BARNETT HOUSE PAPERS. No. 7

Scientific Management and The Engineering Situation

SIDNEY BALL MEMORIAL LECTURE

DELIVERED BEFORE THE UNIVERSITY OF OXFORD
28 OCTOBER 1922

BY

SIR WILLIAM ASHLEY

VICE-PRINCIPAL AND DEAN OF THE FACULTY OF COMMERCE OF THE UNIVERSITY OF BIRMINGHAM, SOMETIME PROFESSOR OF ECONOMIC HISTORY IN HARVARD UNIVERSITY, HONORARY FELLOW OF LINCOLN COLLEGE, OXFORD

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SCIENTIFIC MANAGEMENT AND THE ENGINEERING SITUATION

It is now forty-two years since I first saw Sidney Ball. I had gone to Göttingen to listen to Reinhold Pauli, the historian of the English Middle Ages. On Pauli I called upon my arrival. 'What you must do', he at once exclaimed, 'is to see Herr Ball: he'll tell you everything about Göttingen. We'll go and find him'. Fortunately Göttingen is not a large place; but it took some time to run Ball down, my genial companion muttering strange oaths as we went, to put me at my ease by his command of colloquial English. We found Ball at last, and he 'took over'. Then and there I had my first experience of his prompt kindness, his delicate consideration, his abounding vivacity. 'You must come and have supper with me: but perhaps I had better get some *Fleisch*.' So he hurried me off to a shop, and bought some slices of bully beef, and carried it in his hand to his lodgings, wrapped up in paper. How often since have I recalled that bright figure, with its charm and ease and confidence, so infinitely attractive to an awkward and timid junior!

Ball had taken his degree the year before, and was then sitting at the feet of Lotze. I took my degree the year after. For the next four years I was maintaining myself as a coach, uncertain at the opening of each term whether I should have enough pupils to pay for my lodgings: Ball had soon an assured position as Fellow and Tutor of a college. It may readily be imagined what the comradeship, the eager outpouring of ideas, the ready hospitality of such a man meant to one whose social opportunities had been as limited as mine.

It is now so long ago that it can hardly be indiscreet to add that, if Ball could have had his way, we should have become colleagues in college work. It was not to be. No sensible man who has gained from Oxford what I have gained could think of grumbling because in earlier years hopes more than once

went astray; but he may feel as I do the warmer gratitude—gratitude which grows as he looks back over the perspective of four decades—to the college which did show sufficient confidence in him to invite him into its society.

The intimacy of those early days was broken by my removal across the Atlantic; and Ball's subsequent career as a leading Oxford tutor I was too far off to watch. With passing years, I suppose we tended to diverge—not in social ideals but in our views as to their realization. I have sometimes wondered whether a classical culture, largely occupied with Greek political philosophy, may not predispose a scholar to think too readily of economic conditions as plastic to ideas, as susceptible of large and rapid modification by the will of the legislator; while an historical training, on the other hand, may predispose a student to emphasize—perhaps to over-emphasize—the slowness of social evolution. Ball, I think, always had more respect for orthodox economics: he regarded the just claim of Marx that he built on Ricardian foundations not as an argument against Ricardo, but as an argument in favour of Marx. Individualism and Socialism are, in truth, spiritually akin; they are both examples of abstract thinking; and of abstract thinking which goes for a considerable distance along the same lines. The admiration I felt for Schmoller and the historical economists called forth from Ball, I have to confess, only good-humoured badinage.

There is an aspect of my friend's life on which I should like to dwell for a moment. Coming back to Oxford, from time to time, from Toronto and Harvard and Birmingham—places where, from the nature of the situation, the teacher has commonly to deal with students in the mass—it was a constant surprise to me to see the intimate and personal interest Ball took in the work of the individual undergraduate. It is not every one who is able to rise, so spontaneously and happily, to the fine ideal of the Oxford tutorship. But, if I may trust what the men of his college have repeatedly told me, that is just what Ball did. They might smile at some of his characteristics; but they respected him as a scholar, and they were grateful to him as a friend.

Not only was he true to the best tutorial tradition; he was

intensely devoted to Oxford. To my mind in later years, bent as I was on helping to create centres of scholarship and research right away from Oxford, Ball's academic horizon, in spite of his humanitarian ardours, was perhaps just a little restricted. If his contemporaries here were sometimes disturbed by his eagerness to widen the range of Oxford studies and to extend the University's appeal to the less fortunate classes, they must surely have half forgiven him when they saw how whole-heartedly he believed in the national mission of this ancient seat of learning. His vision of Oxford was the prophet's vision of Jerusalem: 'the mountain of the Lord's house shall be exalted above the hills' and plains of the Midlands and Lancashire and Yorkshire; 'and all nations'—or, as Disraeli would have said, both 'the two nations'—'shall flow into it'.

It is sadly true that concentration on the tutorial work of one college and the limitation of active interest to one university are attended by a grave risk—that professional disappointment, should it come, will be acutely felt, however bravely and smilingly it may be borne. Such a trial my friend was not spared. The more fitting it is that his memory should be kept fresh by this Memorial Lecture in the university which he adorned and loved.

My subject is what is known as 'Scientific Management'. This is a term of which much has been heard in the United States for a dozen years past; since the time when a leading advocate—who has since become one of the Judges of the United States Supreme Court—made unexpected and conspicuous use of it in certain hearings before the Interstate Commerce Commission. That was in 1910. It is characteristic of America that, when a new idea once begins to take hold, it spreads with amazing rapidity; propaganda societies are formed, national conventions held, journals started, courses planned at the universities. And this has been the case with 'Scientific Management'. The movement which the term denoted had lost some of its early fervour and confidence in the land of its birth; it had somewhat changed in character, when it reached England toward the end of the War. Here it has already

attracted a great deal of attention from the younger generation of workshop managers, especially in the engineering and kindred trades. The conditions have been favourable for its reception. The War did much from the first to stimulate tendencies in manufacturing methods which had long been making headway; but the changes continued to be dictated by immediate expediency; they were little theorized or made the conscious subject of reflection. But during the last three or four years the counters of the booksellers in the great cities where engineering finds its centres have been laden with 'Management' and 'Efficiency' literature from across the Atlantic. In the writings of Frederick Winslow Taylor and of his disciples and successors, America has offered English business men a body of teaching for which they were to some extent predisposed, but which it is doubtful whether they would have constructed for themselves. I will venture to add, and I think I shall be able to show, that it is teaching which, in important respects, is out of harmony with the best English traditions.

In studying 'Scientific Management' we may follow one of two courses. We may examine it historically. We may ascertain what were the special ideas which the man who, more than any other, gave to current tendencies the shape of a conscious policy, namely the American engineer, Frederick Winslow Taylor, put in the forefront; how he defined Scientific Management; and how far, if at all, he afterwards shifted his position. Or, still pursuing the historical order, we may take a wider range, and include with Taylor the three men, Gantt, Emerson and Gilbreth—of whom the two latter are, I believe, still living—who have won for themselves reputation and business success by the advocacy and application of derivative or supplementary ideas; and we may notice similarly with them how definitions have varied and emphasis been redistributed. Or we may take the other course of examining Scientific Management analytically. We may look at the body of teaching and the mass of experiment as a whole, and seek to disentangle in our own way the various elements of which it is composed. It is the last course I propose to adopt.

Scientific Management may be defined as the conscious

application of directing intelligence to given manufacturing operations—as distinguished from Commercial Policy which determines the nature and scale of manufacture, and Technology or 'Applied Science' which determines the most appropriate machinery. In actual business practice these three things can never be kept apart; each impinges on the others. Nevertheless, the distinction is important for our purpose. Among manufacturing operations I shall have in mind chiefly engineering and the cognate metal trades.

The task of Scientific Management is, in the first place, simply that fundamental problem of *Administration* which arises in all human undertakings when complex and interrelated operations are carried on in a limited area by a large number of persons. It makes its appearance as the result chiefly of the growth in the size of our manufacturing establishments. And it is not to be wondered at that, until recently, the two other fundamental questions of business activity, viz. Machinery and Markets, have seemed more pressing. In a small shop, it may hardly seem to matter just where the machines are placed, or in what order certain operations are done. It is only when there are many employed with diverse duties, when they begin to jostle against one another, that the situation has to be consciously faced. Let me take an example outside the field of manufacture. Early in the War there grew up in one of the large provincial cities a great office, occupying a whole floor of the municipal building, where several scores of workers, paid and voluntary, were occupied with the distribution of allowances to soldiers' dependants, and with the relief of civilian distress. The accounting technique was soon most carefully thought out; there was an adequate supply of typewriters and telephones. But as the work grew, fresh workers were brought in and planted down just where there happened to be room, and as a result there was soon something like chaos. Somebody had to be found—and fortunately a calm and competent man was available—who could grasp the situation as a whole, divide the staff into departments according to its particular job, divide the floor space among the departments in the way most convenient for the dispatch of the business, and put each under clearly defined

and responsible superintendence. This seems simple enough—when it is done; but, if rumour is not grossly unjust, one if not more of the new government departments hardly succeeded in getting even so far during the War.

It is precisely this matter of the internal order of manufacturing establishments and of their several shops which has come to the front during the more recent course of the Scientific Management movement. That the work should be carried on by the several departments in sufficient, and sufficiently segregated, space; that the areas assigned should be related in such a way as to economize the labour of internal and external transport and facilitate costing; that work which is to be subjected to several processes should be 'routed', i.e. definitely directed by schedules or otherwise, in its passage from machine to machine; that tools and supplies should be systematically stored, catalogued, distributed, and checked; that the orderly sequence of processes should be expedited by mechanical conveyors, and so on: all this seems very obvious. But in this country so many works had grown up from small beginnings without ever stopping to consider administrative problems, that it required the opportunities furnished by the vast new munition works to force such problems upon the attention of business men. I have seen a great works which has a deserved reputation for being 'scientifically managed', and where an American 'efficiency expert' had been highly rewarded for 'installing' his 'system', where all the really important new features were of this purely administrative order. And there is this advantage about such measures: that they need never, if carried through with average common sense, arouse the antagonism of labour.

This is, unfortunately, not so generally true of that second element in what is known as Scientific Management to which we must next turn; and that is the effort to improve the *Method of Remuneration of Labour* in the interest of economy of production. This requires some preliminary explanation.

There was a time when the mere substitution of piece wages for time wages was supposed sufficiently to secure a due degree of application on the part of the workman. It did of course, when first introduced, bring about in most cases a great increase

in output per day or week: the fear indeed in some minds was lest piece wages should stimulate individual workpeople to an extravagant and self-injurious zeal. Even when the reward of the workmen was increased in just the same proportion as the output—and it need hardly be said that this was seldom the case—the more rapid performance of work almost invariably caused a reduction of 'overhead charges' per unit of output. And cheaper production, in the absence of combination among producing concerns, might and did conduce to the advantage of the 'consumer' in the form of lower prices.

Experience, however, has demonstrated that piece wages do not, in fact, work out in anything like so satisfactory a way as was anticipated: that they have led, hardly less than the method of payment by time, to conscious or unconscious restriction of output. Rates of piece wages have been so often cut by the employer when workmen have shown themselves able to earn unusually large sums that workmen take care, speaking broadly, to work well within the speed easily possible for them, unless they feel sufficient confidence that the rates are reasonably permanent. That 'restriction of output', or 'ca' canny', is not mere laziness or malice on the part of workmen; that it is the inevitable result, human nature being what it is, of the general industrial situation is, of course, recognized by every intelligent and frank business man; and it was one of the merits of Mr. Taylor that he asserted this in the clearest and most emphatic way.

The objective of Scientific Management is the removal of this enormous psychological obstacle to economical production. Let me say at once that, in my judgement, the most hopeful direction in which we can look is the growth of complete combination on both sides of the wages contract; with a 'straight' piece-wage system where there is sufficient repetition to make that possible; and, where there is not, with some method of joint rate-fixing in the shops, based on collective bargaining as to normal time-earnings between bodies representing the whole trade. I do not for a moment pretend that this is an easy road to follow; there are difficulties, as we all know, in getting agreements honoured, though I do not think they have arisen

in the engineering trades; and it is hard to find umpires sufficiently trusted by both sides to help a trade out of a deadlock. Still, it is the only road in the long run compatible with a diffused democratic sentiment, so long as the manual work is of such a kind as to cause the workpeople to fall spontaneously into more or less homogeneous groups. That, in my opinion, is likely to be always the case; though mechanical progress may necessitate from time to time a re-grouping.

But the earlier American apostles of Scientific Management thought they had discovered an easier solution. They hit upon the device of the bonus system; herein they found, as they believed, a stimulus to production free from the defects of a mere piece wage; with the further advantage that it enabled them, for the benefit, they held, of society in general and of the workmen themselves, to avoid collective bargaining and entirely individualize the labour contract.

The method of remuneration was not a matter in which Taylor was himself at first particularly interested: what he cared for most was the actual manner of performing the manual work. But he took over the bonus idea from others, and soon gave it a prominent place in his system, laying great emphasis on the contrast, which in his eyes it involved, with anything in the way of a corporate arrangement.

> 'The directors . . . should be informed of the leading objects which the new system aims at, such as . . . the gradual selection of a body of . . . picked workmen who will work extra hard and receive extra high wages and be *dealt with individually instead of in masses.*' (*Shop Management*, p. 129).
>
> 'The writer believes the system of regulating the wages and conditions of employment of *whole classes* of men by conference and agreement between the leaders of unions and manufacturers to be vastly inferior, both in its moral effect on the men and on the material interests of both parties, to the plan of stimulating *each* workman's ambition by paying him according to his *individual* worth.' (*Shop Management*, p. 186.)

English engineering employers, however, have never been such thorough-going individualists as the American advocates of

Scientific Management. It is interesting to observe that, in the very latest statement with regard to 'Payment by Results' recently put forward by the Engineering Employers Federation, they propose that

> 'Piece work prices and bonus or basis times shall be such as will enable a workman of average ability to earn at least 33⅓ per cent. over time rates',—

these time rates being, of course, fixed by collective bargaining between the two bodies representing the trade; that, subject to this guiding rule,

> 'Piece work prices and bonus or basis times shall be fixed by mutual arrangement between the employer and the worker';

and that, failing agreement,

> 'the matter shall be dealt with between the management and a deputation of workpeople'.

English employers recognized the principle of collective bargaining even in the midst of their triumph in 1898, and have never, to my knowledge, since then assailed it—as one, at any rate, of the principles to be jointly applied to the labour contract.

Taylor's own pet method of bonus his followers soon abandoned: but some form or other of bonus has usually characterized Scientific Management or Efficiency schemes in America. In fact, it has often been the most conspicuous feature of a newly introduced 'system', and we must pause now to describe it in a little more detail.

The Bonus policy is briefly this. A time is allowed for the performance of a job or 'task', and a wage fixed for the work when done in that time, at the rate of so much per hour. If the work is done in a less time, the man is paid at the agreed time-rate for the time taken; and given, in addition, something extra. If he were paid the whole of the time wage for the time allowed but not taken, that would be simply a piece rate. Accordingly, he is given a part only of the wage for the time saved. His remuneration is raised; in the sense that, if job succeeds job without loss of time, the man earning bonus carries home a larger sum of money at the end of the week—and it may well be with no greater fatigue. But, at the same time,

his total remuneration per job or piece is of course in this way reduced: the more he turns out in a given time the less the payment to him per piece becomes. This is a quite legitimate object of business management; it may well be in the public interest, and where the work becomes progressively less laborious it may be fair to the workman: but it is not always as clearly stated as candour might suggest.

It is evident, however, that there is nothing in the bonus system to make the remuneration of labour any the less a matter for bargaining between the parties concerned than there is in a straight time or piece rate method. All it does is to break up the bargain into three stages: first, the determination of the wage per hour: then, of the time allowance for a particular job or 'task': and then of the bonus itself, i. e. of the division between the parties concerned of the saving effected by the performance of the work in less than the allotted time. To take the third part first. It is often vaguely thought that, somehow or other, a bonus rate can be devised so inherently right in its division of the savings of extra labour efficiency as to remove the matter beyond the scope of argument or negotiation. That—it is strange that it should need to be said—is not so. The bonus or premium, though it may sound like it, is not a present; it is a part of the return to the workman for the effort of labour. There is no reason, in the nature of things, why the price of the saved time should be divided exactly half and half between employer and employed, or in any other proportion. A perception of this fact has been one of the reasons for the general substitution in the engineering shops of this country, for the American type of bonus earlier adopted, of the Glasgow device known as the Rowan method. According to this arrangement, whatever proportion the workman saves of the time allowed, he receives as bonus the same proportion of the wages for the time taken. Thus, if, suppose, the rate is 10*d.* an hour and the time allotted is 10 hours, and then the work is done in 8 hours, and, therefore, with a saving of one-fifth of the time allowed, the workman gets his 80 pence for the 8 hours actually worked, *plus* a bonus of one-fifth of 80, i. e. 16 pence, making a total earning of 96 pence for the 8 hours. But a moment's

reflection will show that the verbal jingle—'the same proportion of the time *taken* as of the time *saved*'—contains within it no rationale, no logical explication, of the justice of such an arrangement. The Rowan method, indeed, is now rather declining in popularity among employers: it was originally introduced as giving just the right amount of incentive to the workman; it is being modified because, in the judgement of some experienced employers, it does not give enough. But any and every bonus system has necessarily the same characteristic: in essence it is a matter not of an economic principle which can be put into the form of an arithmetical formula, but of the working of human judgement, which must be either a one-sided affair or the result of joint agreement.

And now we must return to the two prior elements: the basic hour rate and the time allowance. In introducing the bonus plan employers have commonly accepted the hour rate already current. The crucial point, therefore, is the time allowance. And, unfortunately, the time allowance has been found by experience to bring back precisely the same evil as it was intended to obviate. For the most ingenious methods for computing the bonus do not remove, though they may lessen, the temptation to cut the time allowance. It is not, in fact, so commonly done as the cutting of piece rates, largely because of the growth of concerted action among large employers, and of the greater caution which has been taught by experience: but it has been done often enough by some of the smaller and less scrupulous employers to keep alive the spirit of distrust. It should in fairness be added that it is not always easy to make workmen recognize the justice of a reduction even when the original time allowance was really excessive.

With bonus systems we have for several years been growing familiar in this country. It is necessary to call your attention now to an element in the Scientific Management or Efficiency movement in America which has there been closely associated with the bonus plan, but which is only beginning to make its way in any conspicuous degree into Great Britain. And first I may be allowed one preliminary remark. The Scientific Management movement in America has been led by engineers.

Now engineering is a matter of exact formulae—a matter of exactly measurable pressures and strains. And the tendency of an engineer when he turns to the labour problem is to imagine that there also formulae are ascertainable which will substitute cold and impartial science for mere opinion and bias and controversy. This was Taylor's evidently sincere conviction. And let us see how he and his followers propose to do it.

The method proposed is that of *Time Study*: and in the United States the idea has spread like wild-fire; I suppose there were soon some hundreds of 'time-study men' employed in the various American factories. For the present we will keep *Time Study* apart in our minds from *Motion Study*, which often goes with it. Motion Study aims at improving the motions employed in a certain operation: in practice it is chiefly interested in unskilled labour. Time Study, taken by itself, does not aim at altering the motions by which the operatives do their work, but seeks to ascertain just how long it takes some standard type of workman to get through a particular job. For this purpose the whole operation is broken up into the units, the several movements, of which it is composed. After the unit-times and the total-operation-time have been ascertained by observation, the unit-times can be utilized, it is held, without fresh observation, in calculations for other jobs, to the extent to which they are composed of the same elements.

At once two questions arise. Can such standard times be ascertained with such accuracy and impartiality as to deserve to be called 'scientific'? And supposing they can be, what is their bearing on the problem of remuneration?

It may be granted that, theoretically, standard times can be ascertained, although we may doubt, as I shall show later, as to their value when obtained. There will arise not altogether negligible questions as to the number of observations, the statistical technique, the type of man to be selected for study; the inducement, if any, to secure his co-operation; the conditions as to environment, &c.; but with a highly trained staff of time-study men and sufficient expenditure of time and money, the difficulties can, in theory, be overcome. In actual practice, however, the ascertainment of standard times in American

'scientifically-managed' shops has been far from satisfying the requirements of impartial science. Side by side with the two treatises of Mr. Taylor, presenting the ideals of Scientific Management, we may place the treatise of Professor Hoxie, presenting the conclusions of the Commission appointed by the United States Government to investigate what professed to be, and was explicitly stated by the experts to be, Scientific Management in practice. I should advise any in this country who desire to look into Scientific Management to begin with these three books. As the Hoxie Commission made abundantly clear, time study as actually practised has been generally made the job of officials of a poor calibre; it has been done hastily; and it has included large elements—such as allowances for interruption, and the like—which were necessarily somewhat arbitrary. In effect it has been, in many cases in America, a mere device to obtain 'scientific' justification for the rate-fixers' otherwise-determined presumption as to the proper time allowance; and in many more it has naturally looked like that to a critical workman, even if it were not.

But grant to time study all that the most enthusiastic efficiency experts claim for it, all that it can do is to furnish one element in the adjustment of wages, viz., the time a job should take. It does not touch the question how much it shall be paid, whether with or without bonus. How are we to effect the transition from the 'task', thus *ex hypothesi* scientifically ascertained, to the remuneration? Let Mr. Taylor himself answer.

> 'The writer has found, after making many mistakes above and below the proper mark, that to get the maximum output for ordinary shop work requiring neither especial brains, very close application, skill, nor extra hard work, such, for instance, as the more ordinary kinds of routine machine shop work, it is necessary to pay about 30 per cent. more than the average. For ordinary day labour requiring little brains or special skill, but calling for strength, severe bodily exertion, and fatigue, it is necessary to pay from 50 per cent. to 60 per cent. above the average. For work requiring especial skill or brains, coupled with close application, but without severe bodily exertion, such as the more difficult and delicate machinists' work, from 70 per cent. to 80 per cent. beyond the average.

> And for work requiring skill, brains, close application, strength, and severe bodily exertion, such, for instance, as that involved in operating a well run steam hammer doing miscellaneous work, from 80 per cent. to 100 per cent. beyond the average.
>
> It is the writer's judgement that for their own good it is as important that workmen should not be very much over-paid, as it is that they should not be under-paid. If over-paid, many will work irregularly and tend to become more or less shiftless, extravagant, and dissipated. It does not do for most men to get rich too fast.' (*Shop Management*, pp. 26, 27).

It is rather unfortunate that Schmidt, Mr. Taylor's pig-iron-carrying model man, finally took to drink. But you perceive the engineer's point of view: the human machine wants just so much fuel, the human animal wants just so much oats, to reach the optimism of efficiency; and it is the engineer's business, like the coachman's, to determine the amount. The proper wages, necessary to secure the desired results, were 'demonstrated' to Mr. Taylor, he tells us, by 'a long series of experiments, coupled with close observation.' (*Principles*, p. 74).

When he speaks thus, be it observed, he conceives himself to be speaking not as a biased employer but as an impartial man of science. He expressly says that not only the task and the length of the day but also 'what constitutes proper pay for this work' 'can be much better determined by the expert time student than by either the union or a board of directors.' (*Shop Management*, p. 186.)

But suppose the machine, the animal, has a will of its own, and differs from the engineer, the coachman, the time expert. Suppose its desires are not limited to the pay-roll. Suppose, wisely or not, it wishes to sacrifice its own immediate interest to the interests of the other machines, the other animals? And this suggests one final observation.

However perfectly 'scientific' a wage system may be, organized labour is compelled by its most essential principle to resist any wage system which in its eyes endangers the solidarity of its combination. For its object is the maintenance, and, if possible, the raising, of the standard of living of the whole body of those employed in the trade. It may seek this end in unwise ways;

ERRATUM

PAGE 16, line 15 *for* optimism *read* optimum

but that is its end. Any plan which, in effect, makes a minority of the workpeople in a trade, as for instance those employed by a particular firm or some of them, so well contented with their earnings, without a similar improvement in the earnings of others, that they no longer care to take part in efforts to safeguard or improve the position of the majority, must be opposed, however regretfully, by labour leaders; just as a general will sacrifice some of his men for the benefit of his operations as a whole.

We come now to the third element in what is known as Scientific Management, and that is the *Regulation of the Manual Processes*. It was with this that Taylor began his career as a Scientific Manager—in the first instance of unskilled labour. I spare you the details of the pig-iron loading episode, which you will find in all the books. The principle asserted was this: that labourers should not be allowed to perform a manual task just as they please, but the one best method of doing it should be ascertained by *Motion Study*, and then they should be taught just how much to lift in their hands, just how far to walk, just how frequently to rest, &c., &c.; though the securing of a body of men sufficiently fit physically and docile mentally to do this for the greater wages which followed on greater performance would naturally take time. Mr. Taylor proved that a selected body of men, possessing the necessary ox-like qualities (as he described them) and working and resting as prescribed, could carry almost four times as much pig-iron in the course of the day, under the stimulus of a 60 per cent. increase of wages; and thereby save the employers 54 per cent. of the cost. All that was in the '80s; the observation which would naturally occur to a really up-to-date works manager of to-day is that labour capable of being reduced to such unvarying muscular elements could now probably be taken off human muscles almost entirely.

But to return to the development of Mr. Taylor's thought. The conclusion suggested to him by common labour he went on to apply to all employment; and in this he has been followed by Scientific Management theorists generally. It is that large economies could and should be effected by the assumption by the management of a far wider and far closer control than has

hitherto been the practice of all the actual steps in any mechanical operation; in other words, that, the job being prescribed, it should be left far less to the workman's discretion how it should be performed. How the management shall gather the requisite information—whether by simple observation of a number of workmen and the selection of the quickest method actually followed by any individual workman, or by elaborate 'Motion Study', beginning with the stop watch (concealed or visible) and ending with stereochronocyclegraphs—on this a good deal will depend in the actual introduction of the new policy.

I would remark indeed, by the way, that some of the main principles of the particular method of Motion Study which has been advocated and practised by its best known American exponent, Mr. Frank Gilbreth, are now being seriously called in question by psychologists. They gravely doubt whether there is always a single 'best way' of doing a job, irrespective of the physical and mental make-up of the several workmen. They are not at all satisfied with Mr. Gilbreth's procedure to get at the supposedly best way. Gilbreth, with Taylor's warm approval, seeks, as I have said, first to break up each particular operation into a series of constituent motions; then to ascertain the quickest way in which any one workman has achieved any one of these motions; then to collect these quickest unit motions into a new series making up the whole operation; and then to teach this as the 'standard' method of work to be followed by every workman. But psychologists and physiologists alike may well question whether the best whole can, in fact, be thus constituted out of best parts; whether there is not often a unity about a whole action, based on a man's general physical and mental constitution, which defies such linear analysis and defeats so crude a synthesis. They go further and question whether the rapidity even of a whole operation is anything like so generally as the followers of Gilbreth suppose the best criterion of productive efficiency. English Works Managers, before they make their plans to follow Mr. Gilbreth's lead, would do well to consider the writings of Dr. Charles Myers, based on enquiries at the Psychological Laboratory at Cambridge, and to take into

account also the examples of a different line of approach to Motion Study which they will find in Mr. Eric Farmer's Reports of last year to the Industrial Fatigue Research Board.

The attitude of English working men to Motion Study, if it ever comes to be practised to any large extent in this country, will depend very greatly on the way in which it is conceived and on the way in which it is carried out. Yet it might be urged by the American efficiency expert that, after all, these are only questions of method—the purpose is the same, to arrive at improved ways of getting work done. It might also be said to be only a question of method—though immensely important in relation to the attitude of the workmen—how the new and improved ways are to be introduced: whether by persuasion or command, whether through 'the old time foreman', or through Mr. Taylor's 'functional foremanship', which puts the workman under the control or tutelage or advice of as many as eight 'bosses'. These are not, after all, Taylor's fundamental idea. What that is, is best stated in his own words:—

> 'Under scientific management . . . the managers assume new burdens, new duties, and responsibilities never dreamed of in the past. The managers assume . . . the burden of gathering together all of the traditional knowledge which in the past has been possessed by the workmen, and then of classifying, tabulating and reducing this knowledge to rules, laws, and formulae. . . .
>
> The development of a science involves the establishment of many rules, laws, and formulae which replace the judgement of the individual workman. . . . All of the planning which under the old system was done by the workman, as a result of his personal experience, must of necessity under the new system be done by the management.' (*Principles of Scientific Management*, pp. 36, 37.)
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> 'As far as possible the workmen, as well as the gang bosses and foremen, should be entirely relieved of the work of planning. . . . *All possible brain work should be removed from the shop* and centered in the planning or laying-out department.' (*Shop Management*, p. 98.)

The advantages of this policy from the point of view of the management are twofold. In the first place, by speeding-up production, it lessens the cost of labour per unit of output, when

it continues to be performed by the same men. This is especially the case when it is associated with an effective reduction of the piece rate through the working of a bonus system. Even when a piece rate remains unchanged, a more rapid output lessens the overhead charges to be allocated to each unit. And, in the second place, it makes it possible to substitute a cheaper type of labour.

'Almost any job that is repeated over and over again, however great skill and dexterity it may require, providing there is enough of it to occupy a man throughout a considerable part of the year, should be done by a trained labourer and not by a mechanic. A man with only the intelligence of an average labourer can be taught to do the most difficult and delicate work if it is repeated enough times. . . . A man, however, whose mental calibre and education do not fit him to become a good mechanic, when he is trained to do some few especial jobs, which were formerly done by mechanics, should not expect to be paid the wages of a mechanic. He should get more than the average labourer, but less than a mechanic.' (*Shop Management*, p. 28.)

'The full possibilities of functional foremanship will not have been realized until *almost all of the machines in the shop are run by men who are of smaller calibre and attainments, and who are therefore cheaper* than those required under the old system. The adoption of standard tools, appliances, and methods throughout the shop, the planning done in the planning room and the detailed instructions sent them from this department, added to the direct help received from the four executive bosses, permit the use of comparatively cheap men even on complicated work. Of the men in the machine shop of the Bethlehem Steel Company engaged in running the roughing machines, and who were working under the bonus system when the writer left them, about 95 per cent. were handy men trained up from labourers. And on the finishing machines, working on bonus, about 25 per cent. were handy men.

To fully understand the importance of the work which was being done by these former labourers, it must be borne in mind that a considerable part of their work was very large and expensive. The forgings which they were engaged in roughing and finishing weighed frequently many tons. Of course they were paid more than labourer's wages, though not so much as skilled machinists. The work in this shop was most miscellaneous in its nature.' (*Shop Management*, p. 105.)

I would not have you think that this is all Mr. Taylor had to say: that he did not go on to show his reasons for believing that the policy in question is beneficial to labour generally. But it will be convenient to leave Mr. Taylor at this point, and cross back to England.

The problem presented to the Engineering Industry of this country, and coming to the front in the recent dispute, is at bottom the same problem as that presented by the paragraphs I have just quoted from Mr. Taylor. It is that of the substitution of a cheaper for a more expensive grade of workman, and of the effect of this on 'labour' generally. In America the issue has been reached by the attempt, during the last quarter of a century, to eliminate brain as far as possible from manual industry through the introduction of planning, time and motion study, functional foremanship, &c.: in Great Britain it has been independently reached, during the same period, by the development of more specialized, more automatic, more completely fool-proof machinery, with the resulting dispute as to machine-manning. But it is clear, on the one side, that planning and motion study in America tends to the introduction of more specialized machinery, whenever the market is large enough for the initial expense. And, on the other hand, the evident purpose of the new machinery in England is to split up operations, and reduce much of the labour to greater simplicity and uniformity. America and England have been moving in the same direction by different, but converging roads; and that direction is the further 'division of labour'.

Before I go further let me interpose a reference to two once well-known books of some ninety years ago. In 1832 appeared the *Economy of Manufactures*, by Charles Babbage, Professor of Mathematics in the University of Cambridge. Babbage followed Adam Smith in regarding division of labour as 'perhaps the most important principle on which the economy of manufacture depends'. He thought, however, that 'the most important and influential cause of the advantage resulting from the division of labour', viz. the cheapness of manufactured articles, had

been 'altogether unnoticed'. That cause, in his opinion, is that

> 'the master manufacturer, by dividing the work to be executed into different processes, each requiring different degrees of skill or of force, can purchase exactly that precise quantity of both which is necessary for each process'. (p. 175.)

Babbage, that is to say, regarded division of labour as consisting in the more economical employment of 'the different degrees of skill or of force' *already available* in a given society. Three years later, in 1835, the same enterprising publisher, Charles Knight, issued *The Philosophy of Manufactures*, by Dr. Alexander Ure. Ure, without mentioning Babbage, loudly dissented from what Babbage had just been saying:

> 'The . . . adaptation of labour to the different talents of men is little thought of in factory employment. On the contrary, wherever a process requires peculiar dexterity and steadiness of hand, it is withdrawn as soon as possible from the *cunning* (*sic*) workman, who is prone to irregularities of many kinds, and it is placed in charge of a peculiar mechanism, so self-regulating that a child may superintend it.' . . .
>
> 'By the infirmity of human nature it happens, that the more skilful the workman, the more self-willed and intractable he is apt to become, and, of course, the less fit a component of a mechanical system, in which, by occasional irregularities, he may do great damage to the whole. The grand object therefore of the modern manufacturer is, through the union of capital and science, to reduce the task of his work-people to the exercise of vigilance and dexterity.' . . .
>
> 'It is, in fact, the constant aim and tendency of every improvement in machinery to supersede human labour altogether, or to diminish its cost, by substituting the industry of women and children for that of men; or that of ordinary labourers, for trained artisans.' . . .
>
> 'The scholastic dogma of the division of labour into degrees of skill has been exploded by our enlightened manufacturers.' (pp. 19–23.)

It is not, I think, too much to say that the future of industrial society turns on the question whether Ure's prognostic is going to be verified. We must do him the justice to acknowledge that his anticipations and hopes have been largely shared by manufacturers; that the immediate motive in the introduction, both of machinery and of much of what is known as Scientific Management, has commonly been the desire to dispense with expensive grades of labour; and that little attempt has been made to go beyond the immediate goal of cheapness of product, and seriously consider the problem of labour as a whole, whether in engineering or in any other trade. The argument put forward by some economists that the cheapening of production will, after a time, create an increased demand for the displaced skill in other directions, has not been reassuring in trades where skill of the kind in question seems in course of displacement from every kindred branch of manufacture. It is, therefore, not to be wondered at that the skilled craftsmen have viewed the substitution of cheaper labour with alarm and met it with stubborn resistance, and that their opposition has taken the form of demanding, not that new machinery should not be introduced, but that it should be manned by the existing skilled men, at the skilled man's rate of pay.

Within less than a generation after the time when, in the engineering trades, the fitters and turners of the modern type had first made their appearance and joined together in the Amalgamated Society of Engineers, the question who should work the several machines came to the front. It was perhaps the main issue in the first of the historic strikes in the engineering trade, that of 1852. And in that, as in the strike seventy years later, the more cautious policy of the men's official leaders was overridden by the alarm of the rank and file.

I should sit down with a feeling of despair if I did not think that a view is tenable of the movement of industrial evolution in the engineering and kindred trades which is very different in its consequences from the philosophy of Ure. Industrial evolution does not simply, as Babbage seemed to think, make more economical use of existing grades of skill. But Ure was even more mistaken in supposing that it simply replaces existing types of skill by machinery. What it does is to create new types of 'skill'. We are too much in the habit of thinking of 'skill' as of a homogeneous thing of which there are different degrees or amounts; whereas, really, 'skill' is a

name which covers things of very different kinds. What I believe is taking place now may perhaps be symbolized in some such way as this:

Labour—I am thinking chiefly of the engineering sort—may be looked upon as having once been either *skilled* or *unskilled*. The skill was mainly manual, or, so to say, tactual skill, associated, it is true, with a certain varying amount of judgement in the choice between different methods and as to the execution of each part of the task, but still a judgement closely bound up with manual dexterity—a 'machine sense' as it has been called. The unskilled labour called for some mental qualities, such as patience and attention; but it was mainly a matter of physical strength. We may call these two kinds of labour the B and the D types. You will see in a moment why I use just these letters. Of course there were, in fact, intermediate conditions; but the bulk of labour approximated pretty closely to the two distinct types; represented substantially by, before the War, the 35*s*. to 40*s*. a week grade and the 20*s*. to 25*s*. a week grade. And it seems to me quite clear, that if there is no interference with what has been called 'the right of the employers to exercise managerial functions in their establishments', class B is bound in no long period to be largely, if not totally, destroyed; both by the introduction of specialized and more completely automatic machinery, and also by the more complete division of labour between planning and executing, which Scientific Management proposes, and which in practice is closely associated with more economical machine methods.

But no machinery can be so perfectly fool-proof, no reduction of work to the carrying out of prescribed movements can be so complete, that manufacturing can be carried on by totally unskilled 'common' labour. The very attempt to do so inevitably tends to create a new type of labour superior to D, which we may call a C type. We commonly indicate this by some such term as 'semi-skilled'; but all such terms are misleading—the semi-skilled man is not one who has half the skill, let us say, of a competent fitter. He has a different kind of skill. He has ability enough to work on a specialized machine; he cannot readily turn his hand to anything else; but on that work he

may become in a sense more skilled—that is, he may turn out more stuff in a given time—than a more all-round man who for some reason for a short time is put on that machine. For the man of real B quality to be put to C work would be a degradation. He may indeed continue—though that in the long run is improbable—to receive the old remuneration; but the more specialized occupation would mean the disuse and atrophy of powers valuable to society and a source of satisfaction and happiness to the man himself. For a man previously of the D type, on the other hand, to succeed in the work of the C class is, speaking broadly, an elevation. His work now calls forth more varied mental powers; it is no longer so preponderatingly a mere matter of muscle. One may hope that C work will in time almost replace D work altogether. It may indeed be 'process work', with the attendant risk of monotony; or it may still mean toil which is largely muscular, even though machinery may reduce the mere strain of haulage or holding-up. But with an eight-hour day, a substantially better wage than the mere labourer used to draw, and the improved workshop or yard conditions that more sensible works administration is bound to bring, there is no reason why we should not regard the evolution as, on the whole, in an upward direction.

The skilled man fears that class C is going to be created by the degradation of class B. It may unfortunately be the case that a certain number of B men—including some men who have a fair claim to rank as skilled—may be so unadaptable for other work, so loth to move elsewhere, or simply so unlucky as to find themselves in the C class and expected to be content with C wages. But in the main the C class is, before our eyes, being created out of the D category. And the new 'semi-skilled' are getting organized in unions. For the present they are not forming unions of their own. Some are now being drawn into the craft unions of the Engineers and the like, with a much warmer welcome than before; but I believe I am right in saying that more are joining the General Labour unions. Such unions are certainly not likely to acquiesce in the permanent withdrawal from their members of the opportunity to work on the new machines and in simplified processes which do

not, in fact, require the B type of skill. And it is notorious that the claim on the part of the engineering employers for 'freedom of management' has, for this reason, received a large degree of more than tacit support from considerable sections of organized labour.

The creation out of class D of a new class C is a phenomenon to which Taylor and other advocates of Scientific Management have sometimes alluded, though they have not laid sufficient emphasis on it. But there is also going on a development at the other and upper end of the working force to which even less attention has been paid, and which is full of hope for the rising generation of highly skilled men; and that is the creation of a new class—of what we may call an A type. It is a mistake to imagine that the old-fashioned type of skill can be replaced by cheaper labour on more specialized machinery without involving further changes. Men are needed under the new conditions who will have much the same manual dexterity, much the same all-round capacity as the old skilled craftsman, but more mental aptitude—more judgement, more initiative, more readiness to take responsibility. With the increasing use of machine tools has come the need for 'tool makers' and 'tool setters': with the replacement of time wages by methods of remuneration of the nature of piece wages, with or without bonus, comes the necessity for inspectors and viewers; with the employment of the C type of skill a larger number are called for of 'leading' or 'charge hands'. Engineering firms and firms in kindred trades have, of course, to adapt their internal organization to the needs of their particular manufacture, and the amount and character of foremanship must vary very considerably. The new class A is therefore not so homogeneous as the old class B; in some trades there is likely still to be a good deal of demand for the old manual dexterity, while in others the demand will be for qualities of judgement and character. But that, in various ways, what may be roughly grouped together as a higher grade is coming into existence is surely beyond doubt. We can hardly expect it to form so large a relative proportion of the whole working force as the skilled men of the old B type once made up; but, with the expansion of British industry, it

may, at no distant date, perhaps become as large a body in positive numbers.

The recent engineering strike was the result of fear. The vogue which American Scientific Management or Efficiency books have lately obtained in this country in managerial circles, has increased the alarm among the skilled men. Their standard of living appears to be in danger; and anything is apt to seem good to them which puts hindrances in the way of change. It is the suddenness with which a change is often announced, which especially arouses bitterness in the mind of the craftsmen. Sir William Mackenzie, in the 'Court of Inquiry', under the Industrial Courts Act, went to the heart of the matter when he pointed out that 'the question of obtaining the prior consent of the workpeople before a direction becomes operative must not be confused with the question of prior consultation', and that 'whatever the opportunities for prior consultation may be, it is reasonable and right that they should be fully utilized'. Moved by these wise counsels, the Engineering Employers have offered to give 'ten days' notice and an opportunity for discussion when a workshop change is contemplated which will result in one class of workpeople being displaced by another in the establishment'; and also have

> 'promised consideration to the case of workpeople of any class displaced by reason of any act of the Management; with a view, if practicable, of affording them in the establishment work suitable to their qualifications'.

And on these conditions the Engineers have accepted the employers' terms and recognized their 'right to exercise managerial functions in their establishments'.

The new grading of labour involved in mechanical progress is bound to come.

> Things are in the saddle
> And ride mankind,

as Emerson says. But this new development may be made to correspond not only to an increase in the production of material goods, but also to an increase in human happiness and dignity. Yet much will depend on the way in which it is carried out. If it is brought about by the mere pressure of business self-interest, and

in the free exercise, without regard to attendant circumstances, of the employers' 'managerial functions', it may create so much soreness as to endanger the very 'basic principle' for which the employers have been contending. I am one of those who think that, in an industry like engineering, the world is still far from being ripe either for nationalization or syndicalization. I want freedom of enterprise and freedom of management to have every just opportunity to show what they are capable of. And the best way to secure and retain this opportunity is for the engineering employers as a body to realize that what is now involved is something far more than the financial prospects of their individual concerns; that it is a large question of industrial transformation; and that the problem before them is to combine the creation of the new types of labour which are called for by manufacturing economy, with that consideration for natural human feelings which is taught by Christianity and is certainly expedient in a democracy.

BARNETT HOUSE OXFORD

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