of workers. The dynamics of technological progress are connected, not only with the situation on the capital market but also with the situation of the labour market. Where the supply of labour is great, unemployment considerable and wages low, technological progress will not be profitable.

Technological progress has, as a rule, for its purpose the increase of the productivity of labour, and the substitution of machinery for the factor of labour. When the worker is expensive, it pays to substitute his labour by a machine. When the labour market shows a rising tendency, then the entrepreneurs do their best to introduce technological improvements, in order to substitute the increasingly expensive labour of the worker by the mechanical labour of the machine, which does not increase in expense.

It is different, however, when the labour market shows a falling tendency. In such a case, the entrepreneur tries, whenever possible, to replace an expensive machine by cheaper human labour. Consequently, the stimulus towards technological development comes to a standstill.

It is for this reason that technological progress is insignificant in economic systems based on slavery or serfdom. In such systems, technological development is quite small, since there we can speak of a glut of human labour, which can be exploited almost without fear of its diminution; saving of slave labour serves no purpose.

An entrepreneur, who has at his disposal a working army of slaves, can easily extend the time of their labour by a few hours daily, and has no necessity to replace their labour by a machine or tool. Similarly, a feudal lord, who had at his disposal unpaid human labour, had no motive to replace such labour by a machine or tool. But in systems in which human labour is free, highly valued and well paid (as it was until recently in the United States), it pays to replace the worker by the labour of a machine or tool. It is only when human labour becomes expensive that the tendency arises to replace it by a machine.

Hence the enormous stimulus towards technological improvements after the World War. After the War, human labour has kept at a high level, mainly due to the development of trade unions, which dictated monopolistic prices on the labour market. Human labour has become additionally expensive as a result of the introduction of health and unemployment insurance, as well as of labour legislation. This was the background for the increasing tendency to substitute human labour by a cheaper machine, for organization and rationalization of labour, the latter surpassing even at times its legitimate limits.

These tendencies came into existence as a result of post-War wages, but soon collapsed with the great crisis of to-day.

3. The demand for inventions depends not only on the situation in the capital and labour market, but also on the intensity of the human struggle. Technological progress is just an instrument of the human struggle. The tool is an instrument of struggle, whether it is a struggle for profit or a struggle for power.

Two forms of struggle are in the foreground: the struggle amongst entrepreneurs for the maximum of profit, and the struggle between the States for the maximum of power. The competitive race between entrepreneurs and the armaments race between nations—the struggle for profit and the struggle for power—have formed at all times the two great forces that shaped technological

development. We shall deal with these two forces in the following sections.

§ 2. THE COMPETITIVE STRUGGLE

The competitive struggle between entrepreneurs provides the main stimulus for technological progress. The more intense the struggle, the greater also will be the stimulus for technological improvements. Where, however, competition is weak and restricted, this stimulus becomes less operative.

Let us give a few examples. In the feudal and guild system of the Middle Ages, the intensity of competition was slight since, in the first place, the craftsmen did not aspire to a higher maximum of abstract profit; their main ambition was to satisfy the customary demands of their families. In the second place, production was regulated and competition restricted; a craftsman was not at liberty to work beyond a certain defined limit, and could not take in an unlimited number of apprentices and so extend his production. Under these circumstances there was not sufficient stimulus for technological improvements.

But even to-day the intensity of competition is not the same in all branches of production. Competition is weaker in handicraft than it is in a semi-industrialized production working for a local market, and the intensity of competition of the latter is smaller again than competition in an industry which works for an international market. In agriculture, which produces, not for the market but for the peasants' own demands (as is the case in many European agricultural countries), competition is weaker than in the case of agricultural production of farmers in the United States. Again, the competition in an industry bound by a cartel is less intense than in the case of a free industry, etc.

Accordingly, we see that technological progress is less intense in handicraft than it is in a semi-industrial production for the local market, in the latter case again less

intense than in an industry producing for the national market, which in turn is less intense than in a highly developed industry working for an international market. The rate of technological progress is lower in European agriculture than in American agriculture. Finally, technological progress is less intense in industries bound by cartels than it is in free industries.

Let us now inquire why the competitive struggle acts as the motive power for technological progress and why it creates a demand for inventions. The competitive struggle arises through the desire of one entrepreneur to expand at the expense of another; he wants to increase his profit, his turnover and his productive machinery at the expense of other producers. How can he realize his desire? He can supply a better article at the same price, or alternatively the same article at a lower price. Only under exceptional conditions can the entrepreneur carry out his plans otherwise than by the introduction of technological improvement. If he can do so by lowering wages, then there will be no necessity for technological improvement. But, sooner or later, all other methods of competition will become exhausted and the entrepreneur will be forced to fall back upon technological improvement, which will make possible either the reduction of the cost of production or the raising of the quality of the product, without any change in price—the result in either case being the same. Consequently, an intensification of the competitive struggle creates an increased demand for inventions.

A further point to consider is, under what conditions the competitive struggle will become more intense, and under what circumstances less intense. As a general rule, the competitive struggle is intensified wherever difficulties of finding an outlet increase, where there is no possibility of free expansion, *i.e.* expansion which does not take place at somebody else's expense. Thus, where the market has not been exploited to the full, the competitive struggle and the motive power for technological improvements are not very strong, because every entrepreneur can increase

his sales without encroaching upon others. Similarly, when the market shows a continuous upward movement as, for instance, in times of inflation (it is a known fact that in times of inflation the rate of technological progress is very small).

There are two fundamental conditions for an intense competitive struggle which are, at the same time, fundamental to intense technological development :—

1. The desire for profit.
2. Economic freedom, *i.e.* free competition.

The desire for profit is the motive power of the competitive struggle. In economic structures where there is no desire for profit (*e.g.* in the Middle Ages), competition is slight, as also is technological progress. Even in the different branches of contemporary production, technological progress may differ in intensity, according to the strength of the desire for profit. The craftsman or the European peasant are concerned less with the desire for profit and more with the satisfaction of the normal demands of their families—in contradistinction to the American farmer, who produces for the market and aims at the maximum of profit.

The second condition of intense competition is economic freedom. Where the freedom to earn and dispose of one's goods according to one's own desire is restricted, where there is no freedom of expanding production at the expense of others, competition cannot assume an intense form. Free trade within national borders and free trade internationally are the basic conditions of growing competition and technological progress. A branch of production which is free to expand the world over is susceptible to technological progress to a greater extent than a branch of production whose freedom of expansion is restricted to a local market, or is generally curtailed and regulated.

The creation of monopolies and cartels, as well as a protectionist policy (all of which are mutually interdependent, since cartels multiply as a result of protectionist policy),

produce unfavourable conditions for technological progress. An entrepreneur shows considerable activity in the field of technological progress only when he knows that, by way of free competition, he can conquer his competitor's market. The very moment, however, when production is restricted in advance, through trade- or cartel-reglementation or by way of concessions and monopolies, the possibilities of applying inventions in industry are lessened. Every step in the development of technology and organization results in increased potential output. If this potential output is held up by restriction, then technological improvements lose their very purpose.

Technological improvements are really, as we stated above, the expression of the struggle between entrepreneurs for a greater share in the market or a greater share in profits. When, however, this struggle is suspended through internal or external reglementation, the stimulus towards technological progress loses intensity. It was not an accident that intense industrial progress came during the time of capitalist development ; the underlying reason was the fact that this was the most liberal period in history.

Intensified competition between entrepreneurs, which was in evidence in liberal capitalism, produced a strong stimulus towards technological development. A decline of liberalism means a decline in technological development. A monopolistic organization of industry would soon lead to a standstill in technological development.

Of course, under present conditions, a complete monopoly is an ideal, and rarely found in practice. Even where there is a legally established monopoly, there is always a possibility of substituting the monopoly article by a competitive article. Accordingly, under such circumstances, competition between monopolies and free industries develops. In cartels, there may be the so-called potential competition between the members of the cartel who, when the cartel is broken up, can at once take up the competitive struggle. Furthermore, both cartels and trusts must reckon with the possibility of "outsiders."

Competition is the essence of contemporary capitalism, even of capitalism which is already tied up, *i.e.* in cartels, syndicates, trusts, and in monopolies and quasi-monopolies. Competition temporarily suspended once again comes to the fore, and may even be intensified. Sometimes competition suspended in one branch of production finds an outlet elsewhere.

So long as there is potential competition, there is also a stimulus towards technological progress. With the monopolization of economic life, technological progress is held up and the stimulus thereto checked. On the other hand, it must be pointed out that even monopolization sometimes leads to improvements in industrial organization, resulting in some saving in the cost of production (see "Organization of Industries" in Part I).

§ 3. MILITARY STRUGGLE

Technological progress is brought about not only by competition, but also as a result of political and military rivalry. It has its origin not only in the struggle for profit between entrepreneurs, but also in the struggle for political power between nations.

History gives abundant proof of the continual struggle between nations for political power and predominance. The strife for military supremacy, which characterizes the whole course of human history, is really a struggle for a better military technique. Technological development generally followed in its train. In ancient and medieval times, it was military technique that gave the greatest stimulus to technological progress. Military technique was superior to the productive technique.

A club, an axe, a spear, or a bow and arrow, as instruments not so much of hunting as of military technique, were the first implements of war. Cart-wheels, which were one of the most important results of early invention, did not perhaps originate for military reasons, but were improved upon for military purposes. (The military wagons used by the Egyptians had well-shaped

wheels, with strong hoops and spokes.) Technique in communication in general, beginning with the construction of roads and military wagons and extending up to the modern construction of aeroplanes and tanks, railways and wireless, owes an enormous debt to military strategy.

Technology in the metal industry owes its beginnings to the production of early weapons, armour and breast-plate. The Greeks had already used shields, imitating the scales of fish and reptiles, and in constructing them they paved the way for technology in production.

Military strategy was the strongest stimulus in the development of technology in building. The erection of castles, high walls, fortresses and towers, as well as the construction of moats and trenches, were the direct result of military strategy and have contributed to a great extent to improvements in the building industry.

The first machines invented by man have been war-machines. The Greeks and Romans already knew the use of enormous and even complicated machines for the besieging of cities, and their technical knowledge in this respect far exceeded their knowledge in production technique.

Similarly, at the close of the Middle Ages military technology far exceeds technology in production. The invention of gunpowder, guns and cannons greatly out-distanced productive inventions and gave a great stimulus to industrial development.

For many centuries industrialization and technological development followed as a result of inventions in armaments. Armaments were the motive-power at the root of mercantilism in the seventeenth and eighteenth centuries, and of the industrial development in France in the times of Colbert. Industries of importance for military purposes developed first of all. The State placed orders with these industries, granted them concessions and all kinds of facilities, recruited labour, supplied capital and even established its own industrial institution for the purpose.

The present intense rate of technological progress is to a great extent a result of militarism ; the tremendous post-War industrial development was the consequence of the Great War and the post-War militarism. Inventions of all kinds made for war purposes in chemistry, in military aviation, in the production of machine-guns, tanks, etc., have been adopted by industry. Inventions have never been rewarded so well as after the War. The "invention rush," which is so characteristic of the post-War period, is closely connected with the race in armaments and the prevailing atmosphere of military preparation. The relation between technological progress and the armaments race can be expressed by saying that they are of mutual influence ; armaments lead to technological progress and technological progress leads to armaments. But this mutual influence breaks up when the catastrophe of war takes place.

CHAPTER II

AUTOMATISM IN TECHNOLOGICAL DEVELOPMENT

§ 4. THE PROCESS OF AUTOMATISM AND DYNAMICS

WE have stated in former chapters that the curve of technological development is upwards, that the very term "technology" implies progress, and that the results of technological development are cumulative. Every new tool or machine made facilitates the making of a better and more efficient machine. There is, therefore, inherent in technology a dynamic force that imbues the economy with the elements of movement, life and development. Technological progress is, therefore, first and foremost a dynamic process, which obliges us to approach economic problems from the point of view of dynamics.

At the same time, however, technological development is also subject to the laws of statics or economic automatism. The curve of technological development is not always on the upgrade; it has its ups and downs, its ebb and flow. It is a spiral, showing considerable periods of retrogression. Economic life is not always on the royal road of technological progress; it has periods when it comes to rest, when it accumulates energy for the further development to come.

As everywhere else, so also in technology we can observe the process of automatism at work. Economic automatism is both a method and a reality. In economics of free capitalism—and our economic system is still in the main a system of free capitalism—such automatism can be observed in almost every branch of economic life, in production and consumption, in demand and supply, in import and export, in capital and labour, in a boom and a slump; it can be noticed almost everywhere. Prices form the mechanism of automatism. Prices, wages, rent,

interest-rate, profit, the value of currency and the rates of foreign exchanges, in short, prices in all their aspects, form the main wheels of the machinery that sets automatism working.

In every boom there are some concealed elements of a future slump, which, after a time, come automatically to the surface ; and, conversely, every economic crisis has the seeds of a coming recovery. The scarcity of a certain article, *e.g.* gold at the present time, and its high price arising therefrom, has in itself the elements of a future excess in supply and a consequent fall in price. The fall in price has in itself the elements of a future rise ; scarcity of workers leads to a greater supply of labour at a later date, etc.

Of course, such automatism is at work only in a free capitalist system, based on three fundamental liberal principles : profit, freedom and ownership. Wherever these fundamentals are absent, automatism cannot work. Where there is no free international trade, increase in imports cannot lead to an increase in exports. Where there is a monopoly at work, automatism of prices plays no part ; where trade unions monopolize the labour market, there can be no automatism of wages. Where the whole economic structure is tied up and rigidly controlled, both internally and externally, the automatism of an economic crisis will proceed at a very slow rate indeed. Where there is no freedom in the international exchange of goods, capital and labour, the automatism of a gold currency will also not be able to function smoothly.

But our economy is still fundamentally liberal, *i.e.* the important branches still have a free internal organization. It is true that this liberalism has been in many respects violated, but profit, freedom and ownership remain everywhere (with the exception of Soviet Russia) the fundamentals of our economic and legal order. Consequently, the process of automatism in a free capitalist economy still goes on, though at a slow and uncertain rate. The slackening of the process of automatism is the most

important consequence of the structural transformation in our present economy.

The process of automatism does not necessarily exclude technological progress ; on the contrary, it can go hand in hand with it. In a static economy, automatism means that in the economic swinging of the pendulum always one and the same point is reached. In a dynamic economy, however, automatism means that increasingly higher points are reached by the economic pendulum. In a liberal economy the economic process is necessarily automatic, but at the same time it is also dynamic in the sense that higher and higher points are being reached by the economic pendulum. In other words, we progress and retrogress, but the point of retrogression is higher now than it was before ; later we progress again and retrogress again, the point of retrogression being higher again than before, and so on. It is a dynamic automatism, *i.e.* an upward swing of the pendulum.

§ 5. AUTOMATISM IN TECHNOLOGICAL DYNAMICS

Let us now attempt to apply this construction of dynamic automatism to technological progress. It would appear, on the face of it, that automatism does not apply to technological progress. This, however, is not so. The application of technological progress in economic life has also its own automatism, namely, a dynamic automatism.

We have stated above that technological progress possesses its own springs and motors, which set it in motion, and that it has conditions favourable to its development inherent in it. We have also stated that profitability of inventions is at the root of technological progress, that its mainspring is the competitive struggle for profit and political power ; and further, that favourable conditions for its development consist in the accumulation of capital and a high level of wages. If we observe the process of technological progress more closely, we shall see that in the course of its application the mainspring of technological progress ceases to operate and finally turns into a brake.

Let us take profitability, which is the basic condition for the application of an invention or an improvement in industry. Without the prospect of profit, no invention or improvement would ever be applied. Profit is the very stimulus which, during the application of the invention, gradually turns into a brake. What is the cause of this? Technological progress in industry usually means a quantitative increase in production and an inevitable fall in prices. Competition becomes more acute, prices fall excessively and very often below the level of profitability. With the fall in prices, the profitability of the application of new inventions decreases and the development of technology comes to an end.

If we approach the matter from the aspect of demand, we shall see that with the application of technology, particularly when the rate is high, the amount of wages of the community falls, thereby causing a fall in the demand for goods. In this case, also, new inventions become unprofitable and technological development ceases.

Let us now take the same matter from the point of view of wages. Intense technological progress brings about an increase in the number of the unemployed, and consequently a tendency towards lower wages. This fact acts as a brake on technological development, since it is only when labour is expensive that it pays to apply technological improvements. Thus, in this case too, the process of technological progress regulates itself.

A similar conclusion will be arrived at when the matter is approached from the point of view of credit. The application of technological progress is equivalent to new investment and a greater indebtedness of the entrepreneurs. A rise in the interest-rate follows, since extra capital is necessary to finance these inventions, while the prices of goods fall. The relative indebtedness of the entrepreneurs increases, and thus further application of inventions becomes unprofitable. We can observe the same result when dealing with a capital market. The increased application of investment leads to a great

demand for capital, and the existing supplies gradually become exhausted. Over-investment results, capital-waste follows, and a scarcity of capital is brought about, which in turn acts mechanically as a brake on technological progress.

Similarly with the competitive struggle. We have stated before that this is an important motive in technological progress, but the latter is, at one and the same time, an anti-competitive factor; since, in the long run it eliminates free competition and leads to monopoly. Technological progress leads to concentration in production, which in turn brings about the supremacy of a few industrial concerns, which enter into agreements for the purpose of restricting competition.

Intense technological progress multiplies the fixed capital of a concern, *i.e.* capital invested in buildings, plant and machinery, which cannot be withdrawn; it also increases the ratio of overhead costs, *i.e.* costs which are independent of the magnitude of output. These factors compel the entrepreneurs to combine and enter into agreements, since production becomes more and more sensitive to market fluctuations. In other words, technological progress is in itself the source of the restriction of free competition and thereby a brake on its own development.

Similarly with the armaments race. We have said previously that this is an important factor of technological progress, since military technique has been at the root of progress in production. But here, too, we notice automatism at work, though its results are evident only in the long run. Armaments reduce the power of accumulation of capital, *i.e.* the fund of savings which finances inventions and improvements, so that technological development does not go on incessantly, but is held up by the lack of savings. Furthermore, armaments finally lead to a war and so to capital-waste, retrogression in economic activity and a general lowering of the standard of culture. This factor obstructs the course of technological progress.

The working of automatism is also observable within the sphere of the influence of technological progress on exchange. As a rule, technological progress widens the field of exchange. This can be directly observed in the sphere of improvements in communication. Every technological improvement in transport and communication widens the field of exchange and extends the markets of sale. Technological progress in industry and agriculture also extends the field of exchange by a fall in the price of its products. It leads to mass production, which is made possible by the widening of the market brought about as a result of the fall in prices. On the other hand, technological progress sometimes leads to obstruction of international exchange, owing to the influence it exerts on the monopolization and concentration in production. Monopolies and cartels demand high prices and import restrictions, and are important factors in the closing of local markets to international trade. This, in turn, obstructs technological development, which requires a division of labour on the largest possible scale, *i.e.* on an international scale. In this case automatism is, in the long run, evident too, since in time technological progress leads to ever greater obstacles and restrictions in international trade, thereby obstructing its own development.

Let us now take automatism in its relation to market fluctuations. Technological progress lengthens the different stages of production and increases fluctuations. In the first stage of the application of an invention there is a general trade revival based on the new possibilities for profit; but this revival gives way later on to a crisis, brought about by the results of technological progress. But the crisis, in turn, stops further development in technology.

Thus we can see everywhere a certain automatism at work (though the extent of its operation is not everywhere the same). The line of technological progress is not an uninterrupted forward line. Every step in technological development brings forth, *ipso facto*, obstacles and obstruc-

tions that retard its further progress or even thrust it back to a former stage.

Every technological development brings forth, *ipso facto*, a standstill period. During such a period, compensation of the effects of former technological development takes place. Dismissed workers are in the meantime again absorbed by industry, wages rise, the former purchasing power is restored, the ties of monopolies get loosened, the interest-rate falls, the capital market becomes more free. These, again, make the further application of inventions and improvements once more profitable, and technological progress starts again on its course from a new but higher starting-point. This is, in short, what we mean by automatism of technological progress, *i.e.* dynamic automatism.

The cycles of the capitalist productive process, *i.e.* the phenomena of boom and slump, have also their specific technological aspect. Boom and slump can also be considered as a result of technological progress. *The technological theory of the crisis is well founded in truth, though little attention has hitherto been paid to it. The process of capitalism is based, first of all, on modern industrial technology, which shows a continuous upward tendency.* Accordingly, this technological aspect of a crisis ought to be taken into account to a greater measure than is the case at present.

§ 6. TECHNOLOGICAL DYNAMICS WITHOUT AUTOMATISM AS A SOURCE OF DISTURBANCES

We have stated above that the different stages of technological development are regulated by automatism. Automatism impedes the progress of technology at the very time when its high rate endangers the economic balance of the country, when it causes immense capital-waste, excessive fluctuations and changes, and then it turns out of employment too great an army of workers. Automatism is, to a certain extent, the regulator of techno-

logical progress, imposing upon it a period of rest and quiet after a period of intense activity.

Serious disturbances occur, however, when automatism is eliminated, *i.e.* wherever automatism is not at work or operates insufficiently. In such a case, technological progress is deprived of its auto-regulator, proceeds blindly on its course, causing more harm than good.

Automatism cannot operate smoothly wherever obstacles and restrictions are imposed on production, exchange or distribution, and where economic activity is not conducted on liberal lines. Wherever economic activity is bound up by monopolies, State planning and intervention or protection, there automatism fails altogether or operates only insufficiently. In such cases technological progress is deprived of its speedy regulator (though some sort of regulation, *i.e.* slow regulation, always takes place in the end), which assists the economic system to apply inventions and improvements without corresponding disturbances and damage.

Let us now attempt to verify the above proposition by application to real cases. Let us take the case of an economic structure with rigidity of prices, brought about by monopolies, cartels or protectionist import duties. In such a case prices do not fall, in spite of the fact that the costs of production have been reduced as a result of technological progress. Progress in technology proceeds then more efficiently and continues for a longer time than would have been the case if prices tended to fall in a free market. In a free market a regulator would be at work, restricting the operation of technological progress to tolerable limits and a reasonable rate. In a monopolized industry the regulating force is eliminated.

In the case of an economy made rigid in the sphere of wages, *e.g.* wages dictated by trade unions, technological progress will not bring about a fall in wages in spite of an existing and increasing technological unemployment. In such a case the working of technological progress will be more efficient and continue for a longer time than in the case of a free labour market; the reason being that

in a free labour market falling wages would make further inventions and improvements unprofitable ; it would not pay to substitute the cheap worker by an expensive machine. When wage-rates are rigid, the regulator of technological progress is out of operation and mechanization in industry proceeds beyond what is reasonable, considering the existing labour market, and beyond the possibility of its adaptation and application by the economic system.

Let us now take an economy made rigid in the sphere of interest-rates. Let us assume that the State or central bank keeps the rate at the rigid and artificial level, regardless of the conditions of the market. In this case, too, the regulator is not operative. When the pace of technological progress is too fast, the money market, exhausted by large investments, shows a tendency towards a higher rate of interest, which fact in turn restricts further investment. When, however, in spite of such a tendency, the rate is kept artificially at a lower level, technological progress proceeds at a greater pace and continues for a longer period than the conditions of the money market warrant.

Economic automatism, which expresses itself in an elasticity of the elements of the economic system, acts not only as a regulator of the pace of technological progress, but it also facilitates the adaptation of economic life to such progress. Obstacles put in the way of national or international exchange hamper such adaptation, thereby causing dislocation in the production and distribution of goods. Intense technological progress extends markets for itself and widens the scope and field of exchange, but when this field is artificially restricted or entirely cut off by new import duties, quotas or other prohibitions, and exchange consequently becomes restricted, difficulties and disturbances occur, and investments made in connection with the application of inventions or improvements turn out badly. If immigration restriction prevents the movement of labour from one country to another—from a country that purchases new machines to a country

that produces such machines—then an additional crisis will occur on the labour market and mass unemployment will result.

When, as a result of legal restrictions or an actual monopoly, certain branches of production possessing natural conditions for expansion cannot expand and absorb labour set free from other industries by technological progress, serious difficulties and violent disturbances occur. Elasticity in economic activity ensures the proper functioning of technological progress at the minimum of dislocation and sacrifice.

Complaints made nowadays ought to be directed, not against technological progress, but, in the first place, against the economic system itself, against all the factors that make economic activity rigid and deprive it of its elasticity and of the functioning of automatism. Only the re-establishment of this automatism will be able to bring back technological development to its proper channels, adjust its pace and reduce to a minimum its victims and its dislocations.

Wherever economic changes make it no longer possible to restore automatism to working order, it becomes necessary to regulate it consciously in a way most resembling the actual working of automatism. This regulation ought to be carried out in such a spirit that, in every single case, voluntary regulation should in its effects be identical with the results of automatism had it been in operation.

The conscious regulation of technological progress ought to be the substitute for automatism, but nothing further. What would have been done by automatism ought, in its absence, to be done by conscious regulation.

CHAPTER III

CONCENTRATION, MONOPOLIZATION AND AUTARCHY

§ 7. THE ABSENCE OF CONCENTRATION IN AGRICULTURE

BEFORE we attempt an analysis of the problem of how far technological progress influences the process of concentration in production, it is necessary to divide production into two principal branches: agriculture, and industry in general.

Generally speaking, the process of concentration is absent in agriculture. Technological progress in agriculture does not bring into existence any definite tendency towards concentration in production and land-ownership. Rather the opposite is true: land-ownership on a large scale is historically connected with a low standard of agricultural technique. Its existence is due to certain political, and not technological, phenomena. The large estates of Western Europe have been historically connected with the feudal system, which brought into existence a land-owning monopoly in the hands of a few. Similarly, to-day the large estates of Soviet Russia are the result of political factors—of a State monopoly directed by the Soviet regime.

Technological progress in agriculture brings into existence two conflicting, yet simultaneously operating, tendencies; on the one hand, a tendency towards de-concentration, and on the other, a tendency towards concentration.

Technological development in agriculture increases the intensity of cultivation, and consequently decreases the area of land necessary for the support of a family. With growing technological development, a family which formerly needed for its maintenance an area of X can now maintain itself on an area of $\frac{1}{2}X$, $\frac{1}{3}X$, etc. In this

respect the tendency towards deconcentration in agriculture is evident. Family estates can, under such circumstances, be divided amongst the members of the family. This was actually the outcome of technological development in Europe, where large estates have been divided up and allotted to individual peasant families.

The other tendency, namely, towards concentration in agriculture, is brought about by mechanization, *e.g.* the introduction of a tractor, with the result that an individual farmer can cultivate a larger area of land than formerly. There comes about, therefore, a tendency towards concentration in the sense that the farmer who can now cultivate a larger area of land tends to increase the number of land units at his disposal.

These two conflicting tendencies differ in their intensity in different economic systems. In a family economy, which is concerned first and foremost with its own maintenance and not with the supply of a market, development in technology facilitates the division of land and diminution in area of agricultural units. In countries, however, in which agriculture forms a kind of industry (as, *e.g.*, in U.S.A.), technological development facilitates the process of concentration, *i.e.* the process of enlarging the average area of agricultural units.

But neither tendency is very strong in agriculture. Furthermore, there is no doubt that in one and the same country the two tendencies may be at work simultaneously, thus neutralizing to a certain extent their own effects.

§ 8. CONCENTRATION AND MONOPOLY IN INDUSTRY

Technological progress in industry creates very strong tendencies towards concentration. It is an important factor making for concentration in production, ownership and control—and consequently a source of transformation of economic structure.

Concentration in production takes the following forms :—

1. Technological progress increases the extent of the division of labour in an industrial institution, *i.e.* the labour performed is divided amongst the greater number of workers. It therefore becomes necessary to employ more workers and to enlarge the existing plant.

2. Technological progress leads to mechanization in production. An increasing number of functions and operations becomes mechanized. Mechanization, in turn, provides wider scope for concentration in production than does manual work.

3. Technological progress allows the accumulation of energy and power in a certain place. The operation of 10,000 and even 100,000 horse-power can be concentrated within a small area. Technological progress brings industry face to face with important problems of production, which can be solved only by means of a concentration of energy and power.

4. The application of technological progress, *i.e.* the introduction of machines and modern equipment, requires considerable capital, which is indispensable in a working of modern industrial institutions.

It is a fact that hitherto technological development has expressed itself in the form of outstanding tendencies towards concentration in production;¹ such tendencies showed, of course, different intensity in different branches of industry. Concentration in production shows different maximum limits in each branch of production. When concentration passes beyond certain limits, the immense industrial concern becomes subject to bureaucratization; it becomes an unwieldy giant which can scarcely be controlled and managed by one directing brain, so that the advantages of an efficient division of labour disappear.

Technological progress leads also to concentration in ownership. The two tendencies towards concentration

¹ "The first thing that strikes even the most superficial observer who compares the old and the new economic era is the continual increase in the size of industrial institutions, a fact borne out time and again by statistics of industry." E. Schmalenbach: "Die Betriebswirtschaftslehre an der Schwelle der neuen Wirtschaftsverfassung," in *Zeitschrift für Handelswirtschaftliche Forschung*, vol. 22, June 1928, p. 243. G. A. Gloeckner, Verlagsbuchhandlung, Leipzig.

in production and in ownership are, of course, closely interconnected.

Technological progress is the source of great capital profits for the entrepreneurs. These profits may be utilized for the purpose of enlarging the works, which are thus constantly increasing. Great scientific inventions are appropriated by big concerns and are usually inaccessible to small industrial units. Intense technological development is also a factor tending to concentration in economic and capital control in the form of trusts, cartels, mammoth concerns and industrial combines. Technological progress augments the share of fixed capital in industrial institutions,¹ *i.e.* the share of the capital value of machines, plant, buildings, etc. The fixed capital, which must needs be amortized and make interest payments irrespective of current production and its profitability, creates a tendency towards chronic over-production, and therefore to constant losses, thereby necessitating the curtailment of over-production and remedying the loss by means of industrial agreements and conventions. Industrial institutions with a high proportion of fixed capital often find that it pays to produce and sell under the cost of production in order to cover the amortization and interest charges rather than curtail production. The latter loss would be greater than the former; they therefore continue production at a loss. When such a state of affairs is general, it becomes necessary to regulate the constant over-production by means of industrial agreements.²

¹ "Inseparable from the development of this kind is the continually increasing growth in the concentration of capital." E. Schmalenbach: *Ibid.*, p. 244.

"An examination of the statistics of industrial balance-sheets, showing what changes take place at an interval of ten years in the value of fixed and variable capital, proves quite clearly that the fixed capital is constantly on the increase." *Ibid.*, p. 244.

² "If the great part of working costs is fixed, then a diminution in production will not bring about a proportionate fall in costs. Further, when, under such circumstances, prices fall, it will be of no purpose to adjust them by restricting production. It will be cheaper to continue production at the current average working costs. Although the factory will thus work at a loss, this loss will be smaller than it would have been had production been restricted, with costs remaining almost as high as before." *Ibid.*, p. 245.

These agreements come into existence mainly where the share of fixed capital in production is considerable.¹ Thus, intense technological progress leads to concentration in capital and in economic control.

These three tendencies towards concentration are cumulative and complementary. Concentration of ownership adds strength to concentration of production, and vice versa. They facilitate agreements between the few industrial concerns and the few owners in a given industry, thus strengthening concentration in economic control.

Thus, technological progress stimulates monopoly and the gradual elimination of free competition. In this sense it is the main factor of monopolistic capitalism. In its turn, monopolization of industry causes further economic transformations, which put an end to free economic activity, both internally and externally.

Internally the monopolization of industry necessitates Government supervision, control and planning. The predominance gained by monopolistic industries over other branches of production must be adjusted, and their relation to agriculture, trade and commerce must be regulated by the aid of Government intervention. Wages become a political question. In general, in countries with a monopolistic structure, State-planning and regulation find their full justification.

Externally, the monopolization of industry leads to the closing of national economies and the decline of international trade.

¹ "If you study the economic history of recent years, you will be able to observe that monopolistic organizations, such as cartels, first come into existence where there are high overhead costs." *Ibid.*, p. 245.

"To-day, having seen so many examples of this concurrent development, it can be stated with certainty that a continuous increase in overhead costs is irreconcilable with the existence of a free economy, and that a free economy, under pressure of overheads, must give way to a new, constricted economy." *Ibid.*, p. 246.

§ 9. AUTARCHY AS A CONSEQUENCE OF MONOPOLIES¹

The contemporary neo-mercantilism is the outcome of powerful internal influences at work in the different economic systems, which bring about the disintegration of the free world economy. The decline of liberalism in the world economy, the increasing restrictions on the international exchange of goods, capital and labour, are nothing but the results of the throttling of liberalism within the sphere of national economies.

What do we mean by this throttling of liberalism? Economic restrictions imposed by Governments, monopoly and State interference are continually on the increase. Cartels, trusts and virtual monopolies continually enlarge their sphere of influence. They necessarily follow a policy of economic restriction, for their very existence is the outcome of protectionism and is based on the exclusive exploitation of the national market. *In a monopolistic world there is no place for a liberal trade policy.* A liberal trade policy is the greatest enemy of monopolistic organizations, for it threatens the prices fixed by monopolies and cartels.

Monopolies curtail the possibilities and use of free trade. The classical theory of international trade, showing the advantages of free trade and its superiority over protectionism, is based on liberal principles and remains true only in relation to a liberal system. When trade is in the hands of monopolies, trusts and big concerns the classical theory cannot find application.

The classical theory maintains, for instance, that protective tariffs cannot increase the national production-capital. This is correct only as long as trade is in the hands of free agents, but not when the place of free traders is taken by monopolies, cartels and big concerns. When big monopolistic organizations are in existence, the imposition of high duties may cause the transfer of

¹ This section is partly a reprint of an address on the "Future of Trade Policy" delivered by the author in Berlin in May 1932, at the International Economic Conference convoked by the *Berliner Tageblatt*.

factories, machinery and plant from one country to another in order to supply the market and circumvent the high tariffs. In such a case tariffs do increase the production-capital of the country, because the foreign company which builds a new factory, *e.g.* in England, has invested new capital in the country. In the times when trade and industry were in the hands of small traders and manufacturers, such a result would have been impossible. At present a number of countries endeavour to promote their national industry by imposing high duties or quotas on products of big industrial concerns, with a view to compelling them to invest capital in the country.

The classical theory also maintains that duties are borne by the local consumer. This is correct in the case of a free economy, but not in the case of monopolies. If a protective tariff is imposed on export goods of some monopoly, such as a cartel, then it often happens that the duty is paid by the monopolist, who tries to recoup the loss sustained by imposing higher prices in the country of production, *i.e.* on the local market where his monopoly is unchallenged. A duty imposed by England on goods of a French monopolist is virtually paid by the French consumers, upon whom falls the burden of prices increased by the French producer. The French consumers are, no doubt, told that this is necessary for the sake of maintaining the French export trade to England, and without such exports the cost of production for local consumption would increase out of all proportion. Such cases would not be conceivable in a liberal economy, but they occur where there are monopolies. This is a typical case of dumping.

Finally, the classical theory maintains that each country can balance her imports by corresponding exports, and exports can be carried on irrespective of the absolute costs of production, for what matters are comparative and not absolute costs. This is the well-known theory of international exchange, or the theory of comparative costs of Ricardo and Mill. But this theory, too, deprived of

liberal foundations on which it was based, has lost its practical importance. The theory is of no value to-day, since costs and prices are no longer free factors, but are quantities subject to artificial modification at the instance of monopolies in all their forms. Export goods of a certain country, though of a comparatively higher quality, may not be able to withstand competition on the world market owing to the dumping of other countries, or due simply to import restrictions. A country may find itself cut off from the world market, although its exports are produced at comparatively low costs.

Monopolization of the labour market produces similar results. Trade unionism, collective bargaining, health and unemployment insurance, wages settled by political considerations, and the whole field of social legislation—all these factors restrict or even wholly preclude the free movement of labour. Immigration restrictions are the product of this social protectionism. As a result the worker has become, so to say, nationalized and *glebae adscriptus*, both in the country to which there was formerly immigration and in the country from which there was formerly emigration. A country where unemployment insurance exists has hardly ever a high rate of emigration. Similarly, a country with unemployment insurance must needs restrict immigration, for no one is willing to maintain unemployed foreigners. "Nationalization" of the worker by means of social protection bears analogy to nationalization of goods by means of a protectionist trade policy.

Let us go even further. Monopolization of banking and credit institutions have similar effects, and result in the restriction of capital and credit exchange in the world economy. The free play of economic forces tends to disappear from the national capital and money markets. The obstruction of the free movement of goods, capital and labour has stopped the automatism of the movement of gold and has undermined the foundations of the gold standard.

All these factors are cumulative, add mutually to each

other's intensity and paralyse the free world economy. A fall in the volume of international trade leads to a shortage of foreign bills of exchange, for the latter come into existence through trade ; again, a shortage in foreign bills of exchange leads to the curtailment of international trade. Immigration restrictions in force in many countries lead to import restrictions, and so on.

The above conclusions can also be formulated in the following way : Internal restrictions necessarily lead to restrictions in world economy. The elimination of automatism within a national economy causes the elimination of automatism externally. The resulting liquidation of international free trade means, in consequence, nothing else but the shrinking of world economy. For what is it that we call "world economy" ? It is a chain of phenomena consisting of international trade, capital and credit, an international gold standard—in short, it is the international exchange of goods, capital, labour and money between the different national economies. Thus, "world economy" is a chain linking up national economies ; and in consequence all impediments to the free economic relations between countries must needs lead to the curtailment and paralysis of the world economy.

The great crisis of to-day is, first and foremost, a world crisis. It is more acute in countries closely linked up to the world economy than in countries whose connection with the world economy is only a loose one ; it is more acute in international banking than in banking operative only within national boundaries. As a whole, the world economic crisis is a necessary consequence of monopolization in the national economic systems.

§ 10. IS TECHNOLOGICAL PROGRESS POSSIBLE UNDER A SYSTEM OF AUTARCHY ?

Technological progress which is designed to promote co-operation between nations (brings nations nearer to each other as a result of progress in the means of communication, such as the railway, motor vehicle, airplane, telegraph and wireless) in its ultimate effects separates nations, creates economic nationalism, with tariff walls and barriers, both psychological and economic.

Technological development takes place under a system of monopolies and autarchy ; in other words, under conditions which are unfavourable not only to the process of compensation but also to the further progress of technology. The development of technology within a system of autarchy means not only an increase in unemployment and the impossibility of remedying it, but also a cessation of technological progress itself. Technological progress is in its essence a progress in division of labour—and every trade restriction leads in the end to restriction of division of labour.

Technological development under a system of autarchy leads to an absurd situation, and will finally bring about its own extinction, perhaps sooner than we expect. Thus technological progress will meet its end at the hand of autarchy, for whose creation it is responsible. For nothing under the sun can go on developing indefinitely, and there must also be a limit for development in technology. The hopes of the eighteenth and nineteenth-century rationalists of unlimited progress have proved an illusion in the sphere of technology as well.

CHAPTER IV

TECHNOLOGICAL PROGRESS AS AN INSTRUMENT OF STRIFE

§ II. THE INFLUENCE OF TECHNOLOGICAL PROGRESS ON ECONOMIC COMPETITION, THE CLASS-WAR AND THE STRUGGLE BETWEEN NATIONS

TECHNOLOGICAL progress brings about in all these spheres one common tendency: to strengthen the strong, in economic competition and in the class-war, as well as in the struggle between nations. In economic competition technology proves helpful to the entrepreneur who has large capital resources at his command. He acquires scientific inventions, improves the organization and introduces expensive and thorough rationalization. But the entrepreneur who is weaker in capital resources cannot afford to apply new inventions. Consequently, in times of intense technological development, the discrepancy between the rich entrepreneurs with big concerns and those who lag behind them tends to widen. Technology provides big business with a new weapon, which is used in the struggle between the big and small entrepreneurs.

We have stated above that technology creates favourable conditions for concentration, that it helps big industrial institutions in their competitive struggle, and thus promotes the creation of monopolies or quasi-monopolies. We also came to the conclusion that technological development causes an increase in fixed capital and so leads to industrial agreements and conventions. Thus technological progress all along helps the capitalist, enables him to acquire monopolies and the monopolist's domination over the whole of economic life.

The same tendency is apparent in the class-war. Here,

too, technological progress strengthens the party which is already strong in capital resources; in other words, it strengthens the position of the capitalists in their struggle with the working class for the distribution of income. The new machines and tools do not strengthen the position of the working class, for the disposition of these machines is not in the hands of the worker. Every new machine or tool becomes the property of the capitalist class and so extends the scope of its economic and political supremacy.

Technological progress strengthens the position of the capitalists in the class-war, since it

1. Favours monopolies, and thus tends to make capitalist organizations strong and consolidated.
2. Increases unemployment in the transitional period, and thus weakens the organization of the working class.
3. Reduces the share of the worker in the National Dividend through the operation of the law of substitution, and thus weakens the position of the working class.
4. Increases fixed capital in production, thus transferring the centre of gravity of production from labour to capital.
5. Increases the Government's power of ruling over the working class by providing the State with the best machinery of war, police and propaganda (wireless, the Press, film, etc.).

Similar tendencies are also observable in the struggle between nations, whether the struggle be military or economic. Here, too, the same influence of technological progress can be traced; it strengthens the position of the country which is rich in capital and weakens comparatively the position of the country with smaller capital resources.

Technological progress is available only to countries

which have large capital resources at their disposal ; for it is quite clear that the application and introduction of scientific inventions necessitates large financial resources. But the application of technological improvements depends not only on the availability of capital resources, which are not at the disposal of poorer countries, but also on a sufficiently absorptive market, which is not usually accessible to economically undeveloped countries. Thus, technological progress tends to reinforce the position of highly developed capitalist countries, bestowing on them new advantages of great economic, as well as strategic, value.

Countries whose international position is continually weakening, owing to their inability to keep pace with the intense technological development of other countries, endeavour to remedy the state of affairs by carefully planned counter-action. They see that their production is less and less able to withstand competition on the international market, on account of the advantageous position in which highly developed capitalist countries find themselves as a result of the introduction of technological improvements. They see also that they are, in course of time, less and less able to withstand competition, not only in the world markets but even in their own local market. Hence the necessity to counteract the economic conquest of the rich countries, and their defence takes the form of import restrictions, tariffs, quotas, etc. This is the main cause of the growth of economic nationalism and of the movement towards autarchy. The disintegration of the world economy into closed national economies tends to paralyse the advance of technology in great capitalist countries, since the loss of markets and the resultant curtailment of production puts a necessary stop to the further introduction of technological improvements. Autarchy acts as a brake, first and foremost, on the development of highly industrialized countries and leads to a cessation of any further introduction of scientific inventions in the industries of such countries.

Technological progress is an important instrument of struggle in all its forms and augments the intensity of the competitive, class and international struggle. It leads to monopoly and militarism, to a dictatorship of the capitalist class over the working class, and to the dictatorship of highly developed capitalist countries in international affairs.

Thus we can see the dangers connected with progress in technology. Technological progress can be abused, and usually is abused, by monopolists and militarists; it then ceases to be a benefit to mankind and becomes the greatest menace to civilization. It paves the way for a new feudalism and new forms of dictatorship. It strengthens the strong and weakens the weak, widening the gap between individuals, classes and nations. To remedy the dangers we have to turn, not against technological progress itself, but to the forces that direct its course.

§ 12. TECHNOLOGY AND THE UNSCRUPULOUS

Technological progress aids not only the strong but also the unscrupulous in international struggle. It creates very effective, but at the same time devastating and barbarous, means of warfare, such as bacteriological, poison gas and aircraft attack. Only an extremely unscrupulous and brutal nation or government would dare to use such means of warfare to its full extent, irrespective of consequences. But it ought to be realized that a nation which, without declaration of war, made a sudden air attack on a country, bombed its capital, gassed its population and destroyed the main centres of the enemy's war industry—and all in the course of a single night—would undoubtedly gain a decisive advantage and virtually determine the fight in its own favour.

Thus technological progress seems to favour unscrupulousness and brutality, and not loyalty and fair play. Matters are going so far as to make education in brutality part and parcel of a nation's military training,

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for it gives victory over an enemy who is less aggressive and more humanitarian.

Here lies the greatest danger that is inherent in modern technology. It puts into man's hands a destructive weapon which, used with barbarity and brutality, may turn out to be the very weapon by which civilization may perish.

CHAPTER V

MAN AND MACHINE

§ 13. DOES THE MACHINE IMPOVERISH THE MAN ?

MAN is at one and the same time the subject and object of every economic activity; he is both the end and the means of every economy. Accordingly, in the last resort, the true criterion of technological progress is the influence it exerts on the human soul, on man's mind and character, on man's intellectual outlook, on his desires, feelings, ambitions and his capacity for social intercourse.

The set of problems which arise in this connection is so vast that we cannot pretend to make our inquiry complete.

The influence of technological progress on the mind, character and social behaviour of man has varied during the course of history.

During the period of primitive technology, man first began to learn systematic work. The first tools and implements were instruments which taught man how to work systematically and how to overcome his natural laziness.

During the period of qualitative technology, every piece of technological progress meant the progress of human labour. Every improvement of a tool was, at the same time, an improvement of the man himself, his work and efficiency. The development of qualitative technology educated and improved man, developed his intellect and his powers of observation; it also gave him better opportunities for education outside his work, for thinking and contemplation.

What is the position, however, on the advent of the machine? Is it true that the machine impoverishes the individuality of man, that it makes him dull and tedious

and brings him down to its own level, *i.e.* to the rank of a soulless being? Those who maintain that this is so present the case in a one-sided and exaggerated manner.¹

The machine is primarily a factor of *activity*. It makes both the worker and the entrepreneur active. At the call of the machine the worker gets into the routine of systematic work, becomes subject to a certain division and rhythm of work, and is driven into a higher tempo of life and activity.

The machine is an *enemy of tradition* and a promoter of rationalism. A new and better machine is a negation of the past and makes one think of the future, which may turn out an even better machine. The machine inspires faith in the power of the human mind and in its ability to mould life consciously; it sets aside all irrational ideas and forces and imposes a rational outlook upon men.

The machine promotes a mechanical and *materialistic* outlook on life. A worker operating a machine sees the world as one great machine, which can also be operated and regulated. It becomes his ambition to improve his material position, to raise his standard of life, extend the scale of his desires and the quality of their satisfaction.

The machine is both the result and the stimulus in the race for profit. Not only the entrepreneur but also the worker endeavours to increase his profit, *i.e.* to earn as much as possible; in the absence of any other means of achieving his end, he falls upon the same device as does the entrepreneur in his struggle for maximum profit, *i.e.* monopolistic organization.

¹ The observations of H. Dubreuil are of interest. Being himself a worker and a good observer, he considers the argument concerning the dullness and monotony of work at a machine as utterly superficial: "I gave much thought to the question, especially at a time when I myself was engaged on repetitive work. I began then to appreciate the immense freedom of thought that is afforded by getting used to movements repeated for a long time and finally performed quite mechanically and unconsciously. I do not suggest that every worker should act thus, but, as far as I am concerned, whenever I had this kind of work to do I took paper and pencil in hand and jotted down all the observations that came to my mind." H. Dubreuil: *Man and Machine*.

"In spite of all the opinions to the contrary, I hold that every kind of physical work, even monotonous work, as long as it is not too exhausting, stimulates thought and planning." *Ibid.*, p. 160.

The machine is an important factor in progressive movements. It inspires faith and hope in a system in which the machine will replace human labour, in which it will become man's servant.

The machine frees man to a great extent from great muscular strain, but demands of him *greater nervous effort*, attention and presence of mind.¹ Thus the machine liberates certain energies, but absorbs others. Hence the great development of sport as an outlet of unused physical energy. The dispensing with great physical effort has resulted in the absorption of women and juveniles into factory work, and has caused new social transformations, with effects on family life.

The machine increases the workers' share of *responsibility* in production. A worker operating a machine may cause the destruction of the whole factory; the motor-driver or pilot may cause an accident involving many victims. A worker at a revolving belt may, owing to his carelessness, cause a hold-up in the whole factory. The absence of attention and conscientiousness on the part of a worker may necessitate extensive and costly repairs. Consequently, the machine requires a highly responsible and disciplined worker; and hence the necessity of high wages in advanced industrialized countries. Altogether, the type of worker in such countries is different from the worker in countries where the application of machinery is limited.

The machine has led to a *reduction in working hours*. The intense development of quantitative technology made long working hours unnecessary. The strain on the nerves, the responsibility and constant attention which is required, made a fourteen- or fifteen-hour day (as amongst craftsmen) impossible.² A craftsman can work in his workshop for thirteen hours daily, but a machine worker could not

¹ Schultze-Gavernitz: "Die Maschine in der kapitalistischen Wirtschaftsordnung," *Archiv für Sozialwissenschaft und Sozialpolitik*, Tübingen, 1930, vol. 63, p. 244.

² "A craftsman can work for thirteen hours daily; but it would be impossible to let a four-loom, still less a ten-loom, weaver work thirteen hours daily. The nature of the work has become different. Muscular effort has been replaced by nervous strain." *Ibid.*, p. 245.

carry on for long with such working hours. Thus the machine gives the worker more leisure time, which he can devote to sport or mental exercise.

The machine has a great variety of uses and objectives, and accordingly requires different types of labour. An elaborate machine requires precision, a typewriter requires speed, a motor vehicle attention and presence of mind, a power-loom requires automatic motion, a traction machine endurance, and so on.

Mechanization itself undergoes *constant evolution*. We can observe its development from a semi-automatic machine to one entirely automatic, such as is found in the spinning and weaving industry. With a semi-automatic machine, man becomes part of the machinery and must continually perform the same movements to correspond with the movements of the machine itself. On the other hand, with an entirely automatic machine, man is no longer part of the machine, but controls and directs it, *e.g.* the pilot of an airplane or the driver of a motor vehicle are not part of the machine, but actually control it.

The development of mechanization brings about a *differentiation* between machine workers. From the hitherto uniform class of workers, two groups have gradually evolved :—

1. An elite of highly skilled workers, with responsible and important functions ; they are well paid and firmly established in their positions ; they control and supervise the whole of the machinery and operate the most important parts of it.

2. The crowd of machine workers, unskilled, badly paid and liable to dismissal at a moment's notice ; they are but a part of the machinery and work under the supervision of the former class.

These changes which take place within the working class as a result of mechanization are, from the social, political and cultural point of view, perhaps the most important.

The machine, being representative of quantitative tech-

nology, suppresses individuality and promotes *uniformity*. Owing to the concentration of great numbers of workers in single individual establishments, together with the discipline and strict division of labour to which they are subject, the workers virtually become soldiers in the great army of labour.

The machine brings about uniformity and standardization of human demands. It throws on to the market products standardized and in every respect uniform. Thus it acts as an important democratic force in the very important spheres of labour and demand. This uniformity extends to intellectual requirements; the cinema, the wireless, the gramophone, the Press—they all exert an influence towards uniformity on the mentality and outlook of men.

§ 14. TECHNOLOGICAL AND HUMANISTIC INFLUENCES

The machine is a factor in what could be termed a technological character of life. The general race to achieve new records pervades almost every branch of human activity. The race for the best productive results, and the resultant over-production, is prompted not only by the desire for profit, but also for the sake of achieving new records. Life becomes pervaded by technology, external aspects of life gain supremacy, and as a result life itself becomes shallow. Looking at matters from this point of view, it seems that this one-sidedness of technological influences may in the long run put a stop to further technological progress. The ultimate source of scientific invention lies in the region of the *moral and humanistic sciences*, and a neglect of the latter will sooner or later have its repercussions on the former, and bring further progress of technological science to a standstill. This is one of the most serious dangers of the machine to civilization.

The machine has given such great stimulus to the development of military technique that the question of war or peace has gained a weight and importance which

it has not possessed before. Local wars waged in the past with the old weapons were not so serious in their destructive consequences, and did not constitute a menace to civilization as is the case to-day. To-day, as a result of the tremendous development of military technique, the problem of peace or war is, in effect, the problem of "to be or not to be" of civilization. It is realized that the use of modern destructive weapons in any future war would bring a catastrophe amounting to nothing short of a complete collapse of Western civilization.

Should the government of a technologically developed country fall into the hands of a warlike and unscrupulous dictator, who would ignore moral considerations, and should Europe be plunged into a war, the ruin and destruction that would result from the use of modern military devices would be such as to throw Western civilization centuries back and annihilate modern economic progress. Though the chances of such an event happening are said by some to be one in a hundred, the unsettled political situation of the world makes the danger of such an occurrence increasingly grave.

The only means of ensuring the further peaceful progress of technological science appears to be the cultivation of the humanistic sciences. The greater the progress of technology and of technological influences, the greater ought to be the interest taken in and the influence allowed to humanistic and moral sciences. The principle of absolute equality and of international brotherhood, as well as the full acknowledgment of the natural and unlimited rights of men and nations, ought to be propagated with increasing force, in order to counteract effectively those destructive influences that seem to have gained ground in recent years.

PART IV

REMEDIES FOR UNEMPLOYMENT

CHAPTER I

THE METHODS OF REMEDYING UNEMPLOYMENT

§ I. THE PROBLEM OF UNEMPLOYMENT

IN this part of my work I shall deal with those problems of economic policy that arise from technological progress. In the first place, it is necessary to deal with the entire problem of technological unemployment and the methods of remedying it. In discussing the remedies, consideration will be given to specific features of remedying technological unemployment as well as to remedies for unemployment in general. But while dealing with this problem, we shall concentrate only on methods of increasing employment; we shall leave out of account the means of mitigating the consequences of unemployment, such as unemployment insurance.

It will help us in our discussion of the problem if we divide the remedies of unemployment into five groups:—

1. Remedies belonging to the sphere of technology, and which consist in adjusting the direction and rate of technological development.
2. Remedies belonging to the sphere of social reforms, such as democratization of ownership, agricultural schemes.
3. Remedies consisting of the reduction of the earning effort of the working class, such as a reduction of working hours, restriction on the employment of women, children and aged persons, elimination of double employment.
4. Remedies which aim at making economic activity more elastic and profitable, especially by increasing the elasticity of the labour market, the profitability of production and stimulating capital investments. These are essentially means of increasing the rate

and capacity of compensation of technological unemployment.

5. Credit and money operations, large-scale public works, etc.

We shall now deal with each of these groups separately :

§ 2. ADJUSTMENT OF THE DIRECTION AND RATE OF TECHNOLOGICAL PROGRESS

Under this group of remedies the *control* of the rate of technological progress and the *regulation* of the direction of technological progress have to be kept distinct.

The control of the rate of technological progress has for its purpose the protection of the labour market from a further wave of technological unemployment. Its aim is to afford the labour market more time in which to settle down and to carry the process of compensation to its conclusion, before a further wave of technological development is felt on the market.

The control of the rate of progress can be effected by various means : by a prohibition on the introduction of new machinery before the period of amortization of old machinery has elapsed ; or by a prohibition of the future dismissal of workers as a consequence of rationalization or mechanization ; or by means of a prohibition on piece-wages, and so on. Mention ought also to be made of such means of obstructing technological progress as the lowering of the wages of the classes of workers involved, raising the rate of interest on investment credits to be applied to rationalization or mechanization, etc. A specially devised system of taxation can also be effective in restricting excessive technological development.

Adjustment of the rate of technological progress can also be effected by making the consent of the workers interested a condition of the introduction of technological improvements. There are many cases in which the substitution of workers by a machine gives only insignificant profit (which can, however, be an attraction

for a "hundred per cent." capitalist), or cases in which the introduction of a machine is for the entrepreneur not a matter of profit but of convenience. In such cases the consideration given to the opinion of the workers may be of value.

In some countries workers' representations are formed in factories, but their character and independence of the factory management varies considerably according to the branch of industry and locality. In Germany the idea is advocated, and sometimes carried into effect, that new inventions which are apt to cause technological unemployment should be applied only with the consent of the workers' representatives, the latter to have the right of proposing conditions on which the introduction of the invention should depend. The purpose of giving the workers a voice in the application of inventions is to prevent too rash an introduction of technological improvements, prompted only by the profit-making motive without consideration of the important problem of technological unemployment; in other words, to prevent the one-sided consideration of net income without looking to gross income. For if an invention increases the net income of an entrepreneur by 1 per cent., but at the same time it lowers the gross income by 50 per cent. (*i.e.* primarily the income of the employees), then its introduction would be against the interests of the community as a whole. In a case of this kind it may be of advantage to give the workers a voice in the matter, in order to prevent too hasty an introduction of technological improvements, unsound from the point of view of economic policy.

There is, however, a danger to be guarded against in this matter of the workers' joint decision. It may lead in some cases to a complete stoppage of technological progress, since the workers, if concerned only with their own selfish motives, may prevent altogether the introduction of inventions.

All the above-mentioned means of obstruction of technological progress are, in fact, a double-edged sword.

They may turn out to be more damaging than advantageous, and may lead not only to the desired slowing down of technological progress but to the very undesirable obstruction of economic progress. As a rule, these methods are of a very exceptional-character and can be applied only with great reserve and for a short time only. The actual adjustment of the rate of technological progress should rather proceed along the lines of the automatism of dynamic progress (see Part III, Chapter II).

Regulation of the direction of technological progress means causing technological progress to proceed along such lines as would eliminate or minimize technological unemployment, or alternatively make compensation more thorough and speedy. In the first place, it would mean the shaping of technological development in such a way as would result not only in "progress in productivity," but also in "progress in novelty" (which usually leads to employment) and "progress in quality."

As far as the labour market is concerned, the effect of progress in novelty is most beneficial; for in the present stage of civilization what is needed most are inventions that would increase human needs (especially those of a higher grade) and would thus bring into existence new branches of production, giving employment to thousands of workers. Thus the desirable thing appears to be, not the obstruction of technological progress, but the re-direction of its course from progress in productivity into progress in novelty.

Greater scope ought also to be given to progress in quality, so as to cause a general improvement in the quality of goods. Of course, the development of progress in quality, which is much neglected to-day, is connected with the whole trend of modern civilization. A complete change in the psychical attitude and in the general cultural style would be necessary. None the less, a change from quantity to quality could well be effected even within the narrow limits of the present system of values, and such a change would no doubt bring about great relief to the labour market.

The direction of progress in productivity on the lines of deconcentration would also be of value. Such a development—as was already stated in Part I—would extend the possibilities and scope of labour. With the decreasing importance of capital in production, man's access to production, and so to the means of income, becomes easier. Success on these lines would be equivalent to revolutionary changes in the system.

Easier but less significant results could be obtained by directing technological progress on to special branches of production or special parts of the economic system.

Progress in productivity affecting transport and communications relieves unemployment and hardly ever increases it—looking, of course, at its long-run effects. Similarly, progress affecting the distributive machinery (banking and commerce) generally decreases unemployment.

The direction of technological progress towards the production of consumption goods rather than production goods is also a device for protecting the labour market, since compensation of technological progress within the consumption-goods industries proceeds easier than in the production-goods industries.

Intense technological progress within the war industries leads to further armament, prompted by the fear of the application of military inventions by neighbouring States. The race in armaments leads to excessive taxation, the decline of profitability and mass unemployment. Consequently, *the development of military technique is a universal calamity.*

I realize that many of the above methods are of theoretical significance and could only with difficulty find practical application. Nevertheless, even within certain limits of our system, it may be possible to influence the direction of technological progress by means of appropriate money, credit and taxation policy, by international conventions, and so on.

§ 3. DEMOCRATIZATION OF OWNERSHIP

Unemployment is not a technical problem but a social problem. It is really the problem of the worker who offers his services for sale and who, as soon as his offer becomes unaccepted, is deprived of his means of livelihood. Where the problem is not of such a nature, there is in fact no real unemployment question. There intense technological progress will express itself in a reduction in working hours and working effort, an increase in leisure and holidays, etc.

Let us suppose that intense technological progress takes place under a system of guilds and handicrafts, in which every family has its own small workshop and carries on production, not for profit, but for its own requirements and according to guild regulations, with a fixed scale of production and prices. A technological improvement, *e.g.*, which makes it possible to produce in the same period of time a 50 per cent. greater output will not create technological unemployment, for the simple reason that in this system the proletarian class is absent. Technological progress in such a system will result in an increased supply to the market and will improve the standard of living, but it will not affect the state of employment; or it may result in a reduction of working hours or of working effort, in the elimination from workshops of women, children and aged persons, in more leisure and holidays, etc. In a system in which every family has its property and has a natural access to production, technological progress can never, even transitionally, cause technological unemployment.

The position is similar in a peasant system with small property holdings more or less equally distributed, and in which the individual economies are run, not for the purpose of enrichment but for the satisfaction of normal needs. In such a system technological progress does not cause unemployment.

In a collective system, in which the means of production would be in the hands of the State and where naturally

the motive for enrichment would be absent, technological development will also not create unemployment. Technological progress in such a system would bring about a shortening of working hours, a raising of the standard of living, or a quantitative or qualitative improvement in production ; for it is clear that the State, being the only entrepreneur, whose interests are coincident with the interests of the population as a whole, would have no motive for allowing technological progress to exceed its proper limits, and for dismissing workers whom it would be obliged to maintain in any case. Besides, in a Socialist State there would be rather the danger of insufficient than of excessive technological progress.

The above examples help to make the problem clear. Technological unemployment is not an eternal problem bound up with every wave of progress, but a social one connected with a certain system of ownership. It exists only in a system in which a vast mass of the population is deprived of property altogether. It is only in a system of concentrated ownership, where great fortunes coexist with mass poverty, that the problem of technological unemployment assumes a serious form.

Thus concentration of ownership, as opposed to democratization of ownership, is a factor causing the growth of technological unemployment and making its compensation more difficult.

The effort towards democratization of the system of ownership, equally necessary for the proper functioning of liberalism, is therefore an effort to remedy technological unemployment and cause its speedy compensation. Should democratization of ownership prove to be impossible within a capitalist system, and should the liberalization of the economic system also become impossible, then, no doubt, technological progress under a system of monopolies will drive economic life on to a system of collectivism, in which technological unemployment (as well as wealth) will be absent.

Fostering of agricultural settlement with a view to putting on the land the surplus urban proletariat which

is constantly exposed to the danger of unemployment is of prime importance. The allotment of small rural holdings to part of the factory workers is a most expensive but, as the same time, a most effective method of remedying unemployment.

Land reform which carries into effect democratization of ownership amongst the agricultural population is of similar importance. It lessens the peasants' scramble into the towns and thus prevents the increase of the urban proletariat. The smaller the number of large estates in the country, the smaller will be the emigration of agricultural workers (Goltz's law), the less workers unemployed, and the less will be the disturbance on the labour market caused by technological improvements. Large-scale agrarian reforms which aim at democratization of ownership ought, therefore, to be reckoned as a means of remedying unemployment.

Our observations on democratization of ownership hold good also on the question of equalization of the distribution of incomes. The creation of monopolies, cartels, trusts and syndicates are a source of great inequalities in the distribution of incomes, which is a factor making for considerable increase in technological unemployment. On the other hand, the abolition of legal or virtual monopolies, complete or semi-monopolies, concessions, etc., is a process of equalization of the structure of incomes and the relief of technological unemployment. The greater the inequalities in the distribution of incomes, the greater the pressure on the labour market.

§ 4. DIMINUTION IN WORKING EFFORT

Reduction in Working Hours.—Working hours undoubtedly influence the growth of technological unemployment and the extent of its compensation. Where working time is long, increase in productivity creates proportionately greater, and where working time is short it creates proportionately smaller, technological unemployment.

Similarly, the extent of its compensation is greater where working time is shorter; for, other things being equal, where working time is short the entrepreneur has to employ a larger number of workers. Consequently, reduction in working hours is a factor facilitating compensation. This method has, however, its limits in application.

Of course, when we speak of a reduction in working hours, we mean such a limitation of working time as is not dictated by hygienic, humanitarian or economic considerations (*i.e.* a reduction below the 46-working-hour week) only for the purpose of relieving unemployment.

In considering the question of a reduction in working hours, a distinction ought to be made between a reduction without a corresponding increase in wage-rates (per hour) and a reduction with an increase in wage-rates (per hour). In the former case, wages (earnings) are lowered; in the latter case they remain unchanged.

In the first case, the complete unemployment of a certain number of workers becomes the partial unemployment of all workers. In the second case, the complete unemployment of a number of workers becomes an additional and paid holiday of the whole group (since partial unemployment paid by the entrepreneur is called a holiday, but when it is unpaid is called unemployment). The first case is a clear problem of the reduction in working hours; the second is primarily a problem of wages.

The change from complete into partial unemployment is really a transfer of unemployment costs on the shoulders of the working class. For part of the unemployment insurance money which the working class has received from general funds is withdrawn and the maintenance of the unemployed becomes a burden on all the employed, whose wages are reduced accordingly. This method of bestowing the benefit of employment on the vast mass of the unemployed by way of equal distribution of work has great moral and social advantages, but its application is rather limited. This method cannot be applied:—

- (a) When the reduced wages fall below the level required for the purchase of necessities, *i.e.* when they make it impossible for the worker to lead a usual mode of life and adversely affect his energy and productive skill.
- (b) When the reduction of working time is so considerable that it creates technical difficulties in the operation of the factory, causes a further increase in the costs of production and has a demoralizing effect on the worker as a result of excessive periods of leisure.
- (c) When the compulsory reduction in working time causes the substitution of a skilled labourer by one who is less skilled or less willing to work.
- (d) When the reduction in working time develops into a permanent arrangement and is not conceived as an emergency regulation to be removed on an improvement in the employment situation.

Cases (a), (b) and (c) are closely connected and can, in fact, be reduced to the statement that neither a reduction in working time nor a reduction in wages can be pushed too far, since they would create technical working difficulties, lower the skill of the workers and cause dissatisfaction amongst them. As a rule, countries with a low standard of living, where wages are at the level of necessities, have limited possibilities for changing complete into partial unemployment. For with such a change, wages fall below the minimum level necessary for existence, making the worker's life, as well as production, difficult.

The change from complete into partial unemployment leads to a reduction in wages, which is, as a rule, a factor of compensation. Although the reduction in wages does not in this case stimulate production, since it does not increase its profitability, it nevertheless always tends automatically to increase employment, owing to the fact that, with the aid of some capital, a greater number of workers can be employed.

The change from partial unemployment into additional

leisure, or simply a reduction in working time with a corresponding rise in the wage-rate, is of a different nature. In this case, the workers' wages (earnings) remain unchanged, but the wage-rate is higher. The costs of unemployment fall, in this case, on the entrepreneur. It is a form of an increase in wages which has usually an anti-compensation character. The capital at the disposal of the entrepreneur has not been increased, but his expenses in maintaining his employees have risen. Thus, if working time has been reduced by 10 per cent. and the wage-rate increased so as to keep wages at the former level, then the entrepreneur has now to spend 10 per cent. more on wages, while neither his capital nor the profitability has increased.

As a method of compensation, its application is even more restricted than the application of the first method. It is limited by the amount of capital which is at the disposal of the entrepreneurs, by the marginal profitability and the possibilities of further technological improvements. It must be observed that the resultant increase in wages cannot be pushed so far as to facilitate a further substitution of human labour by a machine.

The limited application of this method need not lead to its rejection; on the contrary, it should be applied wherever practicable.

Both methods of reducing working time, *i.e.* the transfer into partial unemployment and the transfer into additional leisure, can be applied jointly. The application of the first method would be advisable where the wage-rate is high and of the second method where capital profits are high.

Reduction in working time in the capitalist system is a most important safety-valve in a period of intense technological progress. It is not, however, a radical remedy, but rather a palliative. It aims at giving again to technological progress its real meaning and purpose in the capitalist system—namely, more leisure for working men, at times when it is not possible to bestow on them greater material benefits.

Restriction on the labour of women, juveniles and aged persons as a means of remedying unemployment is similar in its nature to reduction of working time. This method, too, operates automatically by way of a restriction on supply to the labour market ; certain categories of labour are eliminated from the market.

Restriction of female labour is affected either by means of legislation or by way of certain inducements which bring women back into domestic occupation (as was recently done in Germany). Restrictions on juvenile labour are effected by raising the school-leaving age. Restrictions on the labour of aged persons are brought about by lowering the retiring age, *i.e.* lowering the age at which old-age pensions are payable.

These methods of relieving unemployment consist in a division of work amongst workers according to a certain plan and not in accordance with market fluctuations. Unemployment of certain categories of labour is shifted on to others, namely, those whose unemployment is socially and morally less dangerous, or even, under certain circumstances, of advantage. Unemployment of these workers turn either into additional leisure (for it paid unemployment), as in the case of aged persons, or into prolonged education, as in the case of the raising of the school-leaving age, or again, into additional labour in the household, as in the case of the restriction on female labour. There is no doubt that this method of turning unemployment into leisure, prolonged school or domestic work is in many respects beneficial. Of course this remedy, too, is not of a radical character, but merely a palliative, for its application is very limited and expensive. The restriction of juvenile labour by raising the school-leaving age or the lowering of the old-age pension limit means great financial burdens which many nations cannot afford.

Restriction of female labour brings about a fall in the earnings of the working-class family, which may sometimes fall below the minimum necessary for bare existence. Restriction on women and on juvenile labour, which is

cheaper than male labour, is nothing but an additional burden on industry and the reduction of its profitability, the latter again leading to a further increase in unemployment.

This method is advisable in all cases in which its application is possible, *i.e.* in wealthy communities. But even there its application would be restricted within narrow limits, *i.e.* within which there takes place a better distribution of employment without an excessive increase in the costs of unemployment. Therefore, in cases where unemployment can be reduced without a disproportionate rise in the cost of maintaining the unemployed, this method can be effective.

Obviously, even this method must be regarded as a temporary remedy and not as a permanent arrangement.

The elimination of double employment has for its object the automatic increase in the number of situations by the removal of those who are already employed elsewhere. Its aim is the elimination of so-called "cumulative employment." But this method is very often limited in its scope and gives only slight results, while its execution is difficult and, when rigorously applied, can be even harmful.

This method is usually applied only to mental and not to manual workers. It is also important to observe that the double employment of mental workers is very often due to their special qualifications. A business from which such a doubly-employed individual has been removed may suffer seriously as a result of his dismissal.

Furthermore, double employment is usually connected with positions which neither keep a man fully occupied nor fully remunerated. If one business needs a book-keeper for three hours daily and another needs a correspondent for five hours daily, neither of them can give the employee full wages; and so, one employee serves two businesses, thus obtaining full earnings. Should elimination of double employment take place, neither of the two businesses would be able to employ a clerk and the number of situations would thus be reduced.

Double employment is also connected with positions of trust. To some high positions, where cumulative employment is found, persons are appointed in consideration of the trust and confidence placed in them. Some investment and capital transactions are very often made only when certain individuals, in whom confidence is placed, are at the head of the company. Some institutions can only be managed if the capitalist puts his trust in certain people, the free choice of whom cannot be restricted by considerations of double employment. Attempts to eliminate double employment are therefore more harmful than useful, and in practice this method finds very little application.

§ 5. ELASTICITY, PROFITABILITY AND DEVELOPMENT OF THE ECONOMY

Economic Liberalization.—The fourth group consists of methods which stimulate the elasticity, the profitability and the development of economic activities.

The extent of compensation depends on the degree of elasticity of economic life, both internally and externally. Where there are no restrictions on free economic activity, no internal prohibitions, no State planning, regulated wages, monopolies, cartels, where there are no external restrictions on the free exchange of goods, capital and labour, compensation will be considerable. A liberal economic policy is a pro-compensation factor.

As we have stated above, compensation is just a case of economic automatism; consequently, the easier the process of economic automatism, the quicker and greater will compensation be. A liberal economic policy and a return to a world economy afford the best opportunities for a productive remedy for technological unemployment, both within the particular national economies, as well as within the world economy.

Elasticity of the Labour Market.—Technological unemployment takes different forms when labour is free from when it is monopolistic. Free labour means market

wages fixed in accordance with the prevailing demand and supply. When the supply of labour exceeds the demand for it, wages fall; when the demand exceeds the supply, wages rise. Thus wages are elastic and reflect the constant changes and fluctuations of the labour market. Monopolistic labour, on the other hand, means collective wages fixed either by trade unions, arbitration boards or the Government itself. In the case, wages show little elasticity and do not reflect the situation on the labour market.

Unemployment, as also technological unemployment, is generally smaller in a system of free labour than in a system of monopolistic labour. Where labour is free, wages are fixed at a point at which demand approaches supply; in other words, at a point where unemployment is not considerable. Where labour is monopolistic, wages can remain at a high level, even if unemployment is considerable.

When the worker is expensive, above the level determined by the situation on the labour market, there is a tendency to substitute for him some other cheaper factor of production. A number of activities then become unprofitable, marginal works and marginal branches of production must be abandoned.

Great technological unemployment leads inevitably to a reduction in wages and the latter, in its turn, facilitates its decrease. This reduction in wages may be only temporary, but it is an inevitable stage of the process of relieving unemployment. Reduction in wages is sometimes only of a nominal character, since technological progress embraces, as a rule, the cost of living.

Elasticity of wages and a liberal system on the labour market are important factors in remedying unemployment in general, and technological unemployment in particular.

A change in the vocational training of workers is also one of the means of increasing the elasticity of the labour market. We know that a large percentage of unemployment is due to the discrepancy between demand for and

the supply of labour, and this is widened by the lack of adaptation of labour qualifications to new market requirements. A quick change of the vocational training of the worker, his withdrawal from an occupation which has become overcrowded as a result of technological progress, and his transfer to occupations which, also due to technological progress, provide new openings, can contribute to a great extent towards the relief of unemployment and the adjustment of market discrepancies.

It is a well-known fact that unemployment affects, first and foremost, unskilled workers, while even in times of a crisis there is a shortage of skilled and highly qualified labour. It is, as a rule, much easier to place a qualified worker in employment than an unskilled one. Consequently, the training of workers, the raising of their qualifications and their adaptation to new market conditions is a productive remedy for unemployment.

Profitability of Production.—In the capitalist system production is for profit and is conditioned by profit-making. Profit is the motive-power of production, and where there is no profit, production comes to a standstill. Consequently, every effort to make production profitable is an effort to relieve unemployment. Thus, relief of excessive taxation or a reduction in public taxes, rates, etc., tends to make production more profitable and so relieves unemployment. In fact, reduction of taxation on production is one of the cheapest and most effective means of relieving unemployment. It is certainly cheaper and more effective than public works on a large scale, financed by new taxation.

Capitalization.—The extent of technological unemployment depends also on the degree of capitalization. A quick increase of capital diminishes technological unemployment, and vice versa.

Savings usually mean a restriction of the consumption of the well-to-do classes and the transfer of part of their income for the employment of the worker. Savings tend to democratize the structure of incomes and of consumption. In place of the luxury consumption of the rich

comes the consumption of necessaries by workers employed by the capital accumulated by saving.

A country with a high rate of saving would have, other things being equal, a lower percentage of unemployment than a country with a low rate of savings. Workers turned out of industries affected by technological progress will find employment in other branches of capital investment. The accumulation of capital is a source of economic growth and productive expansion, which necessitates the employment of new labour.

It can be argued against this that the basis of "other things being equal" is untenable, since a country with a high rate of saving will also show a high rate of technological progress, and that the latter will, in turn, cause proportionately greater unemployment. But such an argument is only partially correct. A higher rate of saving is not the sole factor, but one of many in technological progress; and further, not all capital investments need be used for technological improvements; they may be used more for the purpose of enlarging plant and the productive machinery.

Accumulation of savings not only increases the demand for labour but also diminishes the supply. A worker who has a certain amount of savings would prefer to see his wife attending to household duties and the care of children rather than her working in a factory. He would send his children to school up to a later age and thus decrease juvenile labour. A worker with accumulated savings is also able to retire from work at an earlier age than circumstances would otherwise permit him.

Thus savings diminish the supply of, and at the same time increase the demand for, labour. Consequently, an increase in savings is also an effort to relieve unemployment.

§ 6. MONEY AND CREDIT OPERATIONS

Credit Expansion.—Two questions need to be considered in this connection, namely:—

- (1) Can compensation of technological unemployment be facilitated by appropriate money and credit policy ?
- (2) Is credit expansion advisable in times of intense technological progress, in order to avoid further disturbances resulting from it ?

An expansion of money and credit provides the community with new means of payment and so increases its purchasing power. This increase is, of course, only transitional, *i.e.* the period in which this expansion takes place is at the expense of the following period. Money and credit expansion shifts the purchasing power of one period into the next. It concentrates purchasing power for a time, allowing an additional present consumption at the cost of future consumption.

This shifting of purchasing power may be, under certain circumstances, of advantage, or even of necessity. When the period of credit expansion runs parallel with a period of intense technological progress, which turns out on to the market an increased volume of goods, then credit expansion facilitates the absorption of these goods and so prevents a rise of unemployment during the transitional period.

The operation of this method is, of course, both limited and difficult. Credit expansion lays a burden on the future and it is important that this burden be not excessive. Credit expansion causes a diminution of purchasing power of the future and therefore continuous injections of credit are necessary in order to maintain purchasing power on the raised level. Hence the danger of running the economic system at a loss, with the resultant dislocation of the whole money and credit system. Credit expansion can therefore be applied only under certain exceptional circumstances, in a period of a great accumulation of commodities turned on to the market by technological progress, and in the time of excessive fall in prices.

Credit expansion may give special results when applied

to "progressive" industries. Consumers' credit¹ used specially for the purpose of stimulating the increased turnover of progressive industries may, to a certain extent, help to increase the demand for their goods and so lead to compensation of technological unemployment within the progressive industries themselves. Thus credit expansion applied to the technologically developing motor industry has made the products of this industry accessible to a large number of people, has increased the demand for them and so helped to create the conditions for a large-scale demand for them. Credit expansion applied to this branch of industry has increased demand, has given the industry the element of mass production, has increased its profitability and so made it a factor of compensation.

Consumers' credit can, under certain circumstances, render valuable services. A discussion of the whole problem is contained in my book, mentioned below. Generally speaking, consumers' credit can produce good results in countries which have a large capital surplus at their disposal, have a low interest rate and highly developed saving institutions; where there is a well-developed producers' credit, where consumers' credit applies to durable goods and branches of production which show a tendency to falling prices.

Currency Operations.—Not only credit but currency operations, too, can facilitate the relief of technological unemployment. At a period of intense technological progress, serious disturbances take place in exchange and in the distribution of incomes; prices fall, indebtedness increases and, as a result, insolvency appears and a large-scale change in ownership of factories and workshops takes place. The share of the creditor and rentier class in the National Dividend increases out of all proportion. Quite naturally, these disturbances cause a temporary swelling of technological unemployment. Under such circumstances, operations directed towards devaluation

¹ I have dealt with this problem more fully in my book, *Economics of Consumers' Credit*, King & Son, London, 1934, p. 112.

may have their full economic justification. They mitigate the effects of the disturbances and spread them over a longer period of time. Their effect is also transitional; but, after all, the whole of economic life is limited to a period of time. A temporary mitigation, say for a number of years, very often gives the desired effects which can, under certain circumstances, be decisive in the shaping of events. In the case of a mild devaluation, disturbances caused by technological progress are adjusted to a certain extent by means of a diminution in the purchasing power of money.

It is important to notice that devaluation could not, by its very nature, form a permanent basis for a money and credit policy, nor could it be repeated too often, since this would altogether unsettle the money market and impede the accumulation of capital. Generally speaking, devaluation can be carried out without damaging consequences only once in a generation, always assuming that it is kept within reasonable limits. This is the reason why Anglo-Saxon countries found it easier in the great economic crisis of recent years to seek refuge in devaluation, than would have been possible for continental countries. There was no devaluation in England or U.S.A. within the last generation, but on the Continent, both during and after the War, inflation and devaluation were introduced on a number of occasions.

Devaluation is a most exceptional method, justified only in cases of great unemployment which must be absorbed at any price, even at the cost of consuming capital and future purchasing power. It is a policy made workable at the expense of the future, but justified where the present is greatly overburdened and in danger of imminent collapse.

Public Works.—Public works undertaken for the purpose of finding work for the unemployed is the oldest, but the most expensive and the least effective remedy for unemployment. Public works must be financed either by the money and credit operations described above or by an additional burden imposed on existing factories in the

form of increased taxation. In the latter case some factories lose their profitability and employment decreases. Offsetting the increased employment in public works, comes a fall in the number of employed in private undertakings.

This method can be applied on a large scale only where there is a need for great public investment with a high rate of profitability and where, at the same time, taxation is not excessive. The possibility of its application is restricted within narrow limits, that is, limits within which the profitability of existing factors and employment will not be adversely affected.

§ 7. NATURAL AND ARTIFICIAL REMEDIES

Having reviewed the principal remedies for unemployment, their difficulties and limitations, it is necessary to consider which remedies are most important; obviously those remedies which are not costly. For all the remedies enumerated in the previous section can be divided into two main groups: expensive remedies and inexpensive remedies.

The intensification of the saving effort, the liberalization of economic life, the elasticity of the labour market, the constant effort to make production profitable and the direction of technological progress into certain branches of production—these are, as a rule, the inexpensive, or the least expensive, remedies. All other remedies are of a costly nature. We may term the former “natural” and the latter “artificial” remedies. The former are also usually liberal remedies, in the sense that they are not based on replemmentation, while the latter usually have the character of planned regulations.

Artificial remedies for unemployment are burdensome and have harmful repercussions on other fields of economic life. These artificial remedies are more or less costly and consequently their application is onerous, generally leading to a fall in employment in certain spheres. Hence the difficulties and limitations on the application of these

remedies, since every additional amount of employment found by means of a productive remedy is coupled with a certain decrease of employment as a result of the financial burden caused by the application of the remedy. Within certain limits, every artificial remedy shows a final credit balance, but once these narrow limits are transgressed the credit balance changes into a debit balance. In other words, these remedies are applicable only within certain limits, and beyond these the remedy becomes a negative one.

If, for instance, public works were to be financed by heavy taxation, then once certain limits were passed the excessive burden of taxation would lead to the unprofitability of factories, and to great unemployment. Or again, if an attempt were made to remedy unemployment by means of large-scale inflation or a radical devaluation on a number of occasions, then the resultant decapitalization would be so considerable as to cause mass unemployment.

Similarly a reduction of working hours could also, if so excessive as to be a burden on entrepreneurs, lead to unprofitability of industrial undertakings, or to a decline of workers' incomes below the level necessary for bare existence. Here, too, the final result would be the reverse of that intended.

Similar results would follow if the method were large-scale agrarian schemes, aiming at settling large numbers of the unemployed on the land. The immense cost of these operations would in a short time have harmful repercussions on the whole social economy. Should the Government resort to compulsory seizure of land without compensation, then the resultant conflicts and disturbances within the capitalist system, the loss of confidence, hoarding of capital and its flight abroad, would be so considerable as to lead finally to mass unemployment and produce in the end a debit balance. On the other hand, should the Government acquire the necessary land by way of compensation, its cost may be so high as seriously to damage the whole of public finance and lead to fatal disturbances on the labour market.

Even a large-scale reduction in taxation would ultimately lead to similar results. Should the Government attempt a large-scale reduction in taxation with a view to increasing the profitability of factories and so creating more employment—even here, once certain limits were transgressed, the result would sooner or later be a heavy loss to the public finances, and the final result would be injurious to the labour market.

We can see, therefore, from the above discussion the relative and limited nature of the application of artificial remedies. As a rule, a combination of a number of mild remedies gives a better result than the application of a single radical remedy, *i.e.* a remedy applied on a large scale. But even such a combination has its limits, since the defects produced by each one of those remedies are accumulated.

Only natural remedies for unemployment give best and lasting results, for they have no onerous effects on the social economy. Amongst natural remedies, the internal and external liberalization of the economic system is of prime importance. Dissolution of cartels and monopolies is part of the process of liberalization, as of the equalization of incomes; it increases both production and employment. The removal of State relementation as well as *the removal of obstacles in the international exchange of goods, capital and labour* helps to increase the volume of employment. The process of making economic life elastic, in the sense of allowing the proper working of economic automatism, is the best and least burdensome remedy for unemployment.

Without the dissolution of monopolies and semi-monopolies and without a *return to world economy*, the absorption of technological unemployment will become a matter of great difficulty with further technological progress. Monopolistic and autarchic economic systems will be faced with a choice of two alternatives: either a complete standstill of technological progress, or a thorough reconstruction of the system of ownership on the basis of the structural elimination of unemployment.

CHAPTER II

THE PROGRAMME OF THE TECHNOCRATS

§ 8. THE TECHNOCRATS AND THE PHYSIOCRATS

IN the thirties of the twentieth century there came into existence in the U.S.A. a new movement and a new doctrine of technological progress, which became known as "Technocracy." This doctrine resembles, in certain of its aspects, the economic doctrine of the French Physiocrats of the eighteenth century.

Technocracy, like the doctrine of the Physiocrats, is not only a theory which attempts to analyse a complex problem, but is also a new design for social and economic life. In fact, it is both a doctrine and a movement; but an intellectual and not a mass movement. The doctrine of the Physiocrats was based on a belief in an inherent natural order and on faith in the immense power of Nature; technocracy is a creed based on faith in the immense power of technology. The Physiocrats were physicians—the technocrats, technicians.

The Physiocrats were a product of France and their doctrine was peculiar to conditions then prevailing in France; it never had any decisive influence outside France. Similarly, technocracy is an American doctrine, a product of special conditions prevailing in the U.S.A., and the attempts to transplant the movement to other countries have so far met with little success.

Taken as a whole, the scientific standard of the Physiocrats is much higher than that of technocracy. Physiocracy was a great contribution to the economic thought of the eighteenth century; and this can hardly be said of technocracy. The simplifications of the Technocrats are crude simplifications, heresies of no useful purpose in the development of economic thought; on

the other hand, the simplifications of the Physiocrats were synthetic, constructive, and stimulated economic theory.

A further analogy can be drawn. Physiocracy reflected the influence of the eighteenth-century rationalists; it is without a doubt a rationalistic doctrine which purported to shape economic life in accordance with certain rationalist principles. Technocracy also reflects rationalistic influences, but in their most extreme form; it is a "hundred per cent." crude rationalism, appearing in the form of a naïve technical doctrine.

Technocracy purports to reconstruct the economic system according to certain technological principles and to put it on a rational and mathematical basis, on a formula in terms of energy. It is clear that only American conditions could give birth to such a doctrine.

§ 9. THE DOCTRINE OF THE TECHNOCRATS

The birth of Technocracy can be traced to the year 1919. The term "technocracy" was coined in that year by William H. Smyth, an engineer and inventor in Berkeley, California, as the name for a new system and philosophy of government which he proposed for the American people.¹ The original gospel and the basis on which the doctrine of technocracy has been built was a book called *The Engineers and the Price System*, written in 1919 by Thorstein Veblen. This small book became the virtual bible of technocracy. But the movement as such began only in the years 1930-3, at the time when economic depression in the U.S.A. reached its highest level. Howard Scott, said to be a scientist and an engineer, assumed the leadership of this group of Technocrats, which was composed of scientists, engineers and economists. Scott, L. Ackerman, Walter Rautenstrauch, Basset Jones and Fred Henderson are the main representatives of the theory of technocracy.²

¹ Allen Raymond: *What is Technocracy?* M'Graw-Hill Book Co., New York and London, 1933.

² *Ibid.*, p. 6.

The main idea of technocracy is its thesis of the necessity of substituting the existing price system by a new scientific system called the "energy system." The present economic system based on private property and profit—such are the Cassandra-like prophecies of the Technocrats—is doomed, for it cannot solve the present crisis, which is chiefly technological. The system withholds the immense constructive energy which is inherent in technology and which can only be made use of by means of a new social and industrial order, in which natural resources will be utilized for the purpose of attaining the best productive machinery.

A theory of economics based on notions of price and profit, money and credit, may have been suitable for an age of poverty, but is out of date under existing circumstances in this "age of plenty." The economics of an "age of poverty" have to be substituted for one of an "age of plenty." Existing natural resources are illimitable,¹ and "only the financial and commercial arrangements for the distribution of goods keep people back from security and a far higher standard of life than they ever have enjoyed."² Everybody—according to the Technocrats—man, woman and child would have an immense income which, measured in 1929 dollars, would be about \$20,000 a year.³

The organization of production should be handed over to engineer-technicians, who would replace entrepreneurs, financiers and economists (Veblen proposed the constitution of a Soviet of technicians). Production ought to be carried to its utmost limits, and not be restricted by considerations of private profit and prices. Production for the creation of property rights should be replaced by production for direct use and service. The only restriction allowable should be dictated by the law of the conservation of energy.

All "complications introduced by monetary systems"

¹ F. Henderson: *Foundations for the World's New Age of Plenty*, p. 51.

² Allen Raymond: *What is Technocracy?*, p. 176.

³ *Ibid.*, p. 4.

ought to be removed. "It is very clear," says Fred Henderson,¹ "that our present economic troubles are due to defective distributive procedure." The world is under a "central illusion of credit," which obstructs the proper view of things as they are in reality. Our economic theory is a "money-centric conception" and based on accountancy calculations. Our whole system is really a "costs-and-prices accountancy" and based on fictitious book-keeping entries of individual ownership rights.

The collapse of our system—explains Henderson—is due to the fact that mechanization has replaced to a great extent human labour in production, and thus the capitalist system of private property is no more dependent on the worker, who is now doomed to starvation. Mechanization has thus undermined the social system of private property, for great masses of workers have been deprived of a means of livelihood. Karl Marx has formulated this idea even better: "In the form of machinery, the instrument of labour enters into competition with the worker. The self-expansion of capital by means of machinery is directly proportional to the number of the workers whose means of livelihood have been destroyed by this machinery. The whole system of capitalist production is based upon the fact that the worker sells his labour power as a commodity. Thanks to the division of labour, this labour power becomes specialized, is reduced to skill in handling a particular tool. As soon as the guiding of the tool becomes the work of the machine, the use-value and the exchange-value of the worker's labour power disappear. The worker becomes unsaleable, like paper money which is no longer legal tender."²

The reforms proposed by the Technocrats are very indefinite, and statements made by representatives of technocracy have varied and contradicted themselves from time to time. Some of the Technocrats, notably Henderson, demand the abolition of the system of private

¹ F. Henderson: *Economic Consequences of Power Production*, 1931.

² Karl Marx: *Capital*. English translation by E. and C. Paul, p. 461.

property and its substitution by "social ownership" or a "Social Estate." Others restrict their demands to the creation of conditions necessary for an equal distribution of the Social Dividend. Others propose only a reform of the system of production and its management and planning by technicians. Others again, notably Howard Scott, propose to abandon the present monetary and credit system and replace it by "energy-consumption certificates." These "certificates are to measure the amount of natural energy that has been consumed in the creation of articles which consumers will wish to use."¹ In the energy-consumption certificates, the figures would represent kilogram-calories, ergs or joules.

A strict control and planning of production, a radical reform of the monetary and financial system, and the management of the country by engineer-technicians are demands common to all Technocrats. The State of the Technocrats would be a new scientific State known as the "Energy State." Under the engineering dictatorship, production will be under strict control. The technicians in charge of the State will decide what goods society needs the most, and how much of them it is socially valuable to make—and also to consume.

In the new "Energy State" envisaged by Scott as Technocracy, apparently if there is any social duty the duty will be upon everyone to consume his share.²

§ 10. THE SUBORDINATE ROLE OF TECHNOLOGY

Technocracy, as a programme and movement, is vague and mysterious, based on false assumptions and erroneous in its conclusions. Technocracy as a movement could be described as a certain form of technological Socialism. It is an exaggeration of the part played by technology, which does play an important part in economic life, but can never control it. Criteria of a technological maximum cannot constitute economic criteria. Technology cannot

¹ Allen Raymond: *What is Technocracy?*, p. 98.

² *Ibid.*, p. 99.

wield sovereign power in economic life, for the main feature of the economy is scarcity, and, *hélas*, not surplus and plenty—as the Technocrats maintained.

Dreams of an “age of plenty” belong still only to the domain of dreams. Should such an “age of plenty” become a reality, economics and all economic institutions would become superfluous. The technocratic conceptions of money and credit are so naïve as not even to deserve serious discussion.

Technocratic planning, if put to the test, would soon prove to be the worst form of planning and would tend to bring out all the defects of planning. It would be technological management against the interests of economic activities, for the supremacy of technology would soon prove disastrous to economic life. Technology must play a subordinate, and not a sovereign, part in economic life. (See Part I, Chapter I.)

THE FINAL CONCLUSIONS

PROBLEMS OF THE FUTURE

A DISCUSSION of the structural problems of our economic system is not within the scope of this book. We have, nevertheless, dealt with this aspect in passing, as it could not be entirely excluded. It may therefore be of advantage to devote a few more lines to this question.

The problem of our economic system is a problem of the future. As such, it is mainly a matter of making prophecies and casting horoscopes. Their nature is not scientific, though many writers attempt to cloak them with a scientific mantle. We shall, notwithstanding, make an attempt at such a forecast.

Will technological progress bring about the collapse of the capitalist system? We saw throughout our discussion how it undermines the fundamentals of liberal capitalism. We saw that technological progress is a factor leading to concentration of production, control and ownership; that it leads to autarchy and consequently to excessive nationalism and militarism. Modern capitalism is not a liberal system; it is monopolistic capitalism. Monopolies hold sway in all the great and important fields of the social economy. The control of production becomes partly a private and partly a State monopoly. In addition to the monopoly of capital, we notice a monopoly of labour, in the form of a trade union control of the labour market. Every field of economic life becomes rigid and subject to both internal and external relementation.

Will the capitalist system, being based on and closely connected with liberal principles, be able to survive the doom of liberalism? Will not the expanding power of monopolies lead to a complete State monopoly, *i.e.* collectivism, or to a rigid system of private monopolies, *i.e.* feudalism? Material circumstances of contemporary

industrial technology drive the economic system into a state of autarchic monopoly. It is difficult to foresee whether it will be a private or a State monopoly, though the latter seems to be preponderating.

“A complete victory of the principle of monopoly, with private property continuing, would create a feudal-like system, in which the whole apparatus of production would be monopolized and concentrated in the hands of a few feudal lords, who could at will tax the population by dictating prices. But the present general outlook, mass education, political consciousness and social structure point rather to the belief that with the complete victory of monopolistic principles capitalism will give way, not to feudalism, but to Socialism.”¹

Private monopoly means exploitation, imperialism and international conflict, excessive poverty on one side and excessive wealth on the other. But neither is the promise of a State monopoly very attractive. It would mean regimentation, centralization, bureaucracy, coercion and the degradation of man to the level of a tool and the deprivation of his natural rights.

Will our epoch completely betray and for ever abandon the principles of liberty and the fundamental rights of man, or will it return to them after all? Monopoly, in both its forms, means the abandonment of the principles of liberty and the basing of the whole economic—and consequently the social—order on compulsion. The present trend of events is away from liberalism. Some nations (Soviet Russia, Germany, Italy, etc.) are sailing at full speed towards some indefinite destination, towards some system which is a combination of nationalism and socialism; a combination of private and State monopoly, and based on autarchy, regimentation and compulsion.

But once the palate has tasted this indigestible mixture, will there not arise a desire for lost individual liberty, even at the price of material and other sacrifices? I am

¹ I have dealt with this problem in my book: *Die vier Systeme der Nationalökonomie Universalismus—Nationalismus—Liberalismus—Sozialismus*, p. 147. Berlin, 1932, Carl Heymanns Verlag.

convinced that after a period of monopoly there will come again a great liberal revolution, which will strike a fatal blow at monopolies (even if the end of monopolies should be brought about at the expense of technological progress) and change the direction and the very purpose of technological improvement.

The fight for liberty that will then start will be a fight against monopolies in all their forms. There is no doubt that this fight for liberty will be a fight for the survival of our civilization, since monopolistic autarchy, breeding aggressiveness and militarism, is a constant menace to civilization.

The fight for liberty will be at the same time a fight for further economic progress, since monopolistic autarchy undermines the fundamentals of further development, and economic and technological activity under such a system is riddled with stagnation.

.

The object to be aimed at is a change in the course and direction of technological progress. This change will have to be in the direction of qualitative, and not quantitative, technology, in the direction of capital saving, and not labour saving. The object in view ought to be the improvement in the quality of production and not an endless increase in output; in place of gigantic factories employing tens of thousands of workers, future development ought to proceed in the direction of hundreds of thousands of small workshops.

In Part I of this book we observed how already to-day there is evident a change from giant concerns to smaller workshops and plant. The great crisis of recent years has shown how difficult to manage are such colossal institutions, and how easily exposed they become to the economic fluctuations.

Should the tendency to decrease the share of fixed capital in industry continue and become stronger, then a change away from concentration and monopoly would

be brought about, and consequently also a return to a free market and a democratic system of ownership.

As far as the aim and purpose of technological progress is concerned, it is important to observe that not economic and technological factors, but rather the general outlook on life, the general cultural style and psychical attitude, are decisive in this matter. The art of culture and the prevailing spirit of the time determine the sense and purpose of technological progress. An examination of this aim and purpose in the course of past centuries leads us to the conclusion that technological development served different purposes at different times. The ultimate purpose of technological progress has consisted of

- (1) Better equipment in the essential commodities of life.
- (2) More leisure, which enables time to be devoted to intellectual pursuits.
- (3) Increased birth-rate.
- (4) The struggle between nations for supremacy.

At different times, different purposes, or a different combination of purposes, have predominated, and these shaped the style of cultural life.

In some periods, technological progress aimed mainly at a better supply of commodities, in order to provide the community with improved means of feeding, clothing and habitation. This was mainly the object of technological development in the era of liberal capitalism.

Rarely has technological progress served the purpose of providing more leisure. In it only in countries with a well-adjusted system of ownership, in which the community is not dominated by a desire for profit, *e.g.* agricultural and handicraft communities, that progress in technology is utilized for the purpose of extending leisure time and the enjoyment of goods that are not of a material nature.

In many periods technological progress has been used for facilitating the increase in the birth-rate. As a result of increased productivity of labour, a population

of ten millions is in a position to increase to twenty millions, since its maintenance is secured through the increased productivity of labour. This purpose served by technological progress has been in evidence throughout the ages, and it is only in the last few decades that some industrial countries show a falling birth-rate.

Again, in other periods of history, technological development was utilized for the purpose of waging military and economic wars. This is to a great extent so in monopolistic capitalism nowadays, for the monopolization of industries is a source of economic and military conflicts and of a militant nationalism in all its forms. The results of technological progress are used for the purpose of improving the means for military defence and aggression and for better equipment in the destructive economic struggle between the monopolies.

Technological progress is being exploited for the purpose of military and economic conquest to such an extent that the resultant armaments race and militarism constitute a grave menace to civilization. Technology seems to have chosen the ruin of our civilization as its ultimate aim and drives the world to destruction, by providing man with such instruments and weapons which he cannot control.

There must, therefore, be a change in the direction and purpose of technological progress. But only a change in the mental attitude and the style and standard of our cultural life can effect it. Moral influences must be allowed to prevail in deciding the fate and in shaping the form of our civilization and of man's place in it.

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