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The Second Industrial Revolution

Author(s): H. Stanley Jevons

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# THE ECONOMIC JOURNAL

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## THE SECOND INDUSTRIAL REVOLUTION

THE thesis of this article is that the advanced industrial countries of the world are now in the first stage of a sweeping change of the methods and organisation of all their secondary industries, and that this new movement is likely to be comparable in its industrial, commercial and social effects with that series of changes which commenced in the latter half of the eighteenth century and is commonly called the Industrial Revolution. The changes are coming about as the result not merely of the application of scientific knowledge to industry, which was, in fact, the last phase of the first industrial revolution, but of the use of the inductive method in the study of an industry, and individual concerns composing it, with a view to gaining facts and generalisations which may serve sooner or later as the basis of the replanning of the productive process and plant. The essence of the new industrial revolution is the search for exact knowledge, and the planning of processes: from the minutiae of manual operations (based on motion-study) to the lay-out of the machinery of a gigantic plant—even of a whole industry throughout the country. The trade and social results are to some extent different according to whether the industry is replanned and rebuilt under conditions of free competition or of monopoly; and in the latter case according to whether the monopoly is in private or public ownership—and absolute or partial. The effects upon wealth production and its distribution vary considerably according to the nature of these conditions; but it is arguable that one ultimate effect will be a stimulus to public ownership and operation of industries.

### *The Beginning*

The movement appears to have had its origin in the union of three distinct trains of ideas, which evolved with their corresponding actions. Accountancy ceased to be a mere record of

past events and developed in the latter half of last century into an applied science designed to aid the business man in the policy of his operations (*e.g.* by determining the relative profitableness of different sections of a business, rates of amortisation, etc.) coincidentally with the rise of the profession of chartered accountants. This led to the invention of cost accounts for factories so far back as the 'eighties.

The second train of ideas originated amongst engineers, who applied the results of pure science in the effort to attain safety and economy in the construction of bridges and other works, and ships and boilers. Methods of rule of thumb, or trial and error, were replaced by exact calculations and measurements. These methods were of paramount importance in electrical engineering and gradually spread through mechanical engineering work also during the past forty years.

Thirdly, there was ever-increasing competition amongst manufacturers and an ever-widening market. The great decline of prices from 1873-94 (in the United States from 1865-96) kept them busy devising ways of reducing costs; and mass production, which was devised in America and introduced into England in the 'sixties,<sup>1</sup> became a highly successful device in the new conditions created by falling prices. Many kinds of things were made in lots of hundreds or thousands at a time all alike, and with interchangeable parts, whereas the previous practice had been to make them in tens or hundreds. In certain industries mass production developed into continuous production, as in making sewing-cotton, paper, biscuits, watches, etc. Strictly speaking mass production merely means making a large number of articles exactly alike at one time for which special tools or adjustments of machines are employed; but in common speech it has come now to be synonymous with continuous production, which, of course, might be called "continuous mass production."

The application of scientific ideas to the tasks of the mechanical workshop combined with cost accounting was responsible for the birth of scientific management. The date 1911, when Taylor published his famous *Principles of Scientific Management*, inaugurates a definite acceleration of the second industrial revolution. True, several firms in the United States were already familiar with his ideas and were using his methods, and Gilbreth was already applying the results of motion study; but from 1911 on the ideas became common property, and "live" engineers and enter-

<sup>1</sup> "American Engineering Competition, 1850-70," by D. L. Burn; in *Economic History Supplement* to ECONOMIC JOURNAL, Vol. II, No. 6 (1931), pp. 297-300.

prising owners of engineering works learnt how to apply them. Success was but partial, however, owing to difficulties with labour, mainly from the neglect of one of Taylor's major principles.

Then came the war and its enormous demand for standardised munitions. Everywhere plants were reorganised on the basis of continuous production with Government-controlled cost accounts. Besides the Taylor ideas, welfare work and industrial fatigue research received a great impetus and general acceptance in engineering and other industries. Co-ordination of production in a number of different plants was secured by a Committee under the Ministry of Munitions. Striking progress was made with the introduction of automatic lathes and machine tools, several being in the charge of one worker.

The tendency to price rings, cartels and amalgamations in England was becoming marked before the war; but in Germany the movement had advanced further. In both countries war needs and measures tended to promote co-operation between producers in the same industry; and the habits of thought so generated persisted and have led to price agreements and amalgamations being a common feature of British industry, as of other European countries.

### *Rationalisation*

In the after-war reconstruction the importance of the new American methods—continuous production, specialisation, the replanning of plants, adoption of Taylor's principles and methods, personnel management and industrial psychology—was more widely recognised by German industrialists than by English. A great movement of reorganisation of industry on the new bases of efficiency commenced, and a few years later came to be known as "rationalisation." This term is appropriate because the transformation of industry which it denotes is based on reason throughout, being a replanning of equipment and labour methods on the basis of observations and estimates having a scientific basis. There appear to be five features essential to the rationalisation of an industry :—

(1) Amalgamation or unified control of companies and elimination of weak concerns, so as to secure control of the market, and thus facilitate on the basis of monopoly profits the raising of the large amount of new capital necessary;

(2) Specialisation of plants and their re-equipment so as to reap the maximum economies of large-scale production,

both in respect of machinery and of organisation; and the building of large new plants for products in the manufacture of which the utmost economy can be reached only in this way;

(3) The planning of each plant for continuous production with specialised machines and tools;

(4) Specialised management, largely functional, including careful buying, grading and mixing of raw materials;

(5) Perfection of manual operations on the basis of time and motion studies, with necessary instruction.

All these are ways of reducing either prime or supplementary costs: their relative importance varies according to the product and prevailing conditions.

It is a matter for regret that the term rationalisation should have come widely into use in this country, though its implications are but little understood. Even economists must be blamed for having sometimes used the term with looseness or ambiguity. Particularly objectionable is the phrase "financial rationalisation," meaning no more than financial reconstruction: writing down book assets, carrying through amalgamations and raising new capital, without necessarily involving the physical improvement of plants.

### *Specialisation*

Rationalisation implies control over practically the whole of the industry in the country, whether that be gained by the commercial method of the large and enterprising capitalist dominating and buying up the smaller, by voluntary combination, or by State intervention. Specialisation, although an essential measure for real success in rationalisation, is also increasingly adopted in industries open to free competition on account of the great opportunities of profit which it provides when followed with boldness and circumspection. Amongst the dozens of examples, mainly American, the one outstanding is the business of Henry Ford. He diagnosed correctly an almost universal want, and with the utmost boldness set out to supply it by continuous production in a specially built plant.

Specialisation is from the theoretical point of view merely the best way of carrying the realisation of the economies of large-scale production to its logical conclusion. Doing so, however, involves a good deal more than is generally realised. The manufacturer, or producer of any kind, makes up his mind to produce

one kind of article only, instead of a range of various articles usually considered as belonging to the same trade. Take, for instance, the old-fashioned trade of a locksmith; he was accustomed to make locks of all sizes and kinds, both padlocks and locks for doors, cabinets, drawers, etc., both in brass and iron. There are still many such manufacturers of locks in England who produce a complete range of styles and sizes. Looking through a Commercial Directory one finds any number of examples in the iron and steel, machinery and hardware trades where manufacturers have a varied output, some of the products being quite unrelated to one another in production.

A manufacturer who decided on a policy of specialisation would decide to make padlocks only, or door-locks only, or window fastenings only, and so forth. He would lay down a special plant for making these by automatic casting machines; or by stamping and pressing machines where sheet steel or brass could be used as the raw material. The hollow-ware manufacturer, if he specialised, would decide to make nothing but galvanised iron buckets, or nothing but kettles or saucepans. The whole of his plant would be constructed according to a plan designed especially to produce buckets and nothing else, with automatic machines, and the material carefully routed.

Specialisation with continuous production has already been introduced in a number of British industries, so that the principles are thoroughly understood by machinery manufacturers. One of the best examples which occurs to one is the modern match factory. The material, from the moment the logs are placed in the veneer-cutting machines until the final packing in 50-gross cases, is never touched by hand, but goes through a continuous series of automatic machines, drying ovens and packing machines which have merely to be regulated, and adjusted and supplied with material. Extraordinary economies can be attained by specialisation. During the nineteenth century the use of machinery and power in the ordinary engineering workshop or hardware factory of this country effected considerable saving as compared with methods involving a considerable amount of hand work; but the further reduction of costs which can be obtained by the use of machines specially designed for the successive operations in making each part of the completed article is so great as to constitute a new or second order of economies in the use of machines and power. In a large factory producing continuously there may be as many as two thousand machines, most of them different and each specially designed for its own work.

*Concentration of Attention*

The very striking reduction of costs which can be obtained through specialisation appears to arise largely from the *concentration of attention* by the proprietor or general manager of the business and the technical specialists he employs upon the problems of reducing costs. When such concentration of intellectual effort and experiment takes place with the aid of experts who have at their command all the resources and accumulated technical experience of this and other countries, totally new ways of producing articles can be discovered; or the old methods can be altered almost out of recognition by pre-treatment of materials, by redesigning the article, or by multiplication or simplification of the machines or other plant employed.

The concentration of attention is needed: (1) before production is commenced; (2) when the plant is running. The work which spells success or failure is, however, done before production starts. The organiser (or organising proprietor) must first decide his general policy. Should he concentrate on one article by specialisation, or should he concentrate on variety? In the first case he looks for profit by making a single article which is in wide demand in a standard pattern for the lowest possible cost, always working before and after construction of the plant to get cost per unit to the lowest possible figure. In the second case he looks for profit by the number, originality, convenience and attractiveness of his designs of the article in question. A bright idea in design may put up the price he can charge for his article by 50 per cent; and this is more important than any economy he would be likely to get with a similar amount of intellectual effort devoted to reducing costs of production, considering the limited market there is for such novelties. In a great number of trades producing articles of clothing and adornment, furnishing and decoration of houses and other equipment, no less than in confectionery and stationery, there is indefinite scope for novelties in design, whether these have to conform with fashion or not. On the other hand, in articles of utility universally used in the kitchen, workshop and so forth, the scope for profit lies in standardisation and concentration on reduction of costs by specialisation. The policy of concentrating on variety and novelty of design, though profitable up to a point, is rarely the means of accumulating a large fortune, and is of small social consequence in comparison with the second policy: that is to say, cost reduction by specialisation on an article in wide demand. We need not be concerned further with the former.

*Procedure in Organising Specialisation*

Specialisation necessarily involves large capital outlay, for two reasons. In the first place, the cost of production can be lowered only by continuous production with the operations greatly subdivided; and to justify such a plant an output is likely to be needed from five to thirty times as great as that of any existing plant manufacturing the article in the country. In the second place, full advantage will not be taken of the new method of production unless semi-automatic machine tools, conveyors, etc. be introduced which are economical in labour cost but costly in capital outlay. Undoubtedly it is the enormous cost of the plant which would be needed which hinders the adoption of specialisation in the old-standing industries of this country. Nearly the whole of the existing plant would be useless for the purpose in many industries.

There are two ways in which specialisation has been initiated in America, Great Britain and other countries. In certain cases a firm has decided that it has sufficient capital resources, or power of raising capital, to enable it to specialise on one or other of the products which it is already producing and marketing. It is prepared to risk a considerable loss in view of the large profits which appear likely to mature from a successful operation of the proposed new plant. The firm relies upon the success of its carefully laid plans to be able to oust its competitors from the market by substantially reducing the price. The outstanding example of specialisation in a competitive market is the Ford car, but many examples could be quoted in the manufacture of watches, locks and tools.

In an old-established industry where competition is severe it is probable that no firm will care to risk the capital outlay necessary for specialisation. It is likely to be introduced only by the amalgamation of a number of firms controlling more than 50 per cent of the output in the trade. The *modus operandi* is as follows. Let there be, for instance, twelve firms each making five or six of the products which we may call *a*, *b*, *c*, to *h*, being kinds of goods which are related in the sense of finding common marketing facilities, or perhaps in needing the same raw materials or manufacturing plant. The twelve firms become united into one; and this large new company establishes eight new plants, each one devoted only to the manufacture of one of the products *a* to *h*. The new company formed by the amalgamation will retain the trade connections and goodwill of all the twelve firms, and may to



some extent find it desirable to carry on business under their names or brands; but any particular product *a* will now be of exactly the same pattern whether marketed under one name or another; except, it may be, in some minor feature for which the machines can be altered at little cost. Combinations of firms which stop short of amalgamation rarely achieve true specialisation.

The problem of introducing specialisation is easier and the risk much less in a new industry than in an old-established industry. By new industry is meant one which satisfies a newly-developed want by means of a new invention: as in former days the bicycle or incandescent electric lamp, and more recently the motor-car, aeroplane and wireless receiving sets. In a new industry it may be possible to gain temporary monopoly by means of patent rights. Even if there is no patent on any part of the article or any of the machines specially designed for manufacturing it, the profits are likely to be large if the cost of production is greatly reduced by a large output, on account of the fact that, being an article which satisfies a newly-developed want, the demand for it will be growing. The manufacturer has the advantage that the demand curve moves away to the right at the same time that quantity demanded on the new curve is increased by the lowering of the price. Moreover, in a new industry it is unlikely that there will be a large number of existing firms. Consequently specialisation may be introduced before the margin of profit has been reduced to that which barely suffices to attract more capital. In such an industry specialisation, if energetically pursued, is safe and very profitable.

In an old industry, on the other hand, the manufacturer is bound to take a plunge, so to speak. There may be other manufacturers planning to do exactly as he is planning. A sudden influx into the market of a competitive article similar to his, also made by specialisation, might spell ruin. Perhaps he is able to find out what other firms in his own country are doing; but he cannot foresee similar competition from abroad, which would be equally damaging in the absence of a protective duty.

There are certain definite inquiries and preparations which a manufacturer considering whether he will specialise on some article and produce it in quantity by continuous production must make. He has first to investigate the market for the article (1) at home, (2) abroad; and must consider, on whatever evidence he can collect, the elasticity of demand. That refers to the total quantity of the article demanded at each price, being the product

of all firms in the industry together. He has further to consider how far his particular article in its new form will be an effective substitute for the particular styles or brands now on the market, and also how far his competitors are likely to be able to lower their prices to meet his competition. There are experts in market research who can undertake such investigations; but he should satisfy himself as to their evidence and reasoning.

I have mentioned that he has to consider the demand for the article "in its new form." In specialising and using automatic machinery the lowest cost of production will be found by adapting the materials used and the method of moulding them to the most convenient machines—that is, those which are most economical in operation. Thus pressing and drawing of sheet or bar metal is substituted for casting; and grinding is substituted for turning and planing. On the other hand, since the article to be manufactured is to be produced in great quantities by a costly plant, it must be standardised, so that the design need not be changed (except perhaps in details) for many years. It is desirable, therefore, before adopting a design to consider most carefully in what respects it might be improved in serviceability, durability and appearance. The utmost of utility to the consumer must be offered at the lowest cost; and these requirements act and react on the design until it is finally settled. It is the business of the production engineer—a young and important profession—to aid in the designing of the article for mass production with these considerations before him; then to design the machines, jigs, tools or dies to produce it, and the layout of the whole plant. Throughout the whole process of arriving at the best design of the article, and the machines for producing it, cost of material and of operation has to be investigated; for the decision is ultimately one of utility to the public *versus* cost, with the qualification that the utility of marginal improvements in design must be separately balanced against their cost. Here again the income class to be supplied has to be considered; and the opinion is usually formed that it is the mass of the people with low and moderate incomes for whom it pays to cater by specialisation.

The design of the article and the character of the plant being settled, steps must be taken towards the erection of the factory. The location needs carefully investigating; and although the firm may have an existing factory, it does not follow that the most economical policy is to extend it or to build another factory beside it. A wholly new locality may be best.

It must not be supposed that the search for economies in

production is ended when the plant and management have been planned and set in operation. A continuous record of results is maintained, with experimental costings of details which it is not worth while continually to record; and this provides information as to the results of trials of changes in methods of operation. An alert management will always be making slight changes in materials, processes or machines and measuring the results with a view to reduction of cost, or to improving the quality of the product, and thus raising its selling price. Such improvements take place not only in the technical (*e.g.* chemical and mechanical) aspects of the production, but also in the methods of the workers, whose movements in relation to material and machines are perfected by the methods of motion study applied by industrial psychologists and other specialists.

Many firms maintain laboratories for testing materials and products; and often they have also a research laboratory. We have here to distinguish between research for three classes of problems: (1) in pure science, such as usually carried on at universities, and science institutes; (2) fundamental research for an industry, such as that carried on by the Shirley Institute, Manchester, for the cotton trade, or in Sheffield University for metallurgy; (3) purely trade research carried on by the firm itself in its own laboratory, in which its own plant, materials and processes are subjected to examination by experts in the light of the results of scientific and fundamental research. The problems of each firm specialising in a particular article are different; and if it has no adequately staffed laboratory it cannot make use of the published results and information placed at the disposal of the industry by a public research institute or department.

The procedure of specialisation by an individual firm has been described in some detail here because it appears to me to be highly important that the principles involved therein should be common knowledge amongst economists and business men. When specialisation follows an amalgamation of existing firms the procedure to be adopted is practically the same as above in regard to each of the articles which they decide to put into continuous production. The difference lies in the possibility of certain other economies accruing from such opportunities as, (1) the employment of whole-time experts; (2) exploiting possibilities of correlating the processes for producing two or more articles, which might involve savings in materials, power and the utilisation of waste products.

In this country the English contempt of logic and love of

compromise is a real danger in the present situation of our old-established industries. A company formed by amalgamation which intends to adopt specialisation with mass production must do so thoroughly. Old plants should be scrapped completely as soon as possible, and wholly new mills or factories built on the largest practicable scale with the latest proved devices for saving labour and for scientific control of the production process. All hankering after using existing buildings and machinery, unless thoroughly adaptable, must resolutely be put aside.

As to the place which large-scale amalgamations occupy relatively to merchanting firms which have an established business in disposing of the products of the industry, there is much to be said for the view that no adequate reorganisation of an industry is practicable so long as home merchants and foreign shippers continue their business on existing lines. Either they must greatly modify their operations to suit the new industrial organisation, or the latter must develop its own marketing at home and abroad, as has largely been done in the newer industries.

#### *Conditions Favouring Specialisation*

Conditions favourable to specialisation did not come into existence until the latter part of the nineteenth century, when the mechanisation of agriculture in North America and most of Europe, and the increasing use of labour-saving machinery in our basic industries, had increased purchasing power; and freight rates by rail and ocean had been greatly reduced. In the last forty years markets have become world-wide, except for tariff obstructions; and the purchasing power of the population of these islands has greatly increased. It may be agreed that general economic conditions have never been more favourable to specialisation by British manufacturers, foreign tariffs notwithstanding. Specialisation is capable of reducing the price at which an article can be sold profitably by 25 to 50 per cent—sometimes by 60 to 75 per cent, if the output be large enough. To obtain a large output disposal abroad at a price somewhat lower than in the home market can be adopted profitably as a permanent policy: witness many American products. Consequently tariffs of 30 per cent, even 50 per cent, will not stop the entry of our goods produced by specialisation into countries not producing with equal economy, and having markets large enough to keep down the cost of marketing.

The above refers to kinds of articles already in use by, or well

known to all but the poorest classes in most countries of the world. In the case of an article for which there is a large potential demand, but which embodies a new idea, and perhaps needs the formation of a new habit, people have to be educated into knowing that the article exists to serve them; and this will cost perhaps more in advertisement than the actual cost of manufacture of the article.

British manufacturers of articles which have been in common use for decades or centuries still cling to the old system of marketing through factors or wholesale houses, except in a few trades like boot and shoe making. This is antagonistic to amalgamations and specialisation; for each manufacturer has his connections in several factors, and each of the latter his connections with retailers on the one hand and manufacturers on the other. To break into such a system with an article, which must be sold everywhere to pay, costs much capital and effort in organisation. Usually it can only be done by an amalgamation of manufacturers in the same trade who can raise capital sufficient to organise mass marketing through their own travellers, or through chain stores.

The foregoing inadequate sketch of the marketing conditions which favour specialisation must suffice, from considerations of space. Another essential condition is the availability of experts who can aid the proprietor, or undertake for him the planning of production and plant. This work is a branch of engineering for which the training is that of a mechanical and electrical engineer, to which must be added a sufficient knowledge of accountancy to understand cost accounting in detail, the balance sheet, and problems of depreciation; and familiarity with wage systems, labour problems and elementary economics. In the United States during the present century production engineering has become a well-established profession comparable with electrical engineering; and much of the astonishing progress of American industries since the war is due to the employment of these experts, both as full-time officers and as advisers or consultants.

A third condition which may be decisive is the availability of new capital. The capital required to build and equip a unit plant for continuous production with modern high-speed automatic machines varies greatly according to the character and size of the article; but is always considerable, judged by nineteenth-century standards. When an industry organised on modern lines has proved profitable the public will invest freely: *e.g.* the gramophone companies in recent years. Obviously a favourable report by well-known independent experts—one a specialist in market

research, the other a production engineer—called in in a consulting capacity would strengthen the prospectus; but such consultants are very few in number as yet in this country and have yet to establish their practice and gain a wide reputation. Another difficulty is that where the article, or machines for making it, cannot be covered by patents, the firm may hesitate to advertise their plans widely by issuing a public prospectus. Investment trusts and issuing houses are needed which will undertake to finance such new plants as their advisers approve, the shares being disposed of to the public after the concern has proved its dividend-paying capacity. There is here an opportunity for the recently formed Bankers' Industrial Development Company, and perhaps for a new investment trust for each of the old-standing British industries.

Capital would be required to the extent of some hundreds of millions of pounds to introduce specialisation throughout our principal industries. I see no prospect of raising the immense sums needed without Government aid; and in our old industries, now subject to intense foreign competition, re-equipment is a speculative investment unless done boldly on a very large scale. Government aid to private enterprise is a vital national concern in the present state of our industries; and it could take the form of advances through investment trusts for each industry or by guarantee of their bonds for a consideration of  $\frac{1}{2}$  per cent per annum. The State must protect its own investment, and should protect capital privately subscribed for reconstruction and re-equipment of any industry for which the prospects are good because the conditions are favourable if the plant be modernised. This indicates the probability that safeguarding duties will be imposed to protect an industry during the period of re-equipment; but, unlike the recent and present safeguarding duties, they should be imposed only after the industry concerned has submitted plans for reorganisation and these have been approved. Protection, which must be at a high rate, should be offered only for the precise period estimated to be needed for rebuilding, and for a standard period of five years thereafter. The practical certainty of large profits for five years would give security to the State and to the private investor. It cannot be seriously held that paying a shilling or so extra for a pair of scissors or gloves is a hardship to the consumer.

Another important condition favouring specialisation is the absence of opposition from organised labour. It is commonly believed that Trade Unions have opposed the introduction of

labour-saving machinery in recent years. Whilst no doubt there have been cases of ignorant obstruction, the truth seems to be that the objection has been to changes which would be liable to lower the earnings of their members, and require longer hours, or more effort and attention during the existing hours, for the same rate of wages, on the theory that work involving greater mental or physical strain should be paid at a higher rate per hour. Piecemeal introduction of labour-saving appliances, or different ways of manning existing machines, is very liable to produce these results if profitable from the employer's point of view. Specialisation with continuous production involves the establishment of an entirely new plant; and the problem is therefore different. Even with an increased output the number of workmen employed is likely to be considerably reduced. Many of the machines can be minded by women or men with some intelligence but little training, and a sufficient supply of such labour can be obtained at substantially reduced wages rates. On the other hand, specialisation rightly carried out is so profitable that high wages rates can be paid in any industry; and it is a wise policy to increase rather than decrease the wages of any part of the staff, and to employ as many as possible of the former workmen. On the assumption that this will be the policy, organised labour is favourable to specialisation. In fact, at the present time the demand for rationalisation is coming from labour circles.

### *Professional Associations*

An important characteristic of the second industrial revolution is the professionalising of industry. The general administrative, technical and managerial functions are becoming clearly distinguished; and there is growing a recognition of the qualifications to be required of the candidates to fill posts for each of these functions. Just as the older professions have each their association which sets up a standard of knowledge and experience for admission, so also the young professions connected with industry are organising themselves and establishing standards of qualification for membership. In some cases tests have been introduced: with others that end is in view, and a policy of admission and education has been adopted which will lead up to its attainment.

This movement has extended much further in America than in this country; but here there are a number of professional associations connected with industry already established and at work, even if their membership be not large. Everyone is familiar

with the Institute of Bankers and the Institution of Mechanical Engineers. Formed in recent years somewhat on the same lines are the Institution of Automobile Engineers, the Institution of Production Engineers, the Institute of Cost and Works Accountants, the Association of Welfare Workers and Personnel Managers, and the Institute of Industrial Administration. Although original members were admitted without examination, all these institutions now regularly hold examinations which young men and women have to pass in order to qualify for admission to membership or associateship. The Institution of Production Engineers deserves to be better known. It has set itself the task of raising the status of the industrial specialist to a high standard of education and technical qualification.

An organisation of a different type which is characteristic of the new industrial revolution is the research institute. This may be, in fact, a Government or University department, an association, or an independent corporation. As examples I may mention the National Physical Laboratory, the Fuel Research Board, the Technological Departments in the Universities of Manchester, Leeds, and Sheffield; the British Engineering Standards Association; the National Institute of Industrial Psychology, with its Scottish branch; and the Shirley Institute, Manchester. Another type of organisation for research is that in which a number of firms in a trade combine to form an association to investigate problems in which all are more or less interested, as in the motor industry. "Management research groups" of this character are doing very useful work.

### *Trade Organisations*

Another feature of the present industrial changes is the growing importance of trade organisations in British industries. We have long been familiar with associations of employers set up in opposition to Trade Unions. These belong to the old order of the first industrial revolution. The associations to which I refer do not concern themselves with questions of wages or conditions of employment, but with problems of marketing, the relation of the industry to Government and taxation, and with supplying their member firms with information of a technical and business character. There are over a hundred and sixty such associations in the various British industries, admitting to membership only firms actually engaged in the industry. Most of these associations are themselves members of the Federation of British Industries,



which has also some thousands of firms in direct membership. This federation has a considerable staff for aiding and informing its members in numerous ways. Having been founded only in 1916, it is still young; and it is possible that it may so develop as to take a leading part in the great changes in industrial structure which are needed and imminent in the older British industries.

### *Trade Results*

It was pointed out above that specialisation may be introduced either in conditions of free competition or following the creation of a complete or partial monopoly. As a rule it has taken place and succeeded under free competition, as in America, Germany and some of the smaller European countries. There has usually been a protective tariff; but when the new plant has come into full operation this has become inoperative and an export trade has been developed. In England specialisation is characteristic of the newer industries, situated for the most part in the South Midlands or around London; but there are isolated examples in the hardware industries of the Black Country, and two or three in Sheffield and the north-east coast.

Specialisation introduced by amalgamations has prospered of recent years in America and Germany. England is amazingly backward in this respect. Such a combine as Agricultural and General Engineers has two or three constituent firms producing similar types of tractors and other machines. The National Light Castings Association seems to be interested solely in maintaining prices of products and has done little or nothing to prevent its numerous member firms duplicating each other's products. A dozen firms may be producing the same article in small quantities and selling at an agreed price through the same agency. In the public interest specialisation and continuous production on a great scale is badly needed in all the house-fittings and furnishing, hardware and cutlery trades of this country; and where price associations exist it is astonishing that specialisation is not organised by amalgamations, or by a system of mutual concessions and joint selling agency.

Specialisation taking place under free competition is irregular and unco-ordinated. Marketing is relatively expensive; and supplies of materials are not always assured at reasonable prices. If amalgamation takes place, and some degree of monopoly is established, specialisation can be introduced almost simultaneously for a series of products capable of being marketed together. There

is a chance for the whole industry to be planned, which allows of important economies being realised both by extension to sources of raw materials and by utilising waste products. There is, of course, a danger that monopoly power may be used to keep up prices in spite of considerable reductions of costs having been realised, as has happened in the petroleum refining and tobacco manufacturing industries. If carried to excess this tendency will lead to a demand either for the control of prices, or the taking over of the industry by a public corporation working not for profit, but for a fixed rate of interest on capital. It is important to realise that the professionalisation of industrial management now beginning, together with accurate cost accounting and statistical systems of control, render public operation of manufacturing industry possible; and far easier than the nationalisation of mines, which is insistently demanded.

### *Social Results*

During the nineteenth century England became unaccustomed to the flooding of its markets by manufactured products from abroad. The idea was self-sufficiency in manufactured products, and a considerable export of the same, whilst importing food and raw materials. The progress of the new industrial revolution in other countries has entirely altered the outlook. Articles produced by specialisation abroad will invade our markets more and more, and protective duties would need to be high to keep them in check. Once a British industry had adopted specialisation and established its position it would not need protection.

The nineteenth-century doctrine of free trade did not envisage a situation in which England would be one of a number of highly industrialised countries in all parts of the world. It is obvious that in the new situation that will be created by the second industrial revolution it will be possible to supply the whole population with manufactured goods of the greatest variety; and the problem will then present an aspect which seems never to have been thought out. Apart from primary industries which are dependent on climate or the locality of occurrence of natural resources, the controversy between free trade and protection resolves itself into the question whether we wish most the development of the industries of transport, with their inconveniences to the workers, or of manufactures. For most kinds of manufactured goods now on our markets the home demand will become so great that the limit of reduction of cost by specialisation will be reached

in supplying the home demand. Interchange with other countries would only be desirable if differences of style or of artistic design were appreciated. There would always be, however, a considerable fringe of articles, often recent inventions, in which the limits of economy by specialisation would not be reached in supplying the home market. In this case specialisation by countries would be desirable. Thus, whether protective tariffs should be imposed to guard a home industry or not depends upon the probable ultimate home demand; and, of course, on whether the industry is prepared to organise itself for specialisation.

In conclusion, it may be well to point out that specialisation, no less than complete rationalisation, in any country which adopted it for all its industries would enormously increase the real income of the community. This indicates the outstanding importance of pushing on rapidly with bringing into being the new structure of industry in this country. Beside this, questions of the distribution of gold and bank credit are of slight and temporary significance. The real solution of the unemployment problem in this country is the reduction of the costs of production in industries and agriculture; and this can be done by specialisation and mechanisation. The faster these are pushed on the more employment will there be in expanding the machine-making industries, and in manufacturing tractors and improved agricultural machinery. The building trade would be enormously expanded in constructing the new factories and in solving the housing problem with the aid of specialisation in the production of all the parts and fittings of houses. It seems probable, indeed, that the technological unemployment created by rapid rationalisation of our older industries could be nearly balanced by the absorption of workers in the constructional industries, so that unemployment would remain at about the present volume during the transition period. When the much lower range of prices and new marketing organisation had been brought into being the volume of unemployment might be expected to fall rapidly to perhaps the pre-war proportion of the population. The capital required for the reconditioning of British industries will amount to very many millions of pounds, needed within five years or so. Progress is retarded partly by ignorance of the methods of specialisation, partly by vested interests, partly by the fancied opposition of organised labour, and largely by a general want of confidence. To provide the capital in the large amounts needed as and when required it seems essential that the credit of the State should be used in one way or another.

H. STANLEY JEVONS