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One of the first among the duties entrusted to the International Educational Cinematographic Institute was a technical enquiry into the possible uses and applications of the cinema. Obviously this study upon which the Institute has already embarked and which it intends to pursue to its conclusion, was no matter for improvisation. The fruits of experience and expert opinion could alone point the way to practical results. By these means the Institute could hope to accomplish the second and no less important part of its mission, namely, to indicate both to producers and consumers all that the cinema may have to offer in the vast field of edueation.

The Institute's first study related to the cinematograph regarded as a social problem. In the March number of the Review and again in one of the first special « Monographs » The International Educational Cinematographic Institute endeavoured to lay the foundations of an enquiry into the influence of the cinema on the public in general and upon children and young people in particular.

Among the subjects treated were the relations of the cinematograph to morals and crime, with special reference to the young, and the laws in force for the safeguarding of minors, particularly as regards film censorship. The enquiry included, in fact, anything that touched upon the social effects of the cinema.

This work gave proof of the Institute's determination to direct its energies towards aims extending beyond those implied in its statutory functions. It was quickly followed by the May number of the Review, which was devoted to the cinema as a means of propagating and disseminating the principles of hygiene — a special number which was republished and supplemented in another monograph dealing with individual hygiene problems and the possible use of the cinema in this domain. The study was divided into an explanatory and a technical part. The purpose was to explain the kind of film preferred and best suited to spread far and wide those principles the application of which is not only a social necessity but a direct contribution to the welfare of mankind.

Immediately after the monograph entitled « Cinema and Hygiene » came one on cinema and eyesight. « Do films hurt the eyes ? » It was discussed at great length, but with no definite result, whether and, if so, how far cinematographic projection is injurious to children's sight. Our work was limited to setting forth and enunciating the problem, the solution of which we left to the experts.

In this connection we should mention that the International Educational Cinematographic Institute has initiated a world enquiry into the cinematograph regarded from various points of view. A questionnaire addressed not only to schoolchildren but to their teachers has been sent in different languages to several countries in hundreds of thousands of copies. Each questionnaire contained a hundred or more questions, so that some really comprehensive result may be anticipated. So far the Institute has received more than 30.000 replies.

One of the questions asked of schoolchildren referred to this effect of films upon the eyesight. The first results of the enquiry (covering about 19000 replies) were published in the fifth number of the Review (May 1930) and in the special monograph on cinema and the eyesight. Thus the Institute has not relied upon theory and science alone to elucidate this very important point ; it has collected valuable first-hand evidence. Upon the conclusion of this first phase of the Institute's activity which extends in every direction where the cinema may be of use and which will include the publication of further special numbers of the Review or other monographs devoted to agriculture, vocational guidance and training, social hygiene and the prevention of accidents, etc., the Institute will proceed to examine and catalogue films deemed to be in one way or another genuinely educational by authorized national Committees or by the Institute itself. It will then make a practical study of the organisation of both the production and distribution of such films, since the Institute desires to be a real agent of international collaboration for the purpose of popularising educational films.

In the meantime the International Convention for the abolition of Customs duties on educational films is to be discussed by a diplomatic Conference. If, as there is every reason to hope, this convention is adopted, educational films, no longer obstructed by almost insuperable barriers, will circulate more freely. The opportunity of ascertaining the educative value of a film before buying it will not be the least of the advantages of this freedom of circulation.

Let us now say a few words about the present number, which is devoted to a much-discussed problem of the day — scientific management, the importance of which is both economic and social.

The aim has been to discover and to reveal to those who may have only a theoretical acquaintance with the subject, the practical forms of a system of rationalisation based upon the principle of minimum effort. This problem vitally affects the economic and social life of nations and deserves the attention of all whose concern it is to ascertain — with due regard to the conditions of work peculiar to each country or area — the general rules or standards for determining the best way of improving manufacturing processes, reducing cost of production and making a rational use of human labour.

Can the cinematograph help in this field ? If so, under what conditions and to what extent ? And, as a corollary, can and should film producers help in popularising the cinema for this purpose ? How could they so help ? The International Educational Cinematographic Institute has endeavoured to treat these questions in the present number of the Review

The discussion has purposely been restricted to scientific management in industry, to the exclusion of agriculture and intellectual work, since the latter has little to expect

from the cinema while the former, on the other hand, presents so vast and complicated a field for film activity as to require separate study, the results of which, when completed, will appear in a publication devoted exclusively to agriculture. As regards intellectual work, we shall consider individual cases of possible cinema application in the columns of our Review.

As will be seen from the information kindly collected for us by one of our collaborators much has been attempted and much already done to employ the screen in the service of human labour.

The Institute's enquiry into the uses of the film in the various branches of scientific management is still proceeding. The replies which continue to be received are daily adding to an already abundant supply of material, and the whole will be examined with the kind assistance of specialists so that it may be presented in detailed and final form to the International Committee of experts, which will be asked to lay down the lines of the Institutes further work in this domain.

The present number of the Review furnishes the necessary basis for discussion by the Committee of Experts now being appointed, in the pages of the Review itself and also, we hope, in the technical and daily press of the different countries, with a view to elucidating all the possible aspects of the problem. The material in this number, too, will be supplemented and reappear in a separate publication which the Institute will send out to every country. It will be followed by another publication containing the views, reports and minutes of the Experts' Committee as well as any further matter of particular interest in this connection which the International Educational Cinematographic Institute may have been able to collect.

Discussion is therefore now open. The Institute has wished to bring officially to the notice of film producers this new and vast field of cinematographic activity and to quote the excellent example of a number of organisations in various countries. This example should be encouraged and followed in order that the cinema — that marvellous instrument for the spread of knowledge — may make its contribution to the rationalisation of human labour.

THE APPLICATION OF THE CINEMATOGRAPH TO SCIENTIFIC MANAGEMENT

(*From the Italian*)

I.

Delimitation of the question.

The cinematograph has already been applied to various labour questions and is finding fresh applications every day, but the subject with which we are here concerned permits of no digression or diversion, however tempting they may be. Our business is to ascertain and suggest, not how useful the cinema may in be in connection with all the different aspects of *labour* — sanitary, economic, industrial, commercial, agriculture, educational — but how the cinema may be of service to that organic coordination of ideas known as « scientific management ». That and nothing else is our concern.

Even after thus circumscribing our subject — the field still remains a vast one — we must make a further delimitation if we are to avoid another error in connection with this intervention of photography — an intervention, be it said, highly desirable — in the sphere of scientific management. Our task is not to seek, manufacture or exhibit scenes which can be equally well illustrated by *lantern-slides*, that is to say, pictures, diagrams and tables which can be examined without the aid of movement. If that were all, the cinematograph would be superfluous. What we are after are *moving* scenes or, better, scenes which cannot be properly understood without movement or in which movement serves some particular purpose of scientific management. The cinema could, however, be used — within the sphere we have already delimited — in such a way as to strike a balance between scenes, diagrams and tables that can be observed when stationary and images which follow one another in rapid succession. By this we mean pictures which, although offering every facility for observation and possessing their full didactic value while stationary (lantern-slides), can nevertheless be shown on the screen at the time when a hand or a person is constructing them. This method is an effective substitute for the cold and motionless slide, and we shall revert to the matter in due time and place.

II.

Scientific management and its branches.

Now that we have reduced the subject to the examination of the applications of the cinematograph to scientific management both as so far effected and regarded as possible in the future — it only remains, at this first stage in our enquiry, to review one after another the various headings and subheadings of this new chapter of science and to make sure whether and under what conditions the machinery

of the cinema can effectively be employed in each particular case. If we conscientiously pursue this method and proceed consecutively from beginning to end, we may be virtually certain that we shall have forgotten or omitted very little.

This, therefore, shall be our procedure.

The field of specific enquiry and the delimitations and sub-divisions of scientific management have not of course been definitively laid down. These are still matters for discussion and controversy. For our part, we propose to follow, at any rate approximately, a line we have already traced and which we may define briefly as follows: 1° Examination of the *productivity* of the worker, both *quantitative* and *qualitative* (including times taken) at the moment and place at which it is decided to transform the ordinary methods of work into rationalised methods; 2° examination, at the same moment and place, of *working tools* and *movements*; 3° still at the same time and place, an examination of the degree and nature of the worker's *fatigue*; 4° numerous experiments changing either simultaneously or successively the conditions governing work with a view to discovering which conditions permit of *increased and improved productivity with a reduction or anyhow no increase of fatigue*. As these conditions include the aptitude or better adaptation of the workman himself, we come to 5° *the bio-psychical examination* of the candidate for some particular task. This examination, however, should be a continuation of a series of studies and selections starting in the elementary school or in post-elementary classes and which may be grouped under 6° *vocational guidance*. Moreover, since it is impossible to carry out the above-mentioned investigations without 7° *a detailed study and thorough knowledge of the occupation* in question (qualities required for its exercise, tools and places of work, characteristics of the raw material used and transformed, etc.), this must constitute a further heading. Next, rationalisation can and should be considered in connection not only with industry, but with administrations and office-work; we must therefore add 8° *scientific management in offices and commercial firms*. Similarly, for sufficiently evident reasons, we must include 9° consideration of *improved pay for the worker in proportion to quantitative and qualitative improvement in output*. For further information concerning this programme we may refer to the monograph we published in the review « Le Assicurazioni Sociali » (Rome, Jan.-Feb., 1929), which in its turn contains references to our earlier works on this subject.

The difference between « Taylorism » proper and our own view of scientific management will be clear to everyone. The latter is based upon conceptions and experimental studies initiated by various European investigators — physiologists, anthropologists, statisticians, experimental psychologists, factory medical officers — before Taylor devised his system or at any rate before it was known. We have dealt with this point in our study of the anthropology of classes and occupations (1908-1910) and only mention it here in passing.

We shall therefore consider one by one, from the point of view of possible cinematographic application, each of the points mentioned above, which, as will be seen, deal, as indeed they should, exclusively with scientific research with a view to increasing and improving *production*, the *human factor* being throughout

taken into account. The use of the cinematograph will therefore for the moment be recommended in so far as it can contribute towards such scientific research. In a word it must be regarded as a new and special instrument to be used to discover something fresh or to throw additional light on what is already known or imperfectly known.

Nevertheless, we do not wish to exclude the use and application of the cinematograph in two other fields of activity which, although they do not come within the scheme we have outlined above, are very closely connected with it:

a) vocational teaching — to some extent even independently of scientific management;

b) the diffusion, among all classes, of an exact knowledge of what scientific management really is.

III.

Preliminary observations:

Psychology of A) method of observing objects and movements.

Before entering upon this subject, we desire to make two purely psychological remarks essential in this matter of observing objects and movements. (It should be borne in mind that the purpose of observing objects and movements is *to discover something* which, when looked at in the ordinary way, is not perceptible to the eye).

The two remarks in question have never been made in connection with studies such as this, and in other fields of research, where they should be taken into consideration at every stage, they are unknown. Both, as we have said, relate to the method of *looking at* objects and movements to discover something new. The first refers to the way of *arranging* objects and to the detailed *decomposition* of movements so that they may be better observed; the second refers to a minute *nomenclature* of the smallest details and least features of objects and movements, again in order to see and discover them better. These two remarks are entirely apposite to the observation of objects and movements by means of the cinematograph. Let us begin with the first of the two and point out that the eye only sees in objects and movements what it is normally in the habit of seeing; it only sees, in fact, what it has learnt to see from regarding objects in their most usual aspect. In a landscape, for instance, the eye only perceives what it has learnt to perceive from the habit of looking at the landscape from *in front* or *horizontally*. It does not observe what it could see if it looked *from above* and perpendicularly. A photograph of a landscape taken from an aeroplane is not recognized by those who know the scene or have seen many ordinary photographs of it. Photographs taken from above present a fresh landscape in which things can be seen differently and new features can be discovered. Similarly, if we watch the successive movements of the legs and feet of a man walking, or the oscillations of the head or hips, we do not observe the many successive positions in space taken up by these parts

of the body. But we should see them quite clearly if they were shown to us under different conditions.

In the one case as in the other (*objects*, *movements*) the eye ends by discovering by different means what is there, but what it did not see before. For example, specialists in scientific physiognomy have often pointed out that satisfactory examination is only possible by the simultaneous and successive study of front face and profile. We have proposed this method and proved its worth in the observation and study of wounds, examining them from the front and in profile so as to obtain different and complementary photographs which enable us to « look at » the wound better and discover its details. Experts in « scientific judicial enquiry » have observed that the photograph of a place (scene of a crime) should not be a single view taken from the front, but should be multiple so as to furnish that series of police photographs which we have called « panoramic and complementary » and which allow of an all-round view of all the objects present, each photograph supplementing the others.

In the one case (front-face and profile) as in the other (all-round view) the eye when it falls on the photographs, is able to see what it could not see by the ordinary methods of vision and photography Therefore scenes of work or of men at work might be filmed simultaneously from two or more different points, or large mirrors should be placed in the background in such a way that, at a single look, the eye can see the several sides of an object, sides which ordinarily we do not see and which we may call « invisible and complementary ». It may be mentioned that this system — without reference to the psychological considerations set forth above or tothe analogy it bears to modern methods of inspecting scenes of crime — has already been suggested or applied in the observation of men at work by means of the cinema.

It should further be noted that the method of looking at things so as to see new and unrecorded details can also be employed by looking at and studying the photographed image *turned back to front*. Let us take for example a photograph or scene which it is desired to look at when stationary, separately from the succession of scenes or photographs which make up a film. Let us suppose that in the photograph the worker's bench is on the observer's right and the window on the left; let us then turn the photograph round so that the bench is on the left, the window on the right. Every photographed image turned round in this way at first presents a new aspect. This system was suggested by experts in police photography when they recommended that copies of photographs should be taken reversed, as stated above, so that the eye might receive this new and different impression and possibly discover something fresh.

Looking at things from above and perpendicularly; looking from the front and from the side and comparing the two views; looking « circularly » by means of a number of panoramic and complementary photographs — all these are new ways of looking which may enable things to be seen which could not be seen before. The cinematograph, by means of views taken simultaneously from different points

by the play of mirrors, and the turning round of photographs from front to back, can effectively help towards this end.

The foregoing remarks refer in the main to a « new » way of looking at *objects*, but they obviously apply equally to the observation of gestures, the succession of small separate movements which constitute a gesture, in the case in point, a working gesture. By the slow-motion process the cinema shows to the eye the hammer descending upon the anvil, the file passing across the iron in a way quite different from that in which the eye normally observes these movements. Just as Marey's brilliant photographic experiments revealed to the eye the different successive positions taken up by a horse's leg when trotting or galloping, — positions which had never before been observed or imagined, — so the slow-motion cinema multiplies our visual powers. If our senses were more acute — an idle wish — we could, as philosophers contemplating the universe have rightly said, hear the buds bursting and see the grass growing. This unattainable wish, however, is partly fulfilled, since the cinematographic image has developed our visual sensibility and, thanks to slow-motion allows us to see and, better still, to watch that imperceptible succession of movements which previously escaped our notice.

We shall see in a moment that the principle of « decomposition » with a view to seeing better and discovering, also applies to *objects*. Every object must be observed not as a whole but each of its parts in detail, as if a net were placed between the eye and the object, so that we had to look separately at that part of the object contained in each mesh of the net.

IV.

Preliminary observations

Psychology of method of observation employed in order to find

(B) a nomenclature for objects and decomposed movements.

We now come to our second general observation, which, like the first is also psychological. We have already noted that the eye sees afresh if the position of objects or its own position is shifted and if objects and movements are broken up into their component parts. We may even quote Montaigne's profound saying that « the eye really sees only what is already in the mind ». This aphorism, which is relevant to the observation of any fact or object, has a quite special application to the observation of things and movements by means of the cinema. For us it means that, unless we have in our mind an exact, detailed and objective nomenclature, under which each smallest feature or function of an action we are observing is known by some name — whether noun, adjective or verb — these features and functions escape our notice, however vigilant, and are as if they did not exist. Here again the principle is derived from the technique of scientific police description. A. Bertillon, the clever inventor of this system of description, considered that, in order to describe a face exactly without omitting any feature at all, it was necessary

1° to decompose — almost mechanically — the aspect assumed by a human face into its innumerable parts, dimensions and special peculiarities 2° to give to each of these parts, dimensions and peculiarities (and even to each graduation of these categories) a name to distinguish it from all the others. If the examining mind is in possession of this rich vocabulary of names — this nomenclature — it sees at once, in the face to be examined und described, what it would not have seen if not familiar with that nomenclature.. It sees just because it knows these names; « the eye really sees only what is already in the mind » (As regards the needs of an *objective* nomenclature for purposes of observation and classification, see our « Metodo Statistico », new edition, Messina 1930, last part, Chap. I or the French edition « Méthode de Statistique » Paris, 1925).

Returning to the question with which we are here concerned, we may note the great importance of this maxim and the lesson it may teach us when, in connection with scientific management, we turn to the observation of the successive decomposed movements of a worker. Here the slow-motion picture, by revealing to the eye a series of movements and positions previously unknown or imperfectly known, not only forces our attention to dwell upon these different phases — hitherto imperceptible — but compels us to give them a name. The enumeration of the different movements made is one of Gilbreth's fundamental principles of any first analysis of work. And to « enumerate » surely means to « decompose » to make an effort to observe one by one the various movements which make up a working gesture and to call each by its own name. The series of names thus arrived at — fixed, as it were, in the mind of anyone engaged in studying a particular work — facilitates the continuation of this study or the examination of similar working process. This series of names, making up a nomenclature, obliges other specialists to take account in all subsequent observation of these successive names, which after all represent a series of movements. This happens even without recourse to slow motion (in cases when there is no absolute need for it, but when direct observation of a succession of movements is enough, at any rate in the most apparent phases). For example, the movements of a worker are decomposed into their successive stages (either by direct observation or with the aid of the cinema) with the result that these stages can be defined one after the other as: looking at (the object); taking hold of (the object); movement of hand through space; movement of body; grasping of tool; bringing of tool into contact with object, movement of tool, etc. A series of movements, in fact, which the eye is not accustomed to differentiate one from the other, becomes fixed in the mind of the specialist, if he has a special nomenclature, in such a way that each of these fractional movements is automatically observed. And this, it will readily be understood, is of great value to the scientific analysis of work.

To sum up, therefore the slow-motion cinema affords facilities for a minute description of successive movements and time-stages, allows us to see better and — if we have a detailed nomenclature — to observe better.

V.

Possible applications of the cinema to the different branches of the scientific organiser's work.

1) Quantity and quality of production; superior and inferior human " samples ".

We have said that the first stage in scientific management consists in examining the quantitative and qualitative productivity of the individual worker or gang of workers. If we desire to organise a specific task, we must first decide what it consists in then see how it should be done, what changes can be made or new methods employed or how to organise it *as it should be organised*. One of the first things to be done is to see how much is produced in successive periods of time (e. g.: first half-honr, second half-hour of days work, etc) and what *quality* of work is produced in these same periods. We must in fact study *quantity*, *quality* and *time* all three together. We shall refer lower down to the methods to be employed in this matter. Here we will only say that, thanks to a preliminary enquiry based upon *individual curves* of the daily output of each worker, we can pick out one who works better and more, one who works less and not so well, or the group of these two categories. « Notice the best work and the best workers » is Gilbreth's first commandment for the use of those who wish to rationalise labour.

A film of the best workers will show *how work can be done* (even before scientific management has been applied) and a film of the other workers will show *how not to work*. These films may be used (*a*) in order that the scientific organiser may observe (by the slow-motion process, lateral or all-round vision, etc) right and wrong ways of working and (*b*) in order to teach the right way to those who are willing to learn — assuming, of course, that the best method of work is tha which is furnished by observation of the best worker or workers.

This selection of a standard worker or standard method of work has obvious drawbacks, but it may be corrected by changes of method suggested by the scientific organiser after a close examination of the film. It remains, however, an *a posteriori* selection, a choice, that is to say, from among the existing workers, whereas the selection should really be made *a priori*, that is, long before the workman starts work The process of selection should in fact date back to the successive periods of general vocational guidance, and specific selection, referred to later on.

In any case, a cinema film showing the *best* and *worst* work at the outset of the enquiry is not without its uses.

At this first stage of investigation we may also recommend the observation of individual symptoms of fatigue at successive periods in the days work. This too, we shall be dealing with in greater detail, but we should like at this stage to mention the value of such a study as a means of ascertaining which worker or workers among the whole staff or in a gang — given an equal qualitative and quantitative output — suffer less fatigue. In this way we shall obtain a human « sam-

ple » even in the matter of fatigue, and a film showing his manner of working would certainly serve a useful purpose.

Thus at the very beginning the cinematograph would give us pictures (which we can study at leisure, repeating our observation as often as we like) showing *samples* as they are at the moment when the scientific management expert starts his enquiry. These *samples* cover quantity (of output), quality, working speed and degree of fatigue, each characteristic being considered separately or along with all the others.

VI.

Possible applications, etc.

2) Examination of movements and tools.

The second paragraph, we said, is devoted to the examination of *movements* and *tools*, again at the time when the organiser first institutes his enquiries. Here, too, we must first see things *as they are*, that is, we must note the movements, tools and working speed of the above-mentioned « samples » or of other workers.

With regard to *movements* and the *times* taken to execute them (the two problems are akin), we must refer to the ingenious experiments devised by Marey and Frémont, who worked by means of a rapid succession of photographs, careh a-ving first been taken to attach luminous points to the hand, arm or leg of the person whose movements the photograph was to record, or to adopt some other procedure. The views obtained — either when looked at one after another or through the recording of successive movements of the body by the same view — allowed the movement itself to be examined, and especially those features which normally escape notice, or rather, which are not registered by the eye as it watches a moving body, but which become perceptible when fixed by photography. The modern applications of the cinema to the study of movement and more particularly that part of a movement which is not generally perceptible to the eye, really originate in the clever photographing of a succession of very rapid snapshots of the kind to which we have just been referring. To-day, thanks to the cinema, movement studies are being carried out in many fields, including the gait of persons known as normal and of persons suffering from nervous complaints.

In the sphere of labour the cinematography of movements lends itself to a wide variety of observations, all of the greatest importance. The method by which movements can be better observed, decomposed, new movements discovered, time and fractions of time counted, has been applied for so long and so successfully that we need do no more than touch upon it.

A movement or gesture is a succession of smaller movements. It must therefore be broken up into its component parts, and these examined one by one. And — be it noted — they must be examined in respect of their *direction*, *extent* and *duration*. The cinema allows movements to be decomposed and furnishes the elements required to express these directions, extents and durations or times numerically and sometimes geometrically.

Decomposition is made possible by the slow-motion process, which, as it were, lays bare the succession of small movements making up what is a discontinous whole to the eye as it sees them under ordinary visual conditions and which, without the aid of the cinema, would be imperceptible.

The cinema makes it possible to express the *extent* and *direction* of these movements in *diagrams* by means of the projection and immobilisation of the successive photographs, one by one, upon a sheet of paper, on which are marked, by coloured points, the successive positions assumed by the different parts of the body or by the tool in course of movement.

The cinema allows the *duration* or *time* of movement to be expressed in exact figures by various means known to all experts in film chronometry. (R. Thun). The times,or rather small fractions of time, within which the successive phases of the working gesture are executed, have long been calculated, as they still are, by means of a clock indicating hundredths of a minute. Each individual worker has his « time sector ». That is to say, given several workmen doing exactly the same job, we find that for some the chronometer records short time-fractions, for others very short ones, for others long fractions. The time-specialist in only interested in the short or very short time-fractions and studies them in those workmen for whom they are recorded. He adds them together, and the result, together with the manner in which the movements are executed, may serve as a scheme for a new system of work or for the training of the worker all of whose « time sectors » are rapid. In all this the cinema, which for purposes of time-measurement has almost reached perfection may be of great help. It may further be noted that, as regards work done by machines, the minimum times sufficient for such and such part of the work and the minimum time for the whole task are more and more frequently indicated by the manufacturers of these machines in the instructions they issue for their use. In the case, therefore, of work done by men and machines conbined, the task of studying times and fractions of time called *partial* or *elementary times* is transferred from those who use these machines to those who make them. But this does not mean that the former need no longer continue to pay close attention to the problem. Quite the reverse.

The foregoing applies also *mutatis mutandis* to the *positions* of the worker and the necessary changes they undergo during work. The position, too, is in a sense a *movement*, which it is desirable to examine in the way we have already described.

As regards tools, their examination — with a view to detecting their more intimate or less visible characteristics and suggesting any necessary alterations — is better undertaken by direct observation than by the cinema. The latter, however, is useful when we come to study the handling of tools. We are then once again concerned with movements. The method of obtaining a rapid succession of photographs showing the positions and movement of tools is an old one and, as we have said, goes back to pre-cinema days (Marey, Frémont, Muybridge) ; we need not therefore dwell further on the point. The direct application of the cinematograph to the study of movements and times also dates back several years and is well-known.

VII.

Possible applications, etc.

3) Observation of Fatigue.

It is not, however, enough to select « samples », such as are offered at the moment when the organiser embarks upon his study and to observe how they do their work. The element of fatigue must also be observed. The cinema, we said, can, in the matter of fatigue, reproduce samples of the « best » and « worst », that is, it can show us the work of the man who is least tired and of the man who is most tired or of various types of workers in these two categories. But can it — and this is the point — can it ascertain the *degree* and *nature* of fatigue and the means and time required to *restore the energy* of the different types or samples of workers ? In other words, can the cinema be included among the various devices to which experimental psychology has had recourse in order to detect and measure the degree of fatigue ? Can it help here ? At present, at any rate, we hesitate to give an affirmative reply. As regards « fatigue », the cinema can, as we have said, be used to furnish « samples » ; it can also help to spread the fundamental physico-psychological principles concerning fatigue, which it is desirable that the workers themselves should know, suchas : what fatigue is, the different forms of fatigue and the various individual ways by which fatigue is caused, the curve of fatigue during hours of the day and days of the week ; how fatigue is studied and measured, alterations in the daily curve of fatigue according to changes in the condition of the individual or in his surroundings (Maggiore, Patrizi, Mosso, Joteyko, Treves, Binet, Amar). For the moment, however, we do not see that the cinema could be specifically applied to the *ascertainment* of fatigue. It could, however, for what it may be worth, be used to record the expression of the face and the position of the body during the expenditure of this or that kind of effort (Binet, Vaschide, Patrizi). In any case the applications we have mentioned, which lie outside the scope of the present paragraph, are more than enough to attract the attention of the scientific organiser to the use of the cinematograph in connection with *fatigue*. The Berlin «Fachfilm» has published several films which show how to measure the consumption of energy during work, the effort expended on the accomplishment of various tasks (raising of a weight, turning of a handle, etc.). The splendid experiments by Imbert of Montpellier on the graphic reproduction of the effort spent on various tasks (lifting weights, pushing barrows, pressure of hand on shears etc.) und on the manner in which breathing is affected, the behaviour of the pulse, and the loss of strength during these tasks, as well as similar interesting investigations by other distinguished scientists (Patrizi, Féré, etc), could be freely drawn upon for the making of films of this kind.

We must not forget that the observation of fatigue is an integral part of scientific management. Those are mistaken who imagine that scientific management is simply a question of times and time-measurements. It is also a mistake to

confuse Taylorism pure and simple with scientific management. It is the greatest mistake of all to think that scientific management — in the wide sense — comes to us from America or that it originated there ; and only the ignorant believe that the importance to scientific management of the study of fatigue and of the human factor is a recent discovery. All these problems were envisaged and dealt with in European laboratories of experimental psychology many years ago; they were reported upon and proposals were made to include them in the study of scientific management at a time when, in Europe at least, Taylor's system was still unheard of.

VIII.

Possible applications, etc.

4) Experiments based upon simultaneous and successive modifications of variables which may be in a certain relation to work and fatigue.

The fourth item in the above-mentioned tabulation of scientific management, that is, the fourth phase in the task of the scientific organiser, is concerned with the numerous experiments which, as we have already said, change simultaneously or successively the conditions under which work is done (even the « best » work) with a view to discovering the conditions or variables which will give a larger and better output while diminishing or not increasing fatigue.

Such experiments include changes in what we may call *external* conditions, such as lighting, space between workers, ventilation, temperature (some even propose changes in the colour of walls) and especially changes in hours of work, pauses and rest periods, and even in the nature, intervals between and size of meals, snacks and drinks — each such change being judged by its effect on productivity and fatigue. Similar changes, however, must be made in the conditions and methods of work as regards tools, attitudes, movements and fractions of movements always with the above-mentioned object of increasing and improving outp ut while diminishing or not increasing fatigue. This programme, more especially as regards fatigue, is pre-eminently our own ; it was formulated and commented upon in Europe, particularly in Italy, by scientists and experts in different fields, some time before Taylorism was known.

It will be asked whether the cinema can be of any use in this work of patient experimentation. We do not see that the cinematograph can be of any direct aid, since the aim is to calculate productivity and fatigue as the result of each change in conditions — a process attained by other non — cinematographic means. Once, however, the *best* conditions have been found, the cinema could help, if not in *discovering*, at any rate in *fixing the details of* the new system devised at such pains. The pictures thus obtained could also be used, as we shall see below, for purposes of technical and vocational teaching. This point, which concerns the better technico-professional training of the worker, would have to be taken into consideration in any scheme for coordinating information of the kind we are discussing.

IX.

Possible applications etc.

5) Examination of future workers: vocational guidance und selection, General remarks.

Among the conditions to be modified one after another and experimented with, to see which give the best results from the point of view of productivity and fatigue, the *human factor*, that is to say, the worker with his physical, physiological and psychical qualities comes first in importance. We have already said that the best man in a gang of workers should be selected te supply material for studying the way work should be done, and we added that this procedure was merely an *a posteriori* choice from among the human material at our disposal. In this matter, however, what is required is orientation and preparation: the choice, on a larger scale, from among all young people who are about to embark on study or who are preparing to learn some particular trade or, still more specifically, some definite task. These constitute the fifth and sixth paragraphs in our study of scientific management and we may even distinguish between : *a*) *a preliminary school orientation*, that is, the study of the bio-psychical personality of children in elementary classes ; *b*) *a second orientation*, carried out in the post-elementary stage, with a view to advising young people, in a general way, to take up one kind of work or another ; *c*) *vocational guidance* and lastly *d*) *generic or specific vocational selection*. The study of all these points by distinguished scientists and first-class experts like Münsterberg, Claparède, De Sanctis, Clackford, Baumgarten Myers, Lahy, Fontègne, Moede, Stern and others, has led to the establishment of an imposing and coordinated series of investigations into the method of analysing the bio-psychical personality of individuals and thence to the choice from among these individuals of those who possess the requisite qualities for a particular kind of work.

We have already referred to the *a posteriori* choice of a « sample » worker or of excellent or good workers from the human material available in the factory. We shall now speak of the choice from among those who are first applying for work (*selection*) and of the indications concerning their future occupation which can be given to schoolchildren long before this — while in the elementary school or in the classes immediately above (*orientation*). And throughout we shall bear in mind the possible uses of the cinematograph.

Let us start with *selection*. The essential point to consider is whether the subject possesses the bio-psychical qualities useful or essential to the work which he proposes to take up. Among bio-psychical qualities we must consider the individual physical, physiological and psychical characteristics, according to the classification we adopted many years ago in our various studies of these characteristics for statistical purposes. Many can be expressed directly or indirectly as measures or precise attributes. Their statistical examination, applied to homo-

geneous or comparatively homogeneous groups, led to the discovery of what may be called « the law of the division of human beings according to bio-psychical characteristics », a law which is, as we know, the expression of the curve known as binonial, Quetelet or Gauss curve. It also made it possible (as we suggested elsewhere and abundantly proved in « Lezioni di demografia » 2nd edition, Chap. IV, Naples 1924) to determine, for each of these characteristics, the approximate limits of its « normality » or « exceptionality » highest limit and lowest limit — account being taken, as regards each characteristic, of the graduation or classification of all the various shades or *nuances* between these two extremes. This result is reached by certain methods we have suggested and examined elsewhere. The whole procedure furnishes us with the bio-psychical relation of a given individual to the group from which he has been selected so that we can show the characteristics by virtue of which such individual is normal or exceptional as compared with all the other members of the group. The methods of tracing these relations are varied. Rossolino, Claparede, Lahy, De Sanctis, Stern and others have supplied methods in respect of psychical characteristics, while others are based upon the proposals of Molissa and Martin for the physical and physiological relations. We ourselves suggested methods, accompanied by numerous examples, both for the physical and physiological characteristics in the human-and also in vegetable — species, as well as for the psychical characteristics (see Chap. VIII of our » Metodo Statistico », new edition). It may be noted further that the direct observation of the *constitution*, according to the modern views of the « constitutionalist » school (De Giovanni, Sigaud, Viola, Pende, Kretschmer, Mac-Auliffe, Bunak, Vidoni, etc), likewise starts with those elements which are likely to furnish the best choice of worker.

Thanks to this abundance of methods and results and to similar investigations to which we need not here refer; but which are well-known to every specialist, we are able to calculate the physical and physiological characteristics of the candidate and, by means of physio-psychical and psychical tests, his psychical characteristics. It is true that the experts in these investigations are still by no means agreed as to the best means of detecting the bio-psychical personality of an individual, especially for purposes of selection, and even for purposes of vocational guidance. In this explory of personality (we are referring more particularly to psychical personality) some prefer the questionnaire, which among other advantages stimulates self-analysis; others recommend various general tests; others certain specific tests ; others again consider intellectual tests — that is, tests of the intelligence — preferable to sensorial and motorial tests, for the reason that occupational skill is more closely correlated with tests of intelligence than with other tests. Some writers — in connection, however, with certain peculiarities in the individual such as the degree of fatigue — assure us that the exploration of the subconscious mind gives the most significant results. Finally, some maintain that tests of general intelligence are enough and that there is no need to test the special intelligence of every category of worker (A. Binet, Simon, De Sanctis, G. C. Ferrari, Patrizi, Saffiotti, Gemelli, etc.).

X.

Study of vocational aptitude and cinematography.

By one means or another the candidate's qualities must be ascertained. Let us see whether the cinema can help in discovering some of these qualities.

Among the detailed lists of the qualities necessary for a particular task drawn up by distinguished experts, we find the following: «Distinguishing of objects not easily visible or ill-lit; their immediate recognition and the distinguishing of them from other objects»; «Exact estimate of distances, heights, speeds, direction of moving objects, accelerated movements and reductions of speed»; «Comparison of short distances... Accurate judgment of angles, especially right angles»; » Rapid recognition of facial expressions... Reading quickly and well... Correct filling up of gaps in vision... Seeing a collection of things quickly and then reproducing all the details », etc. (Lipmann).

Could not these qualities be ascertained by requiring the candidate to observe the successive pictures making up a suitably prepared cinema film? The cinema could in this case constitute one of those means of « psychical exploration » hitherto furnished by fixed images, mechanical or other operations, by collaboration between the subject examined and some system of machines or instruments. A film devised for the purpose and turned quickly or slowly as required can show distances, heights and directions to be estimated, objects difficult to distinguish, long texts to be read quickly, gaps to be filled up and interpreted, and so on, so as to constitute at any rate one means of exploring a candidate's mentality. Lahy made use of the cinema to measure the « sense of acceleration » in motor-bus drivers. The Berlin « Fachfilm » has published a film that can be used to measure the accuracy with which an observer judges the speed of scenes and movements.

To go further is not the mental operation of describing something seen, the operation of « giving evidence » of some importance when examining a candidate's powers of attention and other psychical activities? This problem has as we know been most profitably studied in connection with the giving of evidence (Claparède, Stern, Altaville, De Sanctis, etc), but even in the field of selective examination with which the present paragraph is concerned, the cinema may be very useful. We can discover how the candidate for some particular work describes the film some time after having seen it; what he remembers of it and what he forgets, the processes of reasoning by which he tries to fill the gaps in his memory, etc.

Nor is that all. The investigating tests include tables or diagrams representing scenes or actions containing some absurdity, which is not however immediately apparent. The subject under examination, warned beforehand or not, has to look quickly and point out the absurdity.

Could not these tables or diagrams be replaced with advantage by a film made up of situations containing certain absurd features which would strike the quick observer? And what about the sound film? In view of the progress it is making

and since the power of perceiving slight sounds, identifying them and distinguishing them from others is included among the necessary qualities drawn up by psycho-technical experts, it would seem that specially prepared sound-films might very well be used for testing this faculty of perception and interpretation.

There is, however, another possible application of the cinema to the examination of a candidate's qualities, essentially different in character from those we have been considering. Our earliest teachers,like Lombroso, conceived the idea of exhibiting tables and drawings of a passionate or other kind calculated to rouse some particular emotion in order to watch the observer's reactions; reactions merely imitative; or, better, reactions of breathing or pulse recorded graphically. Even to-day the imitative reactions of persons watching a film — especially children — are the subject of special attention on the part of the teacher or psychologist who desires to confirm his study of the child's mind by observation. Why should not the examination of the imitative response and the graphical examination of the spectators' reactions to a cinematographic scene be included as part of the complex analysis of which we are speaking ?

In conclusion : in order to examine a candidate for a specific task, we test his various bio-psychical characteristics by means of questions, direct observation and psychical tests. As regards many of these psychical characteristics (power of attention, suggestibility, etc.), it might well be of some value to confront the candidate with one or more suitably selected cinematographic projections.

We may now be permitted to make a momentary digression and to anticipate what we shall be saying later on concerning vocational teaching by cinematograph, by observing that the cinema may be useful in the training of the *selectors* and *vocational guides* themselves These men are themselves workers, technical experts and are made not born. Itis true that they must be sought amongt specialists having very varied and exact ideas, but the cinema may be of some help in completing their specific training. The school vocational guide,for instance (*first orientation*) proceeds by questions and conversation ; he has to supervise and initiate special games, subject children to experimental examinations which test their powers of attention, memory, commonsense, powers of observation, powers of associating ideas, perspicacity, inherited culture and ideas, sense of logic, hand-writing, etc. (Pizzoli, De Sanctis, etc). Is it not desirable that the instructor should learn how others, with more experience than he, carry out these tests and examinations ? The cinema will show us the teacher preparing the tests and the pupils carrying them out ; it will also show the teacher judging and making his selection from among the results obtained. And in the *second stage of orientation*, and even more in the stage of vocational guidance, when the tests consist in the performance of special tasks — largely manual or half — intellectual half — manual tasks designed to reveal and measure some particular aptitude — drawings, choice and aesthetic arrangement of colours, decoration, compositions in iron-wire, clay-modelling, various work in wood (Pizzoli) — how is the guide to proceed with the preparation, execution and interpretation of these different tasks ? A film showing another guide (model-guide) at work may be of great help.

XI.

Some remarks on the psychology of « vocations ».

a) Methods of choasing an occupation.

Les us now return to the question of vocational guidance, more particularly the guidance to be given to the lowest classes in elementary schools and to the classes immediately above. Here we require : *a*) to reveal the bio-psychical qualities of the child ; *b*) to discover its vocation ; *c*) to advise and guide it, if only in a general way, in the direction of some particular class of occupations or away from some other class.

Can the cinematograph help in this psychological « sounding » by the teacher-guide with a view to discovering the child's qualities, bringing to light its vocation and finally advising and guiding it ?

At this point it may be well to state what we know or think it possible to conclude as regards : *a*) the normal method of choosing an occupation and the psychology of vocations ; *b*) the ordinary methods adopted in recognizing an individual vocation and the reasons which explain it.

a) The vocational guide must, of course, be in a general way familiar with the mechanism which governs the choice of an occupation. Does the choice depend upon purely subjective and individual circumstances, such as — to take an obvious example — *a congenital vocation* (according to the accepted phrase), or is it essentially imposed by various conditions of *environment* ? Or is it simultaneously a function of both these variables ? And, if so, which generally predominates ?

We may be permitted very briefly to summarise what we have already said in other studies as to the nature of vocations, the way they develop and their importance in the choice of occupations and even in the formation of certain social groups.

We have said, in substance, that the *diversity of physical, physiological and psychical conditions* in human beings — a diversity produced by a constant law of natural variability — engenders a diversity of *being* and *feeling* and therefore a diversity of *aptitudes* and *aspirations*, a diversity in the way of *thinking* and *judging*, from which ensue a diversity of *needs* (moral, intellectual, material), varying with each individual, and of *interests*, a diversity of action and *conduct* or at any rate diversity of aspirations in the matter of action and conduct. The vocation is the instinctive psychological expression, conscious or otherwise, of the bio-psychical personality, which creates aspirations, or inspires action and conduct.

This is a complex mechanism which it has hitherto been the custom to tabulate in the simple form, for example, of *individual desire*. « The choice of occupation », it is said, « depends upon individual desire ». We find, however, that, although this is a powerful factor among the bulk of specialised workers, it has little or no influence upon non-specialists. This complex mechanism is sometimes tabulated as physical constitution, mental constitution, psychical consti-

tution (in other words, the vocation is the result of these constitutions), but this subdivision is an example of wrong nomenclature, since « mental constitution », even if we allow the term, is the same as psychical constitution. Moreover the *real* vocation, which is sometimes dormant in the unconscious mind, may not be known or may be only imperfectly known to the person in question. Some authorities, without regarding the biological and individual mechanism of vocations in all its aspects, see the origin of vocations in facts, all no doubt of an individual character, but of a highly specific nature, as, for instance, one of the following :

1º The reaction, even unconscious aversion of the child to its father, which suggests the choice of a different occupation contrary and opposed to the father's calling. The Freudian influence is evident in this conception.

2º *Organic insufficiency*. The individual, more or less, consciously aware of some organic (and psychical) defect in his person, seeks to counteract this defect by choosing a particular trade or profession (Fr. Thalberg) ;

3. The attempt to *sublimate* some base instinct from fear of its becoming predominant ;

4º or, more simply, the wish actually to satisfy base and unavowable instincts by the pursuit of a calling in which they can find a legitimate outlet ; legitimate satisfaction of deep and more or less unconscious illicit tendencies (Stekel).

All these explanations which probe down to deeply hidden and often unacknowledgeable motives, are no donbt influenced by the *Tiefpsychologie* of the Viennese school, which, in so many parts of its interesting analysis of hidden psychical motives, was anticipated by writers who are often forgotten ; for instance, the psychologists and anthropologists who discovered and described the influence on human conduct of deep, primitive strata — atavistic, unexplored and instinctive — which lie at the roots of each individual mind (Italian school of psychology and criminal anthropology).

The vocational guide, we repeat, requires to know all these different possible factors in the choice of an occupation. He must also examine or know the theories and interpretations at variance with or opposed to those we have mentioned — interpretations based purely upon the *influence of environment*, such as the following : The choice of a boy's occupation is determined by the professional environment of the father (theory of correlation between occupation of father and son studied by Chessa) ; it is determined by the prestige or vogue which the occupation enjoys at the moment of choosing (in this case suggestibility plays a part and the factor of environment is obviously associated with the individual factor) ;the choice is often imposed by local geographical conditions (N. B. Demolins' succession of *categories*; the soil, sub-soil and upper soil of a certain zone determine its fauna and flora; these latter determine the nature of the occupations, trades and professions of its inhabitants, whence results the social type of the zone) ; again the choice of occupation may be imposed by special local conditions of industrial or commercial production (districts where the clock-making industry is traditional) ; finally, the choice may depend on « chance », a factor which should be extra-individual *par excellence*. It is not, however, sufficiently realised that « chance » is one

of those proteiform words which need to be defined before they are used. We mean very different things by the word « chance » Are we using it in Carnot's sense of the convergence of two independent series of circumstances ? Or in the sense of exceptions to the laws of probability, as in drawing out differently coloured counters from a box ? Or do we mean the occurrence of extremely unlikely events ? We could prolong the list indefinitely, for « chance » can be conceived in a variety of ways all of which invite discussion.

As we have seen then the vocation is capable of many interpretations, but these are not mutually exclusive and, as a rule, interpretations of a bio-psychical and individual character do not necessarily exclude interpretations based upon environment, and *vice-versa*. The study of vocations has inspired a copious literature, with which the vocational guide must be familiar (Claparede, Bovet, Stern, Fontègne, De Sanctis, etc). Here, too, the vocation must be conceived as the result of a complex system of forces — some of individual origin and some engendered by environment — we must note in each particular case which of these forces predominate and try to establish a hierarchy of them according to their general potency. It must further be remembered that among the mass of individuals, each so different from the other, we find certain « characters », in whom the individual bio-psychical forces or factors are more powerful than the environment and others « without character », mediocrities or merely average characters, readily adaptable, in whom the individual forces or factors are more or less easily dominated by the environment. We have dealt with this at length in our studies on the psychosociology of language and we showed the difference in speech between men of marked personality and men of insignificant or no personality.

In any case, having now a clear if only a general idea of the complex mechanism governing the choice of occupation, we must now decide whether and how the cinema can help in *discovering* the *real* vocation.

XII

Some remarks on the psychology of vocations.

b) Methods of revealing vocations.

First, however, we must deal with *b*), mentioned above, that is, the methods ordinarily adopted to recognize the existence of a particular vocation and the reasons which explain it.

As we know, the system commonly adopted in order to acquire notions concerning the mechanism of the choice of an occupation and concerning preferences and vocations in general is that of the *questionnaire* : « what trade would you like to follow ? What would you like to be ? What are your favourite books ? Why ?... » An enquiry, in fact, into the child's « professional » and general ideals. This

is certainly a system to retain, although in our opinion, it is, like every other psychological enquiry, attended by the following disadvantages :

1° the semi-insincerity of the person who answers. He takes up an attitude towards the questions rather as if he were in front of a camera ; he adopts a pose. It is true that even the « pose » is a gesture indicating personality, just as the most artificial style is, as we have shown elsewhere, an expression of personality and thus « natural ». In order to reach to the real core of the personality the essential thing is to be able to interpret the intentional disguise which appears in the replies as it does in style.

2° Even if the person concerned makes a firm resolve to yield himself up to the enquiry — as Emile Zola so eloquently declared his intention of doing when he acceded to Dr. Toulouse's request to make a close bio-psychical study of the great apostle of realisim, is it quite certain that the replies, though given in perfect good faith, really conform to the truth? This may be seriously doubted when we consider that each of us lives at all times and exclusively on the surface of his being and does not always know wish to know or dare know the real motives that determine his statements, tendencies and acts. Very often, we have said people do not wish or dare to know them ; they hide them by subtle psychological processes familiar enough to the investigating psychologist, a specialist in the study of those subterfuges by which the « ego » frequently deceives itself.

It needs deep and courageous introspection carried out with method and an abundant store of psychological knowledge to be able to examine oneself and discover the hidden motives of one's actions, most of which cannot face the light of day. As a rule, if we wish to discover the motive of some action it is not a good method to question the person concerned as to the reasons which prompted him to perform it ; often he does not know why ; he gives his own interpretation or conceals the real reasons. The person concerned cannot in fact be both judge and witness. The truth of this was well illustrated about twenty-five years ago by the ethnographic school à propos of the mistake of questioning savages as to the why and wherefore of some particular rite. A sociologist has pointed out the same thing with reference to the study of language, showing how useless and dangerous it is to ask people who utter phrases or words of new formation why they employ these neologisms and whence they come. Lastly, the lesson has been consistently preached by the psycho-analysts with that abundance of detail with which we are all familiar. To ask someone who does something why he does it is the same as asking him what are the causes which *he thinks*, impel him to act, or what, *in his opinion*, are the origins or motives of his act. But these are not the real causes, which are often unknown or purposely disregarded, nor the real origins and motives, which are frequently forgotten.

We do not dispute the value of the questionnaire and of interrogations in general, for, although persons who examine themselves and explain or seek to explain the motives of their acts or words, see an image of themselves falsified by refraction, like a stick half dipped in water, it is always interesting to the observer to

note this error of refraction in the light of which the person sees himself or whatever he is being asked to give a reason for.

3° Another common disadvantage of questionnaires is that the replies to them, with their various elements, do not come within the limits of a single strict and objective nomenclature and thus do not lend themselves to analysis and statistical development to the same extent as modern methods of psycho-statistics.

4° We might also add that, while enquiries of this kind on a large scale may-subject to the reservations mentioned above — throw light on this or that law governing the mechanism of vocations and choice of occupation, they are found wanting when it comes to the examination of the special case. The questionnaire has a collective and statistical value for the purpose of revealing those « group laws », withinwhich it is impossible to include the particular individual. In order to « explore » the individual, another method, of which we shall speak in a moment, is preferable to the system of questionnaires.

First we desire to point out one further drawback attaching to questionnaires addressed to the young. I refer to the *false vocations* peculiar to that age. Who can be sure that the vocation given is much more than the expression of a childish fancy ? This question has been treated at length by psychologists (Bovet and others). The case of the child of well-to-do parents who wants to be a servant, coachman or engine-driver is quite common. There is no need to be a professional psychologist to realize the falsity, or rather the passing nature, of such vocations and to explain them. In such cases, however, the psychological examination must be conducted somewhat less superficially and we must be able to read between the lines of each particular reply.

As regards these individual examinations,the dialogue is preferable to the questionnaire. This second method of ascertaining the vocation brings us back to our subject-matter. *Dialogue* between the vocational guide and the child, but — be it understood — an analytical and a *subtly* analytical dialogue, since it must be conducted by methods approaching those of the psycho-analysts if we are to touch rock bottom. The dialogue under these conditions leads to *discovery* ; it diverts the child from false vocations and guides him towards the true one.

Observation *from outside* may enable the guide to discover in the subject of examination physical, psychical and physiological characteristics corresponding to deeply seated vocations ; the physio-psychical examination — especially those parts of it in which recourse is had to psychical tests or tests which reveal the psychical personality of the subject — may be a great help in this enquiry ; but — let it be borne in mind — the really delicate part of the investigation consists in bringing to the surface of the mind the subject's real vocation, which is frequently hidden in his sub-conscious self. Did not Sainte-Beuve tell us that the critic's real mission is to teach a writer what he does not know about his own work ? Here the critic is the guide, who, if not always, can anyhow sometimes reveal to the subject things about himself which he did not know.

XIII.

The discovery of vocations and the cinema.

After these necessary preliminaries let us return to the question at issue. We are now agreed that we must resort to enquiries or suitable dialogues in order to discover the vocation. In this operation what help can we get from the cinematograph ?

The vocational guide, we said, among his other duties has to :

a) seek and examine quaiities and aptitudes ;

b) reveal the vocation, if any ;

c) advise, guide and divert.

Beginning with *a*), what we said concerning the application of the cinema to the examination and selection of candidates for a specific occupation is valid here also. Here, too, varied and suitable films may be used as psychical tests to discover the conditions of some particular psychical activity in the subject (attention, memory, suggestibility, etc.). If we take the points of a psycho-technical examination, as carried out in one of those vocational training centres now so common, we shall find that for many of them good films would be especially suitable for revealing the existence of one or other aptitude in the subject. Let us for example take the tests used at Zurich and select those for which the cinema might be used or recommended, 1° keenness *of vision*, stereoscopic visual sensibility, estimating differences in dimensions, luminous sense, habituation to darkness, 2° *auditive sense*, metrico-rhythmic sense ; 3° *olfactory and gustative* aptitudes, which do not concern us here 4° *motorial aptitudes*, such as time taken to react, rapidity of movement ; on this point, too, there is little to be said, although the cinema might be employed, as suggested above, to observe the subject's imitative tendencies during certain films ; 5° examination of the *intelligence*, which is interpreted at Zurich in the widest sense. This examination is carried out either by dialogue or by a fairly large number of tests mainly intended to reveal degrees and forms of the memory and imagination ; 6° from all these tests the vocational guide extracts whatever enables him to judge the subject's *character* and *attitude* towards his work (*Arbeitscharakter*) bearing in mind two considerations : first, the behaviour of the subject throughout the tests and his manner of approaching and handling apparatus; secondly, the results of the tests when several tests are given in succession. It is possible to gain a more intimate knowledge of the psychology of the *character in general* through examinations carried out by different methods with a view to throwing light on the temperament, the will, the assurance, self-confidence and special psychical qualities such as powers of concentration, accuracy, and faculty for self-expression.

All this, no doubt, necessitates special tests and the assistance of investigating instruments or material means accompanying the purely psychical study ; every special treatise on experimental psychology or psycho-technics abounds in information of this kind, but the presentation of special films should certainly be included as one of these tests.

As regards points *b*) and *c*) — the duty of the guide to reveal to the subject his real vocation and to advise and direct him or divert him from some false path — if we examine the different kinds of factors both individual and external (environment), which as we have seen may be correlated with the vocation and the right or wrong choice of trade or profession, we shall agree that suitable films shown to the young in the course of dialogues, which must take the form of friendly questionings and confessions, may induce the subject to correct or modify his vague or false aspirations and may reveal to him ambitions some of which were buried in his subconscious mind or which he simply did not know of. The vocational guide will get the best results by choosing from among the various occupational scenes depicted those which show trades approximating most closely to the tendencies and aptitudes which he has already discovered in the subject he is examining. In particular, such scenes could correct the anti-paternal reaction which may lead a boy to mistake his vocation ; they may suggest the sublimation of fundamental instincts which will thereby find an outlet and a social value instead of manifesting themselves in anti-social forms or degenerating into the autodemolition of the personality. The spectacle of a great variety of occupational scenes differing from one another and calculated to arouse in a boy emotions or special mental manifestations apparently non — existent or which had been lying dormant, may awake his youthful interest and thus reveal to him his vocation.

XIV.

Further observations on vocational guidance and selection by the above-mentioned methods.

We have seen that the tendency is towards a general orientation at first and specific selection afterwards, on the basis of a psychological and psycho-technical examination of the subject very different from the usual *school* examination. It would be irrelevant to our subject-matter to compare the results obtained by a classification of subjects according to the *school* or *vocational school* examination and a classification according to a *psychological and psycho-technical* examination. It would be still more irrelevant to ask whether those subjects which psychological and psycho-technical examination shows to be more particularly suited to such and such an occupation are those who do in practice succeed best. Are they really the ones who get on best in life? We might also enquire — to return to factory work — whether workmen declared to be excellent by their foreman or technical manager and then subjected to psycho-technical examination are still found to be excellent by the examiner. We need only say that these points have been treated by one writer or another, frequently by the excellent statistical method of « correlations » ; and it is generally agreed, at any rate as regards the school examination and the psychological and psychotechnical examination that the latter essentially supplements the former, particularly from the point of view of estimating sensibility, manual dexterity, attention, memory, strength, etc. It is also thought

that the classification resulting from the psychnical or psycho-tecnical examination of candidates on entering a vocational school or a factory corresponds fairly closely to any later classification made as a result of courses of study or practical work. Cases are also quoted of candidates for purely intellectual scholarships being chosen by psychological examination with excellent results; in the course of their school career the selected candidates exactly fulfil what the psychological examination prophesied.

In this connection we may recall the recent attempts to establish classes of « gifted » or « more gifted » students from subjects chosen according to the above-mentioned psychological and psycho-technical methods. Studies and experiments made in such different centres as the Schools of Hamburg, Berlin and Leipzig and at the technical arts and crafts schools at Geneva, Chaux-de-Fonds, Paris, etc. have shown the superiority of mixed examinations (academic tests combined with psycho-technical tests) over purely school examinations.

A harder question is whether there is any relation, and if so what, between the school career, aptitudes and special skill on the one hand and success in life on the other. « What qualities are most essential to success in life ? » is a problem wehave dealt with elsewhere in a statistical enquiry on the distribution of wealth among human beings (1).

XV.

Possible applications, etc.

7) Detailed knowledge of the occupation or the «integral» occupational monograph.

Anyone who has examined programmes or schemes of scientific management knows that, however substantially they may differ from one another, they all impose as a primary condition a knowledge of the occupation in its various aspects, whether it is to be scientifically organized or to be practised. We must in other words be acquainted with that collection of facts about an occupation which we may call the *occupational monograph*. Developing the idea, we may even say that this monograph must comprise all the aspects of an occupation and that we must have what we will call an *integral monograph of the occupation*, to distinguish it from the mere occupational monograph, which is essentially economic in character and which has long ago been traced by economists and statisticians.

The occupational monograph added to the family monograph — likewise conceived and illustrated by economists, sociologists and statisticians (Le Play, Cheysson, etc.) — gave particulars of the different branches and processes of work peculiar to an occupation, demographic facts about the class practising it, information concerning its economic conditions, food conditions, death-rate, diseases,

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(1) Compare A. Niceforo, *La misura della vita*, chap. 5 (1919).

accidents, causes of death, rate and seasonal cycle of unemployment, and so on. Later, it was proposed to enlarge this field of the occupational monograph by devoting more space to the study of man, and it was extended to include studies of the biological and even psychical characteristics of the individuals engaged in a specific trade; physical, physiological and psychical defects, congenital or contracted; a biological examination of all those special matters, such as feeding, which had previously only been studied from the economic point of view but which lend themselves to biological and social study also (1).

The *integral* monograph of an occupation includes, so far as it concerns scientific management, studies of the environment, natural or otherwise, in which the occupation is carried on; of a special technique or different techniques which may have to be known; of the qualities necessary to exercise it; of systems of apprenticeship and of all the matters with which an occupational monograph normally deals. It also includes, in the way of general information, notions concerning the place occupied by the trade in question among general occupations, the origin of the materials it uses; their quantity, mode of use and the transformations they have previously undergone. Thus an integral monograph includes the history of the occupation.

What we have to do therefore is to amass a complex body of information relating to the occupation. Can the cinematograph help us here? The various notions mentioned above may simply be intended to help study the occupation in all its aspects, but they may also have an essentially informatory and didactic purpose, and it is in this direction that the cinema can give us valuable assistance.

A film or series of films representing an integral occupational monograph may serve to inform candidates of the special features of any trade or occupation, but it can also show how to execute work and give to gangs of specialized workers fuller notions than they can acquire within their limited circle. It may even widen the field of observation for vocational guides, who after a close examination of some occupational monograph shown in movement on the screen, can derive fresh ideas for the application of their methods.

The question of *apprenticeship* will furnish us with an occasion to refer to the use of these integral professional monographs. For the moment we will only observe that there is no lack of special films which recount the history of a trade or occupation, show it as practised, indicate its importance to national or world economy and show us the actors — workers — in their economic, domestic and social life. This is not the place to survey or even to quote them. We can only hope that they conform to the idea of the integral knowledge of the occupational monograph as we have set it forth alove.

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(1) See our « Ricerche sui contadini ». 1905.

XVI.

Possible applications, etc.

8) Scientific organisation A) of a cycle of operations, B) of the workshop C) of a whole undertaking.

Hitherto we have been mainly referring to the work of the individual considered separately or of gangs, the workers of which are doing an almost identical task. We may, however, consider a larger series of kindred operations carried on successively or simultaneously, for example, more or less large cycles of operations, or even the work of a whole factory or enterprise, with a view to co-ordinating these numerous kindred operations within a single scheme of scientific management. In all this our special concern is still whether and how the cinema can usefully be employed.

A) Given a certain cycle of operations scientific management, after an examination, shortens the time taken by removing or bringing closer together objects, tools or men. Cases have occurred in which by such a procedure cycles have been reduced from 20 days to 6. Whether the film can be used in making the investigations necessary for such results is open to question, but once the best cycle has been obtained as the result of these enquiries and the new processes of work have been fixed, these could certainly be shown in films for purposes of vocational training or with a view to general propaganda to illustrate how a cycle of operations is shortened. These cycles must of course be shown on the screen both before and after they have been rationalized.

B) Similarly, the organization of a whole workshop, from the manager down to the smallest unit, can be conveniently illustrated by a film, not so much for the purposes of *discovery* as for *demonstration*.

Ordinarily, a scheme for the scientific management of a factory is represented by a chart, of which the centre or upper part is occupied by a square representing the general management. From this central or upper square radiate a succession of smaller squares then small circles, then points and other signs, joined or not by lines or arrows and indicating the various functions and the place they occupy in the general hierarchy. Without abandoning this chart, which can be shown on the screen stationary or moving, it would be well to give it more life by making it show each service at work. Thus the first scene would show the general manager's office and would be followed by immediately subordinate offices, such as the chief technical office, works office, administrative office. Then, office by office, the film would show the various branches of work in moving pictures. Let us take as an example the chief technical office. The film will show *a*) the room in which it is situated and the work of the technical experts responsible for studying the means of executing plans *b*) the draughtsmen's room at work, *c*) the shop for reproducing

drawings ; the film could then show in separate scenes the various directing services the technical office, the distributing office, the works office, the inspection and testing office, the accountancy office and the service of upkeep and repairs. It would then pass on to the commercial and administrative services, which are also suitable subjects for scientific organization. Still following the ramifications of the chart, which can be shown, as we have said, either stationary or in the form of animated drawings, we will pass from the central services to the workshops. Here we shall see in succession at work the moulding shops, foundries, the processes of turning and fitting, the various machines in action, etc. (M. Fossati).

C) But let us leave cycles of essentially manual operations and turn our attention to another form of activity, work in offices, administrations, commercial firms, and consider whether methods of scientific management are applicable to these organizations and, if so, what use can be made of the cinema. Here too, no doubt work can be rationalized, if so desired, by the fusion of several operations or cycles into a single operation or cycle, by reducing the number of operations, studying standard methods of work, employing modern mechanical means of dictating, writing, filing, etc. We may mention in this connection the film published by the *Rotterdamsche Bankvereeniging*. Investigations have even been pursued to the point of indicating the special qualities to be required of the staff of an office administration or concern (and factory) and how much of each quality every employee or workman should possess; administrative, technical, commercial, or financial capacity or the qualities necessary for confidential posts (cash and accounts) The necessary « percentage » of each of these qualities varies according to whether we are concerned with the manager, chief of the technical sevice, foreman or workman (H. Fayol).

Although a matter of discussion, owing to the kind of work which it comprises, this method, which some called Fayolism, has its strong supporters and has been applied to the organization of many offices and enterprises of various kinds and also to the organization of large shops, accountancy services and postal money order offices, not to mention the North American municipal offices, where Fayolism appears to be more and more popular.

Here again the cinema, by showing the advantages of the new methods of work, could on the one hand win over the employees instructed to follow these methods and on the other usefully supplement the written instructions found necessary or useful for the use of employees.

A film of this kind could be interrupted from time to time by tables and stationary diagrams, but it must be remembered that such tables will arouse interest if, instead of appearing on the screen all of a piece and as it were crystallized, they are projected bit by bit like a magic drawing which, beginning with a few strokes, is put together little by little or drawn rapidly by a hand appearing on the screen to the astonishment of the spectators, who eagerly await further developments.

XVII.

Possible application to agriculture.

Greatly as agricultural work varies from one place to another and many as are its different aspects, it is nevertheless capable of being scientifically organized and once again the use of the cinema must be considered.

Work with the spade, pick, shears or scythe also lends itself to a scientific study of times and movements, and ploughing implements may be studied in the same way. Special apparatus, based on the principle of Marey's drum and placed between the hand of the workman and the instrument on which he is exercising pressure, record that pressure graphically so that we can measure effort and fatigue, their duration and intensity. In this way we can obtain exact graphs for agricultural work of the kind we have mentioned and, after examining these graphs obtained by successively modifying the working conditions, tools and positions of the body the specialist can determine the conditions under which the effort is least without any reduction or even with an increase of output.

Moreover the standardization of certain forms of farm work — making of wine, jam, cheese etc., as the result of rationalized study could in each branch of production be illustrated by the cinema. Films of this kind, by their stimulating capacity, could usefully serve to popularize rationalization. From this point of view animal husbandry could also find a valuable ally in the cinema, which, although it could not here be employed in investigation. could be used to teach, warn and advise (Fontana, Moszezeuski).

XVIII.

Categories of research and forms of activity closely associated with the foregoing.

In thus surveying the various aspects included in the complete study of scientific management, we have purposely lingered only over those for which the cinema can be used to *discover* some unexpected opening for scientific management and over those for which the cinema may serve to supplement rather than discover. In the first case we have stated conclusions ; in the second we have indicated possibilities.

We must now touch upon two matters which, as we said at the beginning, are not really part of scientific management, but are connected with it. These are :

1° vocational training ;

2° public propaganda to teach what scientific management really means.

The possibilities of the cinematograph in these two fields are so evident that there is no need to insist upon them, but in mentioning them we should perhads arrange and as it were catalogue these many and various applications. And this is what we now propose to do.

XIX.

Vocational training, scientific management and the cinematograph.

As regards vocational training and the cinema, a distinction should be made between two cases :

a) The use of the cinema for *individual* teaching of a specific and technical kind. In this case the pupil has to learn a machine and its component parts, the tools, movements and positions, his working gestures, as we may say. The film, projected slowly or at the normal speed, is a living and suggestive method of demonstration. Thus the screen could show a *first-class* worker and an *awkward* worker, so that the pupil might see how work *should* and *should not* be done. Such teaching, especially if it aim at imparting standardised methods of work, is essential to rationalisation. « It is given in the form of *written* and *oral* instructions and by *practical demonstrations under working conditions* ; the workman must be systematically taught the new technique. For each operation a schedule of instructions is prepared by a specialised employee — very often the employee who has made the time — studies ; the fullest of these schedules contains a list of all the different parts of the operation. The worker is entitled to know the various details which go to make up the schedule, although the latter is supplemented by verbal instructions and demonstrations on the spot » (Thomson). Written instructions, as Emerson reminded us when he formulated the basic principles of his system — a system which has many points of resemblance to Taylor's, — are an essential part of the method : instructions specifying times and processes of work, tools, speed and even the different degrees and percentages of *fatigue*. Surely the film would prove a most persuasive and suggestive means to this end ?

b) The worker should know the *complete task* of which his particular job is a part. He will then understand properly what previously meant almost nothing to him and see it as an organic part in a whole productive scheme. He will also acquire notions that may be useful to him in his own particular work. The film is especially well-fitted to show the whole factory and the different sections and shops at work. What we said above concerning occupational monographs may be repeated in this connection, since the cinema can show us the raw material in all its different phases of transformation, beginning before it reaches the factory and following it through all its vicissitudes until it becomes the finished product (a tree, for example, can be shown growing in the forest and then as a finished piece of furniture).

Lastly, the cinema can show, to a worker tied down to a specific task, all the transformations involved in a particular cycle of operations.

c) It is useful and even necessary for the workman to know the *hygienic conditions* under which his work is performed and what *precautions* he can take to safeguard his health; he ought especially to know the dynamics of *accidents* peculiar to the work he is doing, how and why they occur and how they may be

avoided. In all these matters demonstration by cinema is useful, not only to the worker but to the employer. If the latter sees animated pictures taken from life and showing work before and after the introduction of hygienic improvements, if he is shown apparatus and systems of protection against accidents — scenes illustrated whenever possible by diagrams indicating the frequency curve of accidents in a given branch of industry both before and after the adoption of protective measures, he will realise the necessity of introducing more up-to-date and rational systems.

For some time past the labour bureaux of the different countries have issued special publications containing the results of specific enquiries carried out in certain branches of industry or factories ; these publications give pictures of premises which suffer, economically and hygienically, from bad internal arrangement, defective lighting, etc., and also show other factories or establishments equipped and installed as they should be owing to the enlightened initiative of some praiseworthy industrialist. They likewise publish photographs of recent intelligent systems of protection, such as masks, eye-pieces, safety gloves, etc. ; it would seem that the cinematograph might well replace the use of photographs in showing and encouraging the adoption of these new methods.

The special publications of which we have been speaking devote much space to the scientific study of occupational accidents, and there are, of course, many other such studies which could be transferred to the screen so as to teach (1) the general laws governing accidents ; (2) specific causes of accidents peculiar to each branch of work, and in this way serve as a suggestive visual warning to workers.

The scientific study of accidents is a perfectly practicable study involving a general part and several particular parts. We have already indicated the lines which the general study should follow. We said that although accidents were normally regarded as acts of God which befal workers *from outside*, as it were, they are very often due to the bio-psychical condition of the worker himself, and therefore originate *within*. His sensibility, attentiveness, presence of mind, nonchalance, intelligence, sobriety and health are all factors which either invite or repel accidents, or rather diminish or increase the possibility of accidents. A wise selection of workers, subject to periodic revision, is in itself a factor in reducing accidents. This does not mean that external circumstances do not play their part in determining accidents; undoubtedly, they have their due weight and will have to be considered one by one. External circumstances and individual conditions are often found associated. Accidents have their favourite hours and their days and months of maximum frequency. The analysis of this complex system of causes and concomitant causes is the essence of the scientific study of accidents. Prevention is a corollary of such study and the more salient and suggestive pages in the history of accidents can be conveniently reproduced on the screen to serve as a salutary warning.

With regard to the importance of the individual factor as a cause of accidents, the mechanism of accidents is somewhat similar to the mechanism of crime as observed by certain psychologists and criminologists, more especially of the Italian

school. Crime, too, is not an *external* phenomenon, but is closely connected with the qualities and defects of the criminal,, his age, sex, sensibility, intelligence, education, etc. (Altavilla).

XX.

A DIGRESSION CONCERNING SPECIAL VOCATIONAL TRAINING : DOMESTIC ECONOMY.

" Since we are on the subject of vocational training, it may not be irrelevant to say a few words on the teaching of *domestic economy*, which some authorities, including Miss Christina Frederick, would make a special branch of scientific management. The idea is excellent, although there are difficulties in the way. The aim is to save the housekeeper trouble and fatigue by substituting mechanical for manual work and thus saving time (Mme Lassalle has shown how the time required to make a bed may be reduced by 80%). A saving of work and fatigue is equivalent to a saving of money. With a view, however, to a wider programme than that which has so far been adopted or suggested by experts on this subject (see the proceedings of the Fourth International Congress of Domestic Economy, Rome, 1927), we might propose the use of the cinema in order to teach mothers of families :

a) how to keep their household accounts rationally ;

b) the nutritive value of foodstuffs and a sufficient daily allowance. In these important matters it is not enough to know how many calories are produced by a particular category of food and therefore what amounts are necessary to support the human frame ; it must also be shown that the requisite daily number of calories must be derived from a variety of foodstuffs and it must be explained which these are ;

c) besides the two points mentioned above, the cinema must further inculcate that collection of coordinated notions which some term « domestic training « or even » « domestic science » and which comprises rational cooking, washing, ironing, sewing and mending ; and, in our opinion, this science should include the elements of child rearing both pre-natal and post-natal.

The lantern-slide has in the past effectively helped in the teaching of these various branches of house-keeping, but we may expect even more of the film. How much more effect would be produced by animated diagrams, built up bit by bit before the attentive gaze of the spectator. These diagrams would show, for example, the nutritive value of various fodostuffs, their content in albuminoids, carbohydrates, fats and their equivalent in calories ; they could also show the minimum allowance of all these elements necessary for a man at rest, a man at work, an adult, a woman and a child. A well conceived film could illustrate a good and a bad housekeeper side by side, as they carry out their numerous duties, which are not all so simple and humble as we are prone to think.

XXI.

The cinema and the vocational training of the infirm regarded as part of vocational education and scientific management.

Is it possible to include the vocational training of the physically and mentally deficient within the framework of vocational training regarded as a part of scientific management, and does it fall within the field of application of the cinematograph? The question is one for discussion? It is however worthy of note that « Fordism » has not despaired of utilising the infirm for certain tasks adapted to their potentialities. Thus, after classifying the various kinds of work (work done standing up, sitting down, work requiring one hand or both, work done by artifcial light or daylight, heavy work, comparatively heavy work or work requiring no muscular force, work suitable for the disabled, the blind etc)., Ford has succeeded in making effective use of physically or mentally deficient human material and, by adapting it as well as possible to different tasks, in giving it a productive value. We may also mention the intensive effort made after the war to adapt the various categories of disabled soldiers to some kind of work (De Freminville in the workshops at St. Nazaire, Amar, le Chatelier, Loriga, etc.). For some years, too, an effort has been made to train convalescents in hospitals to various forms of manual work. More especially in the surgical wards, specialists have tried with some success to teach patients' work within their capacity. In this way not only have they been restored to the ranks of producers, but their morale has been raised and their character strengthened. Again, experts have tried to improve the condition of certain chronic cases by training the patients to perform certain manual tasks. Could not the cinema help in the education of all these « unfortunates » by showing them the exact movements required of them in their work ?

Let us now turn to another class of the infirm, viz. the mentally deficient. Here the cinema can unhesitatingly be employed for instruction. Already many elementary schools have formed groups of deficient children with a view to applying special methods to their education. The degree of deficiency naturally varies ; some are merely « of low intelligence » and for them the question is how they shall be prepared for a future occupation. Others are definitely « deficient », and for them simple, useful and productive tasks have been devised, which they are found quite capable of doing after a longer or shorter period of general and special education and adaptation. Numerous are the efforts that have been made, by psychical and physical tests, to classify children when they first enter school in different grades of intelligence, extending from « exceptionally low » to « exceptionally high » and many are the attempts that have been made to ascertain the number included in each of these categories.

Then again, how many means have not been employed to discover and illustrate the « law » of the distribution of persons according to their mental or other psychical differences ! We ourselves have devoted much ink and paper to this study.

Certain it is that in one way or another these early selections result in forming groups of mentally deficient cases, and if it is recognized to be useful or necessary that these should be trained the cinema can no doubt be a great help. Films would have to be made of which some of the scenes would serve to enliven and generally awaken the intelligence ; the purpose of others would be to fill up certain mental lacunae peculiar to one or another category of abnormal children, while others would have to teach the technical side of their work to persons found capable of doing it. Even when these different functions are not combined, the mere fact of teaching the mentally deficient one kind of manual work rather than another, however simple it may be, itself acts as a strong mental stimulus. The cinema is undoubtedly an excellent way of rousing and fixing the attention of those least capable of sustained attention ; it has the same effect on unstable and weak-minded people.

XXII.

Re-education and maintenance of the efficiency of the worker.

A worker's good qualities are found gradually and naturally to deteriorate if he neglects the bodily and physiological duties calculated to keep him in good health and training, and every scientifically organized business has to take account of this possible deterioration. Besides teaching workmen ideas of general and special hygiene, employers should be recommended to instal premises within the factory itself where the men can indulge in the forms of sport best suited to keep them in training and maintain efficiency. We know of more than one industrial establishment where this system obtains. Simple and rational gymnastics, without complicated and cumbersome apparatus, easy to do and accessible to all, like the various systems of Swedish drill so popular nowadays are the best exercise for workmen either at the factory or in their own homes on half-holidays. The effort expended on rational exercises has the effect of generally renewing the physical and even psychical forces and results in a sense of well-being. We would, however, draw particular attention to exercises with which scientific management is more especially concerned, and these we will call *counteractive exercises*. These are simple and suitable gymnastic exercises with the object of avoiding deformations as the consequence of sustained application to a specific task (L. Behr and Th. Fuerst of Munich). Such exercises can teach proper breathing ; by acting upon the different parts of the spine they can prevent apprentices and employees from becoming hump-backed or round-shouldered and can strengthen the abdominal muscles, which become flaccid as a result of a sedentary life, etc. The special books on physical culture are usually accompanied by numerous photographs showing how to bend backwards, how, when sitting on the ground with the legs parted at a right angle or nearly a right angle, to turn the arms horizontally, how to lie down and get up in a certain way, how to touch the ground with the fingers without bending the knees, rhythmic movements, etc. Special films, showing

exactly how these movements ought to be carried out and explaining ther value, would constitute a useful method of education (Fritz Strube of Hanover).

Sport is becoming more and more the subject of statistical studies (See our monograph on the statistical study of sport and athletic aptitudes in the *Rivista di Antropologia*, 1916). Sport must form part of any scientific system for the improvement of the human machine.

It is worth noting in this connection that large industrial concerns are more and more organizing physical and even spiritual welfare institutions on behalf of their workers, and these include the establishment of sports grounds. Special propaganda films, showing the scientific organization of an enterprise, project a picture of the factory playground. This is the case for example in the propaganda film illustrating the scientific organization of a big bank published by the *Rotterdamsche Bank* and mentioned above.

XXIII.

Dissemination of an exact knowledge of systems of scientific management and their purpose.

What is scientific management ?

The general public has little or no idea. Heads of businesses and workmen, however closely concerned they may be, often know no more, and in their ignorance the workers are distrustful of new ideas.

The cinema therefore must tell everybody what scientific management is. To this end, however, the films must be so prepared as to make the question a live one and to impress the public to which they are particularly addressed.

A first series of films, appealing to the widest and least educated public, will show men, machines, scenes of work, qualitative and quantitative production in different branches of industry before and after scientific organization. « The scientific organizer must help to make the results known and especially must guide the younger generation in the direction of more rational vocational training ». This is another commandment, the last, in Gilbreth's decalogue, which we mentioned at the beginning. We could quote many films suited for this purpose, and it would be easy enough to make new ones as various kinds of work become organized on scientific rather than empirical lines.

Confining ourselves to Italy, we may note the existence of a large number of films relating to the scientific organization of different kinds of enterprises ; installation of mining plant, organization of big wine-growing concerns, textile businesses, motor works, tobacco factories, building yards, etc.

Secondly, further series of films may be addressed to a more enlightened public. These will show the different phases in the scientific organization of various enterprises, recommend its application and even teach its methods. We may here refer to our scheme of scientific management and our plan of investigation to be carried out at the place of work with a view to increasing and improving production

while reducing or at any rate not adding to fatigue. We might attempt to translate each item in this scheme and plan into cinematographic films which aim at teaching, suggesting and disseminating the fundamental principles of rationalization and the results of applying them. Among the first,for example, would be a film showing a gang of workers at the moment when scientific management studies are begun ; it will show how the organizer measures and calculates qualitatively, hour by hour and half-hour by half-hour throughout the day, the output of the gang and of each workman (making up parcels, shaping of buttons, soldering of the bottoms of tins, etc.). Moving graphs will show the conditions under which the output of the gang increases or decreases from hour to hour during the day (law of quantitative and qualitative production at different hours of the day) ; other graphs will indicate the individual productive capacity of the workmen making up the gang : X's productivity is sustained almost throughout the day ; Y produces little at the beginning of the day but gradually increases his output to a maximum after which it falls off, picking up again after the midday pause ; Z starts the day with a good output, but gradually falls off. These different productive capacities are explained by the bio-psychical characteristics of the individual worker. Some of these characteristics occur in a more or less pronounced form more frequently than others, and allow of an early selection of those best suited for a specific task ; all these points could be illustrated in other scenes of the film.

The latter will show the effort made to measure the degree of fatigue in the workman hour by hour throughout the day ; the forms which this fatigue takes among the different types of workers mentioned above ; they will show that the total fatigue of a gang consisting of selected men is less or anyhow not greater than the fatigue of the gang as originally constituted while yielding a better quantitative and qualitative output.

In continuation of these scenes, the cinema will be found particularly suited for demonstrating how simultaneous or successive modifications must be made in the conditions of work if we wish to ascertain the changes in the quality and quantity of output and in the nature and degree of fatigue resulting from these modifications. As we know, these may involve a re-arrangement of the worker's bench in relation to the window, the adoption of new tools or a new way of using old tools, variations in the hours of work, in the pauses, moments of relaxation, etc. All these points can be illustrated by animated and indeed highly animated pictures. We could introduce into these films scenes to show the methods of testing the faculties and aptitudes of young people during the earlier stages of vocational guidance and later when the workman is chosen for a specific task. At the same time scenes will be included representing the numerous other aspects of scientific management. The Berlin « Fachfilm » already mentioned has published films relevant to this matter ; they show how times and speeds are studied, the rational organization of office work (Hinz system), etc. There is however much still to be done in this domain and the field to be worked is a vast one.

Finally, the cinema, by depicting the methods and aims of scientific management, will help to bring home its advantages to workers who at the beginning

are indisposed to change their manner of work. It will also serve to educate the workmen filmed, for they will see from the screen any useless or wrong movements they make ; a man may in this way spontaneously correct his error, especially as the scene can be shown on the screen greatly enlarged and at a retarded speed.

XXIV.

THE FILM TO BE GIVEN THE PLACE OF HONOUR IN CINEMATOGRAPHIC REPRESENTATIONS OF SCIENTIFIC MANAGEMENT.

Of all the cinematographic representations that we are considering, one, by reason of its great moral and social educational value, should occupy the place of honour, and that is a film which by means of rapid but unforgettable pictures would illustrate a principle which has really only recently been objectively demonstrated — the principle that work is a boon — physically, intellectually and morally beneficial. Documentary proof of this has been furnished by very exact instruments at the disposal of physiology and experimental psychology. Thanks to these researches, it has been possible to demonstrate clearly that work, if it accords with aptitudes and vocations or if it is simply not at variance with these, constitutes a physical and intellectual exercise which develops sensibility, stimulates the circulatory functions, serves as an outlet for accumulated energy and consequently confers satisfaction and a sense of well-being. All this has been proved by figures and diagrams, the results of patient experimentation, which were collected several years ago by Charles Féré in a work bearing the significant title « Work and enjoyment » and adorned with numerous illustrations. To which we may add that, for the understanding person, work is also a refuge, a moral refuge which protects him from the cares of daily life, a refuge and protection for all who feel, think and suffer. Work is one of the surest sources of consolation, distraction and oblivion, and the science of individual psychology has been making this more and more evident for some time.

This again leads us to the efficacy of work as a great mission. This is familiar enough to workers who know how to plumb the inmost depths of their being and to analyse the *fons et origo* of their feelings. But it is not known to those who, though instinctively seeking joy and relief in their work, do not fully realize its healing qualities. These must be taught what they do not know ; they must be made to realize what they only feel dimly. The factors which give to work these qualities of comfort and peace, although they lie buried in the depths of the worker's soul, are better perceived and understood *from without*, by the observing physiologist or psychologist, than by those who are themselves experiencing their effects. The latter, however, will feel, interpret, understand and appreciate them better if there is someone outside to reveal and explain them. The mechanism is complex and may seem to some incredible, but it will not surprise anyone fami-

liar with the methods of psychology, the very aim of whichis to teach men to know themselves.

Graphic and numerical demonstrations of the kind we mentioned just now, suitably translated into the moving scenes which a clever technique would substitute for dry figures and lifeless diagrams might serve as a prelude to all vocational training. They would teach the lesson of encouragement so well summarized in the philosopher's wise counsel: work, work on, even if you have no goal; it is the only way of forgetting life's troubles (1).

Prof. ALFREDO NICEFORO.

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(1) « travaillez.,, C'est le seul moyen de rendre la vie supportable »: Voltaire, conclusion to 'Candide'; Chap: XXX: Shortly before, Voltaire had made one of his characters say « Le travail éloigne de nous trois grands maux: l'ennui; le vice; le besoin »:

THE CINEMATOGRAPH AND SCIENTIFIC MANAGEMENT.

(From the French)

Scientific management can employ the cinema for three different purposes:

1. As an instrument of research and systematic analysis;
2. For educational purposes;
3. For propaganda.

I. The Cinema as an instrument of research and systematic analysis.

The cinema's most obvious power is that of combining upon a screen in any room at a fixed time the most complex, rare and inaccessible spectacles. These may be shown one after another, each detail following the other; the projection may be enlarged, retarded or accelerated, the internal mechanism made intelligible by plans and animated drawings, while it is possible to analyse at leisure events which for reasons of place or of their rapid or slow development could otherwise not be observed. This has led by a natural process to the documentary film, now so common and which in its present form only aims at supplementing the spectator's general information, and also to the technical film, of value to the engineer or scientist who wishes to study the electric spark, the explosion of a mine or the flight of birds.

Thus by examining the pictures one by one we may decompose the movements of a workman, a machine or of a whole gang of workmen in cases where the naked eye could detect nothing definite. This convenient expedient has, however, been little employed as yet and I had much trouble in collecting a few films of this kind to show at the Scientific Management Congress held in Paris in 1929.

(*a*) A very short film made in 1912 at the Marey Institute on metal-cutting. M. Noguez had used an ultra-rapid cinematograph allowing of very detailed analysis, but this method requires extremely strong lighting, which is difficult to obtain and expensive and which is liable to impede the worker whose activities are the subject of observation.

(*b*) Madame Gilbreth, pursuing the method employed by her husband, had sent a number of films illustrating such various operations as the study of a desk furnished with pneumatic tubes in the central cash office of a large store, improved manipulation of a card-index filing system, the cutting of sandwiches in a confectioner's shop, the packing of cheeses, etc.

(*c*) M. Hymans had supplied three films, one on the manufacture of small pieces of pottery; another, on the formation of piles of samples, led to the invention of a moving table to accelerate the work. The purpose of the third film was to determine the most economical machine for making demand notes for tax-payers.

The use of the film in this last and very instructive case was essential, for the machines, kindly lent by the makers in the fiscal service, had to be returned after twenty-four hours. There was therefore no time to do more than take the films, which could then be analysed with the necessary leisure and care.

In these films the device most generally employed was to place, within the field of the objective a clock with a face 20 to 40 cm. in diameter, on which a needle marked hundredths of a second, but in some cases this accessory, which is commercially hard to obtain, may be dispensed with; it is sufficient if the pictures are taken at as regular an interval as possible and numbered successively, the time being in this way measured by the camera itself.

Jean Cocteau, with a poet's intuition, has already pointed out that, unlike the immobility of fixed projections, « the cinema, even when nothing moves, registers the passage of time ».

It was also the cinema which enabled the Michelin Company to record the mysterious phenomena manifested by the » shimmy » of the front-wheels of motor-cars, and the study of the film allowed the cause of this disturbance to be detected and removed.

The necessary apparatus only costs between 4,000 and 5,000 francs, and if we consider how much time the film saves the ordinary time-measurers, the cost of the device is remarkable. M. Hymans has presented to the French National Committee an exceedingly economical apparatus, which allows of time-measurement by the ordinary methods, and the camera need only be employed for parts of the operation where it is indispensable; this effects a saving of many yards of film.

If, however, the cinema is to be used for education and propaganda, we must look closer and arrive at a clear understanding of its other less obvious, but no less important characteristics.

II. The Cinema as a standard means of education.

1. A cinema performance is normally regarded as pleasant recreation. It is readily attended and the spectators are in a state of maximum receptivity. In the course of the tours organised by the *Est* railway company, the railwaymen visit the « Railway Cinema » in large numbers. Among the lectures on similar subjects, those illustrated by a film are always the best attended.

2. The cinema compels attention and concentration upon the screen. The darkened hall creates a void in the mind of each spectator, who is taken out of himself and isolated from his neighbour. There is little talking in the cinema, even in boxes. The onlookers become, as it were, monks in a dark cell, the only window in which is the screen. These conditions are admirable for teaching, much better than those obtaining in the class-room or lecture-theatre.

3. The cinema offers pictures, which, especially for a more or less uncultivated public, are even more easily assimilated than words, although these are also available, if desired (recitations, professors, captions, gramophones and sound-films). It approaches the spectator through ear and eye together, it makes a call both upon

the visual and the auditory memory and simultaneously makes its impress upon the human organism through the two registering mediums which are the most sensitive and the most closely related to the springs of human action.

4. A film is not the projection of a continuous series of views, any more than a painted picture resembles a photographed view. Thanks to the process of division, which rations the length of each performance, recalls, at the desired moment and for as long as may be wished, some past vision, allows of the concentration, in, as it were, an almost simultaneous musical chord, of several images which in real life were scattered and distinct, giving to each vision the value of a crotchet, a minim or a quaver, leaving them suspended for a pause or a silence, showing close-ups which have the effect of a gong stroke or withdrawing objects to a remote distance as a note is muffled by the soft pedal — in this way the film possesses a *rhythm* which regulates the passing of the images. Quite by chance I was able to test this by a very simple experiment. In the course of a lecture I had occasion to show a film of some poetic value which consisted merely of scenes taken from different industries, but arranged with considerable artistic skill and taste. When rehearsing the film before the lecture in a dark and silent room, I observed that the absence of musical accompaniment almost entirely anaesthetised the spectator. Being short of time, I could only obtain a phonograph and a few records. I chose haphazard a number of strongly rhythmic fragments of Stravinski, Honegger and Prokofieff and put them on in any sequence during the performance. To my great surprise *the whole public (and I myself) had the impression of a score specially composed for the film.* The strong beats of the music appeared to coincide with the close-ups or emphasised parts of the film and the same melodies seemed to differ according to the scene they accompanied. A few days later I happened to be showing the film again and, inorder to be sure that it was not just an extraordinary chance, I put the records on in quite a different order. The effect was exactly the same. The rhythm of the pictures impressed itself upon the spectators so strongly that they only noticed beats conveyed by the ear, when these coincided with the rhythmic beat communicated to the eye. In these psychological impressions, the predominant visual element extinguished those auditory elements that were discordant, while reinforcing the others, which alone penetrated to the conscious mind.

Nothing is more easily implanted in the memory than a rhythmic message. Philologists, among others Marcel Jousse, have recently emphasised this vital point. Before writing was known, texts could only be handed down from generation to generation by reason of their cadenced form, which we call poetry. It is a known fact that prosody was before all else a mnemonic device. The commands of all the gods, the pre-historic chronicles of all peoples have been in verse. We are in fact in the presence only of a special case of the law which tells us that every accumulator of energy — and the human organism is such an accumulator — discharges that energy through certain rhythmic oscillations.

The cinema, by the process of dividing up the film, can vary the *duration* and the *intensity* of the images that it projects ; thus it has at its disposal the oldest and most effective of mnemonic devices.

5. In order to galvanise the memory after a lapse of time, nothing would be more effective than a small book containing the scenario of the film illustrated by photographs extracted from the film, like the samples issued by publishing firms to promote the sale of their books or like the notice of the recent aluminium film.

At the present stage of human knowledge, therefore, the cinema appears to be the ideal educational instrument. It has only very rarely been systematically utilised with a full sense of its valuable characteristics. The endeavour to render physics and Roman history in alexandrines was abandoned, and school text-books might have gained by the adoption of a more subtle rhythm : a balancing of events, strictness of composition, a periodical reminder of essential principles, typographical arrangement. It has been a mistake, but the effects are less in the case of a book, in which, unlike a film, passages can be skimmed through and re-read. The substance of a film must be well masticated, if it is to be assimilated by the spectator at a sitting. The report submitted to the Cinema Week by M. Jean Benoit-Lévy in April 1929 gives a list of the most important achievements so far realised.

Since the cinema allows us to determine the best method of discharging a task, the same or almost the same film will also enable us to impart this best method. This possibility has rarely been properly exploited. Most of the so-called technical education films show approximately how industry at present performs a certain task; but do not show the best way of doing it. The preparatory stage of technical research has been almost entirely neglected.

"We may quote as interesting examples the films belonging to the Paris Joint Transport Company and used to examine and train tram and motor-omnibus drivers. The *Est* and *Nord* Railway Companies have also manufactured films to show the manipulation of hooks for coupling trucks, the handling of haulage cranes, the operation of shunting stations or the mechanical shifting of railway-points (J. Benoit-Lévy).

Films hav ealso been made to show how accidents can be avoided, and I myself projected the film of the Austrian Central Office on this subject at the Paris Congress in 1929. This is conceived on the usual romantic lines and is extremely well acted by professionals. Its object is to arouse workers to the dangers which daily attend all occupations and to keep their attention alive ; the great majority of accidents are due to the carelessness and indifference engendered by habit.

The plot is simple ; a boy happens to witness his father's death as the result of a terrible accident. Impressed by the memory, he devotes his life to the study and prevention of occupational accidents.

The cinema's power of evoking scenes is largely resorted to and, in the course of the young man's lectures or conversations with his comrades we are shown an impressive collection of all kinds of possible accidents. These are reproduced with such fidelity that the spectator experiences on each occasion the shock of an unforeseen catastrophe. The fakes are invisible and the atmosphere of the factory or workshop is wonderfully reconstructed.

This film makes systematic and interesting use of the cinema's powers of suggestion.

Gaumont, Pathé and the *Compagnie Universelle cinématographique* have many catalogues of so-called educational films, but these are rather in the nature of documents and do not fully meet the requirements of, say, the commercial colleges. The latter have therefore recently combined to create a cinema library in exact conformity with their curricula. The secretary, Cantagrel, with the help of the *Compagnie universelle* and several industrial groups, has succeeded in collecting some really educational films, put together by a professor and containing only the essential ideas of a subject : « the captions are reduced to a minimum, are short and to the point. Actual views are in principle restricted to moving objects or are used when it is desired to reveal certain stationary objects in their moving environment or to give a general impression in a panorama. Simple animated drawings are placed over the apparatus whenever the latter conceals some moving piece of machinery which it is important to study. They also serve to synthesise a series of industrial operations ». Thus the attached plan showing the organisation of a brewery is the result of a collection of animated drawings thrown upon the screen. Each drawing precedes and explains an actual view.

In striking harmony with the opinions already expressed, we read that « in order to make this form of instruction fully effective, it has been found useful to provide the pupil with material to prepare him for the film and to enable him subsequently to reconstruct the pictures he has seen. This material consists of the following :

1. A series of views, in photogravure or better in phototype, of convenient size, reproducing the essential parts of the film and constituting, as it were, a means of recalling the original picture. Each pupil is given one copy to put in his note-book alongside his notes.

2. A short description, or summary plot in which the author inserts the mos essential facts : the situation of the factory, the plan of its organisation with the sequence of manufacture if necessary, also the size and type of machines and amount of output.

The views issued to the pupils are eagerly welcomed and we base great hopes upon this method of teaching ».

Special Teaching of Scientific Management.

The methods of scientific management consist in applying a number of rules in order to obtain certain results. Only the results, that is, the factories at work, can be filmed. Thanks to the process of division, objects which, though very different regarded as pictures, are similar by reason of their internal structure, can be so juxtaposed and combined as, with the help of purely visual features, to suggest with irresistible force the rather abstract principles of scientific management. We may take as an example chain-work in factories organised in accordance with the rules of scientific management, but engaged in the manufacture of wi-

dely different articles (e. g. motor-cars, tyres, perfumery, paper, clothes). The chain, which is the measure of the time taken, is a visible materialisation of the voluntary and abstract coordination effected by the system of planning which governs the whole manufacture. It would also be possible to show the film of a single concern taken on Fayol's lines, that is to say, by linking together the different branches of the business not in chronological order of manufacture, but according to the functions they fulfil : initial calculations, organisation, direction, coordination, supervision. Under the last heading we should place the testing of raw materials and of semi-finished products the flying controls on mounting chains, the control of finished products, etc. At the Paris Congress in 1929 I was able to show as a remarkable example the film prepared by the Grodziec Collieries Association (Dombrowa basin) in collaboration with the Polish National Committee on Scientific Management.

This is an extremely interesting film and proves that the methods of scientific management can be successfully applied not only to a workshop, but to work subject to such variable and all-compelling external conditions as is work in coal mines. Several separate operations (transport of wood from its arrival at the mine to the shaft where it is to be used, hewing of coal by a gang, revetting of a shaft) are shown and analysed from three different points of view :

a) an ordinary picture shows the actual operations ;

b) a plan shows the internal structure of these operations, their approximate topographical conditions and their relation to the rest of the work of the mine ;

c) Harmonograms, thanks to Professor Adamiecki's method, allow of an even greater degree of abstraction and a table can be thrown upon the screen to show the exact times spent in productive and non-productive work and their relations with the distances covered. Graphic symbols, particularly well-selected, also illustrate the substitution of a functional organisation for the old geographical organisation : each official, engineer or foreman, instead of being entrusted with a number of functions within a restricted area, is made responsible for one single function throughout the whole colliery. Three engineers, for instance, are kept employed, one on hewing, one on maintenance work, one on supplies, and each foreman is under a different engineer according to the work he performs. Similarly, the supervisory staff is divided up into separate functions. A table shows the distribution of orders for the day.

III. The Cinema as an Instrument of Propaganda.

The cinema's special characteristics make it as effective for propaganda as it is in education. The screen by, as it were, fascinating the spectator empties the mind of its normal content and replaces it by the film. There is no better proof of this than the condition of a spectator left to himself during the intervals, when he suddenly falls back in to the void left in him by the interrupted performance. And when the film is followed by discussion, the latter starts very slowly, each spectator

having to rid himself of the images evoked and emotions aroused by the film before he can collect himself.

It is in obedience to an organic necessity that the cinema, alone among the arts, is compelled to remain in close touch with the masses, whether it seeks to instruct, persuade or simply to please them. The material conditions governing the manufacture of a film therefore necessarily make it an instrument of propaganda, whatever other purpose this propaganda may have. In order to create a work of art, a painter needs only a little canvas and paint, a sculptor a few hundred francs' worth of clay or plaster, a writer a few pennyworth of ink. The cinema artist needs millions, he needs aids and appurtenances, and he needs collaborators. He is the only artist whom society compels, through the factor of payment, to move the masses, who alone pay the piper. All the other arts can be produced for an impecunious and chosen few, as indeed they are. Painters, authors and composers have long been divorced from the common herd. Only the cinema artist enters into more and more intimate contact with the people and digs down deeper and deeper to reach what is common to us all. Charlie Chaplin is scrupulously at pains to continue to represent this universal man, the synthesis of every individuality ; his walk and his clothes belong to no age, no class and no country ; his speech cannot betray him, for he has never uttered a word and his captions reproduce only the words of his fellow-players. In the spoken film upon which he is now engaged, it is understood that his own part is silent. In face of the events which overtake him there is no characteristic reaction by which to identify him; he remains the personification of serene and resigned passivity.

Since the making of a film costs enormous sums of money, the Golden Calf must needs be left free to graze upon Parnassus. The sacrifice of the Calf being impossible, the community naturally imposes upon the art of the cinema its universal character. For while under capitalism, the cinema producer is bound to shoot films which pay, he must in a Marxian society make films which please the people or the government; that is to say, he must make commercial films or propaganda films. The latter can be of very fine quality. No one will question the aesthetic value or the revolutionary effectiveness of such films as « The Mother » and « Potemkin ». According to Eisenstein, the masses themselves collaborate in the making of Soviet films ; they are tried before various publics and, before being completed, are revised or touched up according to the reactions of the spectators. Moreover, not only the heads of a new social order incline to the use of this new weapon ; the most hide-bound capitalist is equally capable of wielding it. Take, for example, the Citrcën film on the Black Cruiser or the film by Walter Ruthman « The Melody of Life », made by order of the Hamburg-Amerika Line.

Once again, this service owed by the cinema constitutes its greatness.

For the cinema producer, as to some extent for the architect, the problem of creation is twofold ; the artist in him has to solve an aesthetic, the manufacturer an industrial problem. Practitioners provide him with fully equipped studios, material and a certain organisation which disposes of some of his technical diffi-

culties ; the industrialist also has the use of his engineers. None the less he has to find financial backing, select artists and technical experts, train them to every gesture or to every change of lighting. Like every head of a business, he has to collect around him various financial, technical and commercial resources before he has the apparatus for the creation of his final work. He has further to conceive the film itself — the plot, the divisions, the innumerable details connected with it, the whole of the strictly aesthetic part of his work, which is the only part to be presented to the public. And in this he has no free hand, since he must take account of his backers, his stars and his future operators.

The cinema producer must unite within himself the artist and the industrialist, must produce an article which satisfies a collective need or must create the need, if it is lacking, and cannot only satisfy his personal craving for self-expression. This duty is imposed upon him by the material conditions governing the making and showing of a film and would not be in the least affected by any social change. Under any system of government the cinema producer, who is a captain of industry as well as the successor to the priest and the poet, in order to please the people, must employ all the resources of the individual and of civilisation.

It is rare to find such diverse qualifications in one man, and it is sought to replace him by a whole team, which includes the author, producer, stage manager, etc Nevertheless the members of this team all have frequently to wrestle with industrial problems, which are intended to prepare them for dealing with questions of this kind. On the other hand the films they make are all subject to one essential condition — they must please the multitude ; that is part of the very technique of propaganda.

The talking film, which within its own sphere is even more effective than the silent film, is not, like the latter, a means of world propaganda. As Alexandre Arnoux has said : « The screen of today, let us all admit it, has lost its universality. It is beoming national, linguistically confined and is renouncing its dream of the unification of elemental ideas and sentiments. It can only claim to strengthen the ties between races which speak the same tongue and works by methods closely resembling those of the press and of literature, reinforced, however, by the power of images, which make on simple minds a stronger impression than the printed word.

« With due regard to proportions and on a more elementary plane, we are witnessing to-day what happened some three centuries ago, when Latin ceased to be the sole interpreter of scientific and metaphysical thought, and philosophies took different roads and acquired a different character, a special colour among civilised nations. Only the Catholic theology escaped this fall, this loss, if not of real greatness, at any rate of influence. The pure cinema has this resemblance, that it does not depend upon local idiom and could aspire towards creating, not of course, a system of world catholicism, but — on a lower level — a more or less universal sensibility, ideology and romance. With the advent of the talking film, we are falling back into the disintegration and dust of the nineteenth century ».

Special propaganda on behalf of scientific management.

This is a problem, not of technique, but of industrial psychology. Having explained to heads of businesses how they can organise, we must tell them why, and must arouse in themselves and in their collaborators the will to organise. We must therefore start by revealing their real motives — far more disinterested than is generally supposed — and by showing that scientific management, besides leading to pecuniary results, satisfies needs which are perhaps more vital and fundamental.

The industrialist of to-day, in his daily work, is concerned less with earning large annual dividends for himiself or his shareholders (Taylor has shown the comparative futility of profits which cannot be realised within a week) than with creation, the fashioning of his enterprise according to the idea of it which he has in his mind. The real joys of creation are no longer reserved to the artists, who, deliberately denying to their work all moral, sentimental or historical significance, confine their endeavours to mere problems of form, colour or space, but to the industrialists, who, with the valuable but wayward aid of human ambitions and of material, financial and intellectual resources, are engaged in constructing organisms as impressive as they are delicate. Paul Claudel, with marvellous intuition, has realised the obscure but profound satisfaction of men who are absorbed into these organisms from the remotest countryside to work along with their equals under acknowledged leaders :

« In modern industry everything is subordinated to a definite end, geverythin functions with miraculous order within the framework of a single task. Workmen, engineers, accountants, draughtsmen, travellers, interpreters, the publicity staff all have their essential duties to perform, and their work reacts immediately upon the whole organisation, of which they never cease to be a vital part. Over all is the manager in the position of absolute monarch, but at all times responsible through every penny of his capital and subject to automatic removal if he is inefficient. Who will deny that a community of this kind, irrespective of the sufferings and diminished importance which it may involve for each member, is in itself admirable ? Has there ever been seen so harmonious a distribution of such vast stores of knowledge and of so many human forces and activities ? Here men are united no longer by mere physical proximity, but by a mutual need, an organic necessity of undreamt-of scope and complexity. And every worker is dimly aware of this. He is no longer alone ; he feels himself necessary to the whole. He is making good among all his equals under competent leaders, and acts no longer in response to an arbitrary word of command, but under a direction and guidance which are indispensable. And that is why he will always choose to serve (I prefer to say « work ») a machine rather than to dig the soil ».

Towards this urge of the manager to create, and of his subordinates to assist in the creation, scientific management contributes the framework and the rules, just as prosody serves the poet's need of expression. It is therefore important to bring

home to all what is not generally realised, namely, the inmost structure of industrial organisations, whereby the energy set loose by customers in the form of orders is gathered into a stream by the planning department, directed through channels to the different workshops and finally materialises in the form of manufactured goods.

When we seek to make this structure perceptible, we find that it consists of a pile of orders or service notes, detailed plans, customs or traditions of the staff, all elements a knowledge of which calls for considerable analytical effort and which are only known in their entirety to the head of the business, the sole onlooker. It would appear that the cinema, with its inexhaustible power of expounding, can alone communicate to others this general view from which the employer derives his supreme delight and his strongest inspiration.

The cinema can show too the change which scientific management brings about in the relations between the different factors of production ; it can show us how the head of the business becomes the servant of the workman to whom he furnishes the various means of performing his task under the best possible conditions, or rather how both are the slaves of the customer, whose absolute dominion, however, fortunately tends to become constitutional through the establishment of rules limiting his caprice.

Obviously the cinema must deploy the whole of its resources in order to produce an impressive film; mere documentation, banality and tedium are dangers that must be avoided at all cost.

This is the price we pay for the cinema's marvellous powers ; the spectator being taken right out of himself, boredom, if it ensues, is both appalling and incurable.

Conclusions

Scientific management has as yet claimed from the cinema hardly any of its potential gifts. It is now timidly beginning to employ the film to analyse movements. In regard to education, other than elementary, we may mention the initiative, still undeveloped, exemplified by the film library of the Commercial Colleges. As regards propaganda, nothing has been done. The catalogues, however, are full of films, either documentary or strictly technical. The French National Committee on Scientific Management has also, as the result of the 1929 Congress, set up a Committee of Cinematographic Enquiry, the main purpose of which is to prepare a number of films dealing with the subject in a worthy manner. For each film a notice will be prepared containing illustrated extracts from the film for purposes of memorisation.

As usual, the difficulties in the way are financial.

Since these films can scarcely be shown commercially, it is necessary to secure the support of industrial groups or public bodies, and this support will be the more readily forthcoming if those concerned are made aware of the importance of the question.

Jean Coutrot.

WORK STUDIES WITH THE HELP OF THE CINEMATOGRAPH

(*From the German*)

I. INTRODUCTION.

Labour problems have been the subject in recent years of intensive study in every quarter and these studies may be collectively grouped under time-studies, movement-studies, psychotechnics and rationalisation. Common to all such studies is the system of decomposing work into its constituent parts, all of which are measurable by different standards. The ultimate aim is to establish the simplest possible elements, each depending upon a few variables only, but including nevertheless all the factors which influence work.

A few examples may serve to explain this aim. In electricity all the phenomena are either electrical or magnetic and from these two fundamentals a number of subsidiary conceptions have been derived, such as electric tension, current, resistance, etc. It was only when all electrotechnical phenomena had been reduced to these few fundamental conceptions that it became possible to apply the experience gained in one field of electrotechnics to another field and methodically to seek the best solutions for certain specific problems. So it is with time-studies. It will not be possible to investigate and systematically study the various possibilities until all labour phenomena have been reduced to a limited number of fundamental notions

The following article deals with the possibilities of the film as a means of ascertaining and studying these basic elements in work. Here the film serves a purpose similar to that of the microscope in metallography. The application of the microscope to metallography made it possible to discover and study the principles underlying the heating of metals. There is a close analogy between the two fields. Just as the microscope enables the eye to see the smallest elements in space, so the film reveals the smallest time-elements. In the same way that in metallography difficulties largely disappear as soon as the element of space under examination is reduced to a small unit viz, the size of a single crystal, so too it becomes very much easier to analyse human work when the elements to be studied have been reduced to a number of fundamental movements. Just as in metallography complications ensue if we start our analysis of conditions with the individual crystal, so also work studies are made more difficult if the fundamental movement is further broken up. Again the two branches are alike in that there will in future be no more need to place a cinematograph beside each worker than it is necessary to put a microscope by the side of every crucible, but, just as many metallographical laboratories to day are provided with abundant microscopical apparatus, so the cinematograph will be found indispensable to the study of a certain number of working processes.

It should perhaps be explained why it is that the cinema has not already been more largely employed in the study of scientific management. The reason lies in the comparatively high cost of this method. In themselves cinema technique and

film analysis are no harder to learn than the technique of the microscope and the examination of microscopic slides. On the other hand, the cost of a time-study film is very much higher than the cost of the chemicals required in microscopic work. For the individual, therefore, it is considerably more difficult to acquire the necessary practice in the use of the cinematograph. On the other hand, collaboration between the cinema expert and the scientific organiser is not altogether a simple matter, for the real advantages of the cinematograph can only be extracted by one who is to some extent versed in both branches.

The following report is based upon years of study, during which account has been taken of the published investigations of many others, especially Gilbreth's. Gilbreth refers to the fundamental movement, but does not specially emphasise the great importance of the conception. In my opinion Gilbreth failed to realise that there is an *optimum* degree of movement subdivision.

My own investigations suggest that there is a very definite optimum represented by the limited number of fundamental movements common to nearly all occupations. Both above and below this optimum the results rapidly diminish. Owing to the high cost of the cinema the number of experiments carried out is small and it is to be anticipated that further research will substantially modify the statements that follow. Nevertheless, the report may furnish useful suggestions to all who are engaged in time-studies, movement-studies, psychotechnics or rationalisation It may also serve as a first step towards unifying all such investigations in the sense that the schedule of fundamental movements given below makes it possible to subdivide the most widely different processes of work into the same elements and thus to compare with one another results obtained in very different fields.

II. THE FUNCTION OF THE FILM IN WORK STUDIES.

Films can serve all kinds of different purposes in connection with work studies, and the same film can be used to solve more than one problem. We must, however, be clear from the outset as to the different kinds of problems which the film can solve. It will then be for the cinema technical expert to see that the same film can be used later for a different purpose, even if it was first shot for a particular reason. Frequently other considerations arise in the course of investigation and it may save a lot of money if all possibilities are taken account of at the outset.

1. Definition of fundamental movements

We said in our introduction that the present study advocates a certain optimum sub-division of times, by which all the existing factors which influence work are most easily distinguished. The elementary movements which correspond to this sub-division will hereinafter be referred to as *fundamental movements* and they represent standard movements, the duration and form of which vary within certain imits according to the individual worker — these limits, however, being independent

of the particular working process. The separate fundamental movements depend only upon a few variables and lend themselves to detailed investigation.

The system of fundamental movements offers the following facilities :

a) *interchange of experience without sacrificing trade secrecy.*

The peculiarities of the separate working processes in different businesses are not based upon different fundamental movements, but are due to the fact that different plant necessitates a smaller or larger number of such movements. Experiments, therefore, which relate to the individual movement, are not trade secrets and the resultscan be exchanged without risk of sacrificing any advantage in manufacture. This is a very important point, because the human factor cannot be studied without the aid of statistics and even the largest business cannot very well furnish sufficient material for any statistical conclusions. An exchange of experience in this sphere is therefore quite indispensable.

b) *Rules governing fundamental movements.*

The fact that in all occupations, a considerable number of fundamental movements recur enables us to establish certain normal rates for the time taken and energy consumed over each movement. These values fluctuate within certain limits, but, as stated above, these limits do not depend upon the process of work itself. These normal rates will presumably vary substantially in different areas. For instance, the times of certain fundamental movements will differ as between a northerner and a southerner. The conditions of work will also affect the factors of time and energy.

It should, however, be possible to lay down certain normal rates for individual areas. Within the area such rates may be used as a basis to determine the total times of certain tasks, the productive capacity of the individual workman, etc. Moreover, these standard rates furnish some indication of how far machinery or processes of work which have proved their worth in one area, may be suited to other areas.

c) *Basis of psychological and physiological examinations.*

Every psychological and physiological examination of work must be based upon a definite movement or process of work. If the latter can be divided into fundamental movements in accordance with a scheme valid for all occupations, the results of the examination can be given a much wider practical application. For example, breathing tests are carried out in connection with certain forms of work, including the lifting of weights. Hitherto, it has only been possible to apply the results of these tests in exactly similar cases, where the conditions are the same. But if the movements made are broken up into general fundamental movements and the influence of any variables ascertained, the results can be made accessible to a much wider circle.

The relative frequency of the separate fundamental movements in the diffe-

rent occupations indicates to the psychologist and physiologist the importance of the individual movements and he can then more easily organise his examination so that it may profit as wide a circle as possible.

d) *Characteristics of the various trades and industries.*

As has already been said, many of the same movements recur in the different trades. The differences between individual trades are largely differences in the frequency percentage of the separate movements and in the time taken by these movements expressed as a percentage of the total time required for the work. In some trades certain movements do not occur at all, for instance, among clock-makers, whose work involves no change of position

Accordingly we may classify the different trades by the proportion of the separate movements to the total time taken over the work. The system will in this way also be of value in vocational guidance and selection and in the manufacture of educational films.

e) *Determination of the factor of worker's efficiency.*

The method hitherto in use of carrying out time-studies with a stop-watch or other registering apparatus is vitiated by the varying efficiency of the worker, although the system of time-measurement itself has been developed until it has reached a high degree of accuracy. In all previous systems, however, the question of how far the speed of work is what it should be, has had to be decided subjectively. It is possible to ascertain from fluctuations of the individual times any deviations from the rate of work peculiar to each individual but there are no suitable means of comparing the rhythm of work of the different workers.

The system of fundamental movements makes it possible to ascertain these values, without necessitating new films for each particular case. For this purpose processes of work are selected in which the successive fundamental movements remain the same with each repetition of the work and in which the nature and the determining influences of the separate movements can be seen with the naked eye. Properly trained time-measurers will always be able to find processes of this kind. The times corresponding to each fundamental movement will then be determined from the table of normal times and the sum of these times compared with the total time taken over the process in question as directly observed. In this way the efficiency factor of the individual worker is ascertained much more accurately than by any procedure hitherto employed.

This method has the advantage of being cheap, since there is no need to take a special film for each case. A disadvantage is that it does not help us to recognize the characteristics of the particular worker. It furnishes a comparative figure of a man's efficiency at the particular task performed, but it does not tell us which of the fundamental movements are carried out above, and which below the normal speed. Some idea of this can be obtained by examining in the way described several processes in which the separate movements are represented in different proportions. This gives us a system of several equations containing several unknowns,

from which we can determine the efficiency factor for the separate movements. Owing, however, to inevitable errors of measurement the result will be only relatively accurate. For this reason at least several films should be made of each worker, and these will directly furnish the values desired.

f) *Aptitude tests.*

The method of fundamental movements can also be used in carrying out aptitude tests, a film being taken of the subject of the test as he performs certain tasks. The times for the separate movements will then be determined and compared with the times (normal times) already ascertained from other workers. The subject may then be declared suited for those tasks in which the movements for which he obtained particularly good time marks represent a large proportion of the total time required for the work.

2. Establishment of working processes.

Hitherto working processes have mainly been determined intuitively. The experience of the factory gave some indication of where improvements might be made, but there was no means of knowing in advance and statistically how any change of method affected the working time. Accordingly, the different possibilities were tested one after another in the factory and the time required by each process registered. The element of practice was, however, a serious source of error. In order to eliminate this factor, every workman must perform the separate process over and over again until he has completely mastered it. This may take anything from a few hours to several weeks. Thus a comparison of different processes by this means may occupy a very great deal of time.

By determination of processes is now understood a procedure by which the probable times required for the different possible processes are calculated in advance, thus furnishing a certain basis of comparison before the different processes are actually put into execution. This is made possible by the system of fundamental movements. The necessary movements are written down in their various possible sequences and the times required for them are ascertained from the table of standard times. The sum of these times gives the total time required for the different processes. The percentages of the individual movements then show what type of workman is especially suited for the particular process and in what direction further improvements may be looked for.

The process thus outlined naturally requires to be tested and controlled in practice, in the same way as a new piece of machinery, but the numerical treatment of individual factors gives a much clearer picture of conditions and in most cases is much more economical of time than former systems.

3. Minute investigation of short processes.

Short processes of work made up of rapid movements cannot be properly investigated except by the film. Examples of such are type-writing, use of calculating

machines, small assembling processes, especially on the running band, etc. Whenever the duration of a cycle of operations is less than 0.4 minutes, any sub-division by measurement with a stop-watch becomes impossible. The different elements can only be determined statistically, unless recourse is had to the cinematograph. It is possible in the case of typing to register the separate taps by an electrical apparatus and the resulting diagrams will show certain time-differences, but it is very difficult to ascertain their causes from the diagrams.

As regards the film analysis of minute processes, a different method can be adopted in each particular case. As a rule, however, it is better to use the system of fundamental movements, since it will facilitate comparison with the results of investigations by others.

4. Other uses of the film in connection with work studies.

The above is the most outstanding example of the use of films in work studies, but they may also serve any of the following purposes.

a) *Documentary determination of working conditions.*

Time-studies by cinematograph establish conditions of work in documentary form and make it possible at any time to examine factors which at first escaped notice, without repeating the time-study. This is particularly important in the case of a subsequent alteration in the working process.

b) *Study material always available.*

The above-mentioned documentation also enables the most detailed time-studies to be carried out in the time-study office on the films themselves without disturbing work in the factory. For comparative purposes, this is an inestimable boon since the observation of one process can be compared with that of another.

c) *Movement studies.*

The cinematograph further allows movements to be studied, especially if my own method is followed of projecting the separate pictures upon a drawing-board and extracting those movements which are of interest or importance.

d) *Further training of time-study experts.*

Time-study films, by reason of the above mentioned facilities for their examination, offer an excellent opportunity for the further training of time-study experts. Experience has shown that experts who have had an opportunity of examining films have greatly improved their powers of observation and thereby do better work in ordinary time-studies with the stop-watch.

e) *Instruction of workmen.*

Time-study films can also be used to instruct workers. This applies especially to the individual manipulations required for flow work, which can be shown to

workers on the film as often as may be desired. For this purpose the same films can be used as for time-studying, if this twofold purpose is taken into account at the time when the film is shot.

Detailed examples of the various applications of the cinema to work studies, together with figures, are given in Part VI, pages 875 *et seq*.

III. THE TECHNIQUE OF WORK-STUDY FILMS.

The following account deals with the technique of work-study films only so far as is necessary for the purpose the film is to serve. Questions of the best light and of developing and printing, on the whole, present less difficulty in cinematography than in ordinary photography, since in the case of films the time of exposure is known and the material of which the negative is made allows of fairly considerable variations of exposure.

When necessary, reference should be made to the available literature on the subject.

1. Photographic apparatus.

Scientific management films can be taken by almost any camera having a sufficiently large box. In order to be able to shoot fairly lengthy working processes without interruption, the box should hold at least 120 metres of film, and preferably 300 metres. The diaphragm should be adjustable. The maximum aperture should be 180°. This makes it possible to take photographs under bad conditions of light and, secondly, the longest possible exposure is often desirable in the interests of detailed study. On the other hand, short exposure is sometimes necessary, and it should therefore be possible to reduce the aperture to a small slit of 5 mm. Any further reduction is useless, since in most cameras the distance between the diaphragm and the film is about 10 mm.

If the camera has a motor drive, the latter must be specially constructed for our purpose, since in this matter it is much more important to observe a regular and constant succession of photographs. For the same reason the tachometers constructed with most cameras are useless, as they are not sufficiently accurate if the number of exposures is also to be taken as the measure of time. In this case the ordinary commercial precision tachometer is to be recommended. The lag of the speedometer should not be so great as to prevent the pointer from measuring small variations of exposure. Clockwork is not suited in most cases.

For the examination of most working processes the camera should take 1000 pictures a minute, or 16 $^{2}/_{3}$ per second. A higher rate is only necessary if very rapid human movements are to be observed, such as in typing. On the other hand, a rate of only 500 or even 200 pictures a minute is very often wanted. These low speeds are required for the analysis of very protracted processes, when it is also important to economise film. Single photographs will betaken when the camera is only required to serve, as it were, as a stop-watch. Thus a single picture will

always be taken in cases when a simple time study would be measured by a stop-watch. This method is considerably more accurate than a mere reading by the stop-watch, and the cost in film material is very small. The camera must be able to focus the view directly in the viewfinder. There is no occasion to observe the picture in the view-finder while the film is being shot, if the finder is efficient. For purposes of scientific management films the stand required is the ordinary cinematographic stand with universal joint. In order to photograph a workman who is frequently changing his position a movable stand is an advantage. The apparatus necessary for taking dramatic films — adjustable diaphragm single-picture registering device reverse apparatus etc. — is not essential. It may be useful to be able to turn the film backwards, if in the interests of economy it is desired to take several pictures on one section of film. On the other hand, each picture is found to be so small when it comes to the examined that this drawback generally out weighs the saving in film.

The foregoing remarks apply to a cinema apparatus when used for filming the movements of workers. The filming of movements of machinery demands quite different conditions. As a rule a far higher rate of turning is needed, up to several thousand photographs a second. This necessitates a special camera, which can also be used for examining human movements, but which has no advantages over the ordinary apparatus? The quickest movement of the human hand can be satisfactorily registered by an apparatus which takes about 150 photographs a second.

2. Lighting.

Whenever possible, scientific management films should be shot by ordinary daylight. If the light is not strong enough, a minimum of artificial light should be employed so that the conditions of work at the time when the photographs are taken are as far as possible normal conditions. For this reason the camera should have a lens working at the largest possible aperture.

If artificial light is unavoidable, care must be taken that it is of the kind normally employed. If, for example, under normal conditions of work the light is indirect, that is, diffused, the same kind of lighting must be selected when taking the film. The pictures will not be so attractive as they would be under strong light thrown from one side, but, what is much more important, the movements shown will more closely approximate to the movements as actually made. The artificial light should be turned on some time before the operator starts turning in order that the worker may have time to get used to it. Incandescent lamps are to be recommended as being less liable to injure the eyes.

3. Time-measurement.

Films in scientific management are primarily useful for measuring times; this at least is one of their essential purposes. Time-measurements themselves may be made by two different methods.

a) *Inclusion of a clock in the photograph.*

The older of the two methods consists in photographing a clock. In this case the number of photographs need be only approximately constant, since the time corresponding to each picture will be registered by the clock itself. In order to facilitate reading, the clock must not be too small, but it must also not occupy too much space in the picture, or it will mask something else. The dial of the clock should consist of white lines on a black background and the white lines should be rather less thick than the spaces between. The hands should be white. In this way we obtain a better picture than by the use of the usual dial with black divisions on a white background.

The number of revolutions of a clock used for this purpose is determined by the following consideration : the normal number of photographs taken is $16\,^2/_3$ per second = 1000 per minute. This rate is enough to measure with sufficient accuracy processes of which each phase corresponds to about 5 pictures, that is to say, the duration of each phase must not exceed 0.005 minutes. If the beginning and end of the phase are to be ascertained with 95% accuracy, the clock must be able to register 0.95 x 0.005 = 0.00025 minutes. A substantially more accurate reading will not be obtaniable even with an aperture of 120° and more, since a more quickly moving clockhand could not be photographed sufficiently clearly.

The clock best suited for the purpose is a Morse clock, but one in which the usual speed-regulator is replaced by what is known as a gramophone-regulator. A regulator of this kind gives a maximum variation 0.5% which is enough for most purposes. The clock has three hands, of which the quickest revolves 50 times a minute, the next 5 and the third 0.5. The reading accuracy varies according to the size of the clock in the photograph, from $^1/_{400}$ to $^1/_{100}$ of the circumference of the dial ($^1/_8$ — $^1/_2$ of a division), so that a reading of 0. 00005 to 0.0002 can be taken by the quickest hand' I have recently used a clock whose hands only revolve at $^1/_5$ of that speed. This clock saves the rather troublesome multiplication of readings by 2, while the readings are sufficiently accurate for most purposes.

In practice the time of each separate picture is often not taken, but only the time at which the movement begins and ends. In such cases it must be possible to read longer times directly by the clock, so as not to have to observe and register each passage of the hand through zero. Slow-motion pictures naturally necessitate more slowly-moving hands. The clock described above with the measurements mentioned is the product of experiments in cinematographic time and movement study. It has assumed its present form as the result of numerous experiments with a wide variety of devices and hand velocities. If at any time one or another hand is not required, it is easily and best taken off before the film is shot, since unnecessary hands only make the clock difficult to read. The size of the dial must depend upon the size of the photograph. The clock is therefore best fitted with a number of alternative dials, each with its own set of hands.

For examinations extending over a considerable time, it may be useful to include in the photograph another clock recording the time of day. As a rule, howe-

ver, it is advisable not to overload the photograph, but to record such particulars as this in a special note.

It is sometimes difficult to place a clock for purposes of photography ; this difficulty can be got over by affixing a clock to the camera. It can then be included in the film either by means of a special lens which reproduces the clock through a small prison or mirror or by means of the principal lens. As the clock is in this case usually on a different focal plane a lens is placed in front of it, which projects it into the focal plane. An advantage of the former procedure is that the clock's focus does not change with adjustment of the lens proper ; on the other hand its presence involves considerable altera tion to the camera. The use of an auxiliary lens only necessitates a few changes, but in this case the auxiliary lens will have to be moved to correspond with every movement of the main lens.

Clocks in which the hands are replaced by automatically moving figures have not been used for these purposes. The figures would have to change in a period of time very short compared with the time of exposure, that, is in about $^1/_{100}$ of a second. Clocks of this kind have not yet been made.

b) *Counting of the photographs.*

Time-measurement is very much simplified if the interval of time between each successive picture is completely constant. The means required for this purpose were discussed in the chapter on cameras. It is then only necessary to count the number of photographs. If the pictures are then projected for examination the projecting apparatus need only be provided with a counting device, which counts the separate pictures and at the same time indicates the time. Another method is to pass through the apparatus a second film alongside the original, this second film being numbered serially. These numbers will then be visible on the film projected. A disadvantage of both methods is that the serial numbers are not attached to the film and, though this is of no account when the projection is for the purpose of examining a single process of work, it makes it difficult to find any given picture again. To avoid this drawback, the serial numbers can be printed on to the film ; this necessitates special arrangements when developing and printing, but facilitates the examination of the films to such an extent as to out weigh this inconvenience.

4. Shooting technique.

Before each picture is shot, the prevailing conditions must be noted down, consisting of the following :

a) Name, sex, age, height and weight, health (any recent illnesses, etc.) of the workman to be photographed.

b) Time of shooting the picture.

c) local conditions (size of room, temperature, humidity, weather).

d) Remarks.

These will include any factors which might influence efficiency, such as recent payment of wages, holidays, strikes, etc.

e) Description of the work to be performed and of the tools used. These notes must be given serial numbers and before the film is actually shot a photograph will be taken of a board containing the corresponding number.

Otherwise the technique does not greatly vary from the normal. As regards lighting, a few rules were mentioned above. The camera must be so placed and the views so chosen as to reproduce the movements without any interruption. In the case of frequently repeated movements the process will be looked at in the view-finder after focussing and any corrections will be made before shooting. The picture in the view-finder is best looked at by the person who will be analysing the film later.

The rate of turning depends upon the nature of the study. In most cases 1000 pictures a minute will be found the best rate. A higher figure is rarely necessary and a lower is only advisable for very long processes and when film must be economised.

The light should err, if anything, on the strong side so as to show details in the shaded parts. This point should be especially observed when the camera is in the hands of an operator who is accustomed to dramatic film work, in which light is mainly thrown on to the light parts, whereas for our work the dark parts are more important.

The camera should not be moved more than is necessary to follow extended movements during the process of shooting, since movements of the camera often make it more difficult to analyse the movements under observation. When a stationary clock has to be included in the picture, the necessity of keeping the clock in view sets a limit to the movement of the camera.

If the film is only intended to give the exact times of certain procedures, one or more single pictures will be taken after each process. In this case the procedure is the same as for ordinary time-studies with the stop-watch. Before shooting, the work to be examined must be carefully noted and subdivided into a number of parts The only difference from a time-study carried out with the stop-watch is that, instead of a reading of the watch and writing downo f the time, a single picture is taken. In this case the camera is best operated by a time-study expert; If three separate pictures are taken, one just before the first part of the work starts, one as nearly as possible at the end of the process and one just after, the accuracy is greatly enhanced. It is generally sufficient if the picture is taken from one side only although certain movements will sometimes inevitably be masked. For the most part the course of the hidden movement can be deduced from secondary signs, and this generally suffices for measurement of times. This may cause certain errors in regard to individual movements, but they are of small account in relation to the total result. If however, the proportion of masked movements is large or if a very detailed examination of movements is being carried out, the technique should be somewhat modified.

To take the simplest case, photographs of one process will be taken from

different positions so chosen that movements which are invisible from one position can be seen from the other. An objection to this method is that, if the same job is repeated several times, certain differences will appear. Still, the method serves its purpose in most cases. Since each process anyhow has to be taken several times. this procedure does not involve any additional consumption of film. It is as a rule desirable to change the position of the camera when taking several pictures cof the same process.

A second method is to take the photograph simultaneously with two cameras in different positions. It is convenient to synchronize the two. either mechanically or electrically. This procedure necessarily involves a double expenditure of film.

Thirdly, a single camera can take a picture from two sides by an arrangement of mirrors. The pictures can be taken with an ordinary camera and without expenditure of additional film, but the field of view is diminished. Which of these three methods is to be preferred must depend upon the circumstances of each particular case.

5. *Preparation of the film.*

The film is developed in the usual way. If the analysis is to be made by counting the pictures, particular care must be taken that no pictures are lost in the process of perforation or at any rate that the number of pictures lost is exactly known.

The examination is best made from a printed copy. If the observer is sufficiently experienced, the negative will also serve, but the need of transposing ligh t and shade values makes the work rather more difficult. Copies of scientific management films should in principle be printed on safety film, so that no special precautions against fire need be taken during their examination. Copies should be thin and soft. They should be as thin as possible in order that they may be projected with a weak illumination andnot become too dry when lying in store. They should be as soft as possible so that detail may be distinguished in the dark as wel as in the light parts of the film. If the copies are printed in a laboratory mainly occupied in printing dramatic films, special attention must be drawn to this point.

Copies are best kept in the tins in which the original films are delivered. Under these conditions they will be least liable to dry up and crack.

Any joins must be made in the usual way. If the analysis consists in counting the pictures with a counting device attached to the projection apparatus or with a counting film, care must be taken not to lose any pictures in the process of joining ; if necessary, a corresponding piece of blank film must be stuck on.

IV. THE ANALYSIS OF WORK-STUDY FILMS.

In scientific management investigation the shooting of the film is only a part of the work and from the point of view of the time occupied a larger part is its subsequent analysis Here we must distinguish between four different techniques.

1. Projection at normal or only slightly less than normal speed of turning.

If the films are projected at the same speed as shot, all the movements will be reproduced with their original velocity, and therefore no more details can be discerned than by direct observation. There is, however something gained by repeated projection, for the film repeats the smallest details of movement in exactly the same form each time, whereas in practice a repeated movement will always vary in some of its details. The examination of the film by this technique alone will rarely yield sufficient results to justify the cost of making it. This method, therefore, should only be employed when the film must anyhow be shot for other reasons, or as a preliminary to the methods of examination mentioned below.

2. Projection of single pictures.

All detailed movement can be much better observed when the pictures are projected singly. For this purpose the best camera is a small projecting apparatus with weak illumination in order that the film may not be set on fire by the rays of light. A small handle is attached to the wheel, and a turn of the handle moves the film one picture on. The shutter is either removed or a shutter is used with one wing only. If the handle is turned by a rapid jerk, we shall obtain the impression of a very slow movement. The effect is the same as by the slow-motion process, only the slowing down here occurs during projection. The fact that the movements appear jerky is scarcely a disadvantage, since their characteristics are thereby emphasised.

This method is the best for reproducing those factors in the process under examination which are most typical. In the majority of cases, however, we must look for certain specific phenomena if really all the details are to be observed and for this purpose the best means is to determine the duration of the fundamental movements, a method we shall describe in detail further on.

3. Establishment of movement paths.

For the purposes of many investigations it is an advantage to be able to see the whole course of movements at a glance and they can therefore be shown in the form of a graph. The film is projected in pictures on to a drawing-board in the way already indicated. The position of important points (finger, wrist, shoulder, head, etc). is marked on the board in each picture by a dot. If these dots are joined by lines, we get the desired movement paths. The connecting lines are best made whenever a new dot is drawn, as otherwise intersecting paths make the drawing of the lines difficult. Similarly, when drawing several paths at once, different colours should be used. If every fifth and tenth dot is specially marked, the drawing will also clearly show the duration of the movement.

These movement paths can also be obtained directly by photographing luminous dots in movement, but the method described above has the advantage of better emphasising the significance of the path, while movement paths can be drawn by means of these dots in cases when illumination presents difficulties.

This method is suitable when it is desired to study in detail the influence of existing conditions of work on short cycles of operations.

4. *Direct observation of the film.*

A fourth method consists in looking at the film direct with the naked eye or through a weak magnifying glass. An advantage here is that the eye can quickly pass from one picture to the next and compare them. Minor movements are often easier to see in this way than when the single pictures are projected one after the other. It is particularly agreable to be able to carry out the work in the light of day and at a writing-desk. It is essential, however, that the time corresponding to each separate picture should be legible without effort. This kind of examination, there fore, requires film with serial numbers printed on it, as it would be impossible to read a clock included in the picture without strong magnification.

Direct observation of film is particularly indicated for determining the duration of fundamental movements, when pictures have to be looked at several times over from different points of view.

All examination of films occupies a considerable amount of time. Before starting, therefore, the nature and methods of work should be carefully thought out and suitable written forms prepared, so that during operations writing work may be reduced to the minimum and the whole attention be concentrated on the photographs. As an example of such work we shall now describe in detail the determination of the times of fundamental movements.

V. FUNDAMENTAL MOVEMENTS.

The purpose of these was dealt with at length in Part II, No. 1, pages 850 to 853. By a fundamental movement is meant the smallest factor in movement consciously induced by an impulse of the will. Modern physiology and psychology enable us to establish various systems of fundamental movements, all of approximately equal value. In the interests of exchange, however, it is desirable that, as far as possible, only one uniform system should be employed. The following is a system proposed.

All possible fundamental movements are divided into the following seven groups. Each group is indicated by a letter of the alphabet.

1. Observation — O.

This group includes all fundamental movements which denote the receiving of a sense impression.

2. Grasping — G.

All fundamental movements designed to effect a junction between or to separate some part of the body and an object.

3. Movements in space — S.

Movements of parts of the body not immediately connected with an object, except the following :

Movements which denote the receiving of a sense impression (see Observation) ;
Grasping movements (q. v.) ;
Changes of position (q. v.).

4. Displacement — D.

Movements of parts of the body directly connected with or resulting in the displacement of an object, in so far as such movements are not in direct execution of work (see Handling of Tools.)

5. Rest — R.

Absence of any movement connected with work, unless they are movements of observation (q. v.).

6. Changes of Position — P.

Movements producing a change in the position of the body.

7. Handling of Tools — T.

Movements necessitated by the manipulation of a tool or machine-tool with the purpose of executing work. Movements not immediately followed by execution, but required as a preliminary thereto (e. g. the clamping of a vice, the backward movement of a file or plane) will also be included under T. In assembling work, the insertion of a screw also comes under this number.

The classification of the different fundamental movements in the above groups presents no difficulties. The movements in groups 2 to 6 are common to all occupations. One or more of the groups may be more or less in evidence ; thus, work done in a sitting posture often involves no « change of position ». The movements in group 1 are also common to most occupations, but in very varying degrees. Group 7 is mostly made up of movements peculiar to the different occupations. But even here there are points of similarity between the various callings. Fundamental movements which it is difficult to classify in any of the above-mentioned groups, must be placed as a general rule in the T group.

The individual groups of fundamental movements are sub-divided according to the following schedule. Another capital letter is used to indicate the sub-division. Each of these separate movements requires a certain time for its execution. The factors influencing these times can sometimes be expressed in figures, sometimes they can only be roughly arranged in smaller groups. The different factors and their weight are indicated by small letters.

a) *Schedule of fundamental movements.*

Group 1. *Observation.*

Movements which denote the receiving of a sense impression. The duration of these movements will not be separately studied if they are simultaneous with other movements under observation the time of which is determined.

1. OS = Seeing.

Observation by sight.

Beginning : i) when preceded by a movement : End of that movement. (ii) w hen preceded by rest : Directing of look on to the object of observation.

End : (i) when followed by a movement : Beginning of that movement. (ii) when followed by rest : Removal of look from the object observed.

OSa = Observation with the minimum exactitude required to recognize a large object.

OSb = Observation with slight exactitude, corresponding to the recognition of a small object.

OSc = Observation with medium exactitude required to read a rough scale.

OSd = Observation with great exactitude, required to read a fine scale.

OSe = Observation with very great exactitude, required to read a Vernier scale.

2. OB = Balance.

Observation of the position of the body in space (e. g. in flying).

Beginning : first change of position in space.

End : beginning of first movements towards adjustment of body to changed position.

3. OH = Hearing.

Observation by the ear.

Beginning : first sign of the direction of the attention towards hearing (tense expression of face, turning of head in direction of sound).

End : Disappearance of every sign of attention directed towards hearing.

OHa = Observation with the minimum exactitude necessary to hear a loud bell.

OHc = Observation with medium exactitude, required to observe a perceptible change of sound, such as the knocking of an engine, loose parts of machinery etc.

OHe = Observation with very great exactitude required to observe oscillations or other scarcely perceptible changes in a noise or sound.

4. ON = Smell.

Observation by the nose.

Beginning : first sign of attention directed towards smelling.

End : Cessation of all attention directed towards smelling.

ONa = Observation with the minimum exactitude necessary for the perception of a strong smell.

ONc = Observation with medium exactitude necessary for the perception of a faint smell.

ONe = Observation with very great exactitude necessary to compare two similar smells.

5. OP = Taste.

Observation by the palate.

Beginning : first contact of tongue with the object to be tasted.

End : Cessation of all contact between tongue and object tasted ; in the case of liquids, beginning of swallowing, or, in the absence of these indications, the cessation of all attention directed towards tasting.

OPa = tasting of an easily perceptible flavour.

OPc = tasting of a scarcely perceptible flavour.

OPe = comparison of two similar flavours.

6. OT = Touch.

Observation by touch.

Beginning : first contact of skin with the object to be touched.

End : cessation of all contact between the skin and the object touched.

OTa = perception of a very uneven surface (more than 0.5 mm.) or of a large difference of temperature.

OTc = perception of a slightly uneven surface (0.05-0.5 mm.) or of a small difference of temperature.

OTe = perception of very slightly uneven surfaces (less than 0.05 mm.). or of very slight differences of temperature.

Group 2. *Grasping*.

Fundamental movements designed to effect a junction between or to separate some part of the body and an object.

7. GS = Seizure.

Movements designed to effect a junction between a part of the body and an object e. g. the touching of an object for the purpose of transferring force or the closing of the hand upon an object.

Beginning : first contact of part of the body concerned with the object in question.

End : 1. when the object is not moved: Cessation of any movement of the part of the body which effects closer junction ; 2. when the object is moved : Beginning of the movement of the object in the direction in which it is impelled (turning the object round to obtain a better hold is part of the act of seizing)

GSa = Simply touching an object.

GSb = Seizing an object easily grasped.

GSc = Seizing a small object, an object less easily grasped, or a delicate object.

GSd = Seizing a very small object, an object lying in a very unfavourable position, or an extremely delicate object.

GSe = Seizing an object when there are several simultaneous obstacles in the way.

8. GL = Letting go.

Movements resulting in the separation of a part of the body from an object.

Beginning : (i) immediately following upon a change in the position of the object: Cessation of all movement of the object in the direction of its previous path ; (ii) not immediately following upon a change in the position of the object : Moment at which the area of contact between the part of the body and the object held begins to diminish.

End : Cessation of all contact between the part of the body and the object.

GLa = Cessatior of simple contact with the object.

GLb = Letting go a large and handy object.

GLc = Letting go a less handy or a delicate object.

GLd = Letting go a very delicate object.

GLe = Letting go an object, when there are several simultaneous obstacles.

9. GR = Re-grasping = GL + SH + GS.

Releasing an object and immediately grasping it again with the same or the other hand. GL is not really a fundamental movement. It is rather a combination of the three movements mentioned above. The combination, however, is a very common one and, as the three fundamental movements coalesce in the very earliest stage to form a single impulse, the classification is permissible.

Beginning : Moment when area of contact between the part of the body concerned and the object begins to diminish.

End. Cessation of all movement of the part of the body in relation to the object seized.

GRa = Re-grasping-simply touching the object for a short time.

GRb = Re-grasping of an accessible object at short distances, or by mere contact at somewhat longer distances.

GRc = Re-grasping of an accessible object at longer distances or of a less easily accessible object at short distances.

GRd = Re-grasping of delicate or very inaccessible objects.

GRe = Re-grasping, in the face of several simultaneous obstacles.

Group 3. *Movements in space.*

Movements of parts of the body, not in immediate connection with an object, except the following :

1. Movements which denote the receiving of a sense impression (see Observation).

2. Grasping movements (q. v.).

3. Changes of position (q. v.).

10. SH = Movement towards (Hin) work.

Movements in space directed towards a piece of work or a tool and followed by grasping of same (GS).

Beginning : (i) following release (GL) : Cessation of all contact between part of the body and the object ; (ii) not following release (GL) : first sign of movement in direction of path which leads to the object.

End : first contact of the part of the body effecting seizure and the object (see also GS).

SHa = Shortest movement of wrist through space.

SHb = Movement of elbow through space.

SHc = Movement of shoulder through space.

SHd = Movement through space combined with a movement of the body.

SHe = Movement though space under especially difficult conditions.

11. SW = Waiting movements.

Movements without other recognizable purpose than that of filling up time.

Beginning : (i) when following a movement : End of previous movement ; (ii) when following rest : first sign of movement.

End : (i) when followed by movement : Beginning of following movement ; (ii) when followed by rest : Cessation of all movement.

The duration of waiting movements is given either by the time of some machine or some other movement. There is therefore no necessity to subdivide waiting movements.

12. SZ = Movement away (Zurück) from work.

Movements in space away from a piece of work or a tool, after release of same (GL) but *not* followed by the seizure of another object. If another object is seized after the movement in space, the movement is to be regarded as a movement towards SH) the object subsequently grasped.

Beginning : Cessation of all contact between the object released and the releasing organ of the body.

End : Cessation of all movement in the direction originally taken.

SZa = Shortest movement of wrist through space.

SZb = Movement of elbow through space.

SZc = Movement of shoulder through space.

SZd = Movement through space combined with a movement of the body.

SZe = Movement through space under especially difficult conditions.

Group 4. *Displacement.*

Movements of parts of the body directly connected with or resulting in the displacement of an object, in so far as such movements are not in direct execution of work (see Handling of Tools).

13. DU = Upwards.

The raising of an object, when the movement is not part of the process of carrying it to or from the place of work (if the latter, see under DH or DZ).

DUa = Shortest movement of wrist.
DUb = Raising movement of elbow.
DUc = Raising movement of shoulder.
DUd = Raising movement combined with movement of the body.
DUe = Raising movement under especially difficult conditions

14. DT = Turning.

Movements which result in turning the object held.

Beginning : first sign of turn. A preliminary movement of displacement of a different nature (DU, DL, DD, etc.) will be included in the movement of turning, if it is of shorter duration than 0.002 minutes.

DTa = Shortest turn of wrist.
DTb = Turn of elbow.
DTc = Turn of shoulder.
DTd = Turning movement combined with a movement of the body.
DTe = Turning movement under especially difficult conditions.

15 DI = Insertion.

Movements to insert one object in another, e. g. insertion of a bolt in its hole.

Beginning : First slowing down of previous movement of displacement.

End : (i) when followed by release : First diminution of area of contact between the part of the body concerned and the object held.

(ii) when followed by movement of displacement : First acceleration in the direction of the movement of displacement.

DIa = Insertion of a solid object in a fairly wide aperture.
DIc = Insertion of a solid object in an exactly fitting aperture or insertion of a delicate object in a wider aperture.
DIe = Insertion of a delicate object in an exactly fitting aperture.

16 DH = Movement or displacement towards (Hin) place of work.

Movement of an object towards the place where it is to be used.
Beginning : Initial movement in the desired direction.
End : Cessation of all movement in the desired direction.
DHa = Shortest movement from wrist.
DHb = Movement from elbow.

DHc = Movement from shoulder.
DHd = Movement involving use of whole body.
DHe = Movement under especially difficult conditions.

17 DL = Laying down.

Laying of an object upon some basis of support.
Beginning : first contact of object with its basis of support.
End : complete contact between object and basis of support.
DLa = Deposit of a solid object.
DLc = Deposit of a rather delicate object.
DLe = Deposit of a very delicate object.

18 DD = Dropping.

Every lowering of an object not forming part of the process of carrying it to or from place of work.
Beginning : first sign of lowering movement.
End : Cessation of lowering movement.
DDa = Lowering movement from wrist.
DDb = Lowering movement from elbow.
DDc = Lowering movement from shoulder.
DDd = Lowering movement accompanied by movement of the body (from the hips).
DDe = Lowering movement under especially difficult conditions.

19. DP = Displacement by pushing.

Any movement of an object which does not remove it from its basis of support, which is not part of the process of carrying it to or from the place of work and which is not a movement belonging to the technique of the process (e. g. in grinding)
Beginning : first sign of pushing movement.
End : cessation of all pushing movement.
DPa = Short movement of a light object.
DPc = Long movement of a light object or short movement of a heavy object.
DPe = Long movement of a heavy object.

20. DPR = Displacement by propulsion.

Movement of an object by imparting to it momentum.
Beginning : First movement to impart momentum.
End : Cessation of contact between the part of the body imparting momentum and the object propelled.
DPa = Movement of propulsion from wrist.
DPb = Movement of propulsion from elbow
DPc = Movement of propulsion from shoulder.
DPd = Movement or propulsion from hip.

DPe = Movement of propulsion with whole body (combined with change of position).

21. DZ = Movement of displacement away from (Zurück) place of work.

Movement of an object away from the place where it has been used to a place where it is not used, but merely stored. If the object is worked upon in this second place, the movement is to be regarded as a movement of displacement towards (DH) that place.

Beginning Initial movement in the desired direction.
End : Cessation of all movement in the desired direction.
DZa = Very short movement from wrist.
DZb = Movement from elbow.
DZc = Movement from shoulder.
DZd = Movement involving use of whole body.
DZe = Movement under especially difficult conditions.

Group 5. *Rest*.

Absence of any movement connected with work, unless it is a movement of observation (q. v.).

22. RT = Thinking (searching).

e. g. Reading of a drawing or an order, looking for an object, reflection, etc.
Beginning : End of previous movement.
End : Beginning of folllowing movement.
N. B. This fundamental movement can be further subdivided in any particular case.

23. RR. = Recreation.

All moments of rest without recognizable motive.
Beginning : End of previous movement.
End : Beginning of following movement.
N. B. No subdivision of this fundamental movement is needed.

24 RH = Holding.

Holding of an object.
Beginning : (i) when preceded by seizure : End of act of seizure (GS) ; (ii) when preceded by a movement of the object : Cessation of all movement of the object.
End : (i) when followed by release : Beginning of relaxing movement (GL) (ii) when followed by movement of object : Beginning of movement of object.
N. B. The duration of the fundamental movement RH is dependent upon other simultaneous movements with the other hand or upon machine-times, and sub-division is therefore impossible.

25. RC = Change of direction.

Interval of rest while the movement changes direction.
Beginning : End of movement in one direction.
End : Beginning of movement in other direction.

26. RW = Waiting periods.

Moments of rest necessitated by the process.
Beginning : End of previous movement.
End: Beginning of following movement.

Group 6. *Changes of Position.*

Movements producing a change in the position of the body.

27. PS = Standing up.

Movement of the recumbent body into the kneeling or sitting position, or of the seated body into the standing position.

Beginning : first sign of raising of upper part of body. End : Cessation of all movement into new position.

PSa = Passage from recumbent to kneeling position.
PSb = Passage from sitting to standing position.
PSc = Passage from kneeling to stooping position.
PSd = Passage from kneeling to sitting position
PSe = Passage from recumbent to standing position.

28. PB = Bending.

Bending of body.
Beginning : first sign of bending movement.
End : Cessation of all bending movement.
PBa = Slight bending of upper part of body.
PBb = Considerable bending of upper part of body.
PBe = Very pronounced bending of upper part of body.

29. PT = Turning.

Turning of body.
Beginning : first sign of turning movement.
End : cessation of all turning movement.
PTa = Turning of shoulder.
PTc = Turning of hip-joint.
PTe = Turning of whole body (combined with change in position of feet).

30. PW = Walking movement.

Advance of foot.
Beginning : first lifting of foot.

End : Completion of act of placing foot on ground or, if a further step is taken, first lifting of other foot.

PWa = Advance of foot (half a step).

PWc = Normal step.

PWe = abnormally long step.

31. PL = lying down.

Movement of standing body into sitting, kneeling or lying position, or of kneeling body into lying position.

Beginning : first sign of change in position of body.

End : Cessation of all movement into new position.

PLa = Passage from kneeling to recumbent position.

PLb = Passage from stooping to kneeling position.

PLc = Passage from standing to sitting position.

PLd = Passage from standing to kneeling.

PLe = Passage from standing to recumbent position.

Group 7. *Handling of Tools.*

Movements necessitated by the manipulation of a tool or machine tool with the purpose of executing work. Movements not immediately followed by execution, but required as a preliminary thereto, e. g. the withdrawing movement of a file or plane, will also be included under T. In assembling work, the insertion of a screw also comes under this number.

Note. The following sub-division of tool movements is purely an initial proposal. Investigations in connection with activities which have not yet been subdivided according to our present method, will require to be developed and modified. On this account no attempt has been made to sub-divide the various fundamental movements.

32. TB = Drilling.

A 90°-110° turn of the fore-arm (e. g. in drilling nails, screwdriving, fixing electric switches).

Beginning : first sign of turning movement.

End : Cessation of turning movement.

33. TP = Pressing and pulling.

Exercise of pressure or of pull e. g. pulling chain of hand-crane, guiding a compressed-air hammer, a hand-drill, etc.).

Beginning : first sign of incipient pressure or pull.

End : Cessation of pressure or pull.

34. TI = Insertion.

Insertion of tool in piece of work or vice-versa, e. g.: sewing, threading a needle, insertion of screw-driver or spanner into screw.

Beginning : First diminution in speed of previous movement of displacement.

End : Beginning of following movement.

35. TG = Guiding.

Movement of a tool in a certain direction (e. g. guiding of soldering or filing-irons, engraving, steering of bicycle, etc.).

Beginning : Initial movement in the desired direction.

End : Cessation of movement in the desired direction.

36. TD = Digging

e. g. shovelling, tossing with spade.

Beginning : Beginning of movement in desired direction.

End : Cessation of movement in desired direction.

37. TF = Filing and planing..

Movements to and fro in a straight line e. g. planing, filing, scraping, etc.

Beginning : first movement in desired direction.

End : end of movement in desired direction.

38. TH = Handle-turning.

e. g. movements with hand-drill, winch, etc.

Beginning : First movement of handle.

End : Completed movement of handle.

39. TA = Affixing.

Affixing of labels and similar work.

Beginning : first contact with object to be affixed.

End : Completed affixing of object.

40. TC = Changing of place.

In adjusting processes.

Beginning : first sign of movement of object in question.

End : Cessation of movement of object.

41. TX = movements with brush.

Rectilinear movement of a tool accompanied by a slight turn of the wrist.

e. g. use of painter's brush, mason's trowel.

Beginning : First movement in desired direction.

End : Completion of movement in desired direction.

42. TR = Rotation (lever movements).

Turning of lever on its fulcrum.

(e. g. lever-press, lever-switch, lever-shears, lever drill, chisel, machine-drill and adjustable spanner).

Beginning : First movement of lever.

End : Completed movement of lever.

43. TS = Striking movements, accompanied by a swing.

Turning movement of wrist, elbow or shoulder.

(e. g. sledge hammer, pick-axe, mason's trowel, etc.).

Beginning : Beginning of swing.

End : Completion of swing.

44. TT = Treading.

Treading movement by the feet to impart force to a tool (e. g. lathes, drills etc. worked by foot ; pedalling in cycling, foot-brakes, action of foot on spade).

Beginning : first movement of the object trodden.

End : cessation of movement of object trodden.

45. TPR = Pressing.

e. g. pressure in setting and honing.

Beginning : First application of pressure in the desired direction.

End : Cessation of pressure

46. TW : Wiping.

e. g. in cleaning work.

Beginning : Contact of wiper with object

End : Cessation of contact between wiper and object.

47. TV = Vibrations.

Quick short movements to and fro.

(e. g. certain movements in engraving)

Beginning : Commencement of movement.

End : Cessation of movement.

The above are some suggestions for sub-dividing work into fundamental movements. It is however impossible to describe the different movements in a few words without ambiguity.

We now propose to prepare schedules for the different fundamental movements which will show in the form of illustrations the exact course of each movement. These will also indicate the important variants, such as the frequency curves of times recorded under varying conditions. They should thus afford a complete survey of human work and the laws which govern it.

VI. PROTOCOL OF WORK.

In the execution of a process of work several fundamental movements are often made simultaneously. Thus the right hand may execute one fundamental movement, while the left hand is executing another, and at the same time the body may change its position. The protocol must therefore contain a number of columns corresponding to possible fundamental movements. In the commonest cases each person participating in the work must be given the following columns :

1. Right hand.
2. Left hand.
3. Head (Observation).
4. Trunk (change of position).
5. Right leg.
6. Left leg.

Entries will be made in the columns, as each case requires. For instance, Columns 4,5 and 6 will not be needed in the case of a piece of work done sitting. If there is no observation of a kind which does not at the same time direct the hands, Column 3 may be dispensed with. If both hands work together throughout, their movements may perhapsbe registered in a single column.

Each column must contain the following indications ·

a) Letter denoting the fundamental movement.
b) Piece of work or tool to which the fundamental movement refers.
c) Absolute time (i. e. total time starting from the beginning of the work).
d) Individual time (i. e. duration of particular movement).

The foregoing is best explained by an example. The film upon which the following analysis is based may be obtained from the *Institut für Kleinzeitforschung* Berlin N. W. 7.

In this example the work to be done consists of assembling a compressed-air hammer from the separate parts placed ready to hand. The hammer consists of the cylinder in which the piston has to be inserted. The cylinder must not be locked in the vice until the holes are level. The piston must be cleaned and greased before insertion. Two gudgeon-pins are then introduced into the cylinder and also an intermediate ring. A valve is then put together from three parts and inserted in the upper part of the cylinder. The handle is then attached and screwed fast. When the hammer has thus been assembled the retaining pin is taken out. The hammer is then turned round and a safety ring attached by means of a special tool. The work ends with the removal of the hammer from the vice.

This work involves the following fundamental movements :

Fundamental movement	symboly	left hand	right hand
Observation by touch	OT	—	1
Grasping (Seizing hold of a part)	GS	15	16
Grasping (letting go of a part)	GL	5	18
Grasping (re-grasping or passing into the other hand)	GR	18	22
Movement in space towards piece of work	SH	15	22
Movement in space away from piece of work	SZ	5	3
Displacement, insertion of one piece in another	DI	5	11
Displacement, moving of a piece towards place of work	DH	8	16
Displacement, laying down of piece	DL	—	1
Displacement, pushing	DP	2	1
Displacement, away from place of work	DZ	2	8
Rest, holding of a piece	RH	8	1
Rest, waiting	RW	16	12
Handling of tools, cleaning	TN	1	2
Handling of tools, pressing or pulling	TP	1	1
Handling of tools, handle-turning or screwing	TH	9	26
Handling of tools, movements with brush	TX	—	3
		110	164

Total with both hands = 274

Summary showing sequence of work and number of movements :

Working process	TIME Total	individual process
Clamping of cylinder into vice	70	70
Cleaning of piston	120	50
Greasing of piston	205	85
Insertion of piston in cylinder	267	62
Placing of piston level with hole, and clamping	416	149
Introduction of Pin N. 1	487	71
Introduction of Pin N. 2	557	70
Placing of intermediate ring	626	69
Assembly of valve	907	281
Placing of handle	1041	134
Screwing up of handle	1216	175
Locking of handle	1412	196
Turning hammer round	1517	105
Affixing safety ring	1694	177
Removal of hammer from vice	1757	63

Both in the above and in the following table, the times given represent thousandths of a minute.

The following schedule shows the separate fundamental movements which were observed in the course of this work as shown in the above-mentioned film. The dividing lines correspond to the sub-division of processes as given in the preceding table.

Sequence of Fundamental Movements.

Left hand				*Right hand*			
Movement	Object	Time		Movement	Object	Time	
SH	Cylinder	9	9				
GS	»	13	4	RW		19	19
DH	Cylinder and vice	29	16	S	Vice	25	6
				GS		26	1
				TH	Loosening of vice	33	7
DP	Cylinder	37	8	RW	Vice	37	4
				TH	Clamping of vice	45	8
				GR	Vice	51	6
RH	Cylinder	70	33	TH	Clamping of vice	71	20
SH	Piston	76	6				
GS	»	81	5	RW		82	11
				GL	Vice	83	1
				SH	Rag	90	7
				GS	»	91	1
RH	Piston	98	17	DH	»	98	7
	Piston (Cleaning)	112	14	TW	(Piston) Rag	112	14
				DZ	Rag	119	7
				GL	»	120	1
				SH	Brush	125	5
				GS	»	126	1
				TX	» (passing of brush over piston)	137	31
				DH	»	167	10
				TX	» (greasing)	190	23
				DZ	»	199	9
				DL	»	203	4
				GL	»	205	2
RH	Piston	213	101	SH	Piston	213	8
	» (into other hand)	223	10	GR	»	223	10
				DH	»	231	8
				DI	» (in cylinder)	255	24
				GL	»	256	1
				GS	»	261	5
				DP	»	267	6
				GL	Piston	268	1
				SH	» guide	283	15
				GS	Guide	284	1
RW		299	76	DH	»	299	15

Left hand				*Right hand*			
Movement	Object	Time		Movement	Object	Time	
GR	Guide	303	4	GR	» into other hand	303	4
DH	» and cylinder	310	7	SH	Piston	309	6
DI	» » »	323	13				
DP	»	348	25	OT	Piston	348	39
				SH	Vice	367	19
				GS	»	370	3
RH	Guide	383	35	TH	Pulling vice tight	385	15
DZ	»	404	21	RW		400	15
				SH		404	4
GR	G. passed into other hand	405	1	GR	Guide	405	1
				DZ	»	415	10
RW		416	11	GL	»	416	1
SH	Gudgeon-Pin No. 1	423	7				
GS	» » »	436	13	RW		441	25
DH	» » »	445	9	SH	Pin No. 1	445	4
GR	» into oth. h.	451	6	GR	» » »	451	6
				DH	» and cylinder	455	4
				DI	» » »	479	24
RW		487	36	GL	» » »	486	7
SH	Pin No. 2	492	5				
GS	» » »	504	12	RW		508	22
DH	» » »	514	10	SH	Pin No. 2	514	6
GR	» into other hand	521	7	GR	» » »	521	7
				DA	Pin and cylinder	529	8
				DI	» » »	555	26
RW		557	36	GL	» » »	556	1
SH	Intermediate ring	563	6	SZ		560	4
GS	» »	570	7	RW		575	15
DH	» »	580	10	SH	Intermediate ring	580	5
GR	» (into other hand)	600	26	GR	» »	600	20
				DH	» » and cyl.	605	5
				DI	» » »	627	22
				GL	» » »	628	1
SH	Valve (1st part)	632	6				
GS	» »	640	8	RW		650	22
DH	» »	653	13	SH	Valve (1st part)	653	3
GR	» »	656	3	GR	» »	656	3
				SH	» (2nd part)	661	5
				GS	» »	673	12
RW		679	23	DH	» »	679	6
DI	Valve (1) into Valve (2)	728	49	DI	Valve (1) into Valve (2)	728	49
				GL	» (2nd part)	729	1
				SH	» (3rd part)	734	5
				GS	» »	746	12
RW		757	29	DH	» »	757	11

Left hand				*Right hand*			
Movement	Object	Time		Movement	Object	Time	
DI	Valve (3) into (1) and (2)	814	57	DI	Valve (3) into (1) and (2)	814	57
GR	» into other hand	872	58	GR		872	58
				DH	Valve (all 3 parts)	876	4
				DI	» into cylinder	899	23
				GL		900	1
RW		906	34	SZ		907	7
SH	Handle	913	7				
GS	»	920	7	RW		926	19
DH	»	932	12	SH	Brush	932	6
				GS	»	940	8
				DH	»	947	7
				TX	» (Grease)	976	29
				DZ	»	983	7
				GL	»	991	8
RW	Handle	999	67	SH		999	8
RH	»	1007	8	TW	Handle with finger	1007	8
GR	» into other hand	1019	12	GR	»	1019	12
				DH	»	1026	7
				DI	» on to cylinder	1041	15
				TH	Screwing-on handle 90°	1045	4
				TH	» » 180°	1055	10
				TH	» » »	1063	8
				TH	» » »	1071	8
				TH	» » 360°	1080	9
				TH	» » »	1088	8
				TH	» » »	1097	9
				TH	» » »	1106	9
RW		1115	96	TH	» » 180°	1115	9
SH	Handle	1121	6	GR	» » »	1121	6
GS	»	1122	1				
TH	Screwing-on handle	1129	7	TH	Screwing-on handle	1129	8
GR	Handle	1134	5	GR	Handle	1134	5
TH	Screwing-on handle	1141	7	TH	Screwing-on handle	1141	7
GR	Handle	1146	5	GR	Handle	1146	5
TH	Screwing-on handle	1153	7	TH	Screwing-on handle	1153	7
GR	Handle	1158	5	GR	Handle	1158	5
TH	Screwing-on handle	1165	7	TH	Screwing-on handle	1165	7
GR	Handle	1169	4	GR	Handle	1169	4
TH	Screwing-on handle	1176	7	TH	Screwing-on handle	1176	7
GR	Handle	1181	5	GR	Handle	1181	5
TH	Screwing-on handle	1188	7	TH	Screwing-on handle	1188	7
GR	Handle	1193	5	GR	Handle	1193	5
TH	Screwing-on handle	1200	7	TH	Screwing-on handle	1200	7
GR	Handle	1206	6	GR	Handle	1206	6
TH	Screwing-on handle	1216	10	TH	Screwing-on handle	1216	10
GR	Handle						

Left hand				*Right hand*			
Movement	Object	Time		Movement	Object	Time	
TH	Screwing-on handle	1223	7	SH	Wood for handle	1226	10
				DI	»	1229	3
				DH	»	1239	10
RW		1253	30	DI	» fixed to handle,	1252	13
SH	Retaining-pin	1264	11	GR	»	1257	5
GS	»	1265	1	RW		1284	27
				GS	Wood	1285	1
				SH	Pin	1288	3
				GS	»	1289	1
TH	Disengaging pin	1305	40	TH	Disengaging pin	1305	16
DL	» »	1306	1	DZ	Pin	1312	7
SZ		1310	4	GL	»	1314	2
RW		1323	10	SH	Wood for handle	1321	7
SH	Wood for handle	1328	5	GS	»	1322	1
GS	»	1321	1				
TH	Fixing wood to handle	1383	54	TH	Fixing wood to handle	1383	61
GL	Wood	1384	1	GR	Wood	1388	5
SZ		1390	6	DZ	»	1411	23
				GL	»	1412	1
RW		1413	23	RW		1420	8
SH	Hammer	1422	9				
GS	»	1423	1	GS	Vice	1422	2
RH	»	1446	3	TH	Loosening of vice	1445	32
				GL	Vice	1446	1
GR	Hammer into other hand	1456	10	GR	Hammer	1456	10
SZ		1463	7	DH	» and vice	1467	11
SH	Hammer	1473	10				
DI	»	1476	3	RH	Hammer	1480	13
				GL	»	1481	1
				SH	Handle of vice	1486	5
				GS	» »	1487	1
				TH	Tightening of vice	1498	11
RH	Hammer	1505	29	GL	Vice	1499	1
SZ		1517	12				
SH	Ring	1526	9				
GS	»	1532	6	RW		1534	35
DH	»	1543	11	SH	Pincers	1544	10
				GS	»	1569	25
RW		1587	44	DH	»	1587	18
DI	Ring gripped by pincers	1606	19	DI	Ring gripped by pincers	1606	19
GL	Ring	1611	5	DH	Ring and pincers brought to cylinder	1617	11
SH	Pincers	1623	12				
GS	»	1627	4				
DI	Ring and pincers	1669	42	DI	Ring made fast to cylinder by pincers	1669	32

Left hand				*Right hand*			
Movement	Object	Time		Movement	Object	Time	
TP	Pincers removed	1671	2	TP	Pincers removed	1671	2
GL		1683	12	DZ		1694	23
RW		1694	11				
SH	Hammer	1700	6	SH	Handle of vice	1703	9
GS	»	1701	1	GS		1704	1
				TH	Loosening of vice	1711	7
RH	»	1719	18	SZ		1719	3
DZ	»	1730	11	SH	Hammer	1729	10
GR	Hammer into other hand	1738	8	GR	»	1738	9
				DZ	»	1751	13
RW		1757	19	GL	»	1757	6

Analysis of Fundamental Movements

1: *Grasping.*

GS Arranged according to times.

Left hand		*Right hand*	
Individual time	Total time	Individual time	Total time
1	1122	1	26
1	1265	1	91
1	1329	1	126
1	1423	1	264
1	1701	1	1289
3	1476	1	1322
4	13	1	1487
4	1627	1	1704
5	81	2	1421
6	1532	3	370
7	570	3	1229
7	920	5	261
8	640	8	940
12	504	12	673
13	436	12	746
		25	1569
74	15	77	16

Mean value 74/15 = 4.95

Mean value 77/16 = 4.8
excluding 1569 52/15 = 3.46

The most frequent and the mean values are low, so that the workman may be assumed to have worked at his maximum rate. The shorter times recorded by the right hand show that he was right-handed.

2° *Movements in space.*

SH arranged according to times.

Left hand		*Right hand*	
Individual time	Total time	Individual time	Total time
5	492	3	653
5	1328	3	1288
6	76	4	445
6	563	5	125
6	632	5	580
6	1121	5	661
6	1700	5	734
7	423	5	1486
7	913	6	25
9	9	6	309
9	1422	6	514
9	1526	6	932
10	1473	7	90
11	1264	7	1321
12	1632	8	213
		8	999
		9	1703
		10	1226
		10	1544
		10	1729
		15	283
		19	367
114	15	162	22

Mean value $114/15 = 7.6$ Mean value $162/22 = 7.36$

The SH times suggest the same conclusions as those deduced from GS.

3° *Re-grasping.*

GR arranged according to times.

Left hand		*Right hand*	
Individual time	Total time	Individual time	Total time
1	405	1	405
3	686	3	656
4	303	4	303
4	1169	4	1169
5	1134	5	1134
5	1146	5	1146
5	1158	5	1158

Left hand		*Right hand*	
Individual time	Total time	Individual time	Total time
5	1181	5	1181
5	1193	5	1193
5	1206	5	1206
6	451	5	1257
7	521	5	1388
8	1738	6	51
10	223	6	451
10	1456	6	1121
12	1019	7	521
20	600	9	1738
58	872	10	223
		10	1456
		12	1091
		20	600
		58	872
173	18	196	22

Mean value 173/18 = 9.6 Mean value 196/22 = 8.9

This list also confirms the conclusions drawn from GS and SH times.

4° *Rest times.*

RW arranged according to times.

Left hand		*Right hand*	
Individual time	Total time	Individual time	Total time
11	416	4	37
11	1694	8	1420
13	1323	11	82
19	1757	15	404
23	679	15	575
23	1413	19	19
26	626	19	926
29	757	22	508
30	1253	22	650
34	906	25	441
36	487	27	1284
36	557	35	1534
44	1587		
67	999		
76	299		
96	1115		
574	16	222	12

RH arranged according to times.

Left hand		*Right hand*	
Individual time	Total time	Individual time	Total time
8	1007	13	1480
17	98	—	—
18	1719	13	1
23	1446		
29	1505		
33	70		
35	383		
101	213		
264	8		

The considerably larger number and longer duration of RW and especially RH movements with the left hand show that the workman was right-handed. The right hand is unemployed for only 0.222 minutes out of 1.757 minutes = 12.5% During this time the left hand is busy so that the total time incl des practically no rest periods.

The foregoing table furnishes some indication of what can be deduced from the figures obtained by the analysis and we now propose to deal with a few of these points.

a) *Normal speed.*

The chief indication that the workman is purposely dallying over the work consists in the considerable number of small resting-times between the different movements, pauses which are hardly perceptible by direct observation. In the above table these « rest-waits » (RW) are shown according to their length. If they are compared with the whole table, it will be found that when one hand is resting, the other is generally occupied. In the above case, therefore, the total time taken was not drawn out.

A second indication of speed-rate consists in comparing individual movements with normal times. The GS and SH movements are best suited for this purpose. As far as can be judged from experiments so far made, the times in the example given coincide almost exactly with normal times.

b) *Efficiency of the workman.*

A numerical statement of the efficiency of the workman under observation is possible as soon as a sufficiently large number of experiments has given us normal times for the majority of fundamental movements. Let us then suppose that
ta, tb, tc = total times of fundamental movements a, b, c in the work analysed.
pa, pb, pc = ratio of average times for fundamental movements to normal times.
P = efficiency figure of workman under observation in respect of the work analysed.

$$\text{Then } P = \frac{t_a \times p_a + t_b \times p_b + t_c \times p_c + \ldots}{t_a + t_b + t_c}$$

If normal times are lacking for certain movements, the corresponding value is $p = 1$.

c) *Rationalisation.*

The work studied can in the main be improved as follows :

a) Elimination of unnecessary movements.

In the example given above, for instance, various parts were seized in the left hand and then transferred to the right hand, which did the subsequent work of assembling. (see 223, 405, 415). The film shows that these unnecessary grasping movements of the left hand were due to the fact that the particular pieces lay on the left of the vice. If they were placed to the right of the vice, the movement of re-grasping and movement though space of the right hand would disappear. The total times of these movements give us at once the possible saving of time, and without a fresh examination of the existing material. If, for example, the placing of the parts on the right of the vice instead of on the left demands a special expenditure of time beforehand, it can at once be ascertained whether this is justified by the possible saving of time.

b) The abbreviation of long times.

It is a matter for study whether comparatively long times taken over individual movements are due to conditions of work which can be changed. For example, the GS movement of the left hand in the total times 436 and 504 and the GS movement of the right hand in the total times 673, 746 and 1569 are disproportionately long. In the first four cases the film shows that time was occupied in picking up small objects which lay flat upon a plate. If these parts had been placed in readiness on a board, the times of these fundamental movements could have been substantially reduced.

Each of these improvements is trifling in itself, but their sum may amount to a considerable fraction of the total working time.

A special advantage of the above method is that any possible improvements strike the analyst in the course of his study and he can determine numerically the amount of time saved.

R. Thun

THE CONTRIBUTION OF THE CINEMA TO TIME-STUDIES

(from the Italian)

A) Importance of working times.

The perfecting of manufacturing processes is no doubt an essential condition of all industrial development, but in the pursuit of this goal we must keep ever in mind the necessity of reducing costs of production and introducing into cycles of operations those prototypes or standards of manufacture which will alone secure the best results. The very aim and object of scientific management or — to use a more strictly correct term — the science of the rational organisation of production — is to find that ideal combination of factors which will furnish the maximum output at minimum cost after defining and analysing those elements which have a decisive influence upon this result. These factors, which are now well known to scientific management experts, are the following :

a) *Time* of execution ;

b) *material* from which the finished product is derived ;

c) the *plant* by means of which the product is prepared, whether semi-automatic machinery or simple hand-tools ;

d) the *workman*, who is the agent of production. This is the most important factor, although the most generally overlooked ;

Editorial Note = Our readers will not fail to note the analogy between Signor Grillo's article and the preceding article by Herr Thun. More particularly in the parts demonstrating the application of the cinema to time-studies, the resemblance is too close to escape notice. When we first observed it, it seemed to us that the publication of both these articles would amount to a duplication of work. On reflection, however, we decided to publish both, the resemblances between the two having a most natural explanation.

Herr Thun, the Director of the Berlin « Fachfilm », is an expert on the subject, as we know from his published works and from the successful practical applications of the principles contained therein. We requested him to furnish the I. E. C. I. with a study to serve as a basis for the work of a committee of experts appointed to collaborate with the Institute in the question of the use of the cinematograph in connection with rationalisation.

Among these experts, Signor Grillo, whose notable studies on the same subject had attracted the Institute's attention, Shared Herr Thun's views so closely that in the illustrative part of his article, he has openly retraced the ground covered by his German colleague. In his introduction Signor Grillo explicitly declares that Herr Thun's work on the application of cinema technique to time-studies has supplied a long-felt need.

We may therefore cease to be surprised at the analogy between the two contributions and rejoice to find in the pages of our Review tivo recognized experts in absolute agreement upon the methods to be followed in employing the cinema for time study, that is, in determining the elements which constitute the very basis of rationalisation.

e) the *quality of the article.* Even in the simplest categories of articles there is a certain prototype or standard, whether clearly defined or not, below which the quality is declared to be inferior.

In order to show the importance of these different factors, it may be useful to say a few words about each of them. In this way the problem of production will receive an organic framework and the importance of the element of *time*, which in the subject of the present chapter, be more clearly perceived.

Time.

This is the universal unit of measure, the basic unit which, in the most dissimilar industries and in widely different places and *milieux*, remains absolutely constant and can thus be employed in the study of the duration and development of a cycle of operations. The only factor in production which is applicable to all circumstances, it is considered as the universal unit of measure.

Material.

In the manufacture of any article at all, economy of the material used is a most important consideration. Economy of material is favourably affected by the care taken of it and by the methodical preparation of his work by the worker. If the handling of material could be as scrupulously controlled as the movement of funds by a bank cashier, every factory would effect considerable savings. If an official is careless or negligent in the handling of funds, he pays for his mistake with the loss of his job, but the manipulator of material may continue to waste large sums of money every year and still be counted a good workman. In some factories, boot factories, for example, the problem of economy in materials has been studied closely and each cutter is paid a wage based not on his cutting speed but on the amount of leather he saves.

This system is possible because the cost of a pair of boots depends more upon the cost of leather than upon the price of labour. Similarly, in glove factories, and factories in general which produce articles from hides, skins and leather, the cutters could produce 20-25 % more in quantity if they were not continually compelled to study the needs of economy. As, however, the price of the labour of cutting leather goods is only 10 % of the price of the raw material, it will be understood that slow and careful work is all in the interests of the manufacturer.

The cost of the raw material and its influence on total cost of production are in general deserving of close attention. Often special enquiry is necessary to determine the standard quantity of material necessary for a given output or to ascertain whether the saving of time effected by rapid execution is not more than outweighed by the resultant wastage.

Plant.

The influence of plant, whether simple or complicated, on quality and quantity of output is obvious to the humblest worker. Plant adds to the worker's capacity to produce furnishes him with means of executing work with exactitude, removes the necessity for revision, supplies the means of checking and controlling work and shortens the time taken over it.

Nevertheless, improved plant, although it usually realises a substantial gain is often very expensive and adds greatly to the cost of production. It therefore requires to be carefully studied beforehand.

Is it always desirable to replace old plant by new? The answer to this question must be based on consideration of two factors, the saving of time in the cycle of operations and the quality of the article. Moreover, as a machine is often less easily adapted to individual variations than a brain-directed hand the human factor must also be taken into account when answering this question.

The workman.

Much has been written of late about the workman. The « psychology of the worker » has been a subject of special study as if there were a separate psychology for the man in overalls and another for men working, for example, in an office. Every one who works regards the advantages to which he aspires from a particular point of view, which is determined by his quality of official, skilled worker, artisan or apprentice.

In planning a new organisation, in studying the development of a cycle of operations, in explaining to operatives the methods to be followed and in giving them suitable encouragement, the technical expert should always take account of human limitations when demanding of them a certain physical and mental effort. The question of the physical effort to be exacted is associated with the question of fatigue which enters in greater or lesser degree into all work. In the application of the system of standardised processes men who are found unsuited for one kind of work are given other work, on the principle that every task demands special physical and mental aptitudes. Suitable and reasonable standards are fixed for each operation and ensure that each workman can do his job without injury or danger. No doubt some work is heavier than other, or demands special application, but in most factory processes, the heaviest work is now done by machinery. The margin allowed for fatigue may be determined by a study of the times upon which the standard times are based.

The encouragement given to workmen in work done according to standardised times varies with the mentality of the workmen themselves and must in no case urge them to over-exertion and fatigue. Piece-rates, bonuses and similar systems are often expedients which are not only unsuited to modern factory conditions but even prejudicial to efficient production. A sound principle of organisation is to proportion wages to relative quality, i. e. to the time units which characterise a man's work. The « time » factor is therefore a reliable element in calculating the efficiency of the « human » factor.

The quality of the article.

In most industries the factor of «quality» is an essential condition, since every artic e must have its standard qua ity. In actual practice, however, no manufacturer has an absolute standard quality ; the standards vary with the caprice of customers, the commercial traveller, even the sales agents. In any organisation study therefore, it is essential to establish and define the standard qualities of the article. When

this study is undertaken in a factory with the aid of a technical expert, the industrialist usually tends to urge the superior quality of his article as a reason for limiting the output. It is always to be noted that quality improves after the rationalisation of the manufacturing cycle owing to the great attention paid by the workman to his work when his wage is meticulously calculated by a study of times, and also owing to the stricter control over workmen and materials.

As a general principle, quantity may be said to be sacrificed to quality; in other words, quantity diminishes in relation to quality, not in direct ratio, but in a measure which varies with the method of production.

The essential purpose of time-studies is to lessen if not to eliminate this quantitative reduction of output by examining details which, if properly studied and exploited, should make it possible to combine high quality with maximum output.

B) TIME-STUDY WITH A WATCH.

Time-study then is the fundamental principle of scientific management. It permits a microscopic analysis of working processes and the elimination of « passive » times.

Time-study or « chronometrage » may therefore be defined as the scientific analysis of the processes and tools required for a given task — which analysis fixes to the smallest detail the best method of work and measures exactly the time needed for its execution. The first advantage of this form of investigation is that it enables the observer to mark the recurrence of many elementary movements in a number of operations. Consequently, it is possible absolutely to standardise fundamenta movements, to determine their « duration » and utilise them in all other operations. Thanks to various combinations of these movements means can be found to reduce fatigue and the time required to perform the most complicated tasks.

The study of elementary times was a discovery of Taylor's, who realised that il required to be supplemented by three essential factors :

a) exact instructions to workmen ;

b) a reward to workers who do more than they need ;

c) the putting and keeping in perfect order of everything necessary forthe execution of work in order that the latter may encounter no obstacles.

The analysis of working times when it constitutes the basis of a rational reorganisation of an industry is a very delicate operation.. It is normally carried out by means of a chronometer. In order to record times, the operator chooses a skilful workman, watches his work, decomposes it into its essential phases and notes the separate elementary times which make up the total time taken over the operation. The duration of each study is a question of calculation and skill and may vary from a quarter of an hour to several days. Except for the purpose of checking conclusions already arrived at by experimenting with various movements or ascertaining the influence of some variable, studies of a quarter or half an hour are not enough to warrant any final conclusions. In so short a time the conditions of work may be exceptionally favourable or unfavourable and the workman under observation may be working with abnormal vigour or the reverse. Even when the conditions are typical, the observer cannot extract the essence of the problem of which he is

noting down the particulars, if a cycle of time elements is being executed specially. It is therefore never advisable to draw any final conclusions from standards established from a rapid study.

The recording of times sounds a simple matter, but it calls for both experience and intelligence on the part of the observer. When reading the chronometer, his mind must act instantaneously so as to register the reading at the moment when the corresponding time-element is completed. At first this duty of registration occupies the observer's whole attention, but as he gains experience his mind records the watch readings more and more unconsciously and finally the image of the reading is imprinted upon his mind for just so long as is necessary to register it. He notes and records the time element of work as mechanically as he buttons his coat. The fact that his sub-conscious mind is pre-occupied with the time-elements and seizes them just long enough to record them sets his conscious mind free to analyse continously what is passing in front of his eyes. It is the same with the stenographer who makes mechanical signs without taking her eyes off the speaker or with the pianist who reads and interprets music while his fingers pass automatically up and down the keyboard.

Skill in simultaneously observing and recording every detail affecting times and in correctly registering the readings of the chronometer are the surest basis of a time study and therefore an effective contribution towards the definition of standard times.

C) The aid of the cinema

The resources of modern technique — in the form of the cinematographic camera-present the scientific organiser with a perfect instrument of investigation and one which assures him an exact measurement of times and facilitates the research work necessary to analyse a cycle of operations.

Until quite recently not much use had been made of the cinema in the technical field — due possibly to the special knowledge required and the precautions involved, but also because the fundamental principles of its technique had never been properly studied.

By his book « Der Film in der Technik », which is undoubtedly a notable contribution to this new use of the cinema, Herr Thun, the Berlin engineer, has been the first, we think, to make good this omission.

The cinema can play many most useful parts in the sphere of work studies. If this new instrument is employed with the necessary understanding and if the material to be observed is properly arranged in advance so that the film contains all the elements required for the particular study, it will always be found possible to reach some concrete result and a substantial saving will be effected in the use of this costly device, which would be quite prohibitively expensive if it were necessary to take a large number of useless photographs of the same phase of work from different points of view.

Before all else cinema technique helps to determine the movements which are characteristic of each working operation. Unlike the chronometer with its elements of uncertainty, the film furnishes an absolutely reliable record granted the operator

makes the necessary arrangements beforehand, and it indicates not only the times required by the analysis, but also the «passive» times or intermediate times between the different fundamental movements. When he comes to study the film, the organiser sees the faithful reproduction of all the phases of work as done in the factory and he has no need to draw upon his memory or refer back to hasty notes in order to recall even after the lapse of time the smallest detail of the operation analysed

Once given the fundamental movements, which the film can reproduce indefinitely, it is possible for similar industries, without divulging trade secrets, to exchange their experience and thus facilitate the establishment of those standards which are the organiser's constant preoccupation.

The fact that many fundamental movements recur in nearly every trade, allows us to fix rules as to the employment of time and consumption of energy in respect of each fundamental movement. The values obtained vary, it is true, within certain limits, but these limits are independent of the process of work. The rules therefore will enable us to note substantial differences in processes as executed, for instance, by workers in different countries, and the rationalisation expert will be able to draw conclusions in which due account will be taken of local factors and to fix the necessary criteria for obtaining identical results in different countries.

We shall omit — as being irrelevant to our present subject — the analysis of the possible services of the cinema in connection with psychological or physiological investigations, in determining the factor of «human efficiency», in reproducing the character of the different industries and in all the other problems pertaining to human labour.

On the other hand, we must say a few words about the technique of the cinematograph in its application to the studies with which we are here concerned, at least in so far as is necessary in order to understand the rational and effective use of this new instrument.

1° *The Camera.*

Any camera can be used for taking scientific photographs, provided the spool is large enough. In order to secure an uninterrupted succession of fairly lengthy processes of work, the spool should be able to hold 120 metres, and preferably 300 metres of film.

The shutter must be adjustable, with a maximum aperture of 180° so as to be able to take pictures in poor light. Sometimes very short exposure is needed and it must therefore be possible to contract the diaphragm to an aperture of only 5 mm. diameter.

If the camera is actuated by a motor, the latter must guarantee absolute regularity, this kind of photography necessitating a perfectly constant rate of turning. Tachometers cannot always be used at the same time as the camera; moreover theyare not always so absolutely accurate as is necessary if the film is to be used tomeas ure times. In some cases use may be made of the ordinary commercial tachometer.

For the study of most processes a rate of 1000 pictures a minute, or 16 $^{2}/_{3}$ per second, is thought sufficient. A higher rate is only necessary in order to observe very rapid movements, as such those of a typist, and it is sometimes advisable to reduce

the speed of turning to 500 or even 200 photograms a minute. Such a rate is indicated for analysis of very long processes or when film must be economised. Very short pictures are taken when it is only desired to record on the film the reading of the chronometer ; in such cases the result is more accurate than is obtainable by ordinary chronometrage, and the cost of the film used is negligible. The camera must permit of the image being regulated directly by the view-finder.

For the purposes of scientific cinematography or work study photographs, use may be made of the ordinary stand with universal joint, which is found of great assistance to « shoot » a workman who is frequently changing his position. The devices required for artistic photography, the adjustable shutter, the counting device and the reversible axis, are not strictly essential in work studies, though the reversible axis may be useful for taking more than one picture on the normal field of view, in order to economise film. The advantage of saving film, however, is usually outweighed by the inconveniently small size of each picture. The above indications apply to cameras used to study human movements and, in order to examine phases of mechanical work, the technical requirements are quite different, especially as regards the choice of camera accessories. In this case the number of pictures taken per minute may be several thousands and this involves the use of devices which, though they may also serve to study times, have no advantages over the ordinary apparatus.

In order to examine even the quickest human movements a turning-speed of 150 photograms per second is sufficient, whereas for the study of the movement of machines the figure may reach 1500 pictures a second. Often use is made of the special Chanz and Rumpf cameras and of the Einemann optical devices. The light is thrown on to the object or person by a system of electric sparks of a specific duration.

2° *Lighting.*

As a general rule pictures should be taken by natural light. If this is insufficient, the minimum of artificial light should be employed so that the characteristic features of factory work may not be influenced or altered during the taking of the film. Accordingly, the camera should have a very strong lens.

If artificial light is absolutely necessary, it must be made to resemble natural light as closely as possible. For instance, if the light of the factory is diffused, the same effect must be given to the artificial light. The photography may suffer somewhat by a loss of light and shade, but the result will be far better, because the workman will be working under conditions as near as possible to the normal. Artificial light should be installed some time before the pictures are taken so that the workman may accustom himself to even slight changes in conditions. Incandescent lamps are preferable to arc lamps, but if the latter are unavoidable, special carbons will be used giving a yellowish colour, and the source of light can be masked, by a simple white sheet, for example.

3° *Measurement of photographic time.*

The film having been shot, we must be able to read the elementary times taken to perform the work which is being analysed. If the operator has been able to

secure a uniform rate of working movements, he will be able to record with sufficient accuracy the times taken from the speed with which the film has been turned. As we have already said, a rate of turning of 1000 metres a minute is equivalent to 16 $^{2}/_{3}$ pictures per second, and, to know the duration of the relative time of execution, we need therefore only count the number of photographs. If the positive is to be projected in order to ascertain these times, the projecting apparatus need only be furnished with a counting-device and the details of time are given us as it were, automatically.

It should be noted that by this system the separate photograms are not numbered, and this may be a somewhat serious inconvenience to the observer, but, to avoid this drawback, the positive need only be printed on a strip of film of which the parts corresponding to the separate photograms are all numbered. Such procedure necessitates, of course, the observance of certain precautions in developing and fixing.

Generally, however, when a process of work is filmed, the elementary times are far from uniform and the times of execution must therefore be registered by the photographs themselves. This is done by including in the field of view a watch or clock with a special dial of suitable size. The dial must be black and the divisions into hours, minutes and seconds must consist of white lines. The hands, which must be thin enough to be discernible between any two divisions on the dial, must be white also.

The hands must turn at a special speed owing to the average rate of turning the film, which may be 1000 m. a minute, or 16 $^{2}/_{3}$ pictures per second. This speed is sufficient to photograph processes of work of which each phase has a duration of not more than $^{5}/_{1000}$ ths of a minute. If the beginning and end of the phase have to be determined, the clock must record readings of 0.05 x 0.005 = 0.00025 minutes. Greater precision could not be obtained even with a shutter of 120° and more, as it would bé impossible to reproduce clearly a hand moving round at that speed.

The best clock for the purpose is a Morse clock in which the speed-regulator is replaced by a gramophone-regulator this arrangement giving an accuracy of 95%. It has three hands, of which the slowest revolves 0.5 times a minute, the second 5 times and the third fifty times. The exactitude of the reading depends upon the size of the clock in the photograph which varies from $^{1}/_{100}{}^{th}$ to $^{1}/_{500}{}^{th}$ of the circumference of the dial, so that the quickest hand can be read to between 0,0005 and 0.0002 minutes. Clocks have lately been made to turn at $^{1}/_{5}{}^{th}$ of this speed; these avoid the trouble of multiplying the reading by 2 and they give sufficiently accurate readings for most purposes.

In most modern analysis of work it is not the custom to note the time on each photogram, but only on those which mark the beginning and end of a certain operation. In this case the clock must turn more slowly and must mark longer intervals of time, so that it is not necessary to read each passage of the hand through the zero point. All these points have been taken into account in the manufacture of special clocks, which are well suited to their purpose; hands which move too quickly or too slowly can be removed and clocks are provided with a choice of dials

of different sizes, so that the clock can be proportioned to the subject of cinematographic study.

In analysis of long duration, it may be useful to record the time by an ordinary clock, but in order not to crowd the photograph, it is advisable to record this time in the notes which accompany any cinematographic operation.

It is sometimes difficult to place a clock within the picture and, instead, a special clock can be attached to the camera and photographed by a special lens passing through a small prism; or by means of mirrors, a clock can be photographed by the main lens, the dial of the clock being arranged on a different plane from the subject of the photograph.

The disadvantage here is that the camera cannot be moved about to suit requirements and it is a complicated matter for the operator to re-arrange mirrors. Clocks with automatically moving numbers instead of hands have not as yet been used, because the numbers would have to change within the space of $^{1}/_{100}{}^{th}$ of a second, and no such clock has yet been made.

4° *Photographic technique.*

Before filming a work study, note must be made of any special peculiarities in the subject of study, the time and place of photography and any other information which may affect the circumstances in which the operator works.

As regards the person photographed, we mustnote the name and Christian name, age, sex, height, weight and state of health, especially whether he has had previous illnesses or met with any occupational accident.

As regards time, note must be taken of the season, date, hour of the operation and of the hours worked in the factory.

Further, mention should be made of the cubic air space, temperature and humidity of the room, as well as a detailed statement of the weather conditions prevailing.

The wages system, staff payment in general, holidays, strikes and, generally, any circumstances that may affect the relations between employer and employee, are all indications of value to the scientific organiser. In addition to these special particulars, the notebook should also include a detailed account of the work that is being studied and of the methods employed in its execution.

In « turning » the film, the camera should not be shifted beyond what is absolutely necessary to observe the most extended movements, and any changes of position must be made most carefully, so that the film may be as clear and coherent as possible when it comes to be examined later. Moreover, any special arrangements necessary and any essential changes in the position of the camera should be provided for in advance. As a rule the photograph need only be taken from one position; if some element is thereby inevitably excluded from the picture, it is generally possible to deduce its importance from secondary indications. Sometimes, however, the masking of movements may necessitate taking the photograph from several positions, which of course greatly adds to the consumption of film.

It may be found convenient to take the picture from two different points

with two cameras absolutely synchronized by mechanical or electrical means. Sometimes, in order to avoid wasting film, mirrors can be used so as to allow a single camera to take the picture from more than one angle. It is for the specialist to decide in each particular case which method to employ.

5° *Preparation of the film.*

The printing of the film calls for no special chemical treatment. In dividing the pictures, care must be taken not to lose any, since every one may be of value to cur study. Should the sacrifice of a few photograms be unavoidable, their number should be exactly determined and they should if necessary be replaced by a piece of blank film. The positive should if possible, be of uninflammable material, so that no special precautions need be taken against fire when they are being studied. The prints should be thin and soft — thin, in order that the film may be projected with weak illumination and thus not incur the risk of rapidly cracking under excessive heat ; soft, in order that detail may be picked out in the shaded as well as in the strongly illumined parts of the picture. If the printers are not specialists in scientific films, their attention must be drawn to all these points. The positives must always be kept closed in special tins, so that they do not dry up and crack.

D) Utilisation of the film.

The photography of our subject is but part of the work and must be supplemented by the analysis of the cycle of operations by the organising expert. In order to use the film for this purpose, four different methods may be employed :

1° Projection of a normal number of photograms ;

2° projection of separate photograms ;

3° curves indicating the successive movements ;

4° direct observation of the film.

If we project the film in the normal way, the movements photographed will be reproduced at their actual speed. This will furnish us with the same details we see by direct observation with the eye, with the added advantage, however that on the screen we can repeat whatever movements interest us as often as we like, whereas in actual fact a workman would find it impossible to repeat a succession of movements in an absolutely identical manner. Thus the cinema offers an advantage which no other means could furnish.

Nevertheless, the details of a workman's movements are of especial importance and these necessitate a projection of photograms one by one.

For this purpose a small camera is used with moderate luminosity. By means of a handle attached to the cylinder, the camera can be so regulated that each turn of the handle brings the next photogram. If the handle is turned quickly or in jerks, we get the impression of a very slow movement, comparable to that derived from the slow-motion process. The projection of the movements by jerks is not a disadvantage, since it really brings out the caracteristics of such movements and helps to determine the duration of the fundamental movements we shall shortly be describing.

Certain investigations of the time-observer require a bird's eye view of the whole

succession of movements. This is obtained by graphs, the films being projected picture by picture upon a sheet of paper pinned to a drawing-board and the important positions (finger, wrist, shoulder, head, etc) being marked by dots. These dots are then joined by lines which together make up the desired graphs. In order to distinguish clearly the different curves, it will be well to use different-coloured pencils and to join up the successive dots by lines as we go along ; otherwise the intersection of lines and the complicated execution of a movement may make it difficult to draw an accurate curve at the end. By this method the experienced observer will be able to obtain a graph of any movement that interests him and the results are more satisfactory than those furnished by the photography of parts of the body the movements of which are shown by small electric lamps.

As regards direct observation of the film — the fourth method of utilisation to which we referred above — this can be made either with the naked eye or through a magnifying glass.

The advantage of this method is that the succession of pictures can be regulated by hand and one photogram can be compared with another. Certain secondary characteristics of movements can sometimes best be observed by this means, while it is also a convenience to be able to make our study seated comfortably at a table in a well-lit room. In this case, however, it is essential that the photograms should be numbered, so that the observer may at any moment note the order in which movements follow each other and calculate their duration. If films are to be observed directly, it is not expedient to place a clock within the photograph, since it will either take up too much space or, if small, require a very strong magnifying-glass to read it.

Fundamental movements.

We may now pass on to the examination of « fundamental movements », which are the smallest elements in a movement initiated by an effort of the will.

According to a system which is now preferred by the experts in scientific management, fundamental movements are divided into the seven following groups:

1° *Observation*; which includes all fundamental movements denoting the imparting of a sensation ;

2° *Grasping*, comprising the fundamental movements which establish junction or separation between a part of the body and an object ;

3° *Movements in space*, i. e. movements of a part of the body which are not directly connected with the object ;

4° *Displacement*, movements of the body in direct connection with the movement of an object or which result in such movement ;

5° *Rest*, signifying the absence of any movement relating to the work ;

6° *Change of position*, which groups together all movements which determine a fresh position of the body ;

7° *Handling of tools* — movements necessary to the manipulation of tools or the handling of machine-tools.

As a rule, every fundamental movement can without any difficulty be classified in one or other of the above groups, but only an expert can say to which category certain of several similar characteristics movements should belong.

NORMAL TIMES OF FUNDAMENTAL MOVEMENTS.

N°	Group.	N°	Fundamental Movement	Symbol	Average Time
1	Observation	1	1. Visual	OE	3
		2	2. Balance	OB	15
		3	3. Auditive	OA	1
		4	4. Olfactory	OO	4
		5	5. Taste (palate)	OP	8
		6	6. Tactile	OT	
2	Grasping	7	1. Act of seizure	GS	1,5
		8	2. » » letting go	GL	1
		9	3. » » regrasping	GR	5
3	Movements in space	10	1. Towards object of work . . .	ST	3
		11	2. Waiting	SW	x
		12	3. Away from object ot work . . .	SZ	3
4	Displacement . . .	13	1. Lifting	DL	3
		14	2. Rotating	DR	3
		15	3. Inserting	DI	7
		16	4. Towards place of work	DH	3
		17	5. Depositing	DD	3
		18	6. Lowering	DLO	3
		19	7. Pushing	DP	10
		20	8. Throwing	DTH	1
		21	9. Away from place of work . . .	DZ	3
5	Rest	22	1. Thinking (seeking)	RT	15
		23	2. Recreation	RR	x
		24	3. Holding	RH	x
		25	4. Pause before changing direction of movement	RC	1
		26	5. Waiting period	RW	x
6	Change of position	27	1. Standing up (from sitting posture)	PS	10
		28	2. Bending (90°)	PB	10
		29	3. Turning	PT	15
		30	4. Walking	PW	10
		31	5. Lying down	PL	100
		32	6. Sitting down	PSI	10
7	Handling of tools	33	1. Boring and drilling	TB	2
		34	2. Pushing or pulling	TP	x
		35	3. Guiding	TG	10
		36	4. Digging	TD	4
		37	5. Filing or planing	TF	7
		38	6. Turning a handle	TH	6
		39	7. Swinging	TS	3
		40	8. Pincer action	TPI	7
		41	9. Rotation	TR	3
		42	10. Striking	TST	1
		43	11. Pressing	TPR	10
		44	12. Vibration	TV	0,5

In the table opposite each group has been subdivided into fundamental movements of its kind and each of these is given a symbol — ordinarily the initial letter of the group and of the individual movement. Thus Observation by the Eye is indicated by the symbol OE, which tells the expert what the movement is. These symbols are very useful in direct observation of the film, since tables of successive times can be compiled which are thus perfectly differentiated.

Alongside the column of symbols the table also gives the average duration of the movement.

Having thus distinguished and catalogued our movements, we will now give a wider, although a succinct, definition of the fundamental movements which constitute the technical basis of the study of the times of each such movement. The figures are expressed in hundredths of a minute; for some movements the figures are replaced by x, which signifies that their duration depends upon the machine by which the workman executes the movement or other concomitant movements.

DETAIL OF FIRST GROUP OF MOVEMENTS.

O — *Observation.*

Activity of the senses. No account need be taken of these movements if they coincide with other movements which are watched and are of a pre-established duration.

1. OE — *Visual observation.*

Beginning : when preceded by another movement — the conclusion of the previous movement. When preceded by a period of rest — the direction of the look towards the object of observation.

End: if followed by another movement, the end of the movement of observation coincides with the beginning of the following movement ; if followed by a moment of rest, the end of the movement of observation coincides with the instant at which the look is removed from the object of observation.

This fundamental movement may be sub-divided as follows :

a) observation with the minimum exactitude necessary to discern a large object (OEa).

b) observation with limited exactitude necessary to discern a small object (OEb) ;

c) observation with medium exactitude necessary to read normal characters (OEc) ;

d) Observation with great exactitude necessary to read very small characters (OEd) ;

2° OB — *Balancing observation.*

Observation necessary to maintain the body in the proper position during work, e. g. in piloting an aircraft or steering a bicycle.

The beginning of this movement coincides with the first change in the position

abandoned and ends with the commencement of the first movements made to retain the new position.

No further sub-divisions of this movement are needed in practice.

3° OA — *Auditive observation.*

Beginning coincides with first direction of attention towards listening (tense expression of face, turning of head towards origin of sound).

End coincides with disappearance of every sign of attention to the act of listening.

This movement may be sub-divided as follows : Observation with the minimum attention necessary to hear a loud bell (OAa).

Observation with medium attention necessary to hear a perceptible noise without effort (such as the knocking of an engine or loose parts of machinery (OAb)

Observation with very close attention necessary to detect distant sounds or to distinguish slight differences of sound (OAc).

4° OO — *Olfactory observation.*

Beginning with the direction of the attention towards the perception of a smell and ending with the disappearance of every sign of such attention. The following distinctions may be made :

a) perception with minimum attention necessary to notice a strong smell(OOa)

b) perception with the attention necessary to detect a faint smell (OOb)

c) perception with the keenest attention in order to compare two different smells (OOc).

5° OP — *Observation by the palate.*

Begins with first contact of tongue with object to be tasted and ends on completion of all contact of tongue with object. As regards liquids, the end coincides either with swallowing or expectoration.

Sub-divisions :

a) tasting of an easily recognizable savour (OPa) ;

b) tasting of a savour hard to recognize (OPb) ;

c) distinguishing between two similar savours (wine-tasting, for example) (OPc)

6° OT — *Tactile observation.*

Beginning coincides with first contact between skin and object and ends with cessation of that contact.

Special distinctions :

a) observation by touching very rough surfaces or by the perception of marked differences of temperature (OTa) ;

b) Observation of slightly uneven surfaces or small differences of temperature (OTb).

c) Observation of very slight irregularities of surface or very small differences of temperature (OTc) ;

DETAIL OF SECOND GROUP OF MOVEMENTS

G — *Grasping.*

Fundamental movements which determine the seizure or release of an object.

1° GS — *Act of seizure.*

Begins with first contact of hand with object. The end of the movement varies according as the object changes its place or remains where it is ; in the former case, end coincides with beginning of succeeding movements ; in the latter case, with the complete removal of hand from the object.

Distinctions can be made according as the object seized is a large object easy to take hold of, a small object not so easily grasped or a very small object like a needle or pin.

2° GL — *Action of letting go.*

A separate movement which determines the release of an object previously held.

Beginning : if the object changes place — corresponds to end of displacement.

If the object remains in its place, the act of letting go begins at the moment when the area of contact between hand and object starts to grow less.

The end coincides with cessation of all contact between hand and object. Distinctions as for GS.

3° GR — *Action of re-grasping.*

Consists in the release and immediate re-grasping of an object with the same or the other hand. Strictly, GR is not a fundamental movement, but a combination of three fundamentals, the release of the hand from the object, a movement in space and the resumption of contact with the object, but as the movement of re-grasping occurs very frequently during a process of work, it is here regarded as fundamental.

Its beginning coincides with the diminution in the area of contact between hand and object and ends with the cessation of all movement of any part of the body in relation to the object seized. The same distinctions may be made as for GS.

DETAIL OF THIRD GROUP OF MOVEMENTS.

S — *Movements in space.*

Movements not in direct connection with an object.

1° ST — *Movement towards object of work.*

This is a movement towards an object which is to be worked on or towards a tool used in work, and is usually followed by a grasping movement.

Begins : If movement follows release of an object — cessation of all contact

between body and object ; if not preceded by release — first motion towards the object.

Ends : First contact of hand with object.

2° SW — *Movement of waiting.*

A movement without definite purpose, to occupy time. Beginning : if preceded by another movement, end of that movement ; if preceded by a period of rest, first indication of the movement itself.

End : if suceeded by another movement, beginning of following movement ; if succeeded by rest, cessation of all movement.

3° SZ — *Movement of withdrawal.*

Begins : with cessation of contact between workman's hand and object released.
Ends : with completion of movement in the direction taken.

DETAIL OF FOURTH GROUP OF MOVEMENTS.

D — *Displacement.*

Movement of parts of the body directly connected with or resulting in the movement of an object, but not movements concerned with work upon the object.

1° DL — *Displacement by lifting.*

The lifting of an object without affecting the place of work.

Beginning : First sign of lifting movement.

End : Cessation of all sign of lifting.

Distinctions may be made by means of special symbols to denote lifting by the hand, fore-arm or shoulder.

2° DR — *Displacement by rotation.*

Begins with first movement towards imparting a movement of rotation to the object.

Ends with cessation of all sign of rotation.

Here, too, we can distinguish between rotation imparted by hand, fore-arm or shoulder, or between rotation imparted by a small or a great effort.

3° DI — *Displacement by insertion.*

Movement to insert one object in another, e. g. insertion of a bolt in its hole.

This movement begins with the reduction in the speed with which the first object approaches the second. It ends when the area of contact between the workmans hand and the object begins to diminish.

4° DH — Displacement by movement of an object towards place of work.

This movement begins with the first commencement of the transfer of the object in the desired direction and ends with the cessation of all movement in that direction.

5° DD — *Displacement by deposit.*

Movement of placing an object upon its bàsis of support.
Beginning : first contact of object with its support.
End : complete contact between object and support.

6° DLO — *Displacement by lowering.*

Movement of lowering an object, but does not include its transport to or removal from place of work.

Beginning and end of this movement coincide with the beginning and end of the act of lowering.

7° DP — *Displacement by pushing.*

A movement of an object along its basis of support, but not including its transport to and removal from place of work.

Beginning : first pushing movement.
End : cessation of all pushing movement.

8° DTH — *Displacement by throwing.*

Movement of propulsion imparted to an object. Beginning and ending with commencement and completion of propelling movement.

9° DZ — *Displacement away from place of work.*

Movement of an object from the bench to the place where it is deposited. Beginning and end are identical with first elementary movement and final depositing of the object moved.

DETAIL OF FIFTH GROUP OF MOVEMENTS.

R — *Rest.*

Absence of all movement relating to work.

1° RT — *Thinking* (*seeking*).

e. g. reading of a drawing, factory notice, looking for an object, reflection.

Begins : with end of previous movement.
Ends : with beginning of following movement.
Further sub-division can be made in any particular case.

2. RR — *Recreation.*

Recreation includes all moments of rest having no specific reason. Beginning and end coincide with beginning and end of preceding and succeeding movements.

3° RH — *Holding*.

The holding of an *object*.

If preceded by a movement of grasping, the beginning coincides with the end of the grasping movement ; if preceded by a movement of the object, the beginning of the act of *holding* coincides with the end of such movement.

4° RC — *Pause in order to change direction of a movement*.

It begins with the end of a movement in one direction and ends with the beginning of a move in another direction.

5° RW — *Waiting*.

Rest moments determined by the execution of the work. Their beginning and end coincide with the end of the previous and beginning of the subsequent movement.

DETAIL OF SIXTH GROUP OF MOVEMENTS.

P — *Change of position*.

Movements which determine a change in the position of the body.

1° PS — *Standing up*.

Movement of a seated person to a kneeling or standing position. This movement begins with the raising of the body and ends with the completion of the movement of the body into its new position.

This movement may be distinguished according as the body passes from the seated to the stooping or kneeling positions or vice-versa, or from the kneeling to the standing position, or from the recumbent to the standing position.

2° PB — *Bending*.

This movement is characterised by a bending from the hips to an angle of about 90°. The beginning and end coincide with the beginning and end of the displacement of the trunk.

3° PT — *Turning*.

Characterised by a turning of the body on its axis. Beginning and end coincident with beginning and end of displacement of trunk.

4° PW — *Walking*.

The movement of advancing the foot. Begins as the foot is raised and ends when the foot is in complete contact with the ground. Distinction may be made between a short step, a normal step and an exceptionally long step.

5° PL — *Lying down..*

This movement may be regarded as the reverse of PS and consists in changing from a standing to a sitting posture, or from a kneeling to a recumbent position. The beginning and end coincide with the beginning and end of the change in the position of the body. The movement is characterised by passage from kneeling to lying, from stooping to kneeling, from standing to sitting, from standing to kneeling and lastly from standing to lying.

6° PSI — *Sitting down.*

Movement of assuming a sitting posture. Begins and ends with the beginning and end of the displacement of the body with a view to taking up a seated position.

DETAIL OF SEVENTH GROUP OF MOVEMENTS.

T — *Handling of Tools.*

Movements necessary to the use of a tool or machine in the course of executing a specific task. These include also movements preparatory to the execution of work.

The following subdivision is neither so full nor so exact as could be wished and this group of movements is deserving of study by time-study experts, who will make the changes and additions required.

1° TB — *Boring and drilling.*

90°-110° turn of the hand (e. g. in manipulating a screw-driver) Begins with first sign of rotation and ends on completion of rotation.

2° TP — *Pushing or pulling.*

Movement exercising pressure or pull upon an object. Begins with first indication of initial pressure or pulling effort and ends with the cessation of all such effort.

3° TG — *Guiding.*

Moving an object in a desired direction. Begins and ends with beginning and end of the displacement of the tool in the desired direction.

4° TD — *Digging.*

Handling of spade, pick, etc. Begins and ends with the beginning and end of the action of the tool in the direction desired.

5° TF — *Filing or planing.*

Rectilinear movements to and fro for the purpose of guiding tools especially locksmiths' and carpenters' tools. Beginning and end coincide with first indication and end of such displacement.

6° TH — *Turning a handle.*

These movements more especially concern the manipulation of windlasses and similar tools. They begin and end with the first indication and cessation of all rotatory movement.

7° TS — *Swinging.*

Movement of wrist, fore-arm or shoulder to impart a rotary movement to the tool (mason's trowel, sledge-hammer, etc.). Begins and ends with beginning and end of the change in the position of the tool.

8° TPI — *Pincer action.*

Rectilinear movement of the particular tool with simultaneous pressure of palm of the hand to set it in motion. Beginning and end coincide with beginning and end of the particular action of the tool itself.

9° TR — *Rotation.*

Movement of semi-rotation to turn the arm of a lever on its axis Particularly relates to press-levers, shears, etc. Beginning and end are easily discernible by close observation.

10° TST — *Striking.*

Movement of wrist, forearm or shoulder to strike an object with a heavy body Beginning and end of movement coincide with gesture of raising the tool with force and with the end of its fall.

11° TPR — *Pressing.*

Movement characterised by the pressure of a part of the body upon an object. Beginning and end coincide with beginning and complete cessation of the manifestation of effort after contact with the object.

12° TV — *Vibration.*

Rapid and charateristic movements in certain branches of work, such as engraving. Begins and ends with beginning and end of the oscillations of the implement.

SYNTHETIC EXAMPLE OF APPLICATION OF THE CINEMA TO TIME-STUDY.

Once the cycle of operations or part of it has been cinematographed in the factory for the purpose of studying the times of execution, the expert is in possession of the elements required to analyse the process of work in detail and can deduce therefrom the average times to be selected as *normal or standard* times and eliminate or reduc e« passive » times with a view to better organisation and speedier production.

In order to analyse the film, the expert prepares notes on the successive movements, taking separate account of movements of the right hand, left hand, head, trunk, right leg and left leg.

This subdivision wil require modification according to the work that is being done (e. g., a man who is seated at his work will not move his legs, etc.) One column of the sheet will be for the symbol representing the movement, another will record its duration, and another the times of the individual movements, the sum of which will give the total duration of the operation cinematographed.

Once all the details of movements and times are recorded on the observation sheet, the specialist draws his conclusions, proceeds to eliminate unnecessary movements and useless pauses, correct irregular movements and thence calculates what saving of time and material can be effected.

We will illustrate the application of the cinema to time studies by a practical example.

Let us suppose that a film has been shot in a factory showing the assembly of a compressed-air hammer, all the parts of which have been prepared in the factory The work consists in clamping the cylinder in a vice, inserting the piston in the cylinder after first cleaning and greasing it, putting a lid on the cylinder by means of two pins and a ring, assembling the three parts of a valve and fitting it to the upper part of the cylinder, screwing on the handle and making sure that it is fast, adding a safety ring and finally unclamping the hammer from the vice.

In his office the expert will examine the film and draw up his sheet of observations after first summarily subdividing the operations needed in the performance of the work. Times are expressed in thousandths of a minute.

Operations	Times *individual*	Times *cumulative*
Clamping cylinder in vice	70	70
Cleaning piston	50	120
Greasing piston	85	205
Fitting piston into cylinder	62	267
Arranging piston so that its hole is level with the hole in cylinder	149	416
Application of Pin N. 1	71	487
Application of Pin N. 2	70	557

Operations	Times *individual*	Times *cumulative*
Application of intermediary ring	69	626
Assembly of valve	281	907
Fixing of handle	134	1041
Screwing on of handle	175	1216
Making sure it is fast	196	1412
Turning of hammer in vice	105	1517
Application of safety-ring	177	1694
Removal of hammer from vice	63	1757

After this first subdivision the observer will make a note of all the fundamental movements involved in this operation, distinguishing each by its symbol, will mention the part of the body by which the movement was executed, and the operation in the foregoing list to which it referred, and he will add the individual and cumulative times.

He will then proceed to draw his conclusions, grouping in separate tables certain elements which attract his particular attention.

He will tabulate all the fundamental movements of the second group under GS and enumerate them according to their duration, without repeating the symbol each time, as follows :

Left hand		Right hand	
Individual time	*Cumulative time*	*Individual time*	*Cumulative time*
1	1122	1	26
1	1265	1	91
1	1329	1	126
1	1423	1	264
1	1701	1	1289
3	1476	1	1322
4	13	1	1487
4	1627	1	1704
5	81	2	1422
6	1532	3	370
7	570	3	1229
7	920	5	261
8	640	8	940
12	504	12	673
13	436	12	746
—	—	25	1569
—	—	—	—
74	15	77	16
Mean value 74 : 15 = 4.93		Mean value 77 : 16 = 4.8	

If we exclude, in the case of the right hand, the time 1562, the result is 3.46 It will be noticed that the most frequent and the mean values are low, from which it may be gathered that the workman has worked at his maximum speed. The lower values for the right than for the left hand show that the worker is right-handed.

Another group to which the observer's attention is drawn is the group of movements in space, and he compiles the following table :

Movements in space' (3rd group).

Left hand'		Right hand	
Individual times	*Cumulative times*	*Individual times*	*Cumulative times*
5	492	3	653
5	1328	3	1288
6	76	4	445
6	563	5	125
6	632	5	580
6	1121	5	661
6	1700	5	734
7	423	5	1486
7	913	6	25
9	9	6	309
9	1422	6	514
9	1526	6	932
10	1473	7	96
11	1264	7	1321
12	1623	8	213
—	—	8	999
—	—	8	999
—	—	9	1703
—	—	10	1226
—	—	10	1544
—	—	10	1729
—	—	15	283
—	—	19	367
114	15	162	22

Mean value 114 : 15 — 7.6 Mean value 162 : 22 — 7.36

This group suggests the same conclusions as the second group (GS).

A third group of importance is the rest-pauses, catalogued likewise according to their duration. The table obtained is as follows :

SOME RECENT AMERICAN STUDIES OF THE PSYCHOLOGY OF THE WORKER IN ITS RELATION TO SCIENTIFIC MANAGEMENT, SUBMITTED TO THE EIGHTH ANNUAL CONFERENCE OF THE PERSONNEL RESEARCH FEDERATION HELD IN NEW YORK ON NOVEMBER 15-16, 1929.

A notable advance towards the scientific solution of problems of occupational adjustment was strikingly exemplified in the series of papers and addresses presented November 15 and 16 at the Eighth Annual Fall Conference of the Personnel Research Federation in New York. Several of these contributions will appear in the Personnel Journal for February, 1930.

Of outstanding interest to business executives, psychologists and students of industrial relations was a series of papers based upon investigation in progress for the past two and a half years in the Hawthorne works of the Western Electric Company.

The first of these, by Mr. G. A. Pennock, reports an experimental investigation of individual variations of output as related to such variables as mental attitude and physiological conditions, rest periods, length of working day, method of wage payment and character of supervision. Since early in 1927, constant observation and experimentation has been made with a group of five women workers engaged in repetitive assembly work in an effort to determine the answer to such questions as the following :

Are rest periods desirable ?

Is a shorter working day desirable ?

What effect do wrong or right methods of supervision have on a worker's efficiency and morale ?

What are some of the factors that determine an employee's mental attitude ?

A second test group consisting of five mica splitters was also studied.

The method consisted in maintaining all conditions as nearly constant as possible, with introduction from time to time of a single variable, such as a different method of payment ; rest periods ; mid-morning lunches ; shorter or longer working day. Information as to amount of sleep, recreation, home conditions and other outside influences, as well as personal influences within the factory such as relation with supervisor, were secured though informal interview. Pulse rate, blood pressure, blood condition readings, vascular skin reactions and other physical examination data were obtained from time to time. Diet and health practices were recorded.

The most surprising outcome was, the output of this test group tended in general to increase no matter what changes in working conditions were introduced. Fatigue was found not to be a controlling factor. Amount of sleep had a slight but significant effect on individual performance. Total daily output was increased by rest

SOME RECENT AMERICAN STUDIES OF THE PSYCHOLOGY OF THE WORKER IN ITS RELATION TO SCIENTIFIC MANAGEMENT, SUBMITTED TO THE EIGHTH ANNUAL CONFERENCE OF THE PERSONNEL RESEARCH FEDERATION HELD IN NEW YORK ON NOVEMBER 15-16, 1929.

A notable advance towards the scientific solution of problems of occupational adjustment was strikingly exemplified in the series of papers and addresses presented November 15 and 16 at the Eighth Annual Fall Conference of the Personnel Research Federation in New York. Several of these contributions will appear in the Personnel Journal for February, 1930.

Of outstanding interest to business executives, psychologists and students of industrial relations was a series of papers based upon investigation in progress for the past two and a half years in the Hawthorne works of the Western Electric Company.

The first of these, by Mr. G. A. Pennock, reports an experimental investigation of individual variations of output as related to such variables as mental attitude and physiological conditions, rest periods, length of working day, method of wage payment and character of supervision. Since early in 1927, constant observation and experimentation has been made with a group of five women workers engaged in repetitive assembly work in an effort to determine the answer to such questions as the following:

Are rest periods desirable?

Is a shorter working day desirable?

What effect do wrong or right methods of supervision have on a worker's efficiency and morale?

What are some of the factors that determine an employee's mental attitude?

A second test group consisting of five mica splitters was also studied.

The method consisted in maintaining all conditions as nearly constant as possible, with introduction from time to time of a single variable, such as a different method of payment; rest periods; mid-morning lunches; shorter or longer working day. Information as to amount of sleep, recreation, home conditions and other outside influences, as well as personal influences within the factory such as relation with supervisor, were secured though informal interview. Pulse rate, blood pressure, blood condition readings, vascular skin reactions and other physical examination data were obtained from time to time. Diet and health practices were recorded.

The most surprising outcome was, the output of this test group tended in general to increase no matter what changes in working conditions were introduced. Fatigue was found not to be a controlling factor. Amount of sleep had a slight but significant effect on individual performance. Total daily output was increased by rest

periods. Home conditions and other outside influences tended to create either a buoyant or a depressed spirit which modified production. Emotional status was reflected in performance ; and the major component of this emotional condition was attitude toward supervision. The inference from these studies was inescapable that the dominant factor in the performance of these workers is their mental attitude.

Consideration of the sensitiveness of the operators to the way in which they are treated led to studies of emotional status and attitudes of other workers. All operators in the inspection organization were interviewed, to secure a picture of their problems, worries, likes and dislikes, in relation to working conditions and supervision. This program is spreading to other departments, and is greatly modifying supervisory training procedures. Rest periods have also been introduced into several operation departments, affecting 5,000 employees, with indications of increases of production paralleling somewhat those of the test group.

The results of these studies have been rather startling, and are deemed of such importance that a larger program of employee relations research has been launched. The present as well as the future findings of these experimental studies will undoubtedly form a valuable contribution to the science and art of human management.

Such scientific study of human behavior in an industrial environment has its difficulties. Emotions and personal reactions are less readily subject to experimental control than are microbes and molecules. The apparent difficulty of bringing this field of exploration clearly within the range of laboratory methods has retarded the growth of exact knowledge. Yet some such approach is indispensable if there is to be a science of industrial relations. The Hawthorne studies illustrate the search for experimental methods adequate to this complicated task. They have been perhaps unexpectedly rewarding in their practical outcome. Indeed, the by-products of this research far outweighed the direct returns, which were, nevertheless, considerable.

One of these practically significant off-shoots of the original investigation is « A Plan for Improving Employee Relations on the Basis of Data Obtained from Employees ». This plan, described by Mr. M. L. Putnam, begins with the training of selected workers to interview other workers, thus enabling the employees readily to communicate to the management whatever they may want to say. Information is then obtained as to what the workers like or dislike about their conditions of work and their personal relations. This information, disguised to preserve anonymity, supplies concrete material for discussion in bi-weekly conferences of supervisors. It is also used in improving working conditions. The vitality which this procedure has brought into the supervisory training program is reflected in the workers' response to the greater personal interest and consideration they are receiving.

The significance of the newer ideals of control illustrated in these Western Electric investigations, was vividly presented by Professor Elton Mayo in a paper on « Changing Methods in Industry ».

Professor John Dewey, speaking on « Psychology and Work », gave the emphasis of his ripe wisdom to the value, both industrial and social, of securing for the worker, as the Western Electric plan does, personal recognition, with opportunity to

realise that he individually counts in the enterprise, and that the way is open for him to make his intellectual as well as manual contribution to its success.

« Fatigue, Morale and Output » was the theme of an address by Mr. Stuart Chase, student of the machine age and of its effects, good and bad, on men.

Ways of anticipating, in advance of training, the likelihood of a young man's success in an occupation were illustrated by Dr. Don S. Taylor, in his report of progress on a three-year investigation of « Abilities of Young Printers ». The first stage of this research was described in the Personnel Journal for June 1929.

« What Preachers Do : A Time Analysis of Activities of Ministers and Church Staffs », by Dr. H. Paul Douglass, of the Institute of Social and Religious Research, illustrated the extension of techniques of occupational study into professional fields and furnished a basis for conclusions regarding organization of work as well as selection and training of personnel to do it.

Mr. Owen E. Pence and Dr. Lester W. Bartlett described three years of notable progress of The Young Men's Christian Association five-year program of personnel research. This extensive and thoroughly fundamental cooperative inquiry was outlined in its many aspects. Special emphasis was placed on the methods used in the studies of the selection and training of Physical Directors and of YMCA Secretaries, recently published by the University of Chicago Press.

The New York State Industrial Commissioner, Miss Frances Perkins, spoke brilliantly on « Government's Part in Solving Modern Work Problems ». Government has three chief duties : to enforce minimum standards of decency in the treatment of men and women in industry ; to furnish a soil favorable to the development of experiments and inventions of better techniques in all matters having to do with the improvement of human relationship to industrial life ; and to serve as an educational influence, to spread among all employers the knowledge of these better techniques that cut down costs of production and improve conditions for the workers. Some problems at present calling for research are, how best to train employees in safe work habits ; how to make industrial life for individuals an educational experience ; how to remove the fear of old-age dependency through insurance and pension plans without at the same time hampering older workers in search of employment ; and how to determine optimum length of working day in different industries.

These are some of the points in which the cinematograph, whether used as a means of propaganda or as an instrument of research and demonstration, may prove of the greatest assistance.

V. W. Bingham.

THE CINEMA AND THE STUDY OF FATIGUE

(*From the Italian*)

If the educational function of the cinematograph and of luminous projections in general is restricted exclusively to the reproduction of movements, places, objects or acts, we must frankly admit that the study of fatigue considered by itself does not come within the scope of this purpose. Although the problem is essentially part of scientific management (the aim of which is to rationalise work with a view to increasing total and individual output and to avoiding all waste of human effort), it is very difficult to reproduce in material form the elements of which fatigue is in the last analysis composed.

Essentially, fatigue is a disease or rather a pathological condition which is not only unaccompanied by any definite symptoms or obvious and constant anatomical features, but which only rarely assumes visible forms. Consequently, it has no characteristics which can be readily transferred to the screen. A diminution in the functional powers of the organs of movement, an altered heart-beat or breathing and, occasionally, facial expression are the only outward and visible signs of fatigue. This is not very much to offer to a public desirous of ascertaining its nosology, nature and effects.

On the other hand, manifestations of effort, which is frequently one of the causative agents of fatigue, and which the layman even confuses with it, lend themselves much better to cinematographic reproduction. Effort, as we all know, has often been represented by painters and sculptors, for the reason that, whether dynamic or static, it takes the forms of exceedingly characteristic attitudes of the human body, visible muscular contractions and expansions, significant facial expression which is easily reproduced. Moreover, it is nearly always associated with the accomplishment of acts or movements, which are essentially subjects for the cinema. As regards a detailed study of the various elements which constitute fatigue and especially a study of its causes and effects and of its association with movements relevant to the teaching of working technique and scientific management, we find several points which lend themselves to visual instruction and therefore to illustration by pictures, whether stationary or moving. Here, however, the idea of fatigue is more or less subsidiary to the methods of revealing its existence ; the many elements of which it is composed furnish such a bewildering variety of material for the film that it is impossible to establish a series of pictures sufficiently coordinated to be intelligible without oral explanations. The film will nearly always have to serve therefore to illustrate some lecture or lesson. In this capacity, however, it is an almost indispensable aid, since not only can it depict significant gestures and movements, but it can repeat them as often as is desired and thus create conditions particularly favourable to scientific research and experiment.

From this point of view, pictures both fixed and moving can be usefully em-

ployed to explain and illustrate phenomena peculiar to the study of fatigue, which we may place under the three following headings :

a) diagnosis ;

b) pathological manifestations ;

c) hygiene or prevention.

Scenes which would seen particularly adapted for screen projection are the following.

1. *Methods of investigation to discover or measure fatigue.*

a) Comparative ergographical curves of different individuals, and curves of the same individual before and after work, before and after meals, in a cold and a warm atmosphere, etc ;

b) dynamometry and dynamography, ditto, ditto ;

c) frequency and rhythm of the breathing before and after expenditure of effort, or before and after work which is fatiguing by reason either of intensity or duration ;

d) frequency, rhythm and pressure of pulse, ditto, ditto ;

e) graph of effort spent on work of varying degrees of difficulty ;

f) measurement of time reactions (tactile, visual, auditive) ;

g) examination of defects in execution of certain standard tasks (reading, writing, etc.) ;

h) examination of reflex action of tendons and muscles ;

i) measurement of organic consumption by analysis of air exhaled ;

j) taking of temperature before and after work.

2. *Pathological manifestations of fatigue.*

a) Muscular weakness after heavy work (shown by inability to lift a certain weight, by a dragging gait, etc.) ;

b) unsteadiness in the execution of certain delicate tasks and in the hand-writing (graphic projections) ;

c) occupational cramp ;

d) diminished output ;

e) position and attitudes of lively and of tired animals, or of animals inoculated with the blood or urine of a tired animal.

3. *Means of preventing, or removing fatigue.*

In my opinion this chapter is better suited than the others for visual and hence cinematographic representation, since the prophylaxis of fatigue offers a much wider field of action than it is possible to fix for diagnostic research or pathological manifestations.

Fatigue can be prevented by: *a*) improving the conditions of the physical environment ; *b*) studying the duration and rhythm of work ; *c*) diminishing the effort. Obviously, the third of these methods is the most easily illustrated by *visual* means.

The rooms or plant upon which conditions of wellbeing (and consequently conditions conducive of fatigue) are dependent can be shown in relation to cubic air space, lighting, ventilation, heating, inhalation of dust and gases, cleanliness ; interesting pictures can be shown of rest-rooms, refectories, shower-baths, wash houses, changing-rooms, etc.

It will, however, in every case be difficult to show the relation between these different factors and fatigue by visual means alone, and without the aid of oral explanations.

Similarly, it would, I think, be useless to attempt to show visually the relation between fatigue and the duration and rhythm of work.

On the other hand, the translation into moving pictures of the methods suggested by scientific management to reduce effort offers boundless possibilities.

This aspect of prophylaxis is of especial importance. Its aim, namely to avoid fatigue, is to a large extent identical with that of scientific management itself (i. e. the rationalisation of the material elements in production) and with that of developing the output capacity of the human worker. The attainment of this purpose presupposes a knowledge of the methods of work most economical from the point of view of the human organism. For this reason vocational instruction, which seeks to increase the productive capacity of workers is bound to take into account the conservation of human energy.

Implementation — that is, the preparation of the best means of executing work — and the study of the positions and movements of the body which physiology shows to be the most economical from the point of view of energy consumption, are in our opinion inexhaustible sources of cinematographic inspiration.

As regards the former, the influence upon fatigue of what may be called generally « plant » conditions is apparent in many trades. These conditions include :

1° The quality of raw materials and methods of treating them ;

2° the properties of working tools (dimensions, weight, hardness, convenience in handling, etc.) ;

3° use of machinery and of mechanical means of transporting materials ;

4° arrangement of premises and installation of the different workshops;

5° height of bench, work done standing or seated, form of seat, position of light, etc.

The study and subsequent teaching of the movements best designed to obtain a maximum quantitative and qualitative output in the shortest time and with least fatigue is an even richer field for cinematographic experimentation, covering, as it does, movements and attitudes of the body and the various shapes and positions of objects to be handled.

Thus a wide variety of film pictures could illustrate :

a) Methods of walking, of carrying loads in the hand or on the back, drawing or pushing them, or carrying them on wheeled vehicles.

b) methods of erecting scaffolding, ladders ; of arranging pullies and cords ; of raising and lowering, of employing hoisting apparatus, etc. ;

c) methods of filing, planing, hammering, cutting, crushing, etc.

In short, any work necessitating muscular exertion affords abundant material for studying working technique and the method of performing that work with the minimum of effort. Sedentary work, such as writing, typing, printing, etc., is also adapted for cinematographic demonstration. Although offering little material for the study of movement, it can teach us much regarding the best positions to be adopted in order to avoid fatigue.

In both cases the problem is identical with that of teaching the best technique for the different processes and it therefore applies to any and every kind of work.

G. Loriga.

WORK AND FATIGUE

(*From the Italian*)

NOTE : *The author does not claim to have written a scenario ; he is simply offering the outline of such a scenario or rather is indicating certain scenes which might illustrate on the screen the main physiological data of work and fatigue. If this outline meets with approval, he will be pleased to develop it and describe the different scenes in detail.*

PART I.

THE PHYSIOLOGICAL LAWS OF WORK.

SCENE 1.

Degree of resistance to work varies with each individual.

a) A railway station. Arrival of a train. Two porters each take in each hand a suit-case of the same size and weight (e. g. 30 kgs) or two small boxes with handles and proceed in the same direction. Arriving at a certain point, one places his load on the ground to recover his breath, while the other continues his way.

The former takes up his cases, proceeds another hundred yards or so and is then obliged to put them down again. The other goes on without stopping until he reaches a house at the end of the street.

b) Five or six men of the same age wearing sports vests and each with a number on his chest are running along a track.

Their order is noted at the end of the first lap. 5 or 10 minutes later the order is registered in which they complete the second lap. The classication for the first lap indicates the order of runners according to their *effort capacity*, that for the second lap the order according to *resistance capacity*.

In all probability the man who finished the first lap first and who thus showed the greatest capacity for effort, will show less resistance capacity than another and will come in second or third at the end of the race.

c) Shows on Treves' ergograph (better than Mosso's) two curves of work by two men of the same age and apparently equal strength. If their degrees of resistance are different (they must be selected before the test), we shall get two different curves very like those known as the Aducco and Maggiora curves. In other words, the line of one will be high and even for some minutes and then slowly fall, while the other's will fall more quickly, if not quite suddenly.

These curves can easily be shown on the screen magnified.

If desired a third person can be selected with a curve similar to that of Patrizi, that is, a curve falling more quickly then the Aducco, but less quickly than the Maggiora curve.

Scene 2.

A) Resistance to work increases with training.

A man mounts the Amar ergographical cycle. After a time (an hour or two) a reading is taken of the number of revolutions. As soon as the man dismounts he is tested with Patrizi's teleoptical sphymoscope (which shows pulsations by an electric lamp which goes on and off) and with the same author's pneumoarythmoscope (registering number of breaths).

The test is repeated the next day and the day after ; the same readings are taken and it is found that (1) the number of cycle revolutions per hour has gradually increased from the first to the third day ; (2) the number of pulsations and breaths has diminished. Accordingly, as the man gets into training, he does more work with less fatigue.

B) *Resumption of daily work is preceded by a few moments of training.*

Show several complete curves of work, announcing that they have been obtained from measurements taken in workshops of different kinds each hour for four consecutive hours. We may take as types of workshop :

1° An office for copying on the type-writer (number of lines copied per hour) ;

2° a button factory (number of dozens or gross of buttons manufactured per hour) ;

3° a cigarette factory (number of cigarettes made or packed per hour).

Show *a*) that the production for the first hour, and especially first half-hour, is below that of second and third, because during the first hour or half-hour the organism is « getting into its stride » ; *b*) that after the third hour output rapidly decreases as the result of fatigue.

Scene 3.

Effort fatigues more than work. Or rather, fatigue increases proportionately to effort expended.

a) Two men meet on a road at the bottom of a long hill. One is carrying a knapsack ; the other is free. They walk on together, but after a time the man with the bag on his back begins to fall behind, then stops, puts down his knapsack, sits down and wipes the perspiration from his face. The other man goes on walking and we see him plodding steadily on, while the man with the bag is still resting.

b) Two men are carrying bags of flour from one floor to another ; the first carries bags of 100 kgs, the second bags of 50 kgs ; both are loaded by other men or take their bags direct from two lorries. After twenty journeys, both have to to take bags of 50 kgs from the ground and hoist them on to their own shoulders to carry them upstairs. The man who has been carrying bags of 50 kgs. can manage this ; the other can't, being more tired than his mate.

Scene 4.

A rapid rhythm fatigues more quickly.

a) Two men are each pushing a hand-cart of identical weight and shape up an incline. One of them starts at a quick pace and gets far ahead of the other, but then slows down and at last stops in a stream of perspiration. The other, who has been going along at a steady rate, catches up his mate, passes him without stopping and we see him in the distance quietly pushing his cart while the other is still resting.

b) A dynamometer measures the strength of two men five or ten times in succession. They are then taken to a running-track, where one runs, the other walks. After half-an-hour their strength is again measured five or ten times by the dynamometer and the first is found to have lost more strength than the second.

Scene 5.

Work done without breaks fatigues more quickly and is less efficient.

a) A workman is is told to cut up small planks to make boxes. He works uninterruptedly. After three hours, he can do no more, stops and sits down. An inspector comes in and tells him to get on with his work. The man, who is exhausted, refuses. The planks are counted ; he has cut up ten.

b) The next day the inspector gives him the same work, but tells him to take five minutes rest after every half-hour of work. He comes back after three hours and finds the man still working with zest. He checks the work and notes that the output is larger than that of the day before.

Scene 6.

Airlessness, and excessive heat and cold accelerate fatigue.

We are shown a blacksmith's forge. The forge is lit.. Two workmen are hammering a piece of red-hot iron with alternate blows. After a while they stop out of breath and remove coat and waistcoat. Then they start again. They stop a second time, however, sit down and mop their brows. At last, one gets up and opens all the windows. After a moment's rest, they resume work.

PART II.

Some manifestations of fatigue.

Scene 1.

Fatigue reduces muscular strength.

The muscular strength of two men is measured by a dynamometer or dynamograph, or else the curve of work is taken by means of the Treves ergograph. The

men are then sent to saw tree-trunks with orders to return after three hours. The same measurements are then repeated and show how muscular strength has diminished (contracting force) With the use of the ergograph we can also show the loss of resisting force, which is indicated by the rapid fall of the curve.

Scene 2.

Muscular strength of men diminishes even in respect of muscles not employed on the work.

The right hands of four soldiers are measured dynamometrically before a march (here, too, the Treves ergograph can be used). On their return the same measurements are taken, and the figures (or graphs) will record a loss of strength in the arms as well as in the legs.

Scene 3.

Mental work also impairs muscular strength.

Measurements are taken as above of three or four secondary schoolboys, before and after a class, and we observe the differences.

Scene 4.

Fatigue also causes muscular incoordination (unsteadiness).

a) Make a number of men sign their names before and after performing heavy manual work (e. g. breaking stones with a hammer, sawing wood, carrying heavy weights in the hand, etc.).

b) The subject of the test holds in his hand a long rod with the end of which he has to follow a complicated and twisted groove in a board. The edges of the groove are of metal and connected with an electric lamp. At each contact of the pointer with the edge of the groove, the lamp is lit, carry out this experiment before and after heavy manual work and count how many times the lamp is lit.

Scene 5.

Fatigue leads to loss of attention and thus causes many mistakes.

At 8 a. m. two youths (a student and a workman) are given a printed text; they are told to count the letters or one single letter (the s's, for instance) within a certain time (two or three minutes). Then they are sent, one to school and the other to the workshop, and are asked to return at midday. The experiment is then repeated. A note is taken of the number of mistakes made and the time taken before and after physical or mental work.

Scene 6.

Fatigue disturbs the psycho-muscular reactions; in other words, reaction is slower.

We see a workman at 8 a. m. before he goes to work. He is told to carry out ten tests by the stopping of the lancet of the Arsonval chronoscope. Note is made of positive and negative values round N. 100. The operation is repeated at midday and the differences shown.

Scene 7.

Fatigue poisons the blood.

We are shown two rabbits, equally strong and vigorous. One is made to run for a certain time in a revolving wheel. It is taken out when it drops from fatigue. It is found to be shaking and exhausted ; it can't stand up and its fur is all ruffled. A few drops of blood are taken from the auricular vein with a syringe and injected into the same vein of another rabbit. After a few minutes the latter also collapses in a state of prostration, and lies inert with ruffled fur.

PART III.

How to avoid the ill-effects of fatigue.

Scene 1.

Choose the trade best suited to your strength and aptitudes. Go to a psychotechnical institute and have your capacity tested.

A picture is shown of which the foreground is a waiting-room and the background a psycho-technical laboratory, with the door wide open. In the waiting-room is a group of young men and in the other room doctors are subjecting other young men to various tests. From time to time, a youth comes out from the inner room and another is told to enter. At the conclusion of the examination the doctor comes out and nails up on the wall the following table of classification :

Healthy : Nos. 1, 10, 19, 20.
Healthy and robust : Nos. 3, 7, 8, 18.
Healthy and nimble : Nos. 5, 6, 15.
Healthy but soft : Nos 2, 4, 12, 14.
Healthy, but delicate : Nos. 9, 11, 13, 17.
Weak : Nos 14, 16.
Normal senses (hearing and sight) : Nos. 10, 7, 19, 20, 3, 6, 4, 11, 12, 15, 9, 13, 17.
Senses affected (hearing or sight) : Nos. 1, 16, 8, 18, 5, 2, 14.

The young men take note of the references to themselves :

b) They are then seen consulting tables on another wall indicating :

1° Muscular work suited to the healthy and robust type : porters, wood-cutters, agricultural labourers, pit-sawyers, etc. ;

2° Work demanding endurance suited to the healthy and healthy-soft types : locksmiths, carpenters, masons, saddlers, postmen and itinerant trades in general, etc. ;

3° Work demanding agility suited to the nimble type : engine-drivers, chauffeurs, motor-boat chauffeurs, etc.

4° Work not requiring any great strength and sedentary work, suited to the healthy but delicate type : barbers, domestic servants, shop assistants, etc.

5° Work demanding keen sight ; watch-making, precision instrument making, driving of engines and rapid vehicles.

Note. It is of course easy to draw up further tables and many other groups of capacities, while the list of trades and professions can be extended indefinitely

Scene 2.

Don't over-exert yourself, especially if you have to repeat the effort many times in succession.

Two rows of trucks which two workmen have to load with blocks of stone or metal weighing about 15 kgs. They approach the truck by an inclined way. The first man carries his blocks one by one ; at first, his mate does the same, but soon tries to carry two together. While the first workman continues steadily at his job, the second begins to wait longer between his separate journeys to and fro, then sits down exhausted and out of breath and mops his face.

(By way of variation, the first workman can be shown from the beginning carrying his blocks one by one, the other two at a time).

The first man takes 10 minutes to load his first truck, the second man only 6 minutes; the former also takes 10 minutes to load his second truck, the other takes 8. But whereas the first man still requires 10 minutes to load his third and fourth trucks, the second takes 12 and 15 minutes respectively.

Scene 3.

Always find out whether there are tools or other means by which you may economise effort.

a) A porter is carrying in his hands two heavy and bulky portmanteaux which hamper his movement. He stops, puts one portmanteau on his shoulder and proceeds with the other in his hand. He still finds it difficult to walk. He stops again, removes his belt, attaches the ends to the handle of each portmanteau and passes the belt over his shoulder so that one portmanteau is across his chest, the other on his back. He now finds it easier to walk, but is still not satisfied. He

reaches a shed goes in and comes out again with a hand-cart, upon which he places both portmanteaux. This time he appears perfectly content and goes quickly on his way.

b) A workman has to pull a heavy box of bricks by a rope up to the first floor of a house that is being built. The work is heavy but the man notices a small windlass not far off; he fixes the end of the rope to the windlass and goes on with his work, pleased at his inventiveness.

c) A man is standing in front of a low table making cardboard boxes. Every now and then he shows obvious signs of fatigue; we can see that his back is aching and he sits down on the table to rest. Finally, he goes in to an adjoining room and brings back a chair in which he seats himself with visible satisfaction before going on with his work.

N. B. Many other examples of this kind could be given.

Scene 4.

Do not adopt too quick a rhythm of work.

a) A man is working the Treves ergograph furnished with a weight of 10 kgs. A metronome marks the contractions of the arm and a chymograph records them. The graph is withdrawn when the curve begins to fall and is shown magnified on the screen with the time occupied.

b) The experiment is repeated, the rate of contraction of the arm being doubled. The new line will show a more rapidly falling curve, and a speedier consumption of strength.

Scene 5.

Learn how to combine speed with effort so as to be able to work several hours at a stretch without undue fatigue.

a) The experiment with the Treves ergograph weighted with 10 kgs., is repeated. Rate of arm contraction : 1 per second. After a few moments, it is noted that the arm can only register 45 contractions a minute. The weight is then reduced to 6 kgs. and the movements of the arm maintain the rhythm of the metronome (60 beats a minute) without any sign of fatigue

b) A workman is putting little nails into a beam with a small hammer which he applies by a series of rapid blows. He is then given larger nails. He selects a heavier hammer and tries to keep up the same rhythm, but stops after a moment, is dissatisfied and decides to reduce the rate of his blows. A third time, still larger nails are brought and this time he does not hesitate, chooses a still heavier hammer, but strikes the nails at a slower rate.

c) A workman is shovelling earth or gravel on to a tip-cart. It takes him twenty minutes to fill the cart. An inspector comes along and hands him a larger spade. The workman resumes the job, but has to reduce his rate of shovelling, with the result that he takes just as long to load the cart.

Scene 6.

Break off work for frequent short pauses so as to produce more with less fatigue.

a) Two companies of soldiers have to march from a place A to a place B (10 km. distant). The first company commander makes the men march without any stops ; the second orders a three minutes rest after every kilometer. On arriving at B., the men of the first company are seen lying tired out on their bunks while the men of the second company leave barracks fresh and spruce, mingle with the local population and are seen dancing with girls of the village.

a) A typist arrives at her office in the morning and begins to type without interruption. After three hours she counts the pages — *ten*. She goes out to lunch, comes back and starts again. Every half-hour she gets up, goes to the window and walks up and down for about five minutes. After three hours, she counts her pages and finds that she has copied *twelve*.

Scene 7.

Dont work in an enclosed and badly ventilated room, but keep out draughts and avoid excessive heat or cold, dust and gases

a) An office showing a number of employees at work. The windows are shut. After a minute or so, one of the employees yawns, another stretches himself, a third leans his head on his hands as if he felt ill, while another fans himself with papers. One after the other they cease working and all look tired. At last one of them rises and opens the window. They all show obvious signs of satisfaction and resume their work.

b) A school class. The teacher starts the lesson. After a few minutes, the pupils begin to become inattentive, they tuck their hands under the arms and cease to listen. The teacher notices this and asks what is the matter. They are cold. The teacher then turns on the radiator and tells the boys they may get up and move about. Shortly afterwards, the lessons is resumed, the class following attentively

c) A large dressmaker's workroom lit by a big glass window. The girls are at work and the sun pours in by the window to their visible discomfort. One gets up and draws the blind.

d) A master locksmith is employing a new man and takes him into his workshop, a dark and grimy room, half underground and without a window. The workman refuses to go in. His employer then shows him a bench and an anvil beneath a small shed near the door of his shop. The man accepts this, puts on his overalls and starts work — files something and occasionally works the bellows.

Another locksmith passes by and asks the workman if he will work in his shop near by. They go and visit this shop, which is large, well-lit, and ventilated with a window and cowls over each forge and near to the filing and polishing bench. The workman is delighted, leaves his former employer and takes his place in the new shop.

Scene 8.

Take up most comfortable position, try not to move more than is necessary ; imitate the best workers.

a) Two workmen are pushing barrows filled with stones. One bends the elbows, the other lets his arms hang down. The first has a label on his chest inscribed « Wrong position », the other a label inscribed « Correct position ».

b) Three men are hoisting weights with windlasses ; the first of these is on a level with the stomach and compels the workman to bend down all the time ; this is labelled « wrong position ». The second windlass is level with the chest and is marked « Excellent position » ; the third is level with the elbows and is labelled « Fairly good position ».

c) Two workmen are filing iron in a standing position. The first worker's vice is on a level with his elbow, the man stands upright, the feet almost together : *good position.*

The second man's vice is much lower and the worker has to bend his back and separate the legs : *bad position.*

d) At a railway station : three small four-wheeled hand-propelled vans for carrying mail. The first is only about 50 cm. high, the second 1 metre and the third 1 m. 50. They are pushed by three men of the same height, who lean their hands on the upper edge of the van. The position of the first man is *wrong*, that of the second is *excellent*, that of the third *fairly good*. Another case : the three men are of different height ; in this case the shortest will push the first van, the next shortest the second, and the tallest the third van.

e) Gilbreth's famous experiment with the builder may be repeated. A mason is building a brick wall. He has to stoop down for each brick and for each trowelfull of mortar. At first he is almost continually stooping ; then, as the wall rises, he has to stretch upwards and stand almost on tip-toe to place the last bricks. At the end of the day the bricks are counted and the man is found to have laid a hundred.

The next day, the foreman arrives on the scene an hour in advance of the workman. He places two trestles, one to the right and the other to the left of the workman. On the first trestle he puts bricks and on the other mortar. As the wall gets higher, the trestles are raised and the mason himself mounts upon a third trestle to work more comfortably.

When the day's work is finished, the bricks are counted and the man is found to have laid five hundred.

N. B. Many other similar examples can be shown.

G. Loriga.

CINEMATOGRAPHY AND THE PREVENTION OF ACCIDENTS

from the Italian)

The use of the cinematograph in the campaign against occupational accidents is a matter of some importance, because :

1° The campaign to prevent accidents has enormously developed in every civilised country during the past twenty years ;

2° As will be seen from what follows, propaganda is not easy, the environment and mental habits of the working classes are difficult to change, the available means are few and their relative value much discussed. For the rest, the cinema would appear to be an instrument of propaganda of undoubted value, which, if it cannot replace other methods, can very usefully supplement them. The mode of its use must be carefully studied and adapted to the mentality of those whom it is desired to persuade and instruct and to the special purpose which it is sought to attain.

The few propaganda films on accident prevention made during the last ten years are only of value as examples of what it has been found possible to do in this field, for the technical conditions for the production of effective films are not yet stabilised and we are far from possessing any exact idea of what constitutes a good propaganda film. It is not enough to propose the making of such film. A subject must be selected, an effective scenario designed to interest the public ; it must be suitably acted by actors who can arouse sympathy and lastly it must be exhibited under conditions which will attract the working man or the peasant whom it is desired to impress.

Here more than elsewhere we should remember the old maxim « Castigat ridendo mores ». The propaganda film must not be a mere technical demonstration of the operation of machinery and apparatus, of the dangers attending their use and of the best methods of avoiding those dangers. A demonstration of this kind would merely bore the spectators, who are already familiar with machinery. What they need is to be interested and impressed by dramatic incidents arising naturally out of some occupational accident.

Accordingly the propaganda film must be played by professional actors, produced by intelligent cinema experts who understand the purpose of the film and the special mentality which it is sought to impress, but they must be assisted by technical experts who are capable of weaving into the plot the technical points which it is desired to bring home to the spectator.

These few remarks are enough to show that it is by no means easy to make a good propaganda film, which may explain the very small number of such films in existence although the cinematograph with its living pictures would naturally seem the most effective aid to the fixed image and the spoken word.

I.

Occupational accidents are among the most terrible scourges of the working classes. Every year thousands of workmen lose their lives in the practice of their trade, hundreds of thousands of others are temporarily or permanently disabled. The economic loss resulting from so much waste of active energy is incalculable. Those who die cease to perform services before they have compensated the community for the cost of training them for their work ; the permanently disabled render less service than the able-bodied, but their requirements as consumers are not only no smaller but are often larger, while workers temporarily disabled render no service during the period of invalidity.

It is impossible therefore to exaggerate the loss to production from occupational accidents. Much more serious still, however, are the direct effects upon the victims themselves. Occupational accidents involve physical and mental suffering, impoverishment and privation for the family, loss of economic and social status. No doubt these hardships are to some extent set off by the system of compensation, but in the last resort compensation is only a re-distribution of the cost of the accident, the total loss to the community remaining the same.

In these circumstances it would seem natural that everyone concerned should of their own accord seek by all the means at their disposal to combat the risks of occupational accidents. It is a regrettable fact, however, that the attitude of those concerned is only too often marked by a kind of fatalism. Accidents are usually regarded as an inevitable accompaniment of industrial activity; each of the interested parties is much too prone to look to the other to adopt any possible measures of prevention. Many workmen believe that the duty of preventing accidents rests exclusively with the employer, while the latter complain that, through indifference or carelessness, their workmen often expose themselves to dangers which they could easily avoid.

It is now generally admitted that both these views are one-sided and mistaken. Industrialists can do a great deal to diminish the risk of accidents, even without the collaboration of the workers. By organisation they can arouse the attention and interest of their workmen and prevail upon them to exercise care. The latter in their turn should not neglect the means of protection offered them or be indifferent to considerations of health and fitness. Lastly, the State, as representing the community and as the guardian of labour, can enact laws and organise a system of labour inspection so as to ensure that the practical measures taken to safeguard workers are carefully studied and strictly observed within the different undertakings.

Thus nothing can be done to prevent accidents without the active and voluntary cooperation of all concerned.

* * *

For a long time it was thought — and the belief still persists in certain quarters — that occupational accidents were caused by machinery alone and it was

therefore imagined that the work of prevention consisted mainly in protecting workmen from more or less direct and dangerous contact with machines. Statistics of occupational accidents, however, have revealed the fallacy of this view and show that a comparatively small percentage of accidents is due to machinery.

According to the statistics published by the United Steel Corporation in 1921, 200.000 accidents were classified, of which only 8.83 % were due to machinery. It is true that this gigantic organisation represents a rather special case, since it has its own mines and railways, which together were responsible for 19.02 % of the accidents. Nevertheless, other published statistics point to the same conclusion. The North Dakota Workman's Compensation Bureau, in its report for 1923, examines the causes of 4969 accidents occurring between 1919 and 1923 and found that only 12.6 % could be attributed to machinery. It appears from this report that, although accidents from machinery are few in number, they are relatively of a very serious nature. For example, 37.9 % of accidents which resulted in permanent disablement and which further represent 19.9 % of the total compensation paid by the Office in respect of accidents, were due to machinery. The same figures, however, emphasize the relatively considerable importance of accidents due to other causes.

The same conclusions are suggested by the statistics of the German Accident Insurance Institutions (*Berufsgenossenschaften*). Of the 53,476 accidents which resulted in either permanent disablement or disablement for at least 13 weeks and which on that account first became entitled to compensation in 1921, 27.1 % were caused by machinery (*Amtliche Nachrichten des Reichsversicherungs Amtes* 1922).

Experience shows that precautions and measures of a purely technical kind cannot avail to prevent all accidents from machinery. Even if we grant that certain expedients, such as good lighting, upkeep of stairways and floors etc, might avoid a number of accidents, it would still appear that 70 % to 75 % cannot be averted by technical means, *because they are due to human nature.*

By way of illustration we may quote here the arguments contained in a recent number of an agricultural paper in an article entitled: « The prevention of accidents in agriculture — *Two-edged tools* »: « We mean by this expression the twofold effects of the machinery or edged tools employed in agriculture. Useful and indeed indispensable as these instruments are to the farmer, they may be exeedingly dangerous both during work and in the course of transport and also owing to the places in which they may be left lying about.

« This explains the frequency of accidents due to this cause. As a matter of fact some 25 % of agricultural accidents may be said to be injuries inflicted by sharp-edged tools or blades.

« Agricultural labourers are being taught by hard facts to reflect and to ask themselves whether nothing can be done to avoid such extensive injury and loss. A study of a few of the commonest cases should convince us that something can be done.

« A peasant is returning from work with a scythe on his shoulder, of which

the blade is pointing downwards ; he stumbles, falls backwards and the scythe enters some inches into his back.

« A farm-lad runs up to the hay-loft, bare-footed, to fetch some fodder. Left buried in the hay is a fork, one of the prongs of which strikes the boys foot, its sharpened steel point inflicting a severe wound.

« It may be said that these are examples of bad luck — risks inherent in the occupation, but has the misfortune really this fatalistic origin ? If a woman, while busy sewing, allows her little girl to get hold of the scissors and hurt herself with them, she may first scold the child, but she should end by acknowledging that the fault was hers for leaving the scissors about in easy reach of the child.

« Why should not the conscience be similarly examined in the two cases described above ? It would then be seen that if the scythe had been held with the blade pointing upwards, or, better still, if it had been sheathed, the peasant's fall would not have had the same serious consequences. Again, if the boy had not been bare-foot, he would have been adequately protected by his boots. Or if the fork had been left in a safer position or at any rate plunged into a bundle of hay, it would not have been a source of danger ».

We may supplement the two cases of agricultural accidents reported by this paper with a personal recollection of one of those accidents which are of daily occurrence in the country and which are often due to mere imprudence or inattention combined with the state of excitement induced by work performed under a hot sun by men and women thinly clad. These conditions are effectively represented in the first act of Gabriele d'Annunzio's « The Daughter of Jorio ». During the mechanical threshing of corn, the leader of the team, mounted upon the platform of the threshing-machine between two or three women, who hand him the sheaves, was passing the latter into the mouth of the thresher. Normally, there is no danger at all, but the man, during his rhythmic movement towards the mouth of the thresher extended his arm farther than was necessary and his right hand was caught between the cylinders. I remember as if it were yesterday the deep impression dug by the teeth of the cylinders in the fingers, exposing the bone. The imminent danger of tetanus was averted by immediate medical treatment, but the man was unable to do his work for several months.

There is no doubt that men are often prompted to acts of recklessness either by youthful exuberance or when working in company with women. All this proves the part played in occupational accidents by the human factor, and it is a factor more complex than the foregoing considerations make it appear, since other elements also enter into its constitution.

In a note headed « The prevention of accidents and scientific management » published under the signature of M. Frois, Inspector of Labour in the April 1929 number of the Review « Protection, Securité, Hygiène », the writer seeks to show the economic importance of accidents and to devise means of avoiding their very serious social consequences. On the basis of statistics and an estimate of the losses sustained by industry, apart from compensation proper, he arrives at the conclusion that accidents cost France 27 million working days a year. From the point of

view of the victims, insurance and production, the total corresponding cost exceeds 4 milliards of francs in the year.

The variation in the number of accidents in the course of the month, week and day leads the writer to study the influence of fatigue as a factor in accidents. On the strength of detailed considerations of a physiological character he concludes that uncoordinated movements and reduced muscular elasticity are definite causes of certain specific accidents.

An enquiry into the real causes of fatal accidents in the first area of inspection in France shows that out of 100 cases 25 are due to chance mishaps which it is difficult or impossible to foresee, 32 to inadequate protection during work and 43 to deficient protection aggravated by the imperfect adaptation of the workman to his task.

Of these 43 ten were ascertained to be unskilled workmen (of whom 5 met with, their accident through some faulty movement); 15 were men physiologically unsuited to their work, while in the remaining 18 victims the psychical faculties were unequal to the demands made by the occupation (lack of attention, insufficient sang-froid, errors of judgment, etc.).

Summing up, 80% of accidents in France are due to the absence of preventive measures, which have not been sufficiently studied, and the consequences of these accidents are aggravated by the physiological or mental defects of the workmen.

In this study it would seem important to emphasize the factor of fatigue, which appreciably reduces the attention necessary to avoid accidents thus resulting in uncoordinated movements, which lead inevitably to accidents. In this, connection some authorities recommend physical exercise and sport, which keep the worker physically fit and healthy — thus ensuring self-control and steadiness — and develop his faculties of attention.

* * *

Accordingly, human nature with its vices and defects is an important factor in determining the number of occupational accidents and, however complex a factor it may be, it is certainly open to the corrective action of those industrial organs which are concerned to reduce as far as possible the number and gravity of accidents.

This has long been recognized, and highly industrialised countries have sought a remedy in the establishment of regulations providing for the supervision of men while at work. Generally speaking, however, it has been deemed impossible to *change human nature* and the high percentage of accidents which has often — sometimes wrongly — been attributed to the faults of the workman, has been regarded as inevitable.

The Americans were the first to adopt new and extraordinarily successful methods, which have permanently benefited both the workers and the whole country.

Until the beginning of the twentieth century, compensation and the prevention of accidents were practically unknown in the United States. In each case

the victim had to claim damages from his employer under the common law on civil responsibility. Labour inspection, which enables the State to adopt effective measures to prevent accidents, did not exist. The Americans themselves admit that the campaign against accidents dates from 1908. The question was first forced upon public opinion in all its magnitude by the shock of two unprecedented mining disasters in which 600 miners lost their lives. The practical-minded American, looking at the accident statistics with an impartial eye, quickly realised that the technical measures of protection were inadequate and immediately set to work to reduce the number of occupational accidents, which accounted, as above-mentioned, for 75% of all accidents, *by teaching workmen to work carefully*.

For this purpose the National Safety Council was created and by the end of 1921 comprised 8000 undertakings employing between six and seven million workers, the State administrations responsible for the compensation and prevention of occupational accidents and a large number of communes and insurance companies.

The Council succeded in convincing a large section of public opinion of the necessity of preventive action and within a short time its characteristically American watchword « Safety first » became a popular slogan.

From the outset the Council concerned itself with technical measures but at the same time strove energetically and successfully to educate the workers on the basis of the following principle : « The great majority of accidents can only be avoided by the aid of educative propaganda in which every worker, every foreman and every member of the managerial staff cooperates ».

The Council thus appeals for the whole-hearted support of the management and is further responsible for two characteristic institutions — « the Prevention Engineer » and « the Factory Safety Committee », relying finally upon the effective collaboration of the foreman. These four essential elements constitute the basis of accident prevention, the methods of which we would emphasise briefly in order to show how the cinematograph may find in them its natural place and an outlet for useful service.

* * *

Propaganda for the prevention of accidents aims at removing all dangers which threaten workmen in the course of their work, and to this end men must be taught where danger lies and how it may be avoided. The most difficult and important part consists in stimulating and maintaining the will to avoid accidents and in inculcating in the individual habits of prudence and care which take root and become second nature. For this purpose the posting up of notices and the distribution of printed rules, instructions and warnings have been found, according to the experience of Europe, to be of little effect. It is essential that the appeal should be made not only to the reasoning faculties, but also to the imagination which must receive a lasting impression.

For the training of new and, specially, foreign workmen Mr. T. Fonda (National Safety News, October 1920) recommends the establishment of regular courses

in accident prevention. For the lower grades the methods in general use are very varied : lectures, if possible with lantern slides, cinema performances, posting up of notices, and competitions. The numerous staff magazines published by industrial undertakings are often used to disseminate the best means of avoiding accidents. As a rule, these do not describe new technical measures of protection, but tell the reader, in the light of experience, how men have behaved in cases of accidents which have actually occurred. The method of presenting these facts is characteristically American in its directness and every care is taken to avoid boring the reader.

The lectures frequently open with a few anecdotes — amusing rather than distressing — so as to arouse the interest of the audience quickly. It is a mistake too for lecturers to assume that their listeners are slow of understanding. At the same time an appeal to reason alone is wholly insufficient ; it must also be addressed to the imagination and to the feelings. Lantern-slides are found very useful for the purpose. In the United States slides are apparently shown with great rapidity — as many as 60 in half an hour. The relative value of lantern-slides and the cinematograph is a subject of much discussion.

As regards the points to emphasize, it has been noticed that the mere exhibition of protective devices and apparatus does not give satisfactory results. It is usually better to show the consequences of accidents and how they originated. Here, too however, account must be taken of the mentality of the audience. A mere reconstruction of an accident is of little use in the case, for example, of skilled workmen of average intelligence, sufficiently well aware of the dangers they incur, but who fail to avoid them from the sheer pleasure of running risks or from fear of being accused of cowardice. In every case it must be fully explained why workmen ought to avoid the risks of accidents, a special appeal being made to the call of family affection. The interesting proposal has been made that workmen should be attracted to lectures by means of printed invitations, which flatter them and persuade them to attend and bring their families.

* * *

It will be seen from the foregoing that propaganda for the prevention of occupational accidents, conducted with such fervour and energy in America for the last thirty years and now being followed by a similar movement in Europe, employs organs specially created for the purpose — such as the technical expert for the prevention of accidents and the Safety Committee — and that the material means used to spread rules of safety and especially a knowledge of the necessity of using the utmost care during work, are the following :

posting up and distribution of printed rules and instructions ;
notice-boards ;
lectures, accompanied whenever possible by lantern-slides ;
cinema performances.

We propose to consider later on the very special value of the cinema as an instrument of publicity and shall now give a few particulars of the work of propa-

ganda carried out in various countries. This will show how fully the experience of the last thirty years confirms the great value derived from the education of the working classes by the above-mentioned means, with the object of reducing the danger of accidents to a minimum.

* * *

Mr. I. Roach, Director of Hygiene and Public Health in the Ministry of Labour of New Jersey, in a report published in 1921 in the « Proceedings of the 8th annual meeting of the International Association of Industrial Accident Boards and Commissions », writes as follows :

« For ten years the Ministry of Labour of New Jersey has been conducting an educational campaign among the representatives of various industries and has sought to secure their effective cooperation in propaganda work to prevent accidents. Each undertaking was asked to appoint a person with the title of « workshop boss » ; this functionary was invested by the Commissioner of Labour with official status and with certain powers in matters relating to the prevention of accidents. These officials met at intervals for lectures and readings and to study and discuss industrial reports, draft laws, etc. This educational campaign was most effective in popularising the work of prevention and facilitated the promulgation and application of new laws. Further, industrialists became more favourable towards labour inspectors, themselves requesting and welcoming the advice of representatives of the Ministry of Labour. This educational work was extended by the formation of local preventive organisations in various parts of the country under the direction and guidance of the Ministry of Labour. These organisations meet monthly for eight months in the year and hold conferences on the prevention of accidents, treatment, medical supervision, etc. Films are also manufactured dealing with the prevention of accidents and a determined effort is made to, direct the attention not only of industrialists, but of the public towards this problem ».

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In the 1918 Proceedings Mr. G. H. Hambrecht, of the Industrial Commission of Wisconsin, in a report on the prevention of industrial accidents in Wisconsin wrote as follows :

« This Commission was set up seven years ago, and from the first has sought to serve industrialists and workmen by furnishing them with all possible information on the means of preventing accidents. The members of the Commission, without neglecting devices by which to protect workmen from accidents, have devoted much time during their inspection of factories to helping employers and stimulating the interest of engineers, foreman and workers by practical talks on prevention. Special meetings have been held at which lectures were given on certain dangerous methods, while use has also been made of lantern-slides and the cinema.

* * *

On the the same occasion Mr. John B. Brownell of the Californian Industrial Accidents Commission read a report on the campaign for the prevention of accidents in California, which included the following passage :

« This Commission established an office for the prevention of accidents in 1924. With the financial aid of the Redwood Association eight films were prepared showing certain typical dangers to be avoided. Mr. J. C. Bennett, an engineer attached to the office had prepared the scenarios and the actors were all workmen whose work and actions were performed in such a way as to show how the necessary precautions were observed. Each of these eight films demonstrated a complete working process. The films were shot at the end of 1917 and were loaned to various saw-mills on the circulating library system.

« To these same proceedings Mr. Robert D. Yonny, technical engineer for the prevention of accidents at the Ministry of Labour and Industry of Pennsylvania, contributed the following:

« In the course of our educational work we first approach industrialists and heads of businesses. We try to persuade them of the importante of preserving their human capital intact. After arousing the employer's interest in propaganda work, we help him, if requested, to conduct a campaign against accidents and furnish gratis a number of films which constitute an effective means of keeping the best workmen interested in their work. These films, prepared by the Ministry of Labour, have already been shown to thousands of workmen and their families and have no doubt had very substantial results ».

* * *

An article entitled « Safety first ; what it has done and is doing » in « The Monthly Herald and Industrial Record », Johannesburg, June 1926, gives a brief account of work done in the South African mines towards preventing accidents, bearing in mind the large number of illiterate natives included among the workers. The Committee for the prevention of accidents has employed the following methods : propaganda by means of printed illustrations, cinema films, encouragement of new suggestions for the avoidance of accidents and the organisation of first-aid competitions.

The article attributes to this active propaganda the diminution shown by official statistics in the number of fatal accidents occurring in the Witwatersrand mines during the past twelve years. The percentage, which from 1913-1916 varied between 3.16 and 3.81 per thousand, lay between 1.92 and 2.63 per thousand during the period 1922-1925. It should also be noted that 40% of fatal accidents were caused by falling rock or by explosions. The Committee is now engaged in making a film to show the right and wrong ways of handling explosives.

* * *

In the annual report of the German professional Associations for 1925 on the question of accident prevention we find the following :

« Every modern means of propaganda is employed to bring about an improvement through cooperation between workmen and employers. Endeavours are made to influence all concerned by means of lectures, courses, lantern-slides and films. Some Associations have made collections of photographs and slides which they place at the disposal of anyone interested. Others have published, or have assisted in the manufacture of films. Propaganda through pictures has been persistently maintained and great success has been obtained by the printing of small and suitably chosen pictures on pay-envelopes. This form of propaganda promises well, since the pictures find their way into the workmans family and thus enjoy a wide circulation ».

* * *

A few years ago the Secretariat of Young Christian Workers in Belgium took up propaganda work for the prevention of accidents and in particular organised exhibitions in various industrial centres. The third of these exhibitions was held at Charleroi from February 18th to 21st 1928. The Institute « Aumoniers du Travail » housed a collection of posters, protective apparatus and machines not provided with safety devices. The exhibition was afterwards to be shown at Brussels and Namur. The organisers intended to arrange for lantern-lectures and cinema performances to be held by schools, business firms and local branches of the Secretariat.

* * *

On page 320 of « Sparwirtschaft » for 1928, we read as follows :

« The Austrian Central Office for protection against accidents, to which are affiliated the Workmen's Accident Insurance Organisations, the Central Inspectorate of Industry and the Employer's and Workmen's Associations, recently exhibited to an invited audience the first Austrian propaganda film on the prevention of accidents.

« The film was shown at the Technical Musum of Industry and Commerce where the Central Office has its premises.

« The Central Office aims in the first place at propaganda on psychological lines, not only because statistics show a large increase of accidents in recent years, but also because accidents due to ordinary causes are three times as many as those due to machinery. The film prepared by the Central Office therefore seeks to demonstrate to the workman how often accidents are caused by sheer carelessness.

« Since it is well-known that purely instructive films arouse only moderate interest and easily bore the spectator, an attempt has been made for the first time to interpolate the representation of an industrial accident in a dramatic film adopted to the mentality of the Austrian people. This film, which consists of a prologue and three acts, has been so prepared that it can either be shown in its entirety, or one act at a time as part of an ordinary cinema performance. It is hoped in this way to reach a far wider public, and, by introducing the idea, as it were, inadvertently, in such a way as to seem natural, to make people more alive to the necessity of avoiding accidents.

* * *

The film referred to in the preceding paragraph was lent by the Austrian Central Office to the Italian National Association for the prevention of accidents. Divided into three parts, each occupying a quarter of an hour, it is intended for cinematographs in factories and is a romantic drama into the plot of which are woven pictures of work in various industries and of various interesting examples of industrial accidents. It thus reproduces passages from industrial life directed by a sound artistic sense and having a definitely educational purpose.

This film was shown on the evenings of January 4th, 8th, 9th, 10th and 11th, 1929 at the works of the Milan General Electric Company, at the Lombardy Iron and Steel Works the Sesto San Giovanni works, the Togni Works at Brescia and at the Breda Factory at Sesto San Giovanni (1).

* * *

For several years now school authorities in America and in Europe have sought to introduce teaching on the prevention of accidents, especially in connection with street accidents. This teaching for the most part takes the form of special lectures and games specially designed to inculcate in small boys elementary rules of safety in the streets. In Italy the *Cassa Nazionale Assicurazioni contro gli Infortuni*, has shown in a number of elementary schools a film on the prevention of accidents. The Minerva Institute has aimed at popularising the question by the same means.

* * *

From all that has been said above, therefore, it would appear :

That propaganda work on accident prevention has during the last thirty years developed enormously in all civilised countries ;

That statistics show how the great majority of occupational accidents have psychological causes and are not attributable to machinery ;

That past experience shows the value of propaganda and the need of appealing to the imagination and the feelings as well as to reason ;

That the means of propaganda are few. Propaganda is oral or written. The latter consists largely in the distribution of printed rules for the avoidance of accidents. In view of what we have said above concerning agricultural accidents and of the environment of the industrial and still more the agricultural worker, these printed instructions are of very doubtful efficacy. Oral propaganda, on the other hand, is difficult, since workmen have to be invited and coaxed to attend meetings and lectures. The aid of pictures in the form of notices, photographs, lantern-slides and cinema films is a recognized necessity. Films have only been employed within recent years and in a few cases ;

The use of the cinematograph for propaganda has led to a discussion of the

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(1) Below will be found a summary of plot and the chief captions of this film.

greater or smaller relative value of notices and films and of the preference to be given to the one or the other.

Dr. Kurt Seemann, in a systematic study of propaganda for the preventive of occupational accidents — a study which the author has tried to make strictly scientific — describes a series of notices which he caused to be prepared with the help of an artist, and he furnishes us with his observations on the impression made upon the workmen by these notices — impressions collected without the worker's being aware of the presence of any observer.

The article concludes that these notices have no propaganda value unless they are really such as to arouse attention and also that propaganda by this means alone is not enough. The writer does not mention films, but says that the notices may be effectively supplemented by lantern-slides.

Supporters of the cinema base their preference upon the fact that films hold the attention and also instruct in a fraction of the time necessary for oral teaching. (David S. Bayer. « Safety education through motion pictures » National Safety News, November 1921). The National Safety News quotes the opinion of five experts on accident prevention as to the kind of film best suited for propaganda (« What safety means in an industrial film », National Safety News, Jannary 1924). Their opinions are not unanimous but are interesting for all that. H. C. Thomson, for instance, believes in the representation of the various processes in a cycle of operations ; in other words, he does not believe that the question of safety proper should be treated separately, *ex professo*. The devices and methods of protection are a part of the whole process of production. Representations of accidents make little impression, because the workman quickly notices that the scene has been reconstructed for the purpose and he thinks that it is exaggerated. Similarly, pictures of family life intended to add a human interest to descriptions of accidents and thus to gild the pill do not move the spectator.

W. T. Boyd, on the other hand, favours the interpolation of such scenes and thinks that persons known to the spectators should be put on the screen as often as possible. A W. Rohweder maintains that, in order to effect its purpose, the film should show life as it is, with the special risks attending factory work, and should emphasise the importance of the supervision of work by the managing staff and the Safety Committee. The other two experts, J. A. Northwood and C. A. Ralston, while disapproving of pathetic scenes, think it of great importance to arouse interest in the spectator by showing the effects of accidents upon the family, and perhaps by inserting within an ordinary plot episodes throwing light upon conditions of work.

Some large American firms do wide propaganda by means of cinema performances. Thus the Pullmann Company presents a different programme every day, with pianola accompaniment, in a huge restaurant. On Monday a comedy is given, on Tuesday the weekly review published by the Ford works, on Wednesday an industrial film, on Thursday a drama, on Friday the Hearst-Pathé News. Such firms, however, are the exception. As a rule, performances are governed by the desire not to take up too many of the workmen's leisure-hours.

* * *

In 1926 the Munich *Museum for the Protection of Workmen*, in conjunction with the Bavarian Builders and Timber-workers Associations, prepared a film on the prevention of accidents in the timber industry. This film was entitled « Look out ! Danger ! » and was written in a prologue and three parts. The first two parts were of a general character, the third related mainly to the professional associations.

This film, together with another called « Imminent danger », prepared by the Austrian Central Office for the prevention of accidents (see above) was criticised from the worker's point of view by H. Sachs in an article headed « The film and its services to accident prevention », which appeared in the *Reichsarbeitsblatt*, No. 35, December 15th, 1928.

The writer objects in particular to the unduly brutal representation of the facts and considers that too large a share of the responsibility for the accidents shown is attributed to the workmen. Analysing the various accidents depicted in the film, he points out that many of them could have been avoided if the employer had taken the necessary steps to remove certain abuses. He is of opinion that the contents and form of propaganda films for the prevention of accidents ought before all things to amuse the spectators, although the real purpose must not be lost sight of. They must make the spectator think without upsetting or irritating him ; they must win his sympathy for the cause of accident prevention and make him cooperate in this splendid work.

The following reply appeared in the Review of the Italian Association for the Prevention of Accidents :

« H. Sachs' article concludes that preventive films must be of such content and form that their effect is left to chance, so to speak, the facts not being driven finally home. The film must make the spectator think without annoying or offending him and it must fill him with the desire to assist in solving this important problem ».

« This conclusion further illustrates the truth of the saying that criticism is easy but art difficult. In comparing the two films « Look out! Danger ! » and « An imminent danger », M. Sachs makes an analysis of the two cases which is to our mind altogether too crude.

In the first film the accident is represented in all its tragic cruelty and in its sad consequences : mutilation, blindness, artificial limbs, crutches — all of which is bound to make an impression. In a word, we see the accident as it happened. In the second, on the other hand, the accident is represented as an imminent danger, a menace which is only fulfilled so far as is necessary to arouse in the spectator a sense of disaster.

« M. Sachs mentions all this, but he comes to no conclusion. The first film is addressed to workmen who are so habituated to their work as to be part of the machinery ; the second as is stated in the notice accompanying the explanations, is intended for the young, boys and girls under 16, and for women.

« Which is the better of these two methods ? We might as well ask which is

preferable, the warning notices issued by the Americans — cool, sometimes puerile, if not grotesque — or the blood-curdling notice as conceived by the Germans, or a mixture of the two ; or should the warning have a somewhat emotional character like some of our own ? The answer depends entirely upon the public addressed.

« For instance, in the first of the two films we are speaking of, M. Sachs thinks it an unnecessary risk to entrust the part of the workman caught in the machine to a real person ; a dummy would have served as well. Even apart, however, from the fact that marionettes can never achieve the palpitating reality of human beings, any more than a musical box or a gramophone can reproduce the voice of human passion and the pulsations of the human heart — the American films, with their exhilarating élan, leave no doubt at all of the overwhelming superiority of flesh-and-blood actors. In the second case, M. Sachs emphasises the necessity of impressing women, so as to win them over to assist in the spiritual and emotional aspects of preventive work, and here we are with him. A great deal may be expected from family feeling, by which the worker continues to be moved during his hard struggle to earn the daily bread and to do his job as best he can. It is on this account that the representation of tragic events and distressing consequences should be tempered by the inclusion of gentle and kindly sentiments, so that the film may interest, move and persuade all classes of the public, the worker male and female, wives and mothers, and also children, who are the workers of the future. There is thus no doubt at all of the efficacy of the cinema, which as a means of conveying the necessary warning, far surpasses the spoken, written or printed word, through its stronger appeal to the workers soul. For this reason it offers immense possibilities for the future ».

III.

This summarised criticism shows that the technique of propaganda films on the prevention of accidents is still in its infancy. Very few films of the kind have as yet been made and these must be regarded as more or less experimental. It is worthy of note, however, that all critics recognize the potential value of a well-constructed film.

The essential advantages of the cinematograph are admirably set forth in an article entitled « The Cinema and Industry » published by M. Klimowicz in the *Mémoires de la Société des ingénieurs civils de France*, 1928, page 1230.

This article, as its title implies, only deals incidentally with preventive propaganda, treating in the main of the various uses that can be made of the cinema in industry, as for example : technical studies, vocational teaching, application to scientific management, commercial and financial propaganda.

The writer points out that the film's universally recognized power of fixing attention and imprinting a recollection of what is shown, makes it particularly valuable for purposes of vocational teaching. A good film, in fact, gives a clearer impression than a visit to a factory. General views reproduce the atmosphere and environment of a business and show operations in all their reality. The development of the film in accordance with a definite didactic scheme, the choice of incidents

and the captions correspond to a guide's explanations and draw attention to matters of special interest. Of inestimable value is the employment of close-ups, which illustrate points of interest that it is often difficult for visitors to observe at close quarters. The ability to show, under a favourable light and in logical sequence, only what is essential — and to emphasise such points by showing them for a longer or shorter time — confers upon the film a very special didactic value. The result is more than a rough reproduction of reality, it is a real illustration of facts.

The author then proceeds to give a few practical examples. The Paris Joint Transport Company is obliged to train quickly a very large staff and needs some guarantee that this staff will be in a position to avoid everykind of accident and incident that may occur in the course of work. For this purpose the Company has established excellent vocational courses and a well-organised laboratory of psychotechnical tests. The use of the cinema in these courses has substantially reduced the number of hours of teaching — a priceless boon, and one which confirms what was said above concerning cinematographic propaganda to prevent accidents.

Again, it was of importance to the Company that it should be able to test scientifically the efficiency of the vocational training given to omnibus and tramway drivers before allowing them to start practising. To this end it rigged up in the laboratory tramway platforms and autobus driving-seats. The pupil driver takes his place in front of the controls, and on a screen fixed in front of him a film is shown representing street traffic with the various incidents that may occur, a traffic block-imprudent crossing of road by pedestrians, etc. The driver has to manipulate his controls just as if he were on a moving car. A special apparatus registers the street incidents thrown on to the screen simultaneously with the driver's reactions, The graph thus obtained supplies a picture of the time taken to react, inattention. faulty manipulation and shows how the candidate has solved the various traffic problems set him.

The creation of the psycho-technical laboratory and the use of psycho-technical tests in the enlistment of staff coincided with the new use of films for vocational teaching, and the Company has therefore been unable to estimate separately the influence of the two factors. It has however been able to record a notable reduction in the hours of instruction (about 15%), while the number of accidents per kilometer diminished by 11% in 1926 and 11% in 1927. This is further proof of the advantages of the cinema from the point of view of the prevention of accidents.

Klimovicz also quotes certain films prepared by industrial undertakings for purposes of vocational teaching, among others, a film by M. Dalimier, Chief Engineer of the Nord Railway Company, which represents « the repair of the railway ».

The staff employed to lay down new sleepers and rails usually belong to private concerns and work under the orders of agents of the Company. Since replacement work must be done fairly rapidly so as not unduly to delay traffic, and because certain safety precautions have to be taken, the Company has resorted to a practical method of training this constantly changing staff. The film made

for this purpose is about 2000 metres long and shows very ingeniously, first, the principle governing operations and then the various details of execution. M. Dalimier has also sought to illustrate what should not be done in certain circumstances. For instance, a man is shown continuing at his job when a train is about to start (this is forbidden). The movement of the carriage knocks him down and the picture of this will certainly remain in the spectator's mind much longer than mere words of warning.

Lastly, the writer mentions an actual film on the prevention of accidents shown recently at the Cologne Press Exhibition. The workers in a printing and paper factory have decided upon a very special strike, consisting in a refusal to observe the measures of protection, which they consider to be absolutely unnecessary. The film then shows the various accidents which result from their imprudence. The pictures are admirably calculated to arrest the men's imagination, but particularly admirable is the way in which the matter is approached. If it had been introduced while the accidents were being shown, it would have put the spectators off, since no one is fond of lessons thrust down the throat. The story, however, entertained them and made them more accessible to the instruction it was desired to convey.

Klimowicz has himself prepared and shown industrial films and is therefore in a position to support his belief in the suggestive power of the cinema. On the other hand, aware of the difficulty of producing good technical films, he writes as follows : « The preparation of films must be entrusted to technical experts, that is to say, engineers, who are in close contact with industrial facts and who are at the same time cinematographic experts, since the film is a means of expression, a language which needs to be studied from the roots if it is to be employed to advantage ».

IV.

The foregoing observations justify the conclusion that the cinematograph, which has as yet been only tentatively employed in the propaganda campaign against occupational accidents, is destined within the near future to outstrip all other methods of such propaganda.

The essential advantages of the cinematograph may be summarised as follows:

Propaganda must not take the form of a mere statement of rules and suggestions for the avoidance of accidents. It must appeal to the imagination and feelings of listeners, awake in them a sense of responsibility to their families, cure them of a certain quixotry and rashness which often cause them to run unnecessary risks, and must encourage them to exercise the necessary caution. The cinema would appear to be of all methods the best adapted for such propaganda.

The cinema makes it possible to show the spectator pictures of machinery in operation, with its attendant risks to workers, better and more easily and conveniently than oral teaching and lectures, even when these are accompanied by lantern-slides. The details can be shown by means of close-ups and observed much more closely than in the factory itself.

The cinema fixes the spectator's attention and imparts its lessons in a small fraction of the time required for oral teaching.

Once a good film is manufactured, it can be reproduced in hundreds of copies and shown anywhere, while it would take a large number of lectures to attain the same purpose.

The cinematograph is patronised by millions of people. A film on the prevention of accidents can be included as part of an ordinary cinema performance and its teaching therefore conveyed to the audience naturally and without previous announcement, whereas people have to be invited and encouraged to attend lectures.

The living pictures of the cinematograph are more effective than words, which often bore ; besides good lecturers are very scarce. Again pictures are far more effective than writings, since, although nearly all workers can read, few enjoy doing so.

These advantages are enhanced by the sound film, which adds to the virtues of the cinematograph that of a clear and convincing interpretation by chosen persons with a gift for explanation.

If on the other hand the cinematograph has not yet been largely employed as propaganda for the prevention of accidents, this is due mainly to technical difficulties. The preparation of a good film for vocational instruction only needs a good technician who has a camera and knows how to use it. A good propaganda film requires more than the photographer. It requires an author who knows how to write an interesting plot suited to the worker's mentality, it needs a producer to stage it and actors to play it, and also the collaboration of the business expert, who has to insert in the plot the pictures of industrial work and of some possible or actual accident. All the films we have considered above fail through the absence of one or other of these elements of collaboration. It would seem, however, that large industrial concerns with manifold resources and the means of uniting these different elements, should easily be able to overcome the difficulty.

V.

The great potential importance of the cinema as an instrument of propaganda for the prevention of occupational accidents is in its turn the result of the great importance which this propaganda has acquired, calculated as it is to save tens of thousands of human lives and an untold amount of suffering every year It should be noted in this connection that although American propaganda has always been inspired by humanitarian motives and the moral obligation to avoid unnecessary suffering in any form, the promoters of the movement in America nevertheless admit that these moral and social considerations do not suffice to persuade the circles concerned to pass from theoretical approval to practical action. For this reason the National Safety Council emphasises that a systematic campaign against accidents has notable economic advantages and in support of this argument quotes the figures furnished by a number of business enterprises. Unfortunately, these

figures do not represent the general situation. It cannot be denied that many businesses are inclined to question whether it is worth while incurring quite considerable expense on propaganda and wonder whether it would not be cheaper to pay compensation for accidents. Anything which serves to reduce the cost of propaganda, counteracts this unhumanitarian tendency and at the same time contributes towards improved labour conditions by diminishing the risks and sufferings involved.

It would seem that here again the cinematograph might reveal one of its essential advantages. A single well-conceived film, prepared in hundreds of copies and projected in public cinemas as part of an ordinary performance is better than dozens of lecturers, who have to speak in special lecture-theatres, dozens of lantershows and hundreds of printed notices and recommendations

MARIO LEVI-MALVANO.

IMMINENT DANGER

Prepared by the Industrial Films Company, Reich Janisch and Co. of Vienna for the Vienna Central Office for Accident Prevention, by Victor Hendryck, Engineer

Under the direction of Robert Reich.

Operators : Karl Hurtz Mayrer and Anton Pudler.

Characters : Binder, a foreman.
His wife.
His son Frank.
The manager of the factory.
His daughter.

Prologue.

Mrs Binder and her little boy pay a visit to Binder at the works and on the way witness a collision between a motorcar and a cart. She has a presentiment of impending misfortune as she approaches the factory. There she meets her husband in the yard and, as they stand talking, Binder notices a workman in danger of being struck by iron suspended from an electric crane. He is in time to rescue the workman but himself falls under the wheels of a passing locomotive. Mrs Binder who has seen the accident, faints at the sight of her husband being carried off on a stretcher.

The poor woman is overwhelmed with grief. In a delirious fever she lives the whole catastrophe over again.

She gradually recovers.

Captions.

1. «Come along, Frankie, let's go and see daddy at the works ; he'll be pleased when you show him your school prize ».
2. « Keep close to me, dear. ».
3. « Walk on the right side of the pavement ».
4. « I don't know why, dear, but. I have a presentiment ».
5. « Please, porter, will you make an exception and let me see my husband ? ».
6. Dear Madame, I entrust the child to your care.
7. Some days later, the poor woman's sufferings reach a climax.
8. The crisis passes. She is saved !
9. End of prologue.

Synopsis of Act I.

Several years have passed. Young Binder — an intelligent lad — has been made foreman. He is seen on several occasions warning the workmen to exercise all possible care in their work. He has set himself the task of protecting his fellow-workers from accidents.

Captions.

10. Years have passed and young Binder by dint of hard work and intelligence has been made foreman.
11. Don't work beneath a weight, it's dangerous.
12. « Well, that's the limit ! ».
13. That's what the trolley's for.
14. You are making two mistakes at once. Punching while the machine is in motion is forbidden and so is unloading.
14*a*. With the handles loose like that, look out.
15. What a fool you are to throw peel in the middle of the path where anyone may fall and break his leg !
16. The day's work is finished.
17. What are you doing ? Don't you know the rules ?
18. Tincture of iodine.
19. Heres another fellow who's always throwing his weight about.
20. You call that throwing weight about ? Have you forgotten what carelessness led to ?
21. You've less reason still to laugh. Don't you remember ?
22. On the way home Binder helps a blind man across the road.
23. Thankyou, Sir I'll stop a moment here.
24. Did you lose your sight in the war ?
25. No, it happened in the factory.
26. If only I'd been careful-they'd shown me often enough how to handle sulphuric acid.
26*a*. Why are you always so sad, mum ?
27. Tomorrow is the anniversary of your father's death.
28. Yes, mother and I've made up my mind to do everything I can to protect my fellow-workers against accidents.

Summary of Act II.

The act opens with an appeal to the workmen to exercise care when at work. To illustrate the necessity, a number of accidents are shown, in which Frank Binder, appointed in charge of accident prevention has occasion to intervene. Owing to some act of carelessness a fire breaks out and Margaret, the managers daughter, is in danger of being burnt. She is saved by Binder. The manager sends for him to thank him. Binder explains that he is making it his business to prevent accidents. The manager promises his support. On reaching home Frank Binder shows his mother, with the aid of statistics, how important it is to drive home the idea of prevention among his comrades.

Captions.

1. Take care ! Your attention is liable to be distracted at any moment. So look out !
2. Not a day passes at the factory on which inattention does not threaten danger
3. Do it like this. Then you'll have more room.
4. Cant you obey the rules ? I lost my father through carelessness like that.
5. Margaret, the managers daughter, comes to fetch her father.

5*a*. The midday pauce is over. Work starts again.

6. Fire !
7. Margaret faints from fear. The car goes on uncontrolled.
8. « Fortunately, Sir, hardly any harm was done. The workmen extinguished the fire almost as soon as it broke out ».

8*b*. « My darling, are you hurt ? ».

9. « No, papa its allright now. I was only frightened ».
10. « Engineer, bring me the man who saved my daughter ».
11. « Tell me, Binder, how did the fire break out ?

11*a*. « Its the old story, Sir, carelessness...

12. ...the consequences of which it is often impossible to foresee ».
13. I see that you are interested in preventive work. Have you any ideas on the question ?
14. « Yes, Sir, Iam now makingan appliance with which it will be possible to observe work and its dangers.
15. With this apparatus I shall be able to show the men the risks of carelessness during work ».
16. « You have my full support. We cannot do too much to prevent accidents ».
17. « You've again forgotten your food, my boy ».
18. « Look at these mother ».
19. Statistics of industrial and commercial accidents in Austria.
20. Between 1922-1926.
21. Number of accidents (1922-1926).
22. Cost per 1000 workmen (1922-1926).
23. « Isn't it terrible, mother, the increasing number of fatal accidents and permanent injuries each year ?
24. And how does it come about ? These figures will tell you »
25. Accidents in 1926. *Table* 1. Accidents caused by machinery.
26. « I myself recently saw a serious accident caused by a circular saw ».
27. *Table* 2. General accidents caused by electric current, explosions, dangerous substances, hand-tools, edged tools, by false movements, loading and unloading, dropping and knocking against material-personal and other-total.
28. « A short time ago I witnessed two accidents during building operations.
29. The carpenter had been too lazy to replace a missing plank.
30. And the second time the workmen had forgotten to prop up the scaffolding.

31. *Table* 3. Statistics of accidents in 1926. Machinery 8171, general 23668. Number of general accidents is thus three times the number of accidents due to machinery.
32. And now I will show you what I am working at.
33. With this appliance I am hoping to show the workmen the risks they run of injuring themselves by carelessness.
34. When I have done that my life's aim will be fulfilled and I shall then be ready to...
35. Dont say that !

Summary of Act 3.

Frank Binder is working at his invention, a magnifiying apparatus. His first tests are successful ; beaming with pleasure, he shows them to his mother. He then gives a lecture to the workmen and engineers of different factories, showing by means of the apparatus the causes of a number of accidents. Margaret, the daughter of his employer, whom he had saved from danger, is present at the lecture and at the end she joins in the applause, grips his hand and says, « I am proud of you ».

Captions.

1. Frank Binder, a skilled foreman, busy on preventive work.
2. His method consists in showing his colleagues how often accidents are caused by inattention. His discovery is successful.
3. « Mother, it's a great success » !
4. « Gentlemen, I present to you our foreman Binder who is going to show you a remarkable invention ».
5. Margaret, the manager's daughter, feels strongly drawn towards young Binder.
6. Gentlemen, statistics show a constant increase in the number of accidents.

Table 2.

Total accidents to workers in 1922-1926.
Number of accidents per thousand workers.

Table 3.

Analysis of accidents in 1926
Accidents due to machinery 8.171
Accidents due to general causse 23.668

Thus the number of general accidents was three times the number of accidents due to machinery.

7. It is high time to take the necessary measures.
8. My apparatus makes it possible to look closely at the representation of what was happening at the moment when the picture was taken.
9. By this means i can show you actual pictures of work in the different industries.
10. ...and point out to you how the least inattention may have serious consequences.

11. Steel works.
12. Each operation demands attention. When the steel is still red hot from the rolling-mill, particular care must be taken.
13. Accidents often happen in pushing trucks, and yet men don't realise.
14. ...but disregard the instructions.
They stand between the buffers instead of on one side.
15. A stone quarry.
16. A series of mines.
17. The alarm signal before the mine blows up.
18. A cool customer!
19. I think these few pictures will have shown you that accidents are very often due to carelessness.
20. You will notice the same thing when we pass on to other industries.
21. A large timber-yard.
22. Workmen are often absent-minded, and this is just as dangerous as a wrong movement.
23. On the second truck the load was not fastened and it is a miracle that no accident occurred.
24. A heavy load is easily set in motion and requires, as you see, special care.
25. An untied boot-lace can easily drag a man into a piece of moving machinery.
26. A notice which can be blown away by a draught is not a sufficient warning.
27. Work should not begin until the current is switched off.
28. Loading coal.
29. The big crane.
30. In this case a momentary inattention and carelessness cost a man's life.
31. Gentlemen, this is the end of to-day's lecture. The pictures will have shown you how necessary it is for both employer and worker, both industrialist and operative
32. ...to take every care to avoid all possible accidents...
33. ...by means of persuasion and warning.
34. TAKE CARE ! !
35. « I am proud of you ».

END.

FILM PROPAGANDA IN FAVOUR OF PROTECTION AGAINST ACCIDENTS

(From the German)

The term « protection against accidents » may be given a very wide interpretation and extended to include life-saving in the water, rescue parties organised in the event of accidents in mines and other similar operations. As a rule, the expression « protection against accidents » is understood to mean the preventive measures taken to avoid accidents occurring suddenly in daily life or in the course of work which directly involve physical harm and even injuries endangering the life of the injured person. For our present purpose we must make certain distinctions and consider separately the following categories :

1. Occupational accidents occurring in industry and agriculture, factories, etc.

2. Traffic accidents in the street or on the railways, motor accidents etc. etc.

3. General preventive measures which have to be taken in daily life, and especially in the home-more particularly protection against fire.

To which we may add certain measures closely allied to protection against accidents which are taken in order that a person's injuries may not be aggravated, viz.

4. First-aid, transport of injured persons, etc.

If wenow consider what persons or organisations are likely to be interested in films coming within these four categories we arrive, as regards Germany, at the following conclusions :

Ad 1. The measures taken to avoid and prevent « occupational accidents » affect first and foremost employers. Hence a high percentage of this class of films has been manufactured by large industrial concerns which use them for the instruction of their own workmen especially apprentices. It is, however, the «professional associations » which in Germany are more particularly concerned to propagate the idea of protection against accidents. These associations, which date from about 1880, originated in Bismarck's fertile brain. Bismarck combined all employers engaged in a single branch of industry within a compulsory insurance scheme under which they assumed a joint responsibility towards all employees and workers in the undertakings concerned (e. g. mines, chemical industry, textile industry, breweries, flour-mills, building enterprises, etc.). The employers further bore all the expenses including not only the cost of treatment but all allowances, annuities and pensions paid to surviving relatives. The most important duty however entrusted to the professional associations by Bismarck's law was protection against accidents. Since every accident is a source of expense to all employers and, owing to the distribution of the burden, to each individual employer, the application of the best preventive measures against accidents and active propaganda to encourage protection against accidents are obviously matters which closely affect employers, if only for purely pecuniary reasons. In this way an appeal has been deli-

berately and strictly logically made to motives of *self-interest* as a means towards an *unselfish* end. At the same time the organisation of professional associations according to industries and specialised occupations necessarily implies a technical specialisation,— not otherwise obtainable — of the associations' officials who deal particularly with protection against accidents, that is to say, the « technical inspectors »

The sixty-nine existing professional associations (the seventieth is about to be created) are grouped within a Federation of German professional associations, whose work on behalf of protection against accidents is coordinated by a central service. This service is in the charge of Herr Michels, formerly *Gewerbeassessor*.

As regards protection against industrial accidents, the following distinctions may be made :

a) Technical measures of protection against machinery, that is, the installation on all machines and plant of devices to prevent accidents.

b) Campaign against the risks of accidents inherent not in machinery, but in *men* (untidiness, inattention, inurement to danger, absent — mindedness, carelessness etc, etc.). Experts have publicly stated that 75% of all accidents are due to human beings and their defects. This alone shows the vital need of propaganda against accidents, to be addressed to each worker directly and in accordance with thedictates of psychology. This necessity has been fully recognized ; hence the establishment — alongside the Federation of German professional associations — of the « Unfallverhütungs-Bild G. m. b. H. » which is also in the charge of Herr Michels and has long been successfully engaged in public propaganda on behalf of protection against accidents, issuing posters and pamphlets, organising lectures, exhibitions, etc. This company is also responsible for the making and showing of films on the subject and offers suggestions as to their mode of preparation.

In addition to the professional associations of industries referred to above, there are also in Germany professional agricultural associations, organised territorially according to the administrative division of the country, and these, too, have their central organ in the Federation of professional agricultural associations. Their competence and methods of work, particularly in the matter of protection against accidents, are exactly the same as those of the associations mentioned above.

Ad. 2. In Germany the duty of warning the public against traffic accidents lies mainly with the Administration. The Reich Ministry of Transport and the police are responsible for maintaining the safety of traffic along public ways. The communal administrations, within their sphere of jurisdiction, also take steps to prevent traffic accidents. Other organisations which have a direct interest in educating the public to avoid unnecessary accidents include the Reich railways and postal administration, the motor industry and the big Automobile Clubs.

These last organisations are united in a Federation known as the « Verkehrswacht », and a sub-division of this federation, the « Schulverkehrswacht » devotes special efforts towards the instruction of schoolchildren in methods of increasing the safety of traffic. Finally, the professional associations, of whose activities we have already spoken, are also interested in the steps taken to prevent traffic acci-

dents, although these rarely occur « within the business », that is, during work. Recent laws oblige the professional associations to grant compensation and treatment even to the victims of accidents which occur while the person concerned is on his way to or from work, although the employer cannot either prevent or avoid such accidents by any precautions on his part. These accidents constitute a heavy burden upon the associations and for that reason the latter too are keenly alive to the need of preventing them.

Ad. 3. Propaganda on behalf of protection against accidents in general, excluding occupational or traffic accidents, is rather neglected in Germany, despite its great importance. As a matter of fact, propaganda to prevent accidents in general ought to be part of the work of all authorities, organisations, associations and companies whose concern it is to safeguard public health. Unfortunately, the « Reichsausschuss für hygienische Volksbelehrung » is so far the only body which deals with this question. Films on protection against and prevention of fire, which are to some extent connected with protection against accidents, form a separate group. The firms concerned, namely, firms manufacturing material, etc. directed against fire, the electrical and other industries, continue to interest themselves in these matters. It is a strange thing that the big public and private insurance organisations take no part in the propaganda campaign to prevent accidents in general, or indeed in any general health relief work. These institutions ought to be interested in measures of protection against accidents and fire and in the steps taken to improve the general standard of public health ; in many countries they are specially entrusted with the application of such measures. The organisations in question even abstained from practically all participation in the big German propaganda campaigns such as the « Reichs-Gesundheitswoche « of 1926 and the « Reichs=Unfallverhütungswoche » of 1929.

Ad. 4. With regard to first-aid and kindred work, the big charity organisations, and especially the Red Cross, have established model institutions and once again we must mention the work of the professional associations. These questions, unlike those of which we have been speaking, are of such general interest that a number of cinematograph firms have directed their attention towards them spontaneously.

We may now mention the *films* which belong to each of the four categories referred to above and it is our intention to enumerate only films which were actually at the disposal of the « Reichsunfallverhütungs-Woche held in the spring of this year. It would be easy enough to give a long list of films shot in the course of past years, but in many cases both negatives and copies have disappeared leaving only the title in the catalogue. On the other hand, the thirty films taken from the archives during the « Reichsunfallverhütungs-Woche », in some cases with a great deal of trouble, are available at any time. The great majority of these films were, of course, shot at the suggestion of professional associations ; some were manufactured by industrial concerns and therefore come under Cagerory 1 :

« Help us to avoid accidents »,' length about 100 metres ; Erich Stöcker

Land und Industrie Film A. G., Berlin, Federation of German professional associations.

« Men in danger », length 480 metres. Central service for protection against accidents — Federation of German professional associations, Berlin.

« Protection against agricultural accidents », length 569 metres ; Erich Stöcker, Berlin, Federation of German professional agricultural associations, Cassel.

« Technical measures against occupational accidents », length 240 metres ; « Ständige Ausstellung für Arbeitswohlfahrt », a Reich institution, Berlin.

« First-aid organised by the professional associations », length 600 metres, Fuhrmann-Film Produktion, Berlin.

« Such is life », length 550 metres, Federation of Reich insurance institutions, Berlin.

« Take care ! Danger ! », length 810 metres Dix-Film, Munich, professional association of iron and steel industries.

« Protection against accidents in the stone-working industry » length 115 metres ; Industrie- und Kulturfilm Körösi, Munich Bavarian Builders Association.

« Accidents through the handling of trucks on the railways of industrial undertakings », length 132 metres, Friedrich Krupp A. G., Essen.

« First-aid in surface-work in mines » length 789 metres, Friedrich Krupp A. G., Essen.

« Rescue of a workman asphyxiated by the poisonous fumes of a blast-furnace » length 248 metres, Friedrich Krupp A. G., Essen.

« Protection against accidents in technical undertakings » length 197 metres Friedrich Krupp A. G., Essen.

« The campaign against accidents », length 848 metres, Association of Printers, Leipzig.

« Protection against accidents in work involving the use of multiple ladders », length 200 metres, Industrie- und Kulturfilm Körösi, Munich, Bavarian Builders' Association.

« Protection against accidents during transport of tree-trunks and timber », length 460 metres, Industrie und Kulturfilm Körösi, Munich, Carters Association.

« The danger of accidents during roofing operations and work on roofs ; preventive measures », length 300 metres, Bavarian Builders' Association.

« Look out, mate ! », length 900 metres, Eisen und Stahlwerk Hoesch A. G., Dortmund.

« Safety measures on board German steamers and merchant vessels », Marine Association, Hamburg.

« Protection against accidents in the sugar industry », Sugar-manufacturers' Association.

« Self-help », Association of Chemical Manufacturers.

« Safety first ! » Association of Saxon textile manufacturers.

Further, the professional associations representing tile-works, precision instrument makers and the electrical industry, together with the Miners' Association,

are now engaged in shooting a number of films and have recently completed certain other joint films.

Ad Category 2 :

« Take care ! Look out ! », length 681 metres, Bergische Film-Industrie, Elberfeld.

« Rul es for pedestrian traffic », length 223 metres, Excentric-Film Berlin, Berlin Traffic Department.

« Educational film on traffic police », length 670 metres, Police Headquarters, Munich.

« Human lives in danger », Eiko-Film Berlin, Berlin Life-saving Office.

It should be added that a few years back the « Universum-Film A. G. », in cooperation with the Berlin police, prepared a traffic film, part of which was of a comic nature ; this was a big film occupying the whole evening.

Ad Category 3 :

We need only mention « The present age », a film in colours (Sirius-Farbenfilm G. m. b. H. Steglitz and Reichsausschuss für hygienische Volksbelehrung). This film deals especially with accidents in the home. Reference may also be made to « Small things lead to big », a film 120 metres long made by the Berlin Federation of Electric Works and drawing special attention to short circuits as a cause of fire. There is also an Ufa film with the name of « Fire ». Finally the Minimax Company (manufacturers of fire-extinguishing apparatus) supplied the Reichs-Unfallverhütungs-Woche with a series of short propaganda films.

Ad Category 4.

« First-aid » length 600 metres, Erich Stöcker, Land- und Industrie-Film A. G., Berlin, Federation of German professional associations.

« First-aid », length 1000 metres, Gervid-Film, Berlin-Steglitz, German Red Cross.

« First-aid stations », length 2619 metres, Gervid-Film, Berlin-Steglitz, German Red Cross.

« Help in case of accidents », length 450 metres, Bergische Film-Industrie, German State Railways.

« Beware of the red lamp ! », length about 500 metres, Bundesfilm A. G. Berlin.

Lastly, the film « Human lives in danger » (see above), length 1200 metres, falls largely within Category 4.

If we now consider for whom these films are intended, it will be seen that those mentioned under 1 have little or no interest for the general public. They are mainly exhibited before factory staffs, technical associations, members of trade unions and, sometimes, Sick Funds. For the most part, they provide illustrative material for the use of the technical staff of the professional associations when giving lectures to workmen in the course of their inspections., It would be well to use these

films more freely in vocational schools, technical schools and for continuation classes. The films mentioned under 2,3 and 4, on the other hand, could be used on a much larger scale, anyhow in the form of extracts, at ordinary cinema performances, at club meetings and, more particularly, in the public schools.

The films mentioned do not, of course, cover by any means the whole of the enormous field opened up by the question of protection against accidents; much still remains to be done. For example, a film on protection aganist motor accidents is gradually becoming an absolute necessity. There would seem to be no insuperable obstacle in the way of the international use of the above-named films, especially as the manufacturing processes and methods of work in the specialised industries and various industrial branches are largely the same, while films of this kind are nearly always shown by lecturers who are in a position to furnish any necessary explanations.

We must, however, have our eyes open to certain difficulties which seriously hamper the sale and therefore the use and dissemination of this kind of film. Health propaganda among the masses is now conducted in nearly all countries. Governments, public utility organisations of every kind, technical and professional associations and the schools regard it as their duty to cooperate in safeguarding public health and in spreading the necessary doctrines throughout the length and breadth of the land. The same, however, does not apply to the prevention of accidents. The mass of the people are unfamiliar even with the use of the term ; it has no exact meaning for them. Thus propaganda against accidents, interest in which was first aroused among the German people by the energetic activities of the « Reichs- Unfallverhütungs-Woche », is only gradually finding an echo in the press and is only slowly gaining ground among the masses.

If this propaganda is to spread, it is essential that all classes of the population should grasp the fact that the totality of accidents claim more victims and result in a larger number of deaths than the gravest epidemics. The propaganda films in the first category, on occupational accidents and especially films which only affect certain branches of industry are almost entirely disregarded by the big organisations, which otherwise make extensive use of the cinema as an educational instrument. Those concerned often argue that they cannot be expected to incur the expense of purchasing or hiring these films or, if the film is lent free of charge, the cost of organising performances, etc.

It is claimed that this propaganda against accidents is a source of saving to employers owing to the very avoidance of such accidents and that therefore the whole cost of it and not only the cost of making the films, should be borne by employers. On the same grounds it might be argued that the purchase, sale and projection of films on public health and social hygiene are exclusively matters for the Sick Funds, district insurance institutions and other organs of German social insurance, which in the end « gain » or at any rate save money whenever accidents are avoided, in just the same way as the professional associations. As I have already said, it must be much more generally realised that propaganda to prevent accidents is, from both the human and economic standpoints, a matter of public interest, if

films on preventive measures against these accidents are to reach any but the special groups to which they are at present exclusively addressed.

It is becoming an unavoidable necessity for schools of all grades to carry out propaganda work against accidents, similar to that which is already undertaken in regard to public health. In Germany, as in all countries, science plays a more and more important part in the national life. Artisans in their shops, agriculture, the home and all public institutions make increasing use of gas, electricity, new machinery and new apparatus which is being daily discovered and the employment of which in economic life in becoming more and more general.

We cannot therefore hope to return to the peace and quiet of the « good old days » and we complain in vain of modern life and its perpetual restlessness. Instead we must adjust our ideas of the age and realise the ever-present danger of accidents to each one of us. The mentality of the whole nation and of all nations must completely change. Granted that old people will never come to see this and that the adults of to-day must for the most part learn from their own experience, it is in any case the obvious duty of those now in active harness to see that their children are brought up to quite different ideas concerning the risks of accidents and are fully imbued with this new mentality by the time they grow up.

Let us take a typical example.

In our day the motor-car inspires in all adults who do not happen to possess one, a profound and scarcely concealed dislike finding vent in a more or less impotent rage. Young people, on the other hand, realise far more clearly the necessity of modern science and therefore also the dangers of motor vehicles. Undoubtedly, the lessons given in many schools on traffic accidents have largely contributed in this matter. It is however no less important to provide for the teaching of accident prevention in elementary schools and, later, in the secondary schools and especially in continuation classes, technical and vocational schools. Just as a man who from earliest childhood has been accustomed to observe the rules of cleanliness and elementary principles of hygiene is far less likely than others to contract disease, so the apprentice, the young workman, the student or the young mechanic will generally and individually obey the rules of protection against accidents much more readily if he has been familiar with the more elementary notions since early youth.

In view of the difficulties to which we have referred — difficulties which still exist — it is essential that the large central organisations dealing with protection against accidents should constantly impress upon all the competent ministries, national and communal administrations and public and private institutions of all kinds the fact that protection against accidents is an exceedingly important branch of public health in general and that public funds should be devoted to this purpose, such as are already set aside for anti-tuberculosis campaigns, child welfare and other work. Above all, active propaganda must be conducted in the schools, if the number of accidents is to be reduced. This number at present runs into several millions a year (in Germany it is estimated that there were in 1927 about

3 million accidents involving about 24,000 deaths) and, in view of the increasing employment of technical material, it may be expected to increase in terrifying proportions, unless the necessary action is taken. If we further consider the economic cost, we shall readily understand that general propaganda in favour of accident prevention must be intensified so as to reach a much wider circle than the small groups most immediately concerned.

We need not emphasise the fact that the film, which vividly illustrates the dramatic features of an accident, thereby creating a deep and lasting impression, is the ideal instrument with which to penetrate and instruct the masses of the people and children in schools. And if we are agreed that accident propaganda must be intensified and that administrations and schools must concern themselves much more closely with the matter than hitherto, we must further urge that the existing films on accidents in general and on certain special kinds of accident, as well as the new films which are being produced every day should, if they are to be of real value, be shown not only to the restricted groups of persons especially interested, but to the public at large and to the young.

Dr. CURT THOMALLA.

THE USES OF THE CINEMA IN THE EDUCATION OF CHILDREN AND YOUTH

(*From the italian*)

(NORMAL AND ABNORMAL - PSYCHIC AND SENSORIAL-ABNORMAL)

I am convinced that the cinema will be useful above all for technical instruction. It is true that, according to Aristotle, hearing was the *sensus disciplinae;* but in his time optics were hardly known. The *sensus disciplinae* would certainly have been the eye also, if only spectacles, the telescope, and the microscope had been known in his time. The cinema proclaims the superiority of the visual sense also for the purposes of culture, considering the help that movement — that is to say the animated vision — affords to the understanding and the memorization of technical knowledge. It is highly significant that at the present time the most efficacious instrument for the « rationalization » of labour is to be found in the cinematograph, rather than in reading or oral instruction. The business man, according to Urwick, doesn't want to listen; he wants to see. This pronouncement is particularly applicable to experimental biological sciences. The development of experimental methods, to which we owe the greater part of our present knowledge of natural sciences, rests on the sight and the touch, rather than on hearing ; culture also has become a cheaper commodity and is offered through the animated vision and to the visual-kinetic sense of pleasure. Thus technical instruction by means of the cinema responds to the Ist *desideratum* of the World Economic Conference of 1927.

Instruction in economy of movement by the film is a benefit to workers and a help in their training. According to Urwick the cinema has been instrumental in effecting a 10% increment in production.

There is in fact a great future for cinematographic teaching. The Cinema is a help in vocational orientation. Vocational advisers can learn from it strictly scientific methods of orientation. Laboratory psycho-technics, which is regarded at present with so much suspicion, will certainly gain by being made known through the cinema. Since the *ascertainment of aptitude*, that is to say of a *vocation*, is the most delicate and the most contested, but also the most specific, point in vocational orientation, the cinema may be the means of securing it the general consensus that it lacks or else the definite opposition that many hope for. In any case, we need evidence first of all. When we have slowed-down films to demonstrate psycho-technic methods, we may then ask for an extensive referendum.

We should like to begin by giving workers and scholars an idea of the means of ascertaining the *general* vocation of industrial workers. A work-test lends itself readily to be cinematographed. This has a double object : to make the technique of the work known and to afford practice to persons of limited aptitude in a manner to enable them to achieve perfection. It is generally acknowledged at the present time that aptitude is perfected by practice.

Practice as a factor of development is demonstrated in many ways by experience. Practice not only fixes, refines, and trains motor ability, but it is capable of developing a number of latent abilities. At one time exercise was considered capable of developing even general intelligence. It is this principle of practice that justifies the « mental orthopedic » exercises, that were so much in use and so highly recommended some 30 to 20 years ago. At the present time we no longer believe in the miracles of exercise for the development of *general intelligence* or the *general factor* (Spearman); but we do believe in the development of special abilities and intellectual adaptation, which depend in fact on practice. It is therefore no mistake to say that the cinema can teach both the technique for ascertaining vocation (apprenticeship necessary for vocational advisers), and the technique for affording practice to persons who have no particular aptitude or those with mono- or oligo-aptitudes, in order to increase the number and quality of their abilities. A successful experiment in scholastic cinematography was made by the Eastman Kodak Company with the National Educational Association. The experiment, as described by T. E. Finegan, was comparative, that is to say it was carried out in respect of two groups of pupils entirely homogeneous in race, intelligence family, social environment, etc. The success was markedly greater in the case of the group taught by film. G. Santini wrote a striking article on this subject in the International Review of July 1929. Both associations and private persons, moreover, make considerable use of the cinema for scholastic purposes all over the world. The following words are psychologically correct : » Shadows that are nothing but shadows to us, continue a long time after the projection as living things in the souls of children ». (Jean Renouard).

Urged by the above reasons and by the example of many psychotechnicians I tried three years ago to think out experiments (capable of being exhibited by the film cinematograph) for the experimental testing of general intelligence and technical intelligence in children and adolescents who were *weak-minded* or of *unbalanced* character. These were to serve the purposes of *scholastic selection*. My programme was not carried out because I was taken up with other studies. I have taken this opportunity to look over the tests I had already prepared ; I have corrected them, as best I could ,and to-day I submit them to the consideration of my colleagues.

My attempt has been enriched by films relating to the vocational orientation of boys of post-elementary school age, pupils in Italian preparatory vocational classes. I therefore suggest certain tests that lend themselves to projection: for motor ability, for technical intelligence and attention applicable to boys aged between 12 and 15 years; tests that aim at evincing the abilities required for any industrial, scientific, or school work.

If they serve no other purpose, these films that I suggest should raise the question of the methods of « generic » vocational orientation of young people. If my suggestion is accepted, the films would enrich the school collections.

To sum up, I suggest :

1st) films for estimating the *general intelligence* of boys of 7 years, so as to

measure any mental deficiency. These would be very useful to scholastic « selectors «.

2nd) Films for instruction in the technique of the ascertainment of working ability. These would be very useful to vocational advisers.

3rd) Films for teaching school pupils, selected for stammerers, lispers, and the totally deaf. Highly useful for the teachers of the abnormal-sensorial.

Estimating general intelligence

Test of *Logical Memory completed by Action*. An account of this test may be read in S. De Sanctis's *Neuro psichatria infantile*, page 204 et seq. Two seven-year old pupils, who were slightly weak-minded (abnormal or weak intelligence) ; and one up to the mark (normal).

Technique :

A) « The teacher wants to know your name ».

« Sit down ».

2° « Ask for an exercise book and a pencil ».

3° « Write your name in the book ».

(The child obeys).

« And now what will you do ? »

Estimating the difference : Success (the task is performed). The normal child does it well and quickly.

B) « The teacher is thirsty ».

1° « Fetch the bottle of water from the cupboard ».

2° « Take that glass from the table ».

3° « Pour the water into the glass ».

(The child obeys).

« And now what will you do ? »

The normal child does it all well and quickly.

Measurement of intellectual deficiency (De Sanctis tests)

These tests have been used in a number of institutes for the past 25 or 30 years ; thus a considerable volume of literature has grown up around them and we know the average results of their application to weak-minded persons and idiots (Cf. S. De Sanctis, *Neuro psichatria infantile*, 1925, page 211 et seq.).

Technique : Experiment on three seven-year-old children : one mentally deficient in a marked degree ; one deficient in a minor degree ; one not at all deficient, i. e. *normal*. (Mental age - chronological age). Measurement of time by stop-watch. The 6 tests of which this process consists are described further in the Scheme of Films

a) We start by applying the test to the child who is deficient in an advanced degree, who at the best may get through the first two tests, but stops at the third.

b) We pass straight on to the *weak-minded* child (commencing afresh with the first test) ; he is likely to get through the first 5 but does not succeed in getting completely through the 6th.

c) We go on to the normal child (always starting anew with the first test) ; he gets correctly through all six.

Estimation of the difference : Last test got through (1st, 2nd, or 6th ?) Time

Technical teaching

Test of the aptitude of pupils in vocational training and pre-apprenticeship classes (*Pre-vocational Schools* and post-elementary schools); age from 12 to 15 years

Ascertaining strength and manual skill

A) Measurement of the strength and resistance of both hands.

Lehmann's aerial transmission ergograph.

Fixed time.

Technique : 20 maximum pressures, one at 3" distance from the other, first with the right hand and then with the left.

Estimation : Total number of kilograms moved by the right and by the left hand.

B) Measurement of *Speed* and *Precision* of the movements of both hands. Walther's discs.

Technique : 41 discs 2 cm. in diameter are cut out of a large thick sheet of paste board. These discs are distributed over another sheet of paste-board identical with the first one in the same positions as the holes left by the cut-out discs. The subject must take the discs up one by one and place them in the holes of the paste-board from which they have been cut out. (The experiment should be made first with the right hand ; then with the left, and lastly with both hands at once).

Estimation : Time - Errors.

C) Measurement of the *co-ordination* of movements of both hands Montessori type puzzle-pieces (the operation is more difficult than with the Walther discs, because all the pieces differ from one another in shape and size).

Fixed maximum time.

Estimation : Time - Errors - Success : to get it out in the time allowed.

Specific ascertainment of attention

A) Test of the *Constancy of visual and kinetic attention.*

Making a banner with coloured beads (Test of the Rome Laboratory).

Technique : A sheet of paste-board one millimetre thick has 16 lines, each of 36 circular holes of the diameter of 2 mm., at 2 mm. distance one from the other, both in the longitudinal and the vertical direction. 800 little Venetian beads are, mixed up in a box, each of the diameter of 2 mm., 200 green, 200 blue, 200 red, and 200 white ; they are mixed up with other beads of the same size, but of different colours, or of different sizes but the same colours.

The subject is handed a pair of tweezers to pick the beads up with and is set to make the banner, by placing in the little holes in the paste-board the beads of corresponding size (fixed time). (Variation of material : Instead of beads make use of mosaic pieces, in which case the *Technique* consists in forming a design with the fragments of mosaic (for instance a head) which the pupil has in front of him).

Estimation : Time - Errors. Success : to do the job in the time allowed.

B) Test of the *Constancy and tenacity* (in spite of distracting stimuli) of *visual attention.*

To draw, according to a prescribed order, 4 geometrical figures in 99 out of the 100 little squares into which school slates are divided, while a gramophone is playing (Test of the Rome Laboratory).

Technique : A slate is divided into one hundred little squares, set out ten by ten along ten lines. The first little square is blacked out so as to avoid the pupil copying the line above as he proceeds. The pupil must draw with the greatest speed he can and always in the same order in each of the little squares one of the following four geometrical figures : a point, a quadrangle, a triangle, and a circle, using his right hand. A gramophone plays.

Estimation : Time - Errors (correct or incorrect).

C) Test of *distributed attention* (or « diffused » attention) Copy on the slate, first with the right hand and then with the left according to a pre-established order 4 geometrical figures (deciding quickly which hand to use). Modified Rossolimo Test).

Technique : On the upper half of the slate along 5 lines, 4 geometrical figures are drawn: a vertical line, a horizontal line, a circle, a quadrangle, following one another in ever varying order and frequency. The subject must copy all the figures on the lower half of the slate, taking care to trace with his right hand all the horizontal lines and quadrangles, and the vertical lines and circles with his left.

Estimation : Time- Errors (of the hand ; of the figure).

D) Another test of distributed attention. Clasp an electric circuit in the left hand, each three beats being recorded by a metronome, while drawing with the right hand on a sheet of paper first a circle and then a quadrangle, one after the other. (De Sanctis Test 1893 emended).

Technique : Same arrangement as the Tapping Test. The metronome works at the speed of 120 beats a minute. The subject clasps the circuit with his left hand (tapping the stylus on the copper sheet) every three beats of the metronome while with his right hand he draws as rapidly as he can first circles and then quadrangles on a sheet of paper in front of him on the table.

Fixed time (3 minutes).

ESTIMATION : Errors - Number of geometrical figures drawn during the three minutes.

SPECIFIC TEST OF TECHNICAL INTELLIGENCE

A) *Executing orders by completing the action* (Test of the Rome Laboratory)

Technique : The orders are given in a work room.

« Look at that bottomless box and those instruments (rough and heavy) which are close to you on the table. Carry the box with the instruments in it as quickly as you can into the next room ».

ESTIMATION : *Efficient carrying out of the job. Skilful completion of the action* (*low figure* — 10).

B) Experiment with Piorkovski and Homburger's *Angular Apparatus for testing Mechanical Ability*.

Technique : The subject, while manipulating the several screws of the apparatus, must arrange the leather belt so that, while turning the wheel, the upper disc situated in a horizontal position, shall also revolve. Fixed maximum time.

ESTIMATION : *Time - - Errors. Success* (*graduation* according to Piorkovski and Homburger's table).

C) *Experiment with Piorkovski and Homburger's Apparatus for testing ambidextrous precision and the co-ordination of movements.*

Technique : The subject, manipulating the two handles with both hands, at the same time, must so manage that the point of the pencil shall pass exactly over the drawing placed on the flat surface of the apparatus.

ESTIMATION : Time - Errors. (deviation of the pencil). Success ?

EXERCISES FOR STAMMERERS AND LISPERS AGED FROM 10-12 YEARS

1st. Taking a pneumogram of a stammerer aged from 10-12 years.

Technique : Chauveau's pneumograph : length of the pen : 20 cm. Chymograph of the speed of 90'' per revolution. The time line in seconds already marked on the smoked cylinder.

Marking of three lines :

a)while the subject is breathing normally and placidly without carrying out any task ;

b) while executing the task of reciting mentally the *Pater noster*.

c) while answering a question by a sentence.

ESTIMATION OF THE TRIPLE PNEUMOGRAPHIC CURVE OF DEPARTURE

2nd. *Vital Capacity* :

a) Breathe in deeply ; then blow out a candle placed successively at a distance of 30 cm., 50 cm., 75 cm., etc., from the mouth.

Distance attained (*basic figure*).

b) Breathe in deeply ; then with the breath keep the flame of a candle placed at a distance of 30 cm. from the mouth in a deflected position.

Maximum time (basic figure).

3 *Breathing Exercises* : Collective exercise. Group of 4-5 stammering pupils aged from 10-12 years. Carrying out 4 exercises :

a) *Raise the shoulders*, hands on hips ;

1. Raise the shoulders smartly and breathe in ; 2. a short pause ; 3. return slowly to original position and breathe out.

b) *Flank movement of stretched-out arms.*

Close fists, stretch arms out in front at a horizontal level.

1. Drop hands at sides and breathe inward; 2. pause ; 3. return slowly to the original position, breathing out.

c) *Drop arms at sides.*

Hold arms straight down at side in position of attention.

1. Raise arms (palm downward) from sides to horizontal position, breathing inward ; 2. pause ; 3. slow return to original position, breathing out.

d) Hold stick behind back, lying in the fold of the elbows. Hands on chest.

1. Breathe in rapidly and deeply ; 2. Hold breath from 3-5 seconds ; 3. Breathe out slowly.

Breathe rhythmically to time beaten by metronome.

4° Lip-reading for lispers.

Position of the lips and tongue first in uttering the vowels and then different words with a group of lispers. Analysis of the sounds of the words.

5° *Lip-reading* for the partially deaf.

The partially deaf subject must carry out the orders imparted to him by the teacher, who speaks to him without uttering the sounds, solely by the movement of the lips : imitating — as directed — the said lip movements.

Scheme of films (Dr. Adolfo Fantini's Scenario)

First Film

1st Picture.

Estimating « General Intelligence »

Tests of *Logical Memory by the Completion of Actions*

In the middle of the room a square table is placed with inkstand, pens, pencils, exercise-books, and a glass. Against the wall is a glass cupboard with various objects inside it, a bottle of water among others. In addition to the experimenter a school-mistress and a maid are present in the room.

The experimenter directs the servant to let in the first of the two pupils to be examined — a boy of seven with slight mental deficiency (abnormal or weak intelligence). The boy enters and is told to walk up to the table in front of which the experimenter is seated. The latter says to him :

« The mistress wants to know your name ».

« Take a chair, ask for an exercise-book and pencil ; write your name on the book ».

The boy sits down and having got an exercise-book from the mistress, *slowly* writes down his name.

When he has done, the experimenter asks him :

« Now what will you do ? »

The boy is at a loss to answer, fidgets with the book, not quite knowing what to do.

The experimenter insists : « What will you do now ? » and the boy answers : « I don't know ».

« Pay attention » says the experimenter « to what I am about to tell you ».

« The mistress is thirsty. Take that bottle of water from the cupboard ; take the glass from the table, and pour some water into it ».

When the boy has carried out the three orders fairly rapidly, the experimenter says to him : « Now, what will you do ? ».

The boy, who still holds the glass in his hand, places it on the table and stands still.

The maid shows the boy out and introduces another, likewise aged seven, but not mentally deficient (normal).

The experimenter says to him, as he did to the other boy : « The mistress wants to know your name », and repeats the three orders which the boy carries out quickly and neatly. Then, in answer to the question « What will you do now » he gets up from his chair and hands to the mistress the copybook in which he has written his name.

Then the experimenter passes on to the second test and says :

« The mistress is thirsty » and repeats the three orders he gave the first boy.

The boy gets up from the chair, goes to the cupboard, and takes out the bottle of water, returns to the table, pours some out, and without waiting to be told « Now what will you do ? » he hands the glass to the mistress.

The normal child executes and completes the orders given him rapidly and well.

2nd Picture.

Measurement of mental deficiency

(De Sanctis Test).

In the middle of the room stands a table bearing a box that contains the material requisite for the tests, namely : A moveable wooden screen 2. Five differently coloured balls (white, yellow, red, green, and blue) ; 3. Twelve wooden cubes coloured alike, of graduated sizes, each one a bit bigger than the last : 4. Three wooden cones of the same wood and the same colour as the cubes ; 5° Two parallelipipeds of the same wood and colour as the cubes and cones ; 6° a sheet of white paste-board, upon which 36 black triangles are drawn, 49 squares and 55 rectangles. The sheet measures 40 x 30 cm. and is divided into ten lines, each of which contains 14 figures. 7. A stop-watch registering fifths of a second.

A maid shows in a first boy aged 7 years, mentally deficient in a marked degree. The experimenter makes him sit down opposite him at the table ; at another end of the table an assistant is seated holding the stop-watch in his hand with which he registers the time taken by the boys in answering.

The experimenter places the screen on the table between himself and the boy, and places the five coloured balls behind it.

He then says to the boy : « Pay attention » and removes the screen. « Give me a ball ». The boy hesitates, then picks up the ball nearest to himself (the red one).

The experimenter again places the screen between the boy and the balls, mixes the latter up, and says to the boy « Pay careful attention », and removes the screen. « Which ball did you give me ? ».

The boy gazes at the balls and doesn't move. The experimenter encourages him : « Now, be a good boy ! which ball did you give me ? »

The boy then points to the ball that is nearest to him (the green one).

Given the result of the second test, it is useless to pursue the experiment.

The first boy is shown out and a second boy shown in, likewise aged seven.

This boy is slightly mentally deficient (abnormal or weak intelligence).

This boy responds rapidly to the first test by picking up the yellow ball, which he recognizes promptly at the second test.

Then the experimenter, having again placed the screen between himself and the boy, lays down pell-mell behind it 5 cubes, 3 cones, and 2 parallelipipeds

He removes the screen and, handing a cube to the boy, asks him « You see this piece of wood ? Now pick out all the pieces like it that you see here.

The boy looks carefully at the piece of wood in the experimenter's hand, and then picks up, one after the other, the five cubes from the table and places them aside (the boy has got through the 3rd test).

The experimenter places the screen back in its place, takes the pieces of wood up from the table, and lays in front of the boy the sheet of paste-board on which the triangles, squares and rectangles have been drawn. He hands a little rod to the boy and and shows him one of the wooden cubes « You see this piece of wood » he says « point out on the sheet the figure that is most like it ».

The boy looks alternately at the piece of wood and the sheet and then with the rod points to one of the black squares drawn on the sheet.

Then the experimenter lays down the cube he was holding in his hand and says. « Pay great attention. Point out all the little squares on the sheet, working line by line, from left to right, as quickly as you can, and not missing any of them ».

The boy carries out the task while the experimenter watches and notes mistakes. As soon as he has finished, the screen is put back in its place and it is noted that he has committed only 7 mistakes (4 omissions and three blunders). Thus he has got also through the 4th test.

The experimenter places the twelve cubes pell-mell on the table behind the screen in such a way, however, that the distance between the furthest-off cube and the one nearest to it is not more than 2 cm. Thus the biggest cube exceeds the one next it in volume by half a centimetre per side.

The experimenter removes the board and says : « Here again are a lot of pieces of wood of the same shape as those that you pointed out just now on the sheet of paste-board. Look at them carefully, and then tell me how many there are ».

The boy counts the cubes, touching them with the fore-finger of his right hand, then answers : « Twelve » (correct).

« Which is the biggest of the lot ? ».

After a little hesitation the boy points to the biggest.

This time again the boy has given a correct answer ; thus he has got through the 5th test.

The experimenter removes the cubes and the board from the table, then turning to the boy, he asks : « Does the sound of a distant bell seem louder or fainter than that of a near one ? »

The boy reflects a moment, and then answers « Fainter ».

« Is the sound of a distant bell really fainter, or does it only seem to be so ? »

The boy is silent, and although the experimenter repeats the question, he is unable to answer.

Then the experimenter asks « Do distant objects look bigger or smaller than near ones ? »

Answer : « Smaller ».

Question : « Are they really smaller, or do they only seem to be so ? »

The boy reflects a little, and then answers, « They seem so ».

The experimenter passes on to the second group of questions :

« Is a thing done yesterday further off than a thing done this morning ? »

Answer : « A thing done yesterday ».

Question : « Must you do first a thing that has to be done in a few days or one that has to be done in a good many days' time ? »

The boy reflects at length, but is incapable of giving an answer.

Question : « Do big things weigh more or less than small things ? »

Answer : « Big things weigh more ».

Question : « Why is it that sometimes small things weigh more than big ones ?

Answer : « Big things weigh more ».

The slightly defective boy gets successfully though the first 5 tests, and incompletely through the 6th.

The boy is shown out and another seven-year old boy of normal intelligence is introduced.

The experimenter repeats with him the first 5 tests tried on the other boys.

The subject answers the first by picking up the red ball. He readily recognizes it at the second test.

At the 3rd test he quickly arranges the 5 cubes without any hesitation.

He performs the fourth task rapidly and correctly, with only two faults of omission, which he promptly corrects.

At the 5th, he answers the first question « twelve » without touching the cubes ; he answers the second and third rapidly and without hesitation.

At the 6th, to the first question : « Does the sound of a distant bell seem louder or fainter than that of a near one ? » he answers, « fainter ».

Question : « Is the sound of a distant bell really fainter, or does it only seem to be so ? »

Prompt answer : « It sounds fainter because it's further off ».

Question : « Do distant objects look bigger or smaller than near ones? »

Answer : « Smaller ».

Question - « Do they seem smaller or are they so really ? »

Answer : « They look smaller ».

Question : Is a thing done yesterday further off than a thing done this morning ?

Prompt answer : « A thing done yesterday ».

Question : « Should you do first a thing that has to be done in a few days' time or one that has to be done in a good many days' time ? »

Answer : « The thing that has to be done in a few days' time ».

Question : « Do big things weigh more or less than small ones ? »

Answer : « Big things weigh heavier ».

Question : « Why is it that sometimes small things weigh more than big ones ?»

Here the boy hesitates a moment. He evidently has an idea of the right answer, but doesn't know how to put it. Then he answers : « Because they have more inside them ».

Thus the boy of normal intelligence has got correctly and promptly through the 6 tests.

SECOND FILM

TECHNICAL INSTRUCTION.

Ascertaining the aptitudes of pupils in preparatory Vocational Orientation classes or Pre-Apprenticeship Classes (Pre-vocational or Post-elementary Schools). Ages 12-15.

PART I.

Ascertaining strength and manual ability.

1st Picture

Measuring the Strength and Resistance of both hands.

Lehmann's aerial transmission ergograph (hand-grip machine) is seen on the table. The pen is in contact with the smoked cylinder of a chymograph set to the speed of three minutes per revolution. Likewise on the table, to the left, is a metronome regulated to one beat per second, the bell of which rings at every three beats. A seat is placed in front of the table just opposite the handle of the grip-machine. A sheet of paper and a pencil are placed on the table. The experimenter and an assistant are present.

A 12-year old boy is shown in, a pupil in the 2nd preparatory vocational orientation class and he is shown a seat.

The experimenter explains to him : « Take a firm hold of this handle » and shows him how by gripping it himself. He then puts the metronome in motion : « Pay careful attention : each time you hear the bell ring, you must clench your fist with all the strength you have; then relax your hold and tighten again when the bell next rings. Keep on doing this till I say « Stop ». Have you understood clearly ? » The boy answers in the affirmative. He is then told to grasp the handle with his right hand; the assistant sets the chymograph in motion, and the experimenter says, « Start to grip ! » The boy waits a moment, and as soon as the bell strikes he grips the handle with force, pauses a minute, then relaxes ; repeats the process at the second strike of the bell, and so on, until, after 10 grips, the experimenter calls out : « Stop ! ».

At each grip, the assistant notes on a sheet of paper the value marked by the hand on the metal disc. The ten values obtained are : 18 ; 18 ; 18 ; 18 ; 18 ; 18 ; 19 ; 19 ; 20 ; 19, corresponding to the number of kilograms compressed. Mean value kg. 18.5. On the smoked paper of the cylinder these values are noted as raisings of weights, the first six of which are equal, the 7th and 8th higher, the 9th higher still, and the 10th equal to the 8th and 9th.

After being given a short pause for rest, the boy is made to execute the same test with his left hand. The results are as follows : 16 ; 16 ; 16 ; 15 ; 15 ; 16 ; 17 ; 15 ; 16 ; 15. Mean value : kg. 15.7.

2nd PICTURE.

MEASURING THE SPEED AND PRECISION OF MOVEMENTS OF BOTH HANDS.
(*Walther Discs*)

On the table is placed a big sheet of paste-board out of which have been cut 41 discs 2 cm. in diameter, which are distributed over a similar sheet of paste-board lying close to the first, in the same position as the holes left by the cut-out discs.

The experimenter and an assistant are present as usual.

The same subject who appeared in the previous picture is shown in and the experimenter explains to him : « You see this sheet of paste-board with all the holes in it ? And close to it is another sheet of paste-board on which a lot of little discs have been laid ? The number of discs is equal to the number of holes. Using your right hand only, you must pick up the discs one by one and lay them in the holes of the paste-board from which they have been cut. Do you understand clearly ? » « Yes ». « Then get on with it ».

The boy sets to work and does the job rapidly and neatly, while the assistant marks time by a second-counting stop-watch.

The boy is allowed to rest during the time that the discs are being removed from the holes and placed back on the other sheet of cardboard : he is then told to do the job with his left hand, and lastly with both hands together.

3rd PICTURE.

MEASURING COORDINATION OF MOVEMENTS
OF BOTH HANDS-MONTESSORI PUZZLE-PIECES

The sheets with the Walther discs are removed and after 4-5 minutes' rest, a box of Montessori puzzle-pieces is placed in front of the boy, from which certain pieces have been removed. These are handed to him apart.

« Do you see all these pieces of wood differing in form and size ? Each of them corresponds to a space in the box into which it can be correctly placed. Please put them in as quickly as possible, using both your hands ».

The boy places the pieces side by side on the table in front of him ; he observes them attentively, notes the spaces in the box ; seizes a triangle and at once sets it in its proper space, and thus, one by one, puts all the pieces in their places. He makes only three mistakes, which he at once sets right.

PART II

SSPECIFIC ASCERTAINMENT OF ATTENTION

4th PICTURE.

Test of the Constancy of Visual and Kinetic Attention. Forming the Flag with Coloured Beads (Test of the Rome Laboratory).

On the table is placed a sheet of paste-board one millimetre in thickness, marked with four lines, each consisting of 36 circular holes 2 mm. in diameter, at 2 mm.

distance one from another, in both the horizontal and vertical direction. Beside the paste-board is a box in which are mixed up 800 Venetian beads, each of the diameter of 2 mm. ; of which 200 are green, 200 blue, 200 red, and 200 white. Mixed up with these are a number of beads of the same sizes but different in colour, or of the same colours but different in size. The experimenter and an assistant are present as usual.

The subject is shown in, a boy of 13, a pupil in the 2nd preparatory vocational orientation class, and he is asked to come up to the table. The experimenter shows him the aforesaid objects and hands to him a small pair of tweezers. He then says : « Take good note of this sheet of paste-board. In the box you will find a number of little beads of different colours of the same diameter as the little holes punched in this paste-board. Make use of the tweezers I have given you, and pick up the beads, one by one ; introduce them into the holes so as to fill them all in such a way as to *form the flag*. Please do this as quickly as you can ».

The boy counts with his finger the number of lines marked on the paste-board and the number of holes of which each line consists, makes a rapid mental calculation, and then picks out a green bead, which seems to him of the proper size, from the box. He tries to introduce it into the first hole of the first line, and seeing that it fits, he picks up a second, then a third, and so on up to 12, which he fits into the first 12 holes of the first line. He then passes to the second line, into the first 12 holes of which he fits 12 green beads, and repeats the operation along the other 14 lines. He then returns to the first line, and fits in white beads from the 13th to the 24th hole, and repeats the process over the other 15 lines. He next fills in all the remaining holes with red beads and presents the sheet thus completed to the experimenter. The card is thus seen to be divided into three equal rectangles, the first green, the second white, and the third red, representing the Italian flag. The boy has carried out the task rapidly and surely; on a few occasions only he got hold of beads of the wrong size and let go of them at once ; he never made a mistake in regard to colour.

5th Picture.

Test of Constancy and Tenacity (against counter stimuli) of the Visual Attention.

(Test of the Rome Laboratory).

On the wall at the back of the room is a common school black-board, divided into 100 little squares, arranged 10 by 10 along 10 lines. The first little square is cancelled. A gramophone stands on a little table to the left.

The same boy who fulfilled the previous test is shown in. He comes up near the black-board and the experimenter, handing him a bit of chalk, says : « You see all the little squares into which the blackboard has been divided ? Now with the chalk I have just handed you and beginning from the second little square (for, as you see, the first has been cancelled), you must write as rapidly as possible and always in the same order in each of the little squares one of the following

4 geometrical figures : point, square, triangle, circle ; using your right hand : « Now start ! ».

The assistant sets the gramophone going and it plays a Suppé *Overture*.

The pupil rapidly draws the figures on the first line ; then at the second he hesitates a moment and does not fill in the first square; at the fourth line he draws in succession two squares instead of a square and a triangle, and then proceeds rapidly to the end, taking in all one minute and 52 seconds and making one mistake and one omission.

6th Picture.

Test of Distributed (« *diffused* ») *Attention*

(Modified Rossolimo Test)

Five lines and one geometrical figure are traced on the upper half of the slate : a vertical line, a horizontal line, a circle, a square, which follow one another in ever-varying order and frequency.

The subject is introduced (the same as in the previous experiments) and he walks up to the slate. The experimenter hands him two bits of chalk and says to him : Look carefully at the figures drawn on the slate. Take a piece of chalk in your right hand and another one in your left.

On the lower half of the slate you must copy the figures in the same order in which they are drawn above. But please be very careful of one thing : draw the horizontal lines and the squares with your right hand, and use your left hand to draw the vertical lines and circles. Please be as quick as you can and try to make as few mistakes as possible ».

The pupil starts the task at first a bit slowly, then as he proceeds he gains in speed and sureness. He gets though the task in 3 minutes and 12 seconds, making three mistakes in the use of his hand and two in the figures.

7th Picture.

Another Test of Distributed Attention.

(De Sanctis's Modified 1893 Test).

A device similar to that used for the Tapping Test is on the table, a stylus with a metallic point which closes an electric circuit each time it taps on a copper plate. A Depretz signal is fixed to the circuit ; this registers the taps made on the smoked paper of the revolving cylinder of a chymograph. Close to it on the table are also a metronome, set to the speed of 120 beats per minute, a big sheet of white paper and a pencil.

The same boy as in the preceding picture is introduced and is told to sit down at the table. The copper plate and the stylus are placed in front of him to his left, and in front of him, to the right, the sheet of paper and the pencil. The experimenter makes him take the pencil in his right hand, and the stylus in his left

and sets the metronome going. He then says « Pay good attention ! You hear the beats of the metronome ? Now at each third beat of the metronome you must tap on the copper plate with the stylus, while with your right hand you draw as quickly as you can circles and little squares on the sheet of paper in front of you. Start ! »

The assistant sets the chymograph in movement while the boy draws rapidly with his right hand and endeavours to tap the copper plate with the stylus exactly at each third beat of the metronome. During the first minute he does not succeed in following the rhythm of the metronome correctly, and commits nine mistakes with his hand ; gradually, however, he gains confidence as he gets into practice, and makes only two mistakes during the last two minutes. At the close of the fixed three minutes allowed, he has drawn 237 figures, and made 3 mistakes with his right hand and 11 with his left.

PART III

Specific test of technical intelligence

8th Picture

Executing Orders by completing Actions

(Test of the Rome Laboratory).

A work-room. On a table, among other objects used for work, there are a bottomless box and a little heap of scrap iron (rough and pretty heavy). Saws, hammers, nails and other carpentry material are lying about on other tables. There are some bits of wooden plank on the floor.

The subject, a 14-year old pupil in the 3rd preparatory vocational orientation class is shown in. He is told to approach the central table and the experimenter says to him : « You see this heap of scrap iron. Please clear the table quickly by carrying it into the next room. Use for the purpose the box that's lying on the table (pointing to the bottomless box). Place the scrap iron inside it, and carry it into the next room, taking care not to let the iron fall ».

The boy at once takes hold of the box, but just as he is about to put the iron inside it he notices that it hasn't got a bottom. He then reflects a moment ; looks about him ; takes a piece of wood and cuts it with the saw to the size of the box ; he seizes a hammer and some nails and makes a new bottom to the box. Having done this, he placed the pieces of iron inside it, and carries it into the adjoining room.

9th Picture.

Piorkowski and Homburger's Angular Apparatus Test of Mechanical Ability.

The apparatus is fixed to a table by three screws loosely fixed, in such a way that the upper disc is in an oblique position and the belt is outside the groove of the wheels.

The subject is shown in ; he is a 14-year old boy, pupil in a 3rd preparatory vocational orientation course. The experimenter points to the apparatus, points out its component parts to the boy, and says to him : « Do you see this leather belt ? You must arrange the different parts of the apparatus, turn the screws, and fix the belt in such a way that, when the handle is turned, the upper disc placed in a horizontal position shall turn also ».

The boy looks attentively at the apparatus, makes sundry ineffectual attempts by turning the screws ; but at last manages to fix it in such a way that the upper disc revolves without the belt getting loose when the handle is turned. He takes 1 minute 10 seconds in his various attempts.

10th Picture.

Piorkowski and Homburger's Test of the Precision and Co-ordination of Movements by the ambi-dextrous Apparatus.

The apparatus is on the table, a sheet of white paper with a drawing on it is lying on the surface of the apparatus. The two handles are displaced in such a way that the point of the pencil is at a certain distance from the drawing.

The same boy who went through the two previous tests is shown in and walks up to the table. The experimenter shows him the apparatus and points out that the point of the pencil wobbles in different directions according to the movements imparted to it by the simultaneous turning of the two handles. He then says : « Grip both handles, one with your right hand the other with your left ; then manipulate them so that the point of the pencil passes exactly over the drawing placed on the surface of the apparatus ».

The boy grips the two handles and carefully manoeuvres them so that, by the end of the experiment, the drawing traced by the point of the pencil coincides almost exactly with the drawing that was on the surface of the apparatus, At two points only a slight outward deviation can be noted. He takes one minute and 3 seconds to carry out the experiment.

THIRD FILM.

PART I.

Exercise for stammerers of 10-12 years

1st Picture

Obtaining a pneumogram of a stammerer of 12 years

A chymograph regulated to the speed of 90 seconds per revolution is placed on the table. On the lower part of the smoked paper of the cylinder the time-line is marked in seconds. A metal stand supports a Marey drum with a 20 cm. long pen. On the table there, is also a Chauveau pneumograph with a long rubber tube attached.

The subject — a boy stammerer aged 12 — is shown in and made to divest himself of his jacket and shirt ; the assistant then applies the pneumograph to his epigastrium and fixes it by a ribbon tied behind his back. He then makes the boy sit down with his back towards the chymograph and by means of the rubber tube places the chymograph in communication with the little Marey drum. The experimenter, making use of the special micrometric screw fixed to the stand, approaches the point of the pen to the smoked cylinder, and then says to the boy : « Try to keep as calm and still as you can. ». He then sets the chymograph in motion, and the pen starts to record the boy's breathing on the smoked cylinder. At the end of 90 seconds the cylinder stops and the respiratory curve can be observed ; this shows irregularity in the rhythm, different heights for the several breaths taken, oscillations, and tremor; the pauses are sometimes lengthened and sometimes absent.

The Marey drum is then lowered to obtain a new curve of the breaths taken. The experimenter says : « Begin to recite the *Pater noster mentally* and without articulating the words. When you have finished, gently raise your right hand ».

The chymograph is set in motion and at the end of fifteen seconds the experimenter says : « Begin to recite the *Pater* ». After a little while the boy raises his hand. At the close of the 90 seconds, the chymograph is stopped and note is taken of the new curve obtained. It is at once seen that the defects of the first curve persist during the first part of it, while the rhythm is somewhat quicker. During the time the boy was reciting the *Pater Noster* mentally the breathing grew more regular ; the height of the several breaths are more uniform, the tremors have almost completely disappeared, the rhythm is more regular.

We then proceed to the taking of a third curve, lower down than the second one. After about ten seconds the experimenter says : « Tell me what you did at school this morning » The boy hesitates a moment, makes an effort to speak, but at first is unable to emit any sound, he then starts to speak, halting, and repeating syllables. At a certain point, the experimenter says « That will do ».

An observation of the curve shows that the boy in his first effort to speak stopped breathing during about 3 seconds ; he then spoke sometimes while breathing in, and sometimes during the pause ; sometimes, after breathing in, instead of at once beginnng to speak, he exhaled a certain amount of breath.

2nd Picture.

Measurement of Vital Capacity.

The same boy as in the previous picture. A candle is held up to him at a distance of about 30 cm. from his mouth. He is asked to breathe in deeply and then to blow out the candle with his breath. The boy obeys easily. The experiment is repeated at a distance of 50 cm. with the same successful result. The candle is then removed to a distance of 75 cm. At this distance the boy is no longer able to blow it out, notwithstanding repeated efforts. The candle is

then brought nearer, to a distance of 60 cm., and the boy at the third attempt manages to blow it out.

3rd PICTURE.

Another measurement of Vital Capacity.

The lighted candle is again held up to the boy and the experimenter says to him : « Breathe in deeply ; then hold the flame deflected with your breath as long as possible » ; and he approaches the candle to within 30 cm. of the subject's mouth. The boy blows towards the candle and at the first attempt he succeeds in holding the flame deflected during 7 seconds, at the second attempt he holds it deflected 10 seconds, and 9 seconds at a third attempt.

4th PICTURE.

Respiratory Gymnastics. Collective Exercise

A group of five stammering boys aged between 10 and 12 years are shown in. They are lined up in two rows at the back of the room ; the first row of two boys and the second of three, at a distance of about a metre and half from one another.

The experimenter stands in front of the boys and says : « Pay careful attention. You must now do the gymnastic exercises I show you : lst) Place your hands on your hips, thumbs back just as I am doing (he shows). Raise your shoulders smartly and breathe in. Stay in this position for a second, then return slowly to the first position and breathe out ».

This exercise is repeated ten times ; then, after a minute's rest, we go on to the second exercise :

Throwing Forward and Dropping the arms.

« Stretch arms forward at horizontal level : with closed fists. Drop arms smartly to sides, and breathe in ; short pause ; return slowly to original position and breathe out ».

This exercise is repeated 10 times, the directions always being accompanied by the example ; we then pass on to the third exercise :

Arms dropped to Sides.

« Hold arms to sides at attention. Raise arms smartly with the palms downward from sides to horizontal position ; short pause ; return slowly to original position, breathing out ».

This exercise is repeated 10 times over ; each boy is then handed a stick and directed (the word being accompanied by the action) :

« Place the stick behind your back, resting in the fold of the elbows. Hands

on chest. Breathe in rapidly and deeply. Now hold your breath until I tell you to breathe. After 3-5 seconds, he says « Breathe out slowly ».

This exercise is repeated 10 times over.

5th PICTURE.

Rhythmical Breathing.

The same five boys as in the preceding picture. The experimenter places on the table a metronome set to the speed of 40 beats per minute. The bell rings every two beats. He then says :

« Place your hands behind your backs with fingers interlaced. Listen to the beats of the metronome. Now, each time you hear it beat accompanied by the bell, you must breathe in ; and each time you hear it beat without the bell ringing, breathe out.

He carries out each experiment together with the boys. The experiment lasts 3 minutes.

PART II.

6th PICTURE.

Lip-Reading for lispers.

A group of 3 lisping pupils aged from 10-12 years.

The experimenter stands in front of the pupils and demonstrates to them the position of the lips and tongue when uttering vowels. He then invites them to repeat the exercise one at a time. He then shows the position of the lips and tongue for the different consonants and makes each boy repeat the exercise.

7th PICTURE.

Lip-reading for the partially Deaf.

A deaf boy of 12 already versed in lipreading.

The experimenter speaks to him without uttering a sound, merely moving the lips, and directs him to open the door. The subject obeys. He then directs him to close his eyes and open his mouth, to raise his right hand, clap his hands, etc., (still without uttering a sound), and the subject obeys the orders easily.

Lastly, he directs him to repeat certain phrases (still using his lips only) : « What's your name ? » « What is your father's name ? » « To-day is Thursday » etc.

The subject obeys, moving his lips only, without uttering the sounds.

PROF. SANTE DE SANCTIS.

VIEWS OF A FILM-MAKER

(*From the French*)

The excellent account given by M. Jean Coutrot shows us how the cinema can help in spreading ideas of scientific management, in teaching its methods and rules and in systematically investigating the best conditions of work.

His account shows clearly that, in this field the cinema can give valuable aid both to the investigator and to the propagandist. Few films have been made with the sole purpose of spreading ideas of management or imparting its methods and, although many touch upon these matters, they lack what is essential, the main idea. Ten years of experience have taught us that there are many ways of treating the same subject in a film and that we must first have a definite aim in view

The fixing of this aim likewise determines the nature of the pictures themselves and the order in which they will follow one another on the screen. The film need not be a good one even if the end in view is clearly fixed, since a special technique is required, but it will certainly be a bad one unless the end to be attained is fully assimilated.

As soon as it is decided to produce an educational or propaganda film on a given subject, the maker must start with a definite conception and apply a special technique to whatever end is to be pursued.

For an educational film, the pictures will consist of a number of plans of different value intended to emphasise the essential points to be illustrated and which when combined will constitute the rhythm, movement and drive of the film.

For a propaganda film, on the other hand, which is intended for a large public, the action must have an emotional basis and consist of pre-eminently human features, which in our opinion can alone grip the masses through their appeal to the heart and feelings.

When the problem of scientific management was put before us by the French National Committee, we found after considerable thought that, in order to disseminate and inculcate the fundamental ideas, both the kinds of film we have referred to were needed. Accordingly, we drew up the following scheme of production:

1. A big propaganda film for the purpose of making known the principles of scientific management, showing particularly how the results are felt in the social sphere and in improved conditions of human life ;

2. Two educational films showing in detail the application of methods of scientific management and the results :

a) in a factory ;

b) in an agricultural enterprise.

THE PROPAGANDA FILM.

Our first task was to investigate the rules of scientific management as found in the writings of the men who promoted the idea. While paying our tribute to the

works of our distinguished compatriots, MM. Fayol and Le Chatelier, it seemed to, us beyond all doubt that the principles underlying scientific management are the same as those expounded by Taylor. The development of scientific management since Taylor's death shows, I think, that the principles he advocated still hold good and constitute the basis of this development.

We might have made a collection of principles and have furnished certain universally accepted examples of their practical application. These examples would have had to be selected from very different fields, comparisons would have had to be made, and parallels drawn, it being all the while remembered that the film was to be a propaganda film emphasising the spirit of scientific management.

If we had pursued this course, we should simply have constructed a documentary film in which the human aspects would have been entirely lacking. On the other hand, we found in the life of Taylor himself all the material required to show the results of his investigations and to emphasise the splendid example to humanity furnished by such a life.

In collaboration with M. Ponthiere we have prepared a scenario, of which the following are the main features.

PART I.

Genesis of his teaching.

1. Young Taylor's eyes hurt him. The doctor forbids him to continue his studies. Shows bourgeois and puritan environment and atmosphere of rigid honesty.

2. Employment of Taylor by William Sellers, a friend of the family. Taylor in the workshop and at games. His energy.

3. Taylor as foreman. His wish to make his gang work. The struggle. The men don't want to work harder. Why ? The daily wage — level of the lowest paid. Piece-rate cut down by the employer.

4. Taylor thinks. What is at the root of the matter ? What is a good day's work ? The task must be fixed. Analysis.

5. Attempt to fix the task. Failure owing to the work not having been prepared in advance ; each man works as he pleases. Necessary first to consider best way of doing work.

6. Lack of organisation. Indefinite instructions ; delays in supply of raw materials ; defective tools ; operation of the machinery. Circulation of material

7. Interview with William Sellers.

8. Distribution of work. The management leaves to the workmen a great deal of work which it should do itself. Share of the management. Laboratory « study of tools and machinery ». The planning department : delivery orders to the raw material shops. Delivery orders to the tools shops. Movement study.

9. The working chart. The standard is established and operates. Materials in the hands of the workman, etc. The process is standardised. It becomes possible to determine tasks quantitatively.

10. Time measurement.

11. The bonus wage system.

12. The maintenance of the « standard ». Functional efficiency.

13. Result : higher wages and lower cost of production; Share of profits : 1/3rd for the worker ; 1/3rd for capital ; 1/3rd for the consumer. Accountancy.

14. William Sellers is dismissed and replaced by Harrah, a financier. The latter only cares about profits, scorns Taylor's methods, but accepts them, because they pay.

PART II.

The efficiency expert.

He establishes the profession of consulting engineer.
Some of his clients.
At Bethlehem ; study of methods of shovelling material.
Discovery of rapid steel.

PART III.

The apostle.

Taylor decides to accept no more fees and to become an apostle of scientific management.

At Boxly. Family life.

The Tabor and Belt Companies. Administration, army and navy. The railways.

President of the American Association of Mechanical Engineers.

His lectures throughout the country and in the colleges.

Pilgrims at Boxly.

Parliamentary enquiry.

Fatigue and dreams. Application of his principles to all activities.

Every man justifies his wage.

The end.

EDUCATIONAL FILMS.

a) On the organisation of work in a large factory.

A film will be made in accordance with an admirable scheme prepared by M. Marcel Bloch, Chief Engineer of the Material and Workshops Department of the Orleans Company, which we annex to the present article.

b) On the organisation of work in an agricultural enterprise.

This is a new subject. Few of us have so far been seriously concerned to apply the principles of scientific management *systematically* to agriculture. The conditions of application are quite different from those relating to industry.

All agricultural work is of a variable character which distinguishes it clearly from industrial work.

Nevertheless, the same spirit of organisation may have beneficial results in this vast field of activity.

First of all we examined the conditions peculiar to agriculture. A study of many farms convinced us of the possibility of producing a film which would illustrate the application of the principles of scientific management in many directions, both outside the farm and inside. Action in these various fields may succeed in creating an attitude of mind.

Care must be taken, however. No section of the community is more critical than agriculturists. None is more individualist, and our examples will be so selected as to give rise to no objections or criticism in any quarter. Our comparisons will be beyond challenge; our conclusions sufficiently elastic and varied to admit of individual interpretation.

This film is now under consideration. The first draft of it is divided into two parts:

1. *Organisation of work outside the farm.*

The waste of time and money will be shown due to the distances between fields. How land, if not crops, might be exchanged.

The disadvantages of « enclaves » and the remedy.

The advantages of having land concentrated around the farm.

Passing next to the organisation of agricultural work, we shall endeavour to show that all the activities of the farm must be organised in order to get the maximum yield from the land:

(*a*) by the selection of implements, motive power and human material;
(*b*) by exact orders;
(*c*) by the organisation of bonuses to stimulate the farm hands;
(*d*) by a systematic campaign against waste of time in general;
(*e*) by the organisation of work necessitating a yard or workshop;

Organisation of work inside the farm.

It will be shown how work is facilitated:

(*a*) by a wise arrangement of buildings (repair workshops close to the shed where the damaged tools are kept. Fodder-preparing room near to the byres; food-storage premises connected with the preparing-room. Quick and easy communication. Toolshed close to the foreman's office, etc.);

(*b*) by a judicious use of ground conformations (how to make use of falls in level);

(*c*) by general or special installations (supply and distribution of water by pressure, production and distribution of power. Substitution of mechanical pumping for the carrying of water on the back);

(*d*) by the organisation of internal work (cowherds, stable-boys, etc.).

This part of the film will create an attitude of mind hostile to routine, *laisser-aller* and careless work and will correct the tendency of farm-hands to work as the spirit moves them.

The three films of which I have described the main features were decided upon and ready to be shot when I heard of the impending appointment by the League of Nations International Educational Cinematographic Institute of a Committee of Experts on Scientific Management. True to the ideal of international discipline which I have always preached and which the international Institute is now to put into practice, I feel it my duty to submit these drafts for the examination of the assembled experts and to wait — not long, I hope — until their manufacture can be proceeded with.

I do not think I can give any better proof than this of my devotion to and confidence in the Rome Institute, from which we are all expecting such great benefits.

JEAN BENOIT-LEVY.
Secretary-General of the French Committee,
of the League of Nations International Educational
Cinematographic Institute.

INQUIRY INTO THE PROGRESS AND USE OF THE CINEMA THROUGHOUT THE WORLD AS AN INSTRUMENT OF SCIENTIFIC MANAGEMENT

Before deciding to appoint a Committee of Experts to study the application of the cinema to the rational organization of production and to labour problems generally, the Direction of the International Educational Cinematographic Institute worked out a plan for an extensive inquiry throughout the world to ascertain the progress made by the cinema towards the solution of labour problems.

Within a few months of its formation, the Institute, having a clear conception of the task before it and the determination to render its efforts effective, succeeded in gathering together the strands of all the sources of information necessary for keeping track of the rapid advance of the film, among all civilised nations, as a means of propaganda and education. By a systematic study of the hundreds of reviews that reach the office from all parts of the world, and an efficient and elastic organization that is materially aided by numerous correspondents, the Institute was soon in a position to carry out its important task as a centre for the collection, study and supply of information.

Thanks to its very complete collection of newspapers and carefully compiled index, this League of Nations institution has acquired the authority of a first-class cultural centre, to which every student of problems connected with the various applications of the cinema may apply with the certainty of receiving valuable advice and assistance.

The inquiry undertaken in all countries for the purpose of ascertaining the progress made by the cinema in the realm of labour organization has yielded an enormous documentation, in five languages. Further documents continue to arrive, but we give below the conclusions reached after a careful examination of those to hand.

During the second half of last year, the Direction of the Institute sent out synthetic questionnaires dealing with these subjects. One of these questionnaires was sent to each Government, and another to institutions and organisations dealing with labour problems in each country. Experts and scientists, special reviews and newspapers in every country were likewise asked for information and their opinions.

NOTE. — *The information supplied by our contributor refers exclusively to the use of the cinema in rationalisation and kindred questions, but not to the general development of cinematography in the different countries. On this subject the* Int. Rev. of the Educ. Cin. *has published articles by expert authorities of various nationalities. As regards France, in particular, we would remind our readers that the August and December numbers contained a very full account of the progress of educational cinematography in France by M. Michel Coissac.*

The questionnaire to Governments was drawn up in the following form :

a) Has your Government concerned itself with the possibilities of the cinematograph in connection with vocational guidance or in obtaining better results from human labour and from production ?

b) Are there any « Official Sections » in your Ministry in charge of scientific management propaganda by means of the cinematograph?

c) Have you any laws regulating this propaganda?

d) In the above fields are there any schools, institutions, clubs or universities for the working classes etc., which make use of the film for the purposes mentioned?

e) Are there any publications, writings, books, etc., in use in your schools which deal with these problems ? If so, please state where such publications, etc., may be found.

f) What systems, if any, are used in your schools for vocational guidance and industrial or vocational teaching? Are there specialised workshops for this purpose? Where they exist, is the instruction theoretical only, or on what system is it based ?

g) Who decides the subjects of films for vocational teaching and guidance?

h) What organizations, institutions and associations in your country deal with these problems, and are any of them subsidized or officially recognised by the State?

i) Who are the persons who deal with these specific technical problems, and further, do any of your propagandists make use of the cinematograph in the fields above-mentioned? If so, could you let us have their names and addresses?

j) Are there in your country any firms producing films dealing with the above-mentioned subjects?

k) Is there a censorship of such films?

l) Are there any archives or catalogues of these films?

m) If these films are accepted, what aid do they give in teaching, and in what direction do they influence students' minds in regard to various trades?

n) Is the cost of educational cinematography in your schools included in your Budget, and if so, to what amount each year?

This questionnaire was accompanied by the following letter:

« The International Educational Cinematographic Institute, an organ of the League of Nations formed for the purpose of coordinating the progress and production of educational and cultural films throughout the world, has undertaken a vast programme of research work, documentation and inquiry.

« Among the subjects studied by our Institute, special attention is given to labour, and to the means offered by the cinema for the organic and systematic development of vocational guidance and teaching and for the scientific organization of labour.

« In order that trustworthy and definite conclusions may be drawn, we must know exactly what has been done, the experiments that have been made, the types of film that have been used and the results obtained.

« The cinematograph, applied to the choice and teaching of trades and, generally speaking, to the scientific organization of labour, may constitute a most valuable aid, as is proved by the decidedly beneficial influence which the cinematograph has had in the propaganda compaign for the prevention of occupational accidents.

« It is therefore essential that our Institute should know in what countries and in what way this collaboration of the cinematograph has been utilised. To this end, we have pleasure in sending your Ministry a general questionnaire summarising the fundamental points on which our international inquiry is based.

« Our Institute, which publishes a monthly review on the problems of the educational cinematograph, in five editions, one for each of the official languages of the Institute, would be very grateful if your Ministry would send us any official publications that it may have issued on the subject of labour problems. We might be able to get useful information out of them for our review, which we would gladly send to you in exchange.

« In the hope of receiving the desired information, for which we thank you in advance, we are your obedient servants ».

The questionnaire sent to the institutions of the various countries was as follows:

a) Has your Institute, in the normal course of its affairs, concerned itself up to the present with the possibilities of the cinematograph in connection with the problems of vocational guidance and training and the scientific organization of labour and, generally speaking, in obtaining better results from human labour and from production ?

b) Has your Institute ever had the opportunity of examining films intended to be used in vocational guidance and training or for problems connected with scientific management?

c) What defects didyou find in those films? Were they of an eminently technical, scientific and educational character, or were they rather in the nature of advertisements failing to give a true picture of whatever it was desired to present?

d) Who sent these films to your Institute? Do you know any film-producing firms of the above - mentioned type? Do you know any private persons or firms who work on similar lines?

e) Do you know whether, in the above-mentioned field, there are any schools, institutions, clubs, universities for the working classes etc., which make use of cinematograph films for the above-mentioned purposes?

f) Do you know whether reports, pamphlets, books, etc., dealing with these problems have been published? If so, could you give us information about them, or at least tell us from what source we could get such information?

g) Would you be kind enough to tell us what systems of vocational guidance and industrial and vocational training are used in your schools; and, if there are any publications on the subject, send them to us orhave them sent to us by the Ministry concerned? What results have been obtained? Have you specialised workshops? Are there many of them ? If you have none, is the teaching purely theoretical, or on what system is it based?

h) Has your Government already concerned itself with the cinematograph as

applied to the teaching and choice of trades or, generally speaking, to the improvement of production and the better selection of persons engaged in manual labour?

i) Have the big unions, whether workers' or employers', so far concerned themselves with this problem ?

j) What measures should be adopted, in your opinion, to attain this end as quickly as possible?

k) Do you think that this type of film should be shown also to workmen, or do you think it would tire them?

l) Does your Institute consider that these films should be of an essentially technical character, or — especially in the case of films dealing with «industrial knowledge » in general — that they would be more likely to interest if they were of a varied and more or less dramatic character?

m) Has considerable progress been made in your country as regards vocational guidance and training? Are there any legislative measures of a general order dealing with the subject?

The following «Communiqué» was sent to all foreign periodicals specially interested in labour problems, with the object of completing the collection of information received in answer to the above-mentioned questionnaires:

« After the formation of the International Institute of Agriculture and of the Institute for the Unification of Private Law, the Educational Cinematograph Institute was created in Rome at the initiative of the head of the Italian Government. At its Council Meeting of August 30 th 1928, the League of Nations accepted H. E. Signor Mussolini 's proposal and offer, and decided that the Institute should be its official organ, with headquarters in the Eternal City.

« To this end the Italian Government offered the historic Villa Falconieri, at Frascati, as the seat of the Institute, and also put the Villa Torlonia at its disposal; it is in the latter building that the Institute now has its general offices. The Government also granted the sum necessary to put the two villas in order and to pay the working expenses of the Institute during its initial stages.

« The International Educational Cinematographic Institute is now, thanks to the generous contributions of the Italian Government, in a position to carry out its vast programme.

« The Institute is a great instrument of education and international collaboration in one of the most important branches of our social, educational, intellectual and economic life.

« The cinematograph is undoubtedly destined to exercise strong influence on the education of the peoples of the world, and much has already been done in this direction; there is no doubt that its mission will become daily wider in its scope.

« One of the subjects in which the Institute is most interested, and which it has studied with special attention, is labour, and the means offered by the cinema to assist the organic and systematic development of vocational guidance, vocational training and scientific management.

« The Institute also deals with: the improvement of the efficiency of the human

factor, which in spite of the enormous progress in machinery, still remains the central factor in all work ; the physiology of labour ; the study of fatigue and automatism ; industrial psychology and individual and collective psycho-technique ; production and the prevention of occupational accidents.

« The cinema undoubtedly offers enormously valuable assistance in all the above mentioned fields, and might have a decidedly beneficial influence on the improvement of modern working conditions.

« The International Institute for the Cinematograph works in perfect accord with the International Labour Office, with which it came to a special working agreement that was approved by M. Albert Thomas and Dr. Luciano De Feo, directors of the Geneva and Rome organisations. The International Management Institute also decided at the May meeting of its Governing Body, to entrust the Rome Institute with the task of collecting and sifting all the material to be found throughout the world on the application of the cinema to methods of scientific management.

« But in order to arrive at concrete results in this documentary investigation, the Rome organ of the League desires to have the opinion of the big manufacturer and of all those who are interested in labour problems, on this collaboration of the cinematograph.

« There are many big manufacturers and sociologists in your country who are interested in the complex questions connected with the scientific organization of labour. We are glad to collaborate in such important humanitarian work, and to invite these gentlemen to express their opinion, with the certainty that they will thereby be contributing towards the realisation of notable benefits to labour and the working man ».

RESULTS OF THE INQUIRY.

As will be seen from the table we give below, 52 different countries were interested in the inquiry as well as numerous individuals, organizations and reviews in each country. The answers cannot, for obvious reasons, be considered entirely exhaustive ; but it is important tonote the number of new correspondents, and the exchange of information, in some cases only just beginning, with such far-off countries as South Africa, China ,Japan, Australia, Canada, etc.

One fundamental point stands out from the examination of the voluminous correspondence to hand, viz., that the possibilities of the cinema, with its multiple manifestations, are everywhere appreciated ; and that the proposal of the Institute has been received with sympathy and approval. There is no doubt, therefore, that if a judicious exchange of correspondence and news and collaboration with individuals and organizations in far-off countries are maintained, the Institute will be able to keep watch over and guide the progress of the educational cinema throughout the world. This is a task of the highest moral and human value, and is of such delicacy and importance that the competent authorities should be convinced of the necessity of assisting the Institute by all the means in ther power.

The two figures under each of the headings: Persons, Organizations, Reviews indicate, the one to the left of the reader, the numberof circulars sent, and the one to the right, the number of answers received :

Country	Government	Persons	Organisations	Reviews
1. Argentina	—	3 = 0	2 = 0	0 = 0
2. Australia	Yes	1 = 0	0 = 0	4 = 0
3. Austria	Yes	6 = 1	13 = 4	0 = 0
4. Belgium	—	2 = 0	5 = 1	4 = 0
5. Brazil	Yes	0 = 0	0 = 0	0 = 0
6. Bulgaria	—	2 = 0	1 = 0	0 = 0
7. Canada	Yes	1 = 0	1 = 0	10 = 0
8. Chile	—	0 = 0	0 = 0	0 = 0
9. China	—	0 = 0	0 = 0	0 = 0
10. Columbia	—	0 = 0	0 = 0	0 = 0
11. Cuba (Havana)	—	1 = 0	0 = 0	4 = 0
12. Curacao (W. Indies)	—	0 = 0	0 = 0	0 = 0
13. Czechoslovakia	—	9 = 0	6 = 3	1 = 0
14. Danzig (Free State)	—	0 = 0	1 = 1	0 = 0
15. Denmark	Yes	3 = 0	3 = 1	0 = 0
16. Estonia	Yes	5 = 0	1 = 0	0 = 0
17. Finland	Yes	2 = 0	2 = 0	7 = 0
18. France	—	17 = 5	24 = 6	18 = 0
19. Germany	Yes	29 = 8	90 = 36	0 = 0
20. Gold Coast	Yes	0 = 0	0 = 0	0 = 0
21. Great Britain	—	36 = 2	15 = 5	1 = 0
22. Greece	—	1 = 0	1 = 1	0 = 0
23. Dutch Guiana	—	0 = 0	0 = 0	0 = 0
24. Hungary	—	1 = 1	0 = 0	2 = 0
25. Iceland (Rejkjavik)	—	0 = 0	0 = 0	0 = 0
26. India	Yes	2 = 0	0 = 0	0 = 0
27. Indo-China (Singapore)	—	0 = 0	0 = 0	0 = 0
28. Irish Free State	Yes	0 = 0	4 = 0	0 = 0
29. Italy	Yes	56 = 15	8 = 2	2 = 0
30. Japan	Yes	1 = 0	4 = 0	6 = 0
31. Java	—	0 = 0	0 = 0	0 = 0
32. Jugoslavia	—	0 = 0	0 = 0	0 = 0
33. Kwantung	—	0 = 0	0 = 0	0 = 0
34. Latvia (Riga)	—	1 = 0	0 = 0	0 = 0
35. Lithuania (Kaunas)	—	1 = 0	0 = 0	0 = 0
36. Luxemburg	—	1 = 0	2 = 0	0 = 0
37. Netherlands	Yes	4 = 2	9 = 4	7 = 1
38. New Zealand	Yes	0 = 0	0 = 0	3 = 0
39. Norway	—	0 = 0	3 — 0	0 = 0
40. Poland	Yes	5 = 0	1 = 1	2 = 0
41. Roumania	Yes	5 = 0	3 = 3	0 = 0
42. Russia	Yes	23 = 0	0 = 0	1 = 0

Country	Governmente	Persons	Organisations	Reviews
43. South Africa (Pretoria) . . .	Yes	4 = 1	6 = 0	0 = 0
44. Siam (Bangkok)	—	0 = 0	0 = 0	0 = 0
45. Sierra Leone	Yes	0 = 0	0 = 0	0 = 0
46. Spain	—	1 = 0	5 = 0	0 = 0
47. Sweden	—	3 = 0	0 = 0	10 = 0
48. Switzerland	Yes	4 = 0	15 = 5	4 = 0
49. Trinidad and Tobago	—	0 = 0	0 = 0	0 = 0
50. Turkey	—	0 = 0	1 = 0	0 = 0
51. United States of America. .	Yes	8 = 1	25 = 8	0 = 0
52. Uruguay	—	0 = 0	0 = 0	0 = 0
Total . . . 22		238 = 37	251 = 81	86 = 1

Considering the time required fully to develop so vast an enquiry, the results so far obtained may be considered decidedly satisfactory.

Although not always very exhaustive, the answers show on the whole a clear understanding of the Institute's high aims, and hold out prospects of coordinated and continuous action to assist the local efforts of governments and scientific organizations. We give below a summary of the answers received from the various States, so that a fairly clear picture may be had of the progress made by the educational cinema. The subject is one for an international Committee, which should work out the broad lines of the programme to be carried out by the Institute.

Australia

The Secretariat of the Prime Minister arranged for the Board of Education to study and answer the questionnaire sent from Rome. Up to the present, there has been no practical application of the educational cinema, but its possibilities are fully appreciated, and it is felt that it should be employed on a large scale.

The Rector of the University of Adelaide and the Director of the Mining and Industrial School are interested in the problem.

The Board of Education of Sydney instructed its Special Office of Vocational Education, which concerns itself with the use of films for purposes of demonstration, to answer the questionnaire. It appears that this Office has arranged an extensive programme making use of the cinema, which will be carried out as far as the means at its disposal permit. The Sidney Office informs us that the Board of Public Health is also seriously considering the use of educational films. Meanwhile, the Rotary Committees are making propaganda by means of the cinema, and are opening elementary courses in the various trades. Up to the present, there are no local firms capable of producing technical films, and the government offices concerned are therefore proposing to produce such films themselves, and then to issue a catalogue of their productions.

The Premier of Melbourne replied that the cinema has not yet come within his jurisdiction as a means of education and instruction, and that he is therefore not in a position to give any information on the subject; but he states that, considerable screen activity for propaganda and educational purposes may shortly be expected.

AUSTRIA.

The *Ministry of National Education* gave the questionnaire serious consideration, and after discussing it with the Ministry of Social Welfare and the Ministry of Industry and Commerce, sent in the conclusions of the three ministries. They are all disposed to support to the utmost the use of the educational film, which has not hitherto been made the subject of special study by the Austrian Government. There is therefore no legislation on the subject, nor any programme for the application of the cinema. The competent authorities have had occasion to observe the interest displayed by young people in educational films., and are disposed to make use of them on a large scale. One of the main reasons why the educational film has not yet been used to any extent is the lack of funds for the purpose, the Government being disinclined to assign the necessary sums in view of the extreme costliness of the new method.

The *Arbeitsgemeinschaft für Psychotechnik*, of Vienna, states that it makes use of educational films for theoretical instruction, and that these films are prepared by special firms.

There are schools in Austria for vocational training and guidance and the film is beginning to be used in these schools, although it is rather a costly method of instruction. The Institute considers that films for workers should be prepared by men who have made a study of the psychology of the worker. or such men should at any rate have an active part in the preparation of the films.

The Technical Section of the *Austrian Industrial Union* informs us that it has not yet made any use of educational films, but is disposed to do so.

BELGIUM.

The *Université Cinematographique*, of Brussels, sends information in regard to its activities, stating that every year it calls twenty meetings together, at which 7 instructive films are projected before being seen by the thousands of men working in the coal mines, tanneries, glassworks, electrical works and spinning mills. Intense interest is taken by the workers in these projections, and the Belgian Cinematographic University therefore proposes to increase the production of instructional films dealing with widely differing subjects.

The University has prepared special films for the Solvay Works in France, for the State Mines, the Philips'Works and the Brickmakers' Corporation in Holland, producing altogether, in the four years of its existence, 560 films, most of them for manufacturing and affiliated companies.

The *Fédération des Charbonnages* of Belgium is preparing an historical docu-

mentary film on the coal-mining industry, which will be projected during the forthcoming exhibition at Liége.

Altogether, the use of the educational film has made considerable progress in Belgium.

CZECHOSLOVAKIA.

The *Institute of the Economy of Labour in Agriculture* informs us that for some time past it has made wide use of the film for propaganda purposes in the scientific organization of agricultural labour, and for the instruction of students in the Agricultural Institute, which is one of the faculties of the Polytechnic of Prague. The Institute does not concern itself with vocational training, but there is a central consulting office in the Capital for this purpose, which is extremely well-equipped.

The experience gained in the field of agricultural propaganda by means of the film has induced the Institute to advise the production of short carefully studied and worked out films, and the Institute is of the opinion that, if it adheres to these requirements, the film may attain unlooked-for results.

The *National Czechoslovak Committee* on scientific management states that it has not yet concerned itself with the use of the educational film, but intends to do so shortly. The commercial and vocational schools have used the cinema for some time past to show the work being carried on in workshops, while the Masaryk Academy uses propaganda films illustrating American systems of scientific management. There is no national production of educational films in Czechoslovakia as yet, and the institutions and organizations making use of these films therefore get them from abroad. It is hoped and expected that there will shortly be an exchange of films between the various nations ; and the institutions, etc. are of opinion that the films should be short (projections lasting from 10 to 15 minutes) and should be based on genuinely technical subjects, so that they may interest the special public to which they will be presented.

The *Institute for Economising Fuel* also replied to the questionnaire, stating that so far it has not considered the possibility of using the cinema for vocational training and labour organisation, mainly because special organizations like the Masaryk Academy make a point of dealing with this branch.

DANZIG.

The *Psychological Institute of the Polytechnic* states that the educational film is considered a very efficient means of instruction, and that its wide use should be carefully studied and supported. Some films have already been adopted for teaching purposes in the Free City and lantern slides are widely used for that purpose. All the Universities and secondary schools have their own projecting apparatus, and some professors illustrate their lectures with films.

The educational cinema is making considerable progress in the Free City of Danzig, but is not proceeding as rapidly as it might, for lack of means. Professor Henning who answers the questionnaire says frankly that the advance of the educational film is entirely a question of « money ».

DENMARK.

The Danish Government has not up to the present given any special attention to the possibilities of the educational cinema, but this branch of cinematograph has been introduced into Denmark and has made considerable progress. It is used more especially by certain technical schools and polytechnics, the Technological Istitute, and the Royal Veterinary and Agricultural Institutes, which make use mainly of foreign films, mostly German, there being no national production. Professors and students are all hoping for a wide use of educational films in schools, considering them of great utility in the teaching of children.

ESTONIA.

The *Ministry of Education* replied to the questionnaire, stating that the Government has not asyet definitely concerned itself with the use of the educational film, and that there are therefore no special laws or regulations dealing with the the subject.

Enquiries have shown that certain teaching or cultural organisations make use of the film, while the schools generally are introducing the educational cinema as a regular and valuable aid to teacher and pupil. To this end a Committee has been appointed to study the question, the majority of its members being drawn from the teaching profession. There is already a catalogue of educational films in Estonia, compiled under the direction of the Curator of the Museum at Tartu.

FINLAND.

The Government replied to the questionnaire through the *Sozial Ministerium of Helsingfors*, informing us that the use of the educational film in the State schools has been the subject of study by a Higher Educational Committee since 1928. The Commitee drew up a programme which has been submitted to the superior authorities.

The Organisation for the Protection of Workers has decided to make use of films in vocational training and has bought some films of this type from abroad ; and the *Head Manager of the Knoppamaeki Domestic Industry* published a book entitled *The Educational Film as a Means of Culture* as long ago as 1926.

The Government has granted a subsidy for the preparation of an anti-alcohol film and the drawing up of a national list of instructional films.

On the whole, the Government of Helsingfors considers the use of the film in scholastic and vocational teaching of great utility and advantage and is disposed to give every support and encouragement to the spread of this means of instruction.

FRANCE.

The Government does not appear to have considered the regular use of the educational film so far but there are special institutions which deal with the question

The *International Committee of Scientific Management* mentions certain educa-

tional and propaganda films that have been produced in France and that mark the beginning of a wider use of the cinema for technical and scientific purposes.

The *Messagerie Hachette* has prepared a special propaganda film demonstrating the detailed organisation for the collection, despatch and sale of newspapers and reviews. The film shows the loss to the seller from the defective sales organisation in kiosks, whereas a rational organisation would lead to a rapid disposal of copies in hand.

The firm of *Robert Bastardie*, of Paris, has prepared a film with the title : « Rationalisation applied to a Banking System ». This film proved to be of great utility in helping to spread modern methods of organisation in banks.

The *International Vocational Institute* introduced the regular use of special films this year, to be projected during vocational classes ; the trial has given excellent results.

The *Standardisation Office for Motor Cars* replied to the questionnaire, stating that so far it had not had an opportunity of making use of educational films. On the whole, the situation throughout France is favourable to the spread of the educational film, which has probably not been able to take firm hold yet on account of the lack of an organised national production.

Germany.

The use of the educational film in all its branches has made enormous strides in Germany, being supported by the Government and by a number of different institutions. Germany is undoubtedly at the head of all the nations in Europe in the utilisation of the screen for instructional educational and propaganda purposes.

Particular attention has been paid to special applications of the film in scientific management ; and a number of firms have been constituted in Berlin, Frankfort and other principal towns, which specialise in the production of these films.

The *Deutsche Institut für wirtschaftliche Arbeit in der öffentlichen Verwaltung* (DIWIV), replying to the questionnaire, states that the educational film has long been the subject of serious consideration by the Institute, which has also made considerable use of it. The films used are not produced by the Institute, but by special firms which show great ability in working out themes and manufacturing the films.

The *Deutscher Handwerks-u. Gewerbekammertag*, of Hanover, states that there is a very extensive use of films among its associated firms, which have the films produced in accordance with their requirements by special firms. The advantages of the cinema in the organisation of labour and the problems connected with it are by now generally admitted by all manufacturers and they make considerable use of it.

The *Arbeitsgemeinschaft für Industriereform*, replying to the questionnaire, observes, that, although recognising the value of the film for educational and instructional purposes, it is compelled to make but small use of it on account of the high

cost. There is no doubt, however that the educational cinema has gained the attention of the ruling classes and of the education authorities, so that its prompt adoption is assured.

The *Deutsche Gesellschaft für rationelle Malverfahren* admits the great utility of the educational film, and states that circumstances have hitherto prevented the use of such films within its field of activities, but that these circumstances will be overcome.

The *Ausschuss für wirtschaftliche Fertigung* beim Reichskuratorium für Wirtschaftlichkeit states that for some time past it has been making use of instructional films specially intended for the scientific organisation of labour, in which field it is very widely used.

The *Institut für forstliche Arbeitswissenschaft*, of Eberswalde, says, in answer to the questionnaire, that the film has been of valuable aid to it for some time past, both for instructional and propaganda purposes. The Institute recently had a special film made on the systems of timber transport in the mountains.

The *Disconto Gesellschaft* had a film produced towards the end of 1927, under the title: « The Modern Management of a Bank » which has proved of great use and advantage to young persons newly employed by the Institute, because by its means they are enabled to follow the working of the complicated and delicate services of the different offices, and so learn to collaborate with the mass of employees.

The *Mercedes Werke*, which produces office machines on a large scale, especially calculating machines, has produced a film on the « Thinking Machine » which gives a detailed picture of the various parts of the machine, their operation and the rational manipulation of the machine by the employee.

The *Psychologisches Institut*, of Munich states that it has already made use of the film with considerable benefit.

The *Reichsahstalt für Arbeitsvermittlung und Arbeitslosenversicherung* strongly favours the use of the educational cinema and describes a film it has had produced, under the title: « From School-bench to Workshop ». This film is of great educational value and may be included in the category of vocational films.

The *Psychotechical Institute of the Dresden Polytechnic* sends information of some scientific films produced by special firms and regularly used by the Institute in its instructional courses.

The *Taylorix Gesellschaft*, of Berlin, informs us of the use on a large scale of films dealing with scientific management and is of opinion that such films, when properly prepared are a really efficient means of instruction and propaganda.

The *Verein Deutscher Ingenieure*, the representative association of German engineers, expresses itself decidedly in favour of the use of the film for educational purposes, and especially of its application to scientific management. Many of its members recognise the value of such films and make wide use of them.

The *Verband Sozialer Baubetriebe*, to which belong 140 building firms, giving employment to about 20,000 workers, states that it has created a section of its own dealing exclusively with the scientific organization of building yards, and that it uses special films for purposes of propaganda among its members, which have been

found very useful for the instruction of both masters (engineers and foremen etc.) and workmen. This is a typical example, which should be particularly noted.

The *Vereinigte Stahlwerke Aktiengesellschaft*, of Düsseldorf, declares that it highly appreciates the utility of films for propaganda and vocational teaching and that it is at present promoting the production of special films dealing with the prevention of occupational accidents.

We could continue to add to this list of documents, but those that we have mentioned sufficiently demonstrate the manifold applications of the film in German industry and technical schools, and the fact that the educational film is being continually improved and more widely used. Germany undoubtedly offers a vast field of observation and study for the International Educational Cinematographic Institute to the eventual benefit of those countries which are still behind in the use o the film for purposes of instruction and the organisation of labour.

INDIA

The *Director of Public Education* of the Board of Education of Bombay made a careful study of the questionnaire and informs us that the possibilities of the educational film in vocational training are well known, but the Government has done no practical work in this field up to the present.

An attempt to promote the use of the cinema in this way would, however, find the Government favourably disposed.

IRISH FREE STATE.

In the Irish Free State, as in South Africa, Czechoslovakia and Germany, considerable progress has been made in the use of films for agricultural propaganda. The Irish Ministry for Agriculture, in its answer to the questionnaire, deals with the many advantages conferred on various branches of activity by the educational cinema, and the special support given to it by the Government.

ITALY

The National Government, which was determined to reserve to Italy the honour and the burden of entertaining the International Educational Cinematographic Institute has clearly shown how much importance it places on the film as a means of instruction, education, propaganda and assistance in everthing connected with the organisation of labour. There is no doubt that within a short time Italy will rank with the United States and Germany in making the widest use of the educational cinema in school, workshop, and before the general public. Work has already been done in many important branches, although there is not yet a regular national production of educational films.

The *L U C E Institute*, which was formed by the Fascist Government for the purpose of undertaking the production of national films of the kind, will certainly be able to make a valuable contribution to this collection.

The *National Institute of Scientific Management*, constituted by the General

Confederation of Industry, proposes to prepare and collect technical films for use in its own sphere of activities.

JAPAN.

The Japanese Government took the questionnaire into serious consideration, and states in its answer that excellent use has been made of the educational cinema in the Far East. Through its embassy at Rome, the Government sent the Institute some publications issued by the Committee of Studies of the Ministry of Education which is responsible for the teaching of arts and crafts. The following are the titles of these publications: « Consideration of the character of a scholar and his preparation for a trade »; « History and meaning of vocational training »

The Ministry publishes a monthly review: « Vocational training ».

The educational and instructional film is therefore the subject of special care and consideration on the part of the Japanese Government, while private institutions highly appreciate the cinema's aid in the field of labour.

NEW ZEALAND.

The *Board of Education* informs us that for the present the Government Publicity Office is preparing films for foreign propaganda. No regular attempt has been made to use the cinema in connection with vocational training and scientific management.

This omission, however, is due to no lack of appreciation of the film's utility, which is indeed acknowledged, but rather to the fact that large funds are necessary to the carrying out of such experiments. The financial question is one for the consideration of the competent authorities; but the way is open for the development of the cinema in the technical and cultural fields and there is no doubt that the Rome Institute will be able to give efficient aid.

POLAND.

The *Polish Institute of Scientific Management* states that the ground is already prepared for the introduction of the film as an aid to teaching and organisation, especially in factories. The Institute has had opportunities of realising the advantages offered by such films, but their widespread use depends on the possibility of obtaining suitable films at a reasonable cost.

ROUMANIA.

This Balkan nation, also, attaches great importance to the use of films in agricultural propaganda, in which branch the Ministry of Agriculture is particularly interested. On this point the Government will send detailed information to the Rome Institute.

The *Psychological Institute of the University of Cluj* has seriously considered the questionnaire sent to it, and states that no practical use has yet been made of the film in vocational training or scientific management, although the value of the film for

these purposes is not disputed. The above Institute has two psycho-technical sections, one at the University of Bucharest and one at the University of Jassy, and an office for vocational guidance in the big industrial and metallurgical centre of Resitza; but the film has not yet been employed. The Direction of the Institute, however, hopes shortly to be able to arrange for its use as a means of propaganda, in the work of vocational guidance, and to aid in psychological aptitude and intelligence tests.

The *Roumanian Institute of Scientific Management*, in its answers to the questionnaire, states that it has not had occasion to make use of the cinema in carrying out its aims, but keeps in contact with various organizations abroad in order to study the progress made in the use of the film. The Institute mentions the following difficulties: *a*) lack of information in regard to developments abroad in connection with the educational cinema; *b*) high cost of other than commercial films.

The Institute is in favour of active propaganda in Roumania in school and working circles for the use of the film in its various instructional and educational aspects.

Russia

We know, through information from various authoritative sources, that the Russian Government makes widespread use of the cinematograph as a means of propaganda and instruction. The *Central Labour Institute* of Moscow answered the questionnaire, and states that one of its tasks is the use of the educational cinema in vocational teaching and scientific management. For its own educational needs, it has prepared some films dealing especially with mechanical labour and the rationalisation of movements.

The workmen's organisations have considered very seriously the use of films within their own branches of activity, appreciating the cinema's advantages and encouraging its widespread use. The value of the film, according to the Moscow Institute, depends on its character and the lines on which it has been prepared. The Institute is of opinion that films for teaching purposes are of great use when they are of a lively, amusing and dramatic character. This secures the attention of the public and thereby helps to attain the end in view.

It is pointed out that vocational teaching has progressed very far in Russia, which is natural enough in a country where work is the sovereign factor of life.

South Africa (Pretoria)

The Chief of the Central Board of Education replied to the questionnaire. As soon as he received the document from the Institute, he sent out a circular on the subject to the competent institutions and organisations of the South African Union, and received 25 replies. His answer therefore represents the results of an inquiry made in his country, and is thus of special importance. The Government of Pretoria is fully aware of the great potential value of the educational cinema, but the work in South Africa is still in its initial stages. The chief use of it is made by the Ministry of Agriculture, which has several propaganda films, with explanations and instruction in the local language and in English.

The psycho-technical laboratories make use of the film for a variety of experiments, and also in certain tests for air pilots.

Professor Powell, a specialist in horticulture at the Transvaal University College took sixteen films, of the total length of 3500 feet, during a long study-tour; one of the films, dealing with the lemon and citric acid industry, is especially interesting. The Government has arranged for a regular use of the educational cinema both for propaganda and in schools and proposes to have studies made of the most suitable type of film that can be adapted to local school requirements.

SWITZERLAND

The *Federal Ministry of Public Economy*, Commercial Division, sent answers to the questionnaire, stating that the film has not yet been adopted in Switzerland for vocational training and that there are no organisations or institutions which produce such films.

Certain private firms have had films produced for propaganda purposes and for certain branches of industry. No catalogue of instructional films has yet been prepared, and none of the technical schools possess even a projecting apparatus.

The *Psycho-technical Institute* of Zurich states, on the other hand, that in its own sphere it is very much interested in the use of the film and has had several propared by special firms.

There is a more or less pronounced tendency in the different cantons to make use of the educational cinema, and also to employit in connection with scientific management. At Zurich, especially, the ground is well prepared.

UNITED STATES

The *United States Government* replied to the questionnaire through the Education Office of the Home Department, to the effect that the various States of the Confederation exercise direct control over the working of their respective schools and that the Central Government does not directly interest itself in these affairs. The film is widely used in schools for teaching and educational purposes, the selection of films being made by the teaching staff.

The *Ministry of Agriculture* also answered the questionnaire, stating that it concerns itself with the production of propaganda films with the object of arousing interest in every form of agricultural activity and stimulating collaboration among farmers in selecting systems of cultivation, developing forests, building roads, etc.

The purpose of the film is to attract the attention of that part of the farming population which is engaged in special branches of production.

The special aim of the United States Governmet in connection with agricultural labour problems is to secure the maximum output from each labourer rather than a greater yield per unit of the area cultivated; to that end, it encourages the maximum employment of men and animals on the land, with all the aid that can be given by apparatus and machinery to save fatigue. In the development of this propaganda, the Department of Agriculture has had occasion to appreciate the inestimable advantages of the film.

The *Office of Domestic Economy* of the Department of Agriculture, which is chiefly concerned with problems connected with the domestic side of farm life, states that it attaches great importance to the use of instructional and educational films. These films, however, must be rationally conceived and must not be of too theatrical a nature, if they are to please the public. Hitherto, films of this type have as a rule been prepared only by those interested in offering their own products and making commercial propaganda.

The *American Home Economics Association* states that, up to the present, it has not decided on a regular use of educational films. The Y. M. C. A. and the Washington Federal Board for Vocational Education are more especially concerned with this branch. The Eastman Kodak Co., of New York, makes a speciality of the production of educational films.

The *Industrial Relations Counsellors*, of New York, tell us that in the course of their activities they frequently make use of the film for instructional and propaganda purposes, having a high opinion of the value of the educational cinema. The association sends, together with its answer to the questionnaire, a list of associations and libraries which are in a position to give information concerning the American production of educational films.

The film has been employed in many useful and interesting ways in industry.

The *Detroit Edison Co.* states that it has realised the necessity of having a film prepared showing the dangers of high tension electric wires, and that this film has been shown broadcast in schools and to the general public. It is a typical example of a propaganda film for the prevention of occupational accidents.

The *Lidgerwood Manufacturing Co.*, of Elizabeth, states that it makes regular use of films reproducing all the details of the machinery used in its work, their rational use, the working methods to be followed and the results obtained. These films are projected before the trade corporations and especially before new workmen, so that they may understand the tasks that will be allotted to them before they enter the factory and may also realise the working of the factory and thus be able to fit into the part assigned to them. A knowledge of the machinery and its working, and a knowledge of the accidents that are liable to occur and how to prevent them, serve as a good preparation to the worker before entering the organisation.

Conclusions

One of the most important results of the inquiry is that we have ascertained that there is a widespread realisation in the more advanced countries, of the possibilities of the cinema as a means of instruction, education, propaganda and assistance in the rationalisation of labour, while it is universally agreed that the film constitutes an effective means of education and instruction.

The necessity of organising agriculture, which was impressed on several Governments in Europe and America immediately after the termination of war revealed the great value of the cinema as a means of propaganda and instruction. It is highly advisable, therefore, that other countries which are equally interested in the rational development of their agricultural resources but which make little or no use of the

screen for the instruction of their rural populations, should at once set to work to utilise this asset.

The International Educational Cinematographic Institute undertakes to assist governments and organizations, encourage initiative, coordinate the efforts of the various contries and instruct committees of enquiry in what has been done and what is being projected elsewhere.

The organisation of industry is likewise proceeding, but this branch requires much more detailed and exact study than that of agriculture, since it encroaches upon the psycho-technical field: choice of vocation, preparation for a trade, improvement of guilds and corporations, cycles of operations, fatigue, prevention of accidents, etc.

The inquiry has shown that very few nations utilise even a part of the numerous possibilities of the film in studying the problems connected with the organisation of labour, while only two or three make use of these possibilities to the utmost. One main reason for this failure to benefit by the screen in this connection is the *excessive cost* of films. The industrial conditions of the present time make it possible for only a few privileged nations to incur the necessary outlay.

In the face of these financial difficulties, to which may be added other difficulties of technique and organisation, such as the production and exchange of films, the International Institute has a number of varied and complicated tasks to carry out which cannot be entrusted to other institutions. In order that these tasks may be carefully studied and defined, and the criteria and methods of carrying them out drawn up, it will be necessary to appoint an international committee of experts to plan and direct the work of assistance which the Direction of the Institute is called upon to undertake.

Lastly the inquiry has shown that the possibilities of the educational cinema throughout the civilised world are numberless, and that it may develop into a highly important source of instruction, education, prevention and protection.

The important work to be carried out and developed by means of this instrument that science has put in our hands necessitates such an immense and regulated output of energy that the men who are called upon to accept the responsibility ask the League of Nations to give its serious attention to the matter.

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