

EFFORT

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FOREWORD

THIS publication is an attempt to demonstrate the results of the team work of two authors of widely differing experience in life, one being an artist, and the other an industrialist.

The urge to collaborate arose from their common interest in Human Effort, and the conviction that the study of Effort is to-day necessary to everyone in his own personal life, and in every field of activity in which he may engage.

The authors desire to express their thanks to A. Proctor Burman, who has helped them indefatigably to sort the material of research accumulated over many years from which the present book is derived.

Burman, an engineer and Olympic skater, contributed to many valuable discussions relevant to our theme and to the exposition of our principles, both theoretical and practical.

We ought in justice to extend our thanks to many thousands of people with whom we have worked and experimented, and it is our hope that all our collaborators will find in this publication the best possible expression of our gratitude.

RUDOLF LABAN

F. C. LAWRENCE

Manchester

July 15th, 1947.

BIOGRAPHICAL NOTE

RUDOLF LABAN, born in Bratislava, Czechoslovakia, even in his earliest years found a fascination in observing people's movements. His desire to probe the secrets of physical and mental effort led him on a long course of study, experiment and research. Architecture first attracted him, but did not satisfy. He went to Paris, Berlin, Vienna and other centres of learning to study the arts and sciences essential to the student of movement, amongst them Mathematics, Physics, Chemistry, Physiology and Anatomy.

He was led from the academic to the practical all over the world in search of indigenous and cultivated activity—to the American Indians, the natives of Africa, the peoples of the Near East, and the Chinese—in order to study at first hand their peculiar habits and the manifestations of their power.

Ballet naturally claimed his major attention and in time he became Director of Movement in the Berlin State Opera and one of the best known of choreographers. Reacting against the artificiality of the theatre, however, he sought expression of his art and philosophy amongst the common people, and, all over Europe, centres were established in his name for the artisans who came to seek advice on their own working problems; the strains and stresses involved in their various occupations. In these centres they found the bodily awareness, understanding and relief in the courses of movement that were provided especially to meet their needs.

The freedom thus bestowed on them found no place amidst the wickedness of Nazidom, and Laban, with some of his pupils, sought sanctuary in England. Remarkable developments followed in this country, till then so backward in appreciation of man's capabilities in dance or at work; sport seemed the only outlet for this urge to movement.

To-day, the Laban Art of Movement Guild, recently incorporated, is the centre of the expression in Britain of Laban's

growing influence in Education. In many schools the children are being trained and selected by Laban methods; also, in Art, where for instance, Laban's emancipation of the Ballet from its stylised tradition is evidenced in the work of one of his pupils, Kurt Jooss.

The Laban Movement Notation is used all over the world, and in New York there is a special bureau that controls its use in the U.S.A.

More recently, Laban has turned to industry, and in the past five years established the Laban-Lawrence Industrial Rhythm which comprises new methods of notation, selection, training, investigation of working processes and job valuation. This development has been made in association with F. C. Lawrence, in whose practice as Management Consultant these new methods have been brought to a point when they can now be said to offer a vital contribution to the solution of the difficult problems that arise in the management of men and women in industry.

MACDONALD & EVANS

July 15th, 1947.

PREFACE

THE tremendous collective effort made by political and economic associations, nations and the whole of mankind is evident to-day to everyone who reads the papers and listens to the radio. The struggle for the technical mastery of our environment fascinates the spectator to such a degree, that the importance of individual effort is often forgotten. The success or failure of our striving to resolve the difficulties of existence and to bring order and prosperity out of chaos depends primarily on the personal contribution of millions of people to a common aim. Few people realise that their contentment in work and their happiness in life, as well as any personal or collective success, is conditioned by the perfect development and use of their individual efforts. We speak about "industrial effort," "war effort," "cultural effort," without realising that each collective action is built up from mental and manual efforts of individual people. We forget that all our striving to be reasonable and friendly and to combat our wrong habits are so many instances of individual effort. But what effort really is and how this essential function of man could be assessed and adapted to the specific necessities of life remains for most people an unsolved problem.

Education, and to a certain extent industry, but in the greatest degree the cruel devastation of war, have each called attention to the individual efforts of children, of adult workers, and men in the Services.

Methods of selection and training have been devised, but individual effort has never been really investigated. What has been taken so far as the basis of examination and test was but the surface indication of effort, not the effort itself.

Here, from a new angle, an attempt is made to penetrate to the core of man's effort, an attempt born in the joint authors' lifelong occupation with movement in two different fields of human activity—namely, art and industry.

The pooling of the two authors' experience coincided with

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the Second World War, when the necessity to simplify and condense the methods of assessment of human effort became urgent. The resulting method of effort control here introduced has made it possible to achieve in 10 to 20 hours what previously occupied 100 hours when observation, analysis, and the working out by trial and error were the vogue. This new method, however, proved to be more than a time-saving device. Shedding a new light on the nature of effort, it revealed itself as a method of instruction and training leading to increased enjoyment of work through the awareness and practice of its rhythmic character.

Now that this method has been established in practice in a number of factories, as well as in the realms of art and education, the details must be published, so that its extensive use may contribute to the return of prosperity, and to the broadening of human relationships in private and communal life.

In spite of the fact that all of us judge the efforts of other people every day from the cradle to the grave, the source and origin of such judgements was never seriously studied. We assess our own efforts partially, and other people's efforts critically. A mass of almost superstitious beliefs and routine practices help us—or are thought to help us—in the endeavour to know ourselves, and to select people for posts, or as team members, or for executive positions. Everyone has found in life a sufficient number of instances where the unjust and superficial assessment of his own or of other people's efforts has caused trouble, misunderstanding and misery. Peaceful intercourse, well-being and economic prosperity depend upon the right assessment of our own and our neighbours' efforts.

A person's efforts are visibly expressed in the rhythms of his bodily motion. It thus becomes necessary to study these rhythms, and to extract from them those elements which will help us to compile a systematic survey of the forms effort can take in human action.

A rhythm may consist of strong, quick and direct movements. People who are strong, quick and direct can easily be distinguished from those with sensitive fine touch, sustained consideration and a flexible approach to decisions and actions. Persons thus endowed look and move differently from the strong, quick and direct

people. You will recognise them if you meet them, and you may recognise such characteristics in yourself.

The lesson to be learnt from these distinctions is that human effort is variable in its manifestation, and a compound of several elements mixed together in an almost infinite number of combinations.

The deeper understanding of the endless variations of rhythm movements demands, however, a complete technique. The rudimentary knowledge of a principle is not sufficient for the assessment of a person's aptitude for special work or for guiding him to the right choice of a profession. It would be presumptuous to teach or to train a person for higher efficiency in work and life on the basis of such scanty knowledge.

Once rightly assessed, individual effort can be changed and improved by training, for, in the end, all education is based upon effort-training. The conscious penetration into our effort life can be used, and, what is more, is needed for many purposes. The recognition of the nature of effort is necessary for that self-training of our own efforts which is so painfully enforced upon us in the hard school of life.

We are striving to become the rulers of ourselves, and though we are still far from the achievement of this aim, human society has progressed some way towards the goal. Now a more efficient and more impartial control of all the individual efforts is demanded than was hitherto possible.

The control of individual effort advocated in this book, and the realisation that this control is based on the observation of rhythmic movement, is not a specific that will cure all evils. Yet, it is a serviceable basis on which to make our selections and examinations, our education and training, and finally also some of our most important social measures and economic decisions, and that in a more humane and adequate way than in the past.

Something should be said about the form of research from which the facts contained in this book are derived.

To-day research becomes more and more a matter of team work. No longer does the student retire from the world in order to record his own visions and dreams. Knowledge, in most fields, has become too complex to be mastered by any one

man, and many branches of knowledge have to contribute to the elucidation of special problems. The physicist and the mathematician investigate motion, and the engineer bases his practical activity on their researches. The anthropologist and physician offer data to the teacher on which he can build up his educational principles. The industrialist uses the knowledge gathered by the sociologist and economist who investigate motion again from a different angle. The artist cannot do without the experiences of the anatomist, and the circle is closed by the philosopher, who tries to link ideals with realities. Human effort plays thereby an increasingly appreciated rôle. Motion, visible everywhere in the whole universe, permeates all these sciences and practical fields of application, thus to build an almost inextricable network of common interest in its study.

This branch of knowledge and practice is in its contemporary form not much older than half a century. Taylor, the protagonist of what he called "scientific management," first used the expression "motion study," and he foresaw its application particularly in the field of industry. Since his time, education and art as well as many other pursuits have adopted the methods of effort research, which is an essential part of motion study. In this epoch of industrial revolution or evolution such research is bound to find its first and greatest application in industry.

The pooling of common experiences from all the fields contributory to this subject has to-day become an imperious necessity, and in this publication we make a modest attempt to show the results of team work—the pooling of knowledge, experiments, and practical application—drawn from at least two main human activities, industry and art. From the training of an apprentice to the function of a manager the mastery of individual effort is ultimately decisive for success.

Even the technical part of industry dealing with the flow of material, and indirectly only with the rhythmic movement of man, has in the present civilisation—often called the machine age—the greatest influence upon the development and deployment of individual effort.

The other important source of inspiration for modern effort study is the art of movement on the playground and on the stage.

Rhythmic movement is the basis of play and art, both prominent factors in the education of children and adults, in which the development of individual effort is the essential aim. The actor on the stage shows in his rhythmic movements a great variety of efforts which are characteristic for almost all shades of human personality. The actor studies the movements of all kinds of people in real life and what he observes are exactly those elements of bodily motion which are of vital interest to effort research.

The line of approach the authors of this book have taken in dealing with their subject is in some respect similar to that of the actor studying his models. In searching for the hidden effort behind the rhythm of movement and sound, it has been discovered that practically everyone has the natural gift to discern rhythm. Few people, however, realise that what they discern is in reality effort. They hear the sound variations in a tune produced by the efforts of the musician. They can at the same time see these efforts by observing the musician while he is playing; indeed, if we see a musician playing on the screen, and the sound track should fail, it is still possible to discern whether the tune is vivid or languid, gay or sad. In watching dancing, our interest is focused upon the visible efforts forming the rhythm expressed by movement. In a similar way we can discern the rhythm in the efforts of any working person.

When the efforts of the musician, dancer or workman are strong, direct and quick, the impression upon us will be quite different from what it is when the efforts are light, flexible and sustained.

This impression is based upon the fact that rhythm speaks to us independently of the task to which it is applied. We can gather the meaning of a movement and though it seems to be difficult to express it in exact words, rhythm conveys something by which we are influenced: we may be excited, depressed, or tranquillised.

The amalgamation of the two impressions of rhythmic movement gained in industry and art offers the new approach to the problems of individual and collective effort.

Unconscious effort-reading is the explanation for our belief that we can see the thoughts and feelings shown in facial expression, in body carriage, and in the almost imperceptible expressive movements of hands, shoulders, and so on.

The subtle effort rhythms appearing in the smaller everyday movements are more difficult to decipher than the larger action efforts in work and play.

The degrees of effort-expression as well as the ability to read them are individually different. Some people might show in their effort rhythms—small or large—an astonishing variety and intensity, others might avoid any superfluous movement not needed for a practical purpose.

To be a good observer of other persons' effort-expressions, one need not oneself have great bodily expressiveness. Good movers may be poor observers, for they may see nothing in small effort-rhythms, and may even be unable to notice the evident rhythm in larger movements.

Our age and civilisation are definitely on the poor side, both in effort-expression and effort-reading.

It is appalling to contemplate how the general intellectual trend during the past two thousand years has brought the effort-rhythm components of the human mind ever nearer to stagnation. Effort-rhythm was the cohesive medium of all living styles of architecture, painting, sculpture and fashion in ancient times. It was the basis, too, of movement and behaviour in everyday life, and of the working actions which resulted in the creation of so much beauty. To-day all that remains of this former rhythmic vitality has been directed into mechanical devices in which the living, driving force of man has been neglected and left without articulate expression. To-day it is the audible rhythm of music which alone remains as a last concession to man's desire for a language of effort. But music alone cannot suffice to create harmonious and efficient action—it is as if we were standing somehow detached from our rhythmicity instead of it being an integral part of our lives.

Seen in this light, the investigation into the nature of effort takes on a new aspect, which, however, exceeds the scope of the main theme of this book on effort control in industry.

It is in the working actions of man that efforts become most clearly discernible. It is in industry that the control of effort has become an urgent necessity. The results of the study of working efforts are, however, of universal interest because man uses the same efforts in all his activities and even in his expressive gestures.

Although the practical application of the new knowledge of human effort in industry differs from that in education, art and other fields of human activity, the fundamental principles remain the same.

Investigations dealing with the different aspects of effort control in other domains are reserved for treatment in later publications.

CHAPTER I

ECONOMY OF HUMAN EFFORT

THE tendency of our age to replace human-power by machine-power represents one side only of the problem of the economy of human effort.

The other side is the rational use of human-power so far as it is still employed in industry

Two main considerations determine the construction of machines. One is that the machine shall be able to do the work hitherto done by men in a more efficient manner than men can do it, and the other is that the handling of machines by men shall be made as easy as possible.

Yet there is another aspect, perhaps the most important aspect of the economy of human effort.

The efficient machine which can be easily operated is driven and assisted by men who should be enabled to use their own bodily power in the right way

The capacity to do so is unevenly distributed by nature. The faulty ways in which the human body engine is used vary individually, and a very small number of people only have the innate gift to apply their muscular power efficiently to whatever tasks confront them. Some people have a natural vocation for certain tasks. Put on work which is consonant with their gift, they will show an admirable economy of effort, and this is the first prerequisite of skill. Confronted with tasks lying outside their natural capacity they might be, however, as awkward as the majority of people who cannot adapt themselves easily to any kind of work.

The two necessary measures to further a general economy of human effort are selection and instruction. Selection means the putting of the right man on the right job, instruction is the teaching of people how to use the bodily engine in the right way

Efficient selection and instruction demand both a thorough knowledge of the nature and the display of human effort. A man

might show exceptional skill in certain operations, and to employ him on tasks in which these operations occur is common sense. Yet it is quite possible that the man in question has more than this one gift, and he might even be still more efficient in another task than that given to him. It is a waste of human effort to employ a man on tasks for which he is less gifted and deny him the opportunity to exercise his best faculties.

Without a thorough knowledge of the nature and the display of human efforts, opportunities are often overlooked to the employer's as well as the employee's disadvantage. It is likewise a waste of human effort if a latent capacity, which could be easily developed by adequate instruction, is left to remain undeveloped. A further necessity of instruction arises from the general lack of skill as shown by the great majority of people. Everybody knows that a long experience enables one to do particular jobs with an acceptable degree of efficiency. Apprenticeship is based on this fact. Adequate instruction can shorten apprenticeship, and this is desirable because it is a waste of human effort to leave a person longer than necessary in an untrained state. During the instruction of apprentices latent gifts might become evident. Many who do not show any appreciable sign of skill might have dormant qualities which can be awakened and fostered. To leave latent qualities undeveloped is again contrary to a rational economy of human effort.

Knowledge of the nature and the right display of human effort can be acquired in several ways. Personal experience in apprenticeship training and selection remain forcedly restricted to the type of the economy of effort most needed in the industry in which the experience has been gained. A more general survey can result from the collection of the experiences made by several people and in various fields of human activity. A third source of knowledge is the investigation of the effort capacities displayed in the functions of man's bodily engine, and of the rules which govern their economic and efficient application.

This third type of investigation forms the main theme of the present treatise. The description of the bodily engine and of its functions envisages a vast field of research with which a whole series of sciences such as anatomy, physiology, biology, psychology and anthropology, including sociology, are linked.

The description of a machine is, however, quite different from the description of its practical handling, and so the description of the human body engine differs from that of its practical use in any kind of work.

Any handling of things, and the bodily functions engaged in it, is an art demanding not only knowledge but also skill. The rules of skill, which are in essence applied science, have been most clearly developed in recreational activities such as sports, games, gymnastics, the dance, music and the theatrical arts. The application of the experience gained in these activities to industry is in its initial stages only. The fact that not only industry but also recreation—indeed any kind of activity—have profited from the exchange of ideas concerning economy of human effort might justify the publication of the new viewpoints arising from those aspects of the problem common to both the art of management and the art of the recreational trainer.

A simple example will make the difference between the scientific and the practical approach to the problem of economy of effort clear.

Suppose a man has to push a heavy object away. The practical consideration will be to determine whether he is able to do this efficiently or not. When he uses the right economy of effort, he will perform the task efficiently. If he is inefficient, one of the first things discerned will be that he uses either too much or too little strength. This lack of the control of strength might have many causes of greater or lesser interest for his instructor. The main thing, however, is to develop the man's capacity to control strength in the degree to which he is physically able to exert it.

In investigating such effort the different branches of science will dwell upon special causes which might or might not be relevant in practice.

A knowledge of anatomy and physiology will inform the instructor that the average man uses, in pushing things away, such and such muscles, which receive their stimulus from such and such parts of the nervous system, and that a certain alternation between exertion and relaxation must take place in order to avoid over-fatigue. Biology will teach the instructor that the weakness or coarseness of muscular action can be inherited or acquired. Psychology will differentiate between a voluntary or

involuntary inhibition of control, and seek its causes in some remote or recent experiences of the working person. Anthropology and sociology might discover a connection between the social situation of the man and his physiological and psychological inhibitions. All this information could lead in the best case to the removal of all the causes of failure, if such removal be possible.

The main practical problem is, however, to assist the man to exert tightly controlled effort under all and even the worst exterior conditions.

Practical analysis of effort offers a more secure and immediate help. It will be easy to determine whether the deficient action is done with exaggerated or with too little strength, and it can also be seen whether the effort errs by excess or defect. Witness of this is the progress of the pushed object in Space and Time. The man can push the thing along a straight line much farther than intended, or he can reach his goal by a roundabout path, which both constitute a waste of effort. The movement can be wrongly timed it can be too quick or too slow. The essential point is how the control of the Weight-moving force fits with the control of the progress in Space and Time. It is the sense for the proportion between the degrees of these motion factors which determines the degree of the economy of effort used.

This criterion of efficiency, the right proportionality of Weight, Space, Time and the control of the Flow of movement, is also the peculiar aim of observation from which all scientific analysis can draw its conclusions. The deficiency or redundancy of the effort becomes visible in this proportionality only. Suspected causes of anatomical and psychological character can be investigated by circumstantial tests and questioning afterwards, but the decisive first impression consists in nothing else than in the observable co-ordination of Weight-Space-Time control during the movement.

As long as a man is only occasionally disturbed by outward circumstances, it is of no use to pay too much attention to them. It is much more important to foster his sense of proportion, so that he will be able to maintain a perfect effort even in adverse situations. When such disturbances prevail habitually the development of the sense of proportion becomes imperative, and is then quite as important as the removal of the extraneous

obstacles that hinder the full deployment of his capacity for effort.

The external arrangement of working conditions and personal inhibitions lies outside the scope of this publication. The central problem is, in our opinion, the development and safeguarding of the sense of the proportions of the factors of Motion, Weight, Space and Time, and their controlled Flow. The lack of the sense of proportion is the main stumbling-block of efficiency.

Man is conscious of the efforts bridging the gulf between our intentions and the realisation of them by our movements and actions. In these cases movements and actions are preceded by a conscious decision to perform the definite task. Many movements are, however, done involuntarily—that means, without the investigation and guidance of a conscious decision. In the automatic repetitive movements used so frequently in industry, man does not think of the motive, or even the effect of his movements, he simply performs them in the right order after having taken the initial decision to do the work.

Any voluntary or involuntary movement involves an effort. The state in which no effort is made is rest. Rest is something else than relaxation, as in rest all effort is absent, while in the activity of relaxing some effort is present. In relaxation the degree of exertion contained in the effort might be reduced without, however, abolishing it altogether. Examples of this are the relaxed movements which alternate with movements of greater exertion and create thereby the simplest form of rhythm. Rests inserted between exertions for the sake of recovery from fatigue represent the cessation or end of a movement or of a sequence of movements. The length of rests between operations must be proportionate to the length and intensity of exertion in order to allow the muscles and nerves to recover from fatigue. The time needed for recovery is that sufficient (*a*) for the elimination of waste material accumulated during work in the muscle and nerve tissues, parts of which have been burned up in producing the efforts, and (*b*) for the building up or feeding of new muscle tissue which can be used in the following exertions.

Such replacing of waste material by new fuel can, however, take place to a certain degree during the relaxed parts of a well-proportioned rhythm of effort. Well-regulated rhythmic move-

ment is thus less fatiguing than those movements in which exertions and relaxations are distributed regardless of the repeated recovery of muscle tissue and nervous energy.

Rhythmic movement is pleasant, partly because its energy-saving qualities are felt by the operator and partly because it gives to the actions a certain perfection.

Distorted and cramped performance of rhythmic exertions are, however, resented not only as harmful but also because of the feeling of frustration they engender.

The contentment accompanying the beauty of well-rhythmised and therefore skilled movements plays a great rôle in the economy of human effort.

CHAPTER II

THE APPROPRIATE USE OF MOVEMENT

Any inappropriate use of movement is just a waste of effort. The only advantage is that the intelligent person using for a time the inappropriate movement will, in time, learn by trial and error more or less accurately the movements appropriate to the job.

This is, in fact, the case in all learning. An occasional chance success will be noticed, and the learner will try to repeat the advantageous combination of motion factors. The inappropriate forms of effort will be discarded by degrees until the most appropriate form is almost automatically employed. This final stage of perfection is called skill.

Skill is acquired through the gradual refinement of the feel of the movement, and any training has indeed to promote this feel, which, in its essence, is the awakening of the sense for the proportions of motion factors. Some people will learn quicker than others. The self learner, being restricted to the trial and error method, will acquire skill in a longer or shorter time according to his natural ability. The methodically trained learner has the chance to advance more quickly, even if he is less gifted. The best practical method consists of a combination of exercise and the awakening of the understanding of the rules of the proportionality between motion factors.

It is obvious that a learner, who has been made aware of the fact that he exerts too much or too little effort in his operation, will have the advantage of another learner who must detect the cause of failure by prolonged trial. Few people realise in the beginning of their learning period that they may lack the necessary capacity for exertion, and the finer distinctions in the display of it.

The trainer who is able to develop the lacking capacity will implicitly convey the finer shades of exertion to his pupil. A shortening of the learning period will result in all cases, no matter if the pupil is gifted or not.

Mental understanding, which contributes to the awakening of

filled to its complete loading capacity without breakages. This was a regular job twice a week or so.

The men disliked the work and grumbled each time they were delegated to it, while the girls enjoyed the large swinging movements by which the sticks were gathered, passed from hand to hand, and restacked in good order in the van.

In this tale the accent is to be laid upon the simple swinging effort in contrast to the complicated and cramped efforts of gathering and transmitting haphazardly formed bundles of staves. The sight of the overcrowded row of men working with the bound flow of overcrowded effort generated in the mind of the observers the contrasting vision of a light and simple free flow of the material. The employment of a lesser number of more flexible operators was the natural consequence of the vision and of an improved flow of material, resulting in a more cheerful attitude of the operators content with their success.

This special operation was an ancillary sideline within a series of activities. The aim of the investigation was to determine operations suitable for women.

In the whole concern of rural industry connected with agriculture and forestry only a dozen jobs had been estimated as being suitable for women. The investigation showed that 180 operations can be easily done and done better by women. The total number of women needed turned out to be much smaller than the number of men employed formerly, and this was mainly due to the new vision of the flow of efforts required for the jobs in question. In some cases, however, the original estimate of the suitability of jobs for women had to be revised. It had been assumed that operating a machine for drilling holes into medium-sized logs, involving little weight-lifting and simple handling of a few clamps and switches, was a relatively easy job, and could therefore be quickly learnt by a girl. What had been left out of consideration was that the job is very straightforward, requiring direct and angular movements. The space effort to be used thereby does not correspond with the natural nimbleness and flexibility of feminine effort. Our argument was that unless a girl could be found who had a masculine flow of movement, the job had better be left to a man or a boy. The foreman, disregarding our advice as a too subtle speculation, delegated to the job a

CHAPTER VII

THINKING IN TERMS OF EFFORT

Most successful foremen, supervisors and managers think involuntarily in terms of effort. Many of them, however, are frequently distracted from this kind of thinking because it is not only involuntary but they are also entirely unconscious of it. Blinded by the ordinary conception of the task which must be somehow fulfilled, they do not much care for the "how," and frequently use the most clumsy means because the work has always been done in this or that way, or because they do not wish to fight against outer circumstances. A person able to visualise the rhythm of the efforts used in a job is often confronted by a grotesque spectacle.

During our early experimental investigations we once witnessed in a sawmill the loading of a van with small staves. The workers employed on this job were a dozen heavily clad strong men whose ordinary job was the transport of heavy trees from the forest to the gantry where they discharged their lorries, piling up the tree trunks in gigantic heaps and balancing on them with remarkable acrobatic skill.

Delegated to the loading of the small staves, which were piled up for drying under a shed, they formed a solid row from the piles to the van and passed on to one another a voluminous bundle of staves, during which a good number of sticks fell on the ground. The two men in the van had great trouble in heaping the irregular bundles of staves inside the vehicle, with the result that many of the staves were broken and the loading space could not be used to its full capacity.

Replacing the twelve men by five girls—of whom three were standing equally spaced between the stacks and the van, while one collected the staves one at a time from the piles, and another arranged them in the vehicle—the task was performed in half the time by less than half the number of workers, and the van was

girl who compensated the straightness of the efforts needed by dance-like evolutions connected with many unnecessary steps. Her insufficient output and profound unhappiness were attributed to personal stubbornness and unreliability, until we found her a suitable job in the orchard, where she did very well.

The work in the orchard gives the opportunity of mentioning another unsuspected application of the vision of flow. Complaints of customers called attention to the fact that the lower layers of cherries collected in baskets were ripe, while the upper layers were unripe. Carelessness on the part of the Land Army girls who did this job was assumed to be the cause. Observation of the flow of their operational movements showed, however, that these movements, which were at the beginning quite determined and relatively regular, became afterwards erratic and undecided. It turned out that after a time they could no longer discern the red colour of the ripe cherries from the yellow colour of the unripe ones, which made them run uncertainly from one tree to another. This increasing hesitation and restless way of working were obviously caused by eyestrain. In staring at the small spots of colour among the green foliage fluttering in the wind, the operators soon lost the faculty to discern the colour of the cherries. Red and green are complementary colours which are confused by naturally colour-blind people. The remedy for the temporary colour-blindness of the operators consisted in short relaxations of the eyes at regular intervals, after collecting each layer of cherries they were instructed to look at some spot of neutral colour or to shut the eyes for a moment. The result was not only baskets full of ripe cherries but also a much quicker filling of the baskets. The cause of the disturbing irregularity was detected by the observation of the changes of efforts which resulted finally in movements characteristic of blind people. When the girls had become used to relaxing their eye muscles at regular intervals, the foreman had no further cause or opportunity to admonish the girls for carelessness, and as the job was now done more cheerfully, the whole atmosphere of work was changed from restless discontent into peace.

Thinking in terms of effort seems to govern certain labour regulations, as, for instance, the stipulation concerning the limits of weight-lifting for age groups and sexes, or the payment of

overtime, and so on. The consideration of the weight and time efforts contained in these regulations, however, is not based upon real effort-thinking. Very few operations consist of a simple weight effort only, and questions of timing and speed can never be solved independently of the other efforts involved in a job.

There is a great difference when a heavy object is simply lifted from the ground on to a bench and when the object lifted is carried over a long distance, as, say, in a foundry when a mould filled with sand is carried to the bed. There is again a difference between the shouldering of a sack of potatoes and the lifting of a heavy object on to a high shelf. The efforts used in each of these operations are quite different. To say that a boy or a woman can lift so much and a man can lift a certain number of pounds more is an over-simplification.

In the early stages of our experimental investigation we visited a factory where motor-car tyres were subjected to certain manufacturing processes. The small tyres, the weight of which represented approximately the official lifting limit allowed for women, had disappeared together with private cars because of war conditions. At the same time, and for the same cause, female labour was introduced. One of the activities involving a certain weight effort was to hang the tyres on pegs at above shoulder height. Our investigations proved that the prescribed limits for handling weights are based on prejudice. The action of hanging the tyres on the pegs contained, if well performed, almost no lifting effort, so that the women could easily handle tyres of almost double the weight of those quoted in the official scales. It was, of course, necessary to instruct the operators not to lift but to give the tyre a swing, by which it is carried by its own momentum to the desired height. It was also necessary to train the operators to support the tyre at the right instant before it had exhausted its momentum, which action requires little strength but involves the faculty of suddenly changing the sustained free-flowing effort used during the swinging into a bound flow in order to stop the movement. The presumed lifting operation thus vanished into a rhythmic alteration of the contrasts of flow effort and time effort. The observation of two women painfully pushing the tyre to the desired height engendered the vision of the freely flowing

material which needed only a small addition of human energy exerted by one woman.

The Time-Weight mistakes resulting from the inability to think in terms of effort are legion. One of the favourite time-honoured tests of apprentice efficiency in engineering activities is the filing of metal.

It is worth while considering these tests in detail, because they so well reveal the present deficiency of effort-thinking.

The attempt was made to assess efficiency in this job through the measuring of the number of the filing strokes and the amount or weight of the filings produced.

Everybody knows that one does not file metal in order to produce filings, but to give the piece of metal some desired shape. In other words, filing is a form-giving activity.

In spite of this, the amount of filings produced in a certain time has been taken in the investigation of filing metal as the measurable result of the action. It was a great surprise to the investigators that the amount of filings produced does not increase at the same ratio as the speed of movement—that is, the number of filing strokes during a time unit.

In doing appreciably more than ninety filing strokes in a minute, a limit of speed is soon reached beyond which filing ceases to be effective.

Between the output in filings there is, however, no appreciable difference if either ninety strokes or seventy strokes are made in one minute. The twenty strokes over the seventy, therefore, constitute a pure waste of effort.

What can be learnt from this experiment is that speediness does not always increase efficiency.

But this is not all. It was discovered that the output does not change regularly with the speed. Slow filing with from thirty-three to thirty-five filing strokes in one minute produces 20 to 26.5 grams of filings in an hour, while double the amount of filing strokes, namely, from sixty-six to seventy strokes in one minute, does not produce, as might be expected, double the amount of filings, namely, 40 to 53 grams in an hour, but produces in fact triple the amount, namely, 68 to 81 grams of filings in an hour.

From this it will be seen that for the simple purpose of removing

material through filing there is an optimum speed. All these calculations concerning speed, however, become meaningless when a shape is to be created. Mental efforts come into the picture and are bound to influence the rate of output. The addition of mental elements necessarily demands a modification of the traditional outlook on effort research.

Apprentices twenty years ago spent seven years filing and chipping in order to become fitters. To-day dilute labour is taught to do these things in six months, purely through the efforts having been studied and performed correctly.

Yet still there is an idolisation of speed, against which the modern student of effort-rhythm has constantly to fight. It must be realised that speed cannot be increased indefinitely, or rather up to the utmost capacity of an individual, without endangering the quality of the action and thus also the quantity of output.

Exaggerated speed kills reflection, too speedy action is wrong, as it leads to thoughtlessness. Returning to the example of filing, the real aim is to shape the piece of metal by exerting a sustained cutting pressure upon it. This cannot be done purely mechanically—time must be left for the intelligent observation of the shape. This factor has been forgotten in the tests described above.

The lack of care for the shape can be clearly seen in the ineffective hasty rubbing which characterises speedy filing. Visual attention is a mental effort, and the degree of its presence or absence can be seen in the performance of the filing movement. The worker is unable to control the effect of hasty strokes.

There is also a technical point which has escaped the attention of early investigators, and that is the fact that actions are transmuted into other actions by increasing or decreasing their speed. The new actions have quite a different effect. For instance, the sustained pressure of good filing cannot remain a pressure if too quickly done. A pressure is always relatively slow. Anybody can try this out by pressing slowly and then by increasing the speed. He will notice that the action is transmuted into a kind of thrusting punch. Thrusts cannot be used effectively in good filing.

Modern effort research has led to the discovery of the gradual

transmutation of actions through the changes of single elements of effort, as, for instance, speed. But motion has more elements than one, and the harmonious interplay of all of them must be taken into consideration if the aim is to determine how far an operation has been performed efficiently.

The faculty of man to get the conscious sensation (colloquially "to get the feel") of such mutations and of any other changes in rhythm and effort is something which is an essential addition to effort-thinking.

Many prejudices concerning human effort are artificially inculcated into the mind and effort-habits of the unfortunate industrial apprentice. The learners are no better off when entering a factory where the same thoughtless insistence upon the phantoms of speed and mass continues to impair their working efficiency and happiness.

Thinking in terms of effort should, however, precede the probable failures resulting from the usual trial and error methods, instead of being applied in cases of emergency and after accidents or debacles only. Many operations of our highly mechanised epoch require effort-combinations which are not at all natural and do not correspond to the ordinary movement habits of man. Mind and body must be sometimes trained upwards to the machines as their structure and rhythm become more and more exacting. The functional purpose of the machine may produce such increases of temperature, speed, noise and so on, that man can hardly endure it.

This is again a new view of future effort-thinking, that in effort-training a simple device is offered by which man can be provided with a higher degree of endurance. There are, of course, cases where additional mechanical devices are the only resource, but looking at these devices one will see that although they do not require an increase of physical strength they doubtless ask for highly increased attentional efforts and other forms of mental strain.

Many new inventions demand new movements and combinations of efforts for which the human body engine does not seem to be adapted. Take, for instance, parachute-jumping from an aeroplane. Although this is not exactly an industrial operation in the narrower sense, it shows clearly man's adaptation to the

use of machines, and is most characteristic for the new effort-combinations arising in our present form of civilisation.

The main and first experience of a parachutist is the falling into the void. It is connected with a feeling of passivity and sudden relaxation of all muscles, frequently followed by a complete cramping of the body, which both stand in great contrast to the efforts needed for a successful descent. The parachutist has to release the canopy—if this is not done mechanically as with modern military parachutes. He has to look up to see if the canopy ropes are twisted, if they are twisted he must try to untwist them by kicking his feet or by methodical swinging. He must release air from the canopy, providing thus for a direct descent. He can do this by grasping the forward or the rear webs on which he hangs. Sometimes he must grasp diagonally and pull either one or two webs to release air. He must occasionally turn round to see the ground beneath him, which movement is effected by crossing his arms and pulling the webs simultaneously.

In preparing the landing, he must either grasp the front webs, bend his head down, press his feet together, toes up, knees bent, if he wants to land by rolling on his back, or grasp the rear webs, head down, feet together, toes up, knees bent and turned slightly sideways, if he wants to land forward.

Landing sideways or diagonally requires slightly different positions and actions all aiming at the preservation of ankles, knees, hips, shoulders, elbows, head, from a too vehement impact with the ground.

None of these combinations of positions and efforts is natural to man, but he can be trained to get the feel of them and even to automatise their most salient features.

The greatest danger is to carry the head high—the traditional gesture of heroic man—which leads infallibly to concussion or even to a broken neck.

To-day these movements have all been thoroughly studied—but after how many tragic and fatal trials and errors! Thinking in terms of effort at the outset of the first parachuting experiments, and of many other new and unusual exertions, would have saved the lives and health of many thousands.

The difference between such outstanding examples of new forms

of human efforts and the modern complication in ordinary industrial life is not so great as might be surmised. The drivers of all the numerous vehicles which man has invented need clear effort-thinking, but the basic preconditions of this kind of thinking are still in the dark.

The possibility of discovering the sources of individual effort-failures and of improving results by effort-training must be extended to group work and team work.

As an example the following experimental investigation may be mentioned.

The cause of an atmosphere of discontent and general mistrust in a factory, or in one of its departments, is usually ascribed to unhappiness in work. Such a statement, however, offers no solution to the problem. Searching for the root of such detrimental moods in a special case, it became obvious that it could be neither the excessive heaviness of the work, because the job was not heavy, nor could it be any other outer condition, such as irregularities in the flow of material or in insufficient payment or bad treatment, because the outer conditions were excellent.

Common negative criticisms of administration measures were rather the result than the cause of the mood, because these criticisms were without serious foundations.

Only two men seemed to stand apart or be free from the common brooding in this department, and these two were people who performed the operations with the relatively light efforts which were really needed for the specific task. All the others overstrained themselves without necessity.

Following up this cue, the individual performance of the rest—some twenty people working separately on the same job—was investigated in all its details. The astonishing fact was that they all showed the same divergence from the natural effort-sequence applied by the two men who alone did not adopt the negative attitude of the others.

The exaggerated efforts used by the majority can be briefly described as a kind of cramped weight effort, due perhaps to the fact that they had never received any essential movement instruction in the performance of the relatively light job, accordingly, they devised their own method of dealing with it. This method consisted mainly of regularly recurring violent contractions of the

muscles of hands and arms, similar efforts are the expression of anger, impatience and even fury. In this special case the continuous repetition of these efforts seemed to engender or at least to promote the mood of anger and impatience without any root or cause in outer circumstances.

The increasing excitement was brought to a standstill, the mood gradually disappeared and the self-inflicted overstrain gradually ceased when the men were induced to use the calm effort-sequences of the two peaceful men.

The only obstacle to a complete cure was the manager, who was himself a man with spasmodic hand and arm muscle contractions. He was not able to think in terms of effort and was strongly opposed to a systematic effort-training. His conversion would have required the training of himself.

Much good can be done when the logic of effort is grasped and assimilated by the logic of the brain. In heavy engineering team piecework is unavoidable. Equally unavoidable is the conflict within the team, of which fifty per cent. do the real work while the other half of the team shares the payment without greatly contributing to the output. We met such a case during one of our early experimental investigations. The great variety and changing character of the work in heavy engineering, where teams are needed for the production of a single piece of work, say, of boilers, does not allow for any of the usual yardsticks of the value of work.

Templet-makers, grinders, hand burners, smiths, drillers, platers and many other helpers who co-operate in the production of one article, all need different amounts of time for each special job. The time needed by a templet-maker might vary from fifty hours for a complicated job to a few minutes for a simple one. The templet-maker must reflect more than other members of the team.

Some jobs can be done in a speedy way—others require sustained work. A fast plater is usually crude, but there is a difference between a sustained plater who does his work thoroughly and a slow plater who uses awkward methods of procedure.

Some jobs require great strength while others must be done with fine touch. Although few of the jobs occurring in this

team-effort were really repetitive, there were some jobs which had to be done in series, such as the adjusting of pipes by the fitters. The foreman estimates the duration of the work on a certain item containing a series of pipe settings, say, a hundred, and if there is any slowing down, which would tend to retard subsequent jobs, the operators are "pushed on" by the foreman.

Some jobs are neither repetitive nor serial, but consist of entirely free operations adapted to the requirements of the moment. Minute operations alternate with work requiring much space or with that demanding great flexibility within a relatively small space. Some of the workers may sit and work leisurely, while others, as, for instance, those operating inside the boiler, have to adopt strange contortions. The flow of work is in each job different, continuous flow can be seen besides irregularly interrupted sudden actions.

A job-effort graph showing the rhythm of these various operations looks like a score of orchestral music, because there is not one line of efforts only but several which are performed simultaneously by different persons.

Such an effort-graph, however, offers the solution of the problem of how to measure the value of the individual contribution to the team effort. Each individual's performance does or does not fit into the common rhythm, and this determines the positive or negative value of his contribution to the team-effort. Degrees of fitting into the team-effort become discernible. One man never falls out of the common rhythm, another sometimes fails in the tight joining in, and a third might continuously hamper or obstruct the common action—not to speak of those who carefully avoid joining in at all, leaving the work as far as possible to the others.

A relatively high degree of effort-thinking is required for the establishment or specification of such complex forms of job rhythm. When the latter has once been established it is easy for any intelligent foreman to control the personal performances efficiently. The result will then be "payment according to performance," and such form of bonus payment up to a certain percentage of basic wages has indeed been tried out in some places following our recommendation. The method has been found satisfactory enough to be kept going for years without the

troublesome complaints to which team piecework was hitherto subjected.

The assessment of the individual performances within a team cannot be done without thinking in terms of effort. It has been found, however, that the foremen instructed for this purpose have assimilated this kind of thinking very readily in a few weeks. Another important point is that the office routine, by which the assessments of the foremen are translated into money value, must also be guided by effort-thinking. The administrative personnel facing this task responded excellently and thus contributed to the happy solution of the problem.

The not entirely unexpected but not directly intended result of this kind of effort-control was that it gave an incentive to better and happier work and to higher output. This becomes understandable if one considers the effect of work control based upon effort-thinking in all the simpler cases mentioned previously.

In such cases the managing staff and administrative personnel are directly involved in the effort-control of production. This, however, does not yet mean that the administrative activities themselves have been measured according to the principles of effort. Steps towards this aim can be seen in some of our experimental investigations, chiefly in those concerned with the selection of higher executives. In order to exemplify the salient features of procedure, one of these cases might be sketched in its general outline.

Confronted with several applicants for the post of an executive, it was decided to complete the information gained at the usual interviews by observing the personal movement efforts of the applicants while being interviewed. The bodily efforts with which they entered the room, sat down, reacted to questions, presented documents, took leave and left the room were recorded in terms of effort without any psychological annotation. Two main points turned out to be of interest. First, those common traits which obviously arose in connection with the kind of job for which they had applied became obvious. Second, the personal differences giving an insight into the personal effort-balance of each applicant could be stated.

The efforts contained in the common traits were with a few applicants very clear and intensive, in one case even over-

intensive. To a person knowing the job in question it became quite obvious which of the applicants was the most suitable, or, in the special case, when two of them had the necessary array of efforts which could make them successful. It was even possible to set up a kind of job-effort graph in which all the desirable efforts were included.

The personal efforts extracted from the records gave a quite different picture. Effort-habits could be noticed which were either poor, consisting of few and lopsided efforts, while others were rich, consisting of a certain number of contrasting efforts. Poor as well as rich efforts were of different intensity. Concentrating on the two applicants who seemed to be most suitable in their job-efforts, it was found that one of them belonged to the group with rich personal effort, while the other was decidedly lopsided.

This case was an experimental investigation and no decisive rôle was given to the effort-assessment, the only practical success was that one of the applicants who was interested in the procedure took up the study of thinking in terms of effort, and according to him he derived great benefit from our findings in trying to correct some of the incongruities of his personal effort-graph made on this occasion.

In cases investigated later, the executives observed were informed of the results of the investigation, which frequently showed that the person observed had qualities quite different from those which he himself imagined he possessed.

A production manager, who changed successfully to salesmanship after consultation with the observers of his efforts, is well remembered, because he was at first extremely distrustful and doubtful, fearing that his position might be impaired through the investigation. However, he obtained a better position in which he is much happier than in the former one and he knows now something about his effort-habits and their connection with earlier failures.

An enlightened industrialist who is an excellent man at all kinds of business meetings was anxious to know our impressions of his personal efforts during such meetings. Responding eagerly to his invitation, for such an opportunity to investigate the efforts of leading industrialists is quite rare, we found our-

selves at a round table in illustrious company. Our attention was concentrated upon the Chairman, who had invited us, and his main antagonist. What we were able to record was a kind of effort-dialogue in which certain small movements appeared, which, though entirely independent of the object of speech and bargain, gave an interesting picture of the kind and intensity of intentions with which the controversy was conducted.

The whole line of this effort dialogue can best be summarised as follows :

ANTAGONIST : attacked vigorously with intensive cutting and hitting shadow moves.

CHAIRMAN : answered with quiet smoothing gliding efforts and occasional sharp dabbing gestures.

ANTAGONIST : lost the intensity and reverted to twisting pressing efforts.

CHAIRMAN : took to hitting and piercing moves, attenuated finally by a light flicking.

ANTAGONIST : reintensified his efforts with several heavy thrusting efforts.

CHAIRMAN : applied a whole battery of gliding, thrusting, floating, flicking and slashing efforts.

ANTAGONIST : became slightly floating, and afterwards lost any clear effort-expression.

It was clear at this moment that the Chairman possessed a much richer scale of intentional effort and great agility in changing them, while his antagonist was less balanced, much more exaggerated in intensity and almost poor or, at least, lopsided in his effort-manifestations.

The dialogue, interrupted frequently by other persons who stimulated the antagonist as well as the Chairman in their specific effort utterances, ended thus :

ANTAGONIST : continuous pressing effort with a sudden explosion into a mighty thrust.

CHAIRMAN : light flicking, short dabbing, some pressure soon relieved by floating.

ANTAGONIST : motionless—short wringing—his mental effort was knocked out.

CHAIRMAN : quiet smoothing gliding and a final dab as a kind of relaxation.

The demonstrations in this and other meetings were first considered as great fun, yet not without the charm of a certain eccentricity and originality. Later on it led to more serious applications and opened the door for the investigation of the rhythm of whole enterprises including production and administration.

One point is of interest in this connection, namely, the pounding of machine efforts with human efforts. The inventor and builder of a machine or mechanical device obviously intends to replace and to enlarge at the same time some specific human effort. Machines hit, press, lift, carry, smooth, flick, dab, wring, and so on, like a man, but machines can mostly exert one effort-action only, though in an intensified way. Man can exert several or all efforts, but their intensity remains very restricted when compared with those of the machine. The rules of the co-ordination of the machine effort with the human effort became clear to us in so many experimental investigations that they cannot even be enumerated here.

What is to be gained by the application of effort-thinking to the functions and tasks of machines might perhaps be seen best from an example of unloading goods from vehicles and storing them in a shed. In olden times, such operations were done by men who climbed into the vehicle, shouldered the goods and carried them into the shed where the wares were stacked, either by the cartiers or by their helpers. To-day cranes and trucks are installed which can collect and lift several sacks, boxes or bales in one grip and transport them easily and speedily to any distance and height desired. Human effort is only used in preparing, hooking and unhooking the load and in driving the cranes and trucks.

Many people say that man has become the servant or slave of the machine, which is, however, equally as nonsensical as the idea that man is the master of the machine. The effort of the machine is in reality an artificial extension of man's effort. When some part of the effort—no matter whether its mechanical or

living half—runs wild, the effort is not mastered, that is to say, it is wastefully applied, to the damage of those who use it.

The sanest way to look at the combination of mechanical devices and human energy is to consider them as a complex unit, like the teamwork of several people, and not as the work of two separate entities. The whole rhythm of the operation can thus be gathered within one effort-graph which resembles to a certain extent again a score of orchestral music, in which several lines of effort develop simultaneously. While one crane stacks the goods just lifted from the truck which brought them from the train into the shed, another crane outside lifts simultaneously a new load from the train on to another truck which is ready to carry the new load to the crane inside the shed. Everybody will agree that it is more difficult to understand a verbal description than a graphical representation of this simple coming and going. It is a part of the thinking in terms of effort that such simultaneousities are quickly grasped and the importance of their uninterrupted flow tightly understood.

Breakdowns within this continuous flow are almost always caused by the deficient function of one or several of the men loading or driving cranes and trucks. There might be some exerting physical human effort in preparing the load or in pushing the goods into their final position on the stacks. On the whole it is an attentional effort of each of the workmen connected with their rhythmic feel of the flow of the operation which guarantees flawless success.

This is an entirely new aspect which demands the developing of the rhythmic feel of the workmen. Hitherto little has been done to satisfy this need of modern production, and it is only by thinking in terms of efforts that the problem of the co-ordination of human and machine effort can be brought nearer to its solution. The real benefit of the increasing mechanisation cannot otherwise be achieved.

It is obvious that executives and managers have to understand and to consider this new viewpoint, because the best functioning rhythmic feel of the workman is powerless when the whole job is planned without more profound knowledge of what has been called the logic of efforts.

It must be mentioned that our experiments have not been

restricted to industry. Any of the 18,000 different occupations in which modern man endeavours to earn his living is full of the most interesting effort-manifestations.

A great number of them have been investigated, with a special bias for the profession of the teacher. This is quite natural, because effort instruction is a new branch of teaching, and the job-effort specification of teaching lies, therefore, within the orbit of our research. The impressions gained in schools do not differ essentially from those encountered in factories. It is as important to know and to study the efforts of specific groups of children gathered in a class as it is the efforts of the employees in a department of a factory.

Teachers could easily learn all they should know about effort in industrial enterprises. They could be selected and instructed in a similar way to industrialists or workmen. They could apply the same methods of assessment in studying the effort habits of the children for whom they have to care.

The training of the efforts of children is, however, slightly a different matter. The main problem is without doubt the keeping alive of the natural effort-richness which most healthy children possess. The cure of effort-deficiencies is a secondary task, like that of the education of the so-called backward children. Experiments have shown that the main problem, and possibly also the secondary ones, can be solved within the art education in school, and there mainly by an appropriate kind of dancing.* In dance the working efforts of man are sublimated and used for a recreational purpose. This fact points to a means by which the problem of effort-training in schools should be tackled.

Apart from those engaged in industrial work and the teaching profession, there are very many others who can benefit by thinking in terms of effort. The professional artist is the man who mirrors the efforts of other people, and he is able to do that through thinking in terms of effort. And we must not forget that management is an art and the manager must think in terms of the efforts of his workers. The doctor must study the efforts of his patients, the author the efforts of those to whom his works are addressed.

Effort-training for children, for artists, for industrial workers

* See R. Laban, *Modern Educational Dance*, published by Macdonald & Evans 1947.

and for members of the professions differs in detail, but the basic need of thinking in terms of effort remains the same for all people of the present and future generations. And, after all—and we hope our readers will agree with us—thinking in terms of effort can be a most interesting subject and an entirely new accessory to the mastery of work and life.