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THE THEORY OF MARGINAL VALUE

BY

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PREFACE

THE purpose of this treatise is not to give an entire system of economics, but to initiate the student in the methods, notions, or fundamentals of the marginal theory, and at the same time to carry him so far as to enable him to work out the problems for himself. Hence the first part of this book has been worked out in great detail, contrasting the rather condensed exposition of the difficult 4th and 5th parts, where the student, in a lesser degree, needs the guidance of his teacher. This book does not contain anything about the mechanics of economics, being reserved for a second volume.

In order to avoid delay the diagram blocks, used in the Danish edition, have been utilised in the English version; in some of the diagrams Danish words appear, and although their general sense is obvious, I would note the more important cases: In Diagram XIIa and XIIb, "maengde curve" stands for "curve of quantity; "Nödvendighedsvare" for "necessary," and "luxusvare" for "luxury." In Diagram XVI. (pp. 185–6) "arbulyst" stands for "disutility of labour," and "varens Nytte" for "utility of the commodity," and "pengenes-nytte" for "utility of money." In some cases the diagrams have been drawn in terms of "Danish Krone," but these have been interpreted in the text in terms of "English shillings."

I am indebted to Messrs. Fred Zeuthen, M.A. (Copenhagen), Hugh Dalton, M.A., Cambridge, and Thomas A. Joynt, M.A., Edinburgh, for valuable advice both as to form and matter, and to the latter for his patience and courtesy in reading of the proofs.

Dr. L. V. BIRCK.

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BOOK. I

UTILITY.

CHAPTER I

THE DISUTILITY OF LABOUR

1. The Economic Motive.—Mephistopheles does not appear to have grown wiser by experience when he agrees that his claim to Faust's soul shall be conditional upon the learned doctor becoming so much enraptured by the pleasures provided by the fiend that he must exclaim : " Oh ! stay, stay for ever, happy hour ! " For nobody has felt the happiness of a moment so intensely that he wishes to stay the fleeting seconds. Memories and anticipations make themselves present, throwing us out of our momentary happiness. Ascetic and pessimistic philosophy teaches happiness as depending on the subjugation of our desires ; by killing every germ of human desire we attain a state of happiness, the complete mental equilibrium in which our mind, drained of all desire is ready to merge in the " Nirvana." The optimistic, hellenic view of life is that happiness is attained through positive enjoyment and the avoidance of pain.

These two opposite theories of life have one truth in common : that a state of happiness is brought about by exterminating our desire, whether by killing it in its embryonic state or by drugging it with satisfaction.

Happiness, then—in so far as it can be defined—is identical with the cessation of desire, and the state of happiness is that point of complete satisfaction, of harmony of body and mind, in which state we are pained by no desire, because desire either has not yet been aroused or has already been satisfied. The further we are from this harmony the more pain we feel, and the greater is our discontent.

It is not a matter for economic science to decide, which of the two theories of life—the ascetic or the epicurean—is the right one ; only this—in our mind life we experience this striving to attain harmony, which is a characteristic of all life. The classical school of economists have, however, experience on their side when they maintain that human beings, from an egoistic point of view, regard happiness positively as the satisfaction of our desire, and negatively as the avoidance of pain, *i.e.*, the satisfaction of as great demands as possible in return for the smallest

possible sacrifice. This is the basis of the fundamental economic postulate—the rule that *our economic motive is maximum satisfaction and minimum sacrifice.*

2. The Working Hour.—In relation to his economic activity man is *the end* in his capacity of consumer, and *the means* in his capacity of producer. From this it must not be concluded that each individual is the end in view of his own activity, for we are only units in a community of many; but even the existing community is not the end in view, as every generation living in the present interval between the two eternities—the past and the future—is in itself a link in the chain of humanity. "Public welfare" has a longer range than thirty years; economic ethics cannot acknowledge benefit for the individual as an indicator of the correctness of an economic action

As a means man is a *working machine* which creates and supplies *energy*; our consumption refunds us the energy expended by our activity; part of the energy supplied through our consumption is expended merely in keeping alive—in "preserving the machine." We know from feeding-experiments that the functions of life consume a great part of the calories of the food, and that only part is transformed into muscle; only part of the energy supplied is converted into productive work. Progress, whether individual or universal, is founded upon the existence of a surplus of energy; part of the energy at our command we invest in the productions of our labour. The *workman* is possessed of *working-power* which produces "doses" of *energy*. These doses of energy may be useful in themselves (personal services) or be incorporated in things (*substances*); substances as well as services are thus economic goods. We now have the circle: Human energy—production — economic goods — consumption — satisfaction — energy. Compare: want—effort—satisfaction.)

Labour has two dimensions—*time* and *intensity*. As a third dimension quality might be mentioned (for instance, mental in contrast to manual labour), but this is in another plane and compares with the other two dimensions, as movement in time with movement in space.

As the correct unit of measurement—the unit of energy—cannot be defined, it is necessary in the following pages to employ *the working hour*, by which is meant something similar to Karl

Marx's reduced normal working hour, which is the product of average intensity and average skill.

By economic work we mean exertion of energy through the incentive of mainly economic ends, even if the object need not be the worker's personal benefit. The work must be *necessary for the purpose*, in the sense that the object would not have been attained without performance of the work in question or *equal* work. The singer who beats rhythm to the reapers is as productive as they by accelerating their speed; the government official who creates safe working conditions, the inventor who improves working-methods, and the manager who organises production, all perform indispensable work themselves. Not all indispensable work is remunerated, and much superfluous work is paid for—the wages thus being no indicator of the productivity of work; the relative indispensability of the individual *worker, not of the work*, determines wages.

By production—*i.e.*, applying working energy to substance—(the active and passive element respectively) we *produce* economic goods. To produce means converting substance into a shape in which it is *useful* and thus able to satisfy our demand. To *consume* means transforming goods into such a state that they are no longer able to satisfy our demand (destruction in an economic sense—not to be confused with destruction in a physical sense; a chair without legs is consumed, destroyed economically, without being destroyed physically).

3. The Curve of Productivity of Labour.—It is natural for a healthy human being to exercise energy, and when Simon Patten speaks of the "joy of work" he states something more than a paradox. What makes labour disagreeable is its monotony, and the fact that too much of it is required—the presence of an element of compulsion, breathless routine (specialising kills the joy of work) and often special aversion against repeat work. Unemployment is felt to be an evil, not only for economic reasons, but because idleness is tedious (there is a distinction between idleness and leisure); the joy of work is furthered by change of work, but the product of labour is increased by uniformity of movement.

The exercise of energy involves fatigue, which has objective as well as subjective effects. After conquering the sluggishness,

the yield of labour may increase during the first few hours, but afterwards it will decrease every hour (although a pause may again increase the yield) until it perhaps becomes negative; as far as piece-work is concerned the decrease in yield can be directly measured, but where the worker is adjunct to a machine and must follow its movements, the mistaken policy of long working-hours is proved by breakdown of machinery, accidents, and sometimes by the disappointing quality of the product (for instance, weaving-faults). This may be illustrated by diagram 1.

Along the abcissa or lateral axis in a system of co-ordinates we mark out the units of time, while the working intensity during the periods of time in question is marked out along the ordinate or perpendicular, the rectangles thus drawn up indicating the quantities produced during each unit of time (intensity multiplied by time).

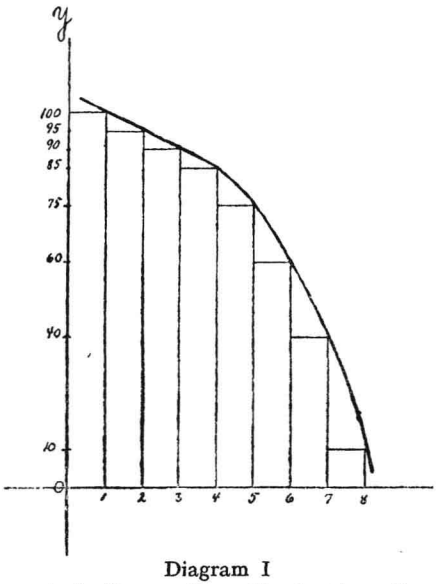

Diagram I

If the units of time chosen are sufficiently small, the connecting-line between the corners of the rectangles will form a continuous curve—the curve of working-intensity, which starts high and declines—thus illustrating the decreasing productivity of labour.

4. The Curve of Disutility.—The subjective effect of fatigue is a feeling of disinclination for work, and this may be increased by other elements, as, for instance, a loathing for the kind of work in question, monotony, etc. This disinclination is akin to pain. Few men can work for the sake of work itself; the work of the scientist or the poet need not, however, be attended by any disinclination; he is often driven on by a kind of demonic power (Socrates' "daimon").

But where this is not the case, and where work has ceased

to be a natural and spontaneous exertion of energy, it throws us out of our physical and mental equilibrium, and is felt as something onerous, varying in degree according to how far we are from our equilibrium, from the scarcely noticeable disinclination at the first dig with a spade, to the stinging pain after sixteen hours of work. The disutility of labour is thus dependent upon how much work a person has previously performed, and is not alike for all working-hours.

Supposing the disutility of the first instalment of work to be $u_l \cdot q_1$, the disutility of the second instalment will be somewhat larger, the worker being more fatigued after performing one instalment of work than before. The disutility of the second instalment might be described as $u_l q_1 \cdot q_2$, in which $q_2 > q_1 > 1$; the disutility of the third instalment is still larger; this is denoted by $u_l q_1 \cdot q_2 q_3$, in which $q_3 > 1$, and so on down to the n-th instalment, the disutility of which accordingly amounts to $u_l \cdot q_1 \cdot q_2 \cdot q_3 \cdot \cdots \cdot q_n$. That $1 < q_1 < q_2 < q_3$, etc., is in accordance with the *rule of gradually increasing disutility of the work* to produce the article in question. If we *assume* that the difference between q_1 and q_2 and between q_2 and q_3, between q_3 and q_4, etc., between q_{n-1} and q_n are small enough to be regarded as negligible quantities, we have $q_1 = q_2 = q_3 = q_4 = \ldots = q_n$. Thus we arrive at the following assumption:—

The disutility of the first instalment of labour amounts to $u_l \cdot q$, of the second to $u_l \cdot q^2$ of the third to $u_l \cdot q^3$, of the fourth instalment to $u_l{}^r q^4$, etc.

By assuming that the difference between q_2, q_3, q_4, q_n is infinitesimal we arrive at the hypothesis, that *the burdensomeness of work increases in geometrical progression corresponding to the arithmetically progressing increase in the quantity of work performed*, and that q = the rate of increase of this disutility—varies inversely with our capacity for work and proportionally with our susceptibility to pain or fatigue.

Without attempting to judge the correctness of this hypothesis, we must maintain that to adopt it will lighten our task without doing any harm. The formula $u_l \cdot q^4 > u_l \cdot q^3$ expresses clearly to the eye that we are comparing the third and the fourth working hour, and that the disutility of the fourth hour's work is greater than that of the third. Further, I shall not be tempted to draw any other conclusions from the designation of the disutility of the two

first working hours as $u_1(q + q^2)$, than I can if it was written $u_1(q + q \cdot q^2)$. If $u_1 \cdot q$ is the disutility of the first hour the disutility of the t-th hour will thus be $u_1 \cdot q^t$, that of the $(t-1)$ *th* hour will be $u_1 \cdot q^{(t-1)}$. Assuming that I work t hours in all, we describe the t-th hour as the *marginal* hour, the work of *this* hour as the *marginal* labour, and the specific burdensomeness of this hour's work as the *marginal disutility* of labour. The *total* disutility of t hours work is, then :

$$u_1 \cdot q + u_1 \cdot q^2 + u_1 \cdot q^3 \ldots\ldots u_1 \cdot q^t = u_1 \ (q + q^2 + q^3 \ldots . + q^t)$$

for which sum I use the contracted term $u_{1 \cdot t}$.

From this it is immediately apparent that $t \ (u_1 \cdot q^t) > u_{1 \cdot t}$, *i.e.*, that the total disutility of the labour is less than the product of the time of working and the marginal disutility. This can be graphically represented (Diagram II.) by a system of co-ordinates, in which the hours are marked out along the abscissa and the disutility attending the work along the ordinate; in this case also we arrive at a curve, which illustrates the disutility of labour. The curve of disutility starts low, near the base, and ends high, thus indicating the increasing disutility of labour.

To compare time with pain, for instance, by writing the first + the second hour equal to $u_1(q + q^2)$ would be incorrect. Apart from the fact that the equation is misleading, because the disutility of four hours of work is more than twice as much as that of two hours, we are not justified in comparing quantity with feeling because physical quantities and mental conditions are incommensurable.

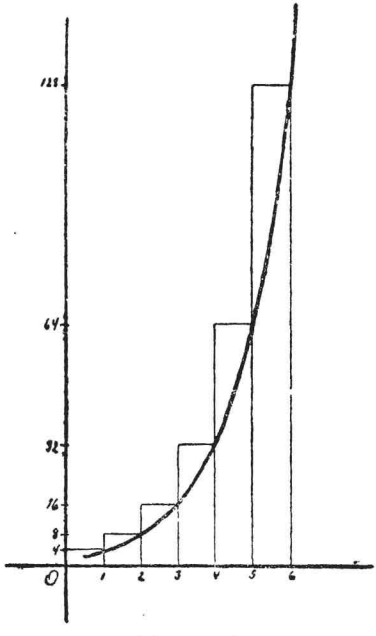

Diagram II

Work reveals itself in three ways : (1) as an objective quantity of work, (2) as the result of work, and (3) as a feeling of onerousness by the person who performs the work. Quantity and onerousness (dis-

utility) are like two quite different pictures of the same thing in two differently prepared mirrors—the retina of our eye and our feelings. Quantity of work applied and result cannot be compared either, even if the latter can be measured by the former.

The conditions of our work, then, are hard: objectively the yield decreases with increased working-hours, subjectively it causes us greater and greater discomfort each hour. If we add to this, that nature also grows more and more unwilling to yield the substance—the raw material—to which we apply our labour, and thus makes increasing resistance, we see that each human being as well as humanity generally in a sense works under the law of decreasing return. Capital and human ingenuity can mitigate this, for us, unfavourable fact.

5. Professor Lehman's Responsum.—The hypothesis of the logarithmic proportion between the quantity of work and the feeling of onerousness is far from unreasonable; Jevons quote several treatises, and has himself made some experiments with the object of measuring the increasing fatigue of uniform work, and his results confirm the hypothesis. Professor Dr. Phil. Alf. Lehmann has sent the following responsum to my inquiry:

"In reply to your inquiry concerning the variation in intensity of sensations and their relation to outside influences, I am able to give you the following particulars:

"Concerning the feelings of inclination, of desire, no experimental investigations are available. This is quite obvious, as any attempt to establish a formula for the proportion between the intensity of this feeling and outside influences must fail, because of the fact that we have no indicator of the intensity of the feeling. We cannot directly judge that the sensation at the present moment is a certain number of times more or less intense than at a certain previous moment. Bernoulli's mathematical expression of '*la fortune morale*' is therefore—as I have pointed out in my book, *Principal Laws of Human Emotional Life*, p. 195—a hypothesis, which in any case cannot be verified by experiment. But this does not preclude the possibility of testing it in a different way, *i.e.*, from practical life instead of through the laboratory. Here the external actions accompanying the feelings will certainly in many respects be available as indicators of the intensity of

emotions, and for this reason I do not by any means consider it impossible to verify Bernoulli's hypothesis, or even to find a more exact expression. I support this assumption on the fact that it appears to be actually possible to measure a certain feeling of disinclination.

" For feelings of disinclination generally the case is similar to that of feelings of inclination—we have no measure for them. But for that state of discomfort which accompanies physical and mental fatigue, it will in any case not be difficult to establish a certain measure without being too arbitrary. Fatigue itself, as a purely physiological state, can easily be made the subject of experimental investigation and be measured exactly through the decrease in the production of labour, either in quantity or quality.

" A rule may thus be established for the increase in fatigue in proportion to the quantity of work performed. When this rule becomes known, and we are able to form a not altogether improbable hypothesis as to the increase in fatigue, the outcome of this will evidently be a rule for the increase in disinclination in proportion to the quantity of work performed.

" The progress of fatigue has been examined repeatedly, for physical as well as mental labour; I have some time ago adapted a couple of experiments with a view to the question before me. Through a series of ergographic measurements of muscular fatigue I have found that fatigue measured by the number of maximum exertions required for the performance of certain work increases approximately in geometrical progression, as the work performed increases in arithmetical progression. By adapting a series of pedagogic experiments concerning intellectual fatigue—fatigue from mental labour—I arrive at approximately the same rule. A rather large class of children have been kept working for several hours without a break, and their fatigue has been measured at the end of each hour, through the number of mistakes made in test work (exercises from dictation, etc.). Here also it is proved that fatigue approximately increases in geometrical progression when the work performed—measured by the number of working hours—increases in arithmetical progression. (Compare Körperliche Aeusserungen Psychischer Zustande 2 Teil, Leipzig, 1901, Pg. 147–52).

" If now we dare assume that the disinclination accompanying fatigue increases proportionally with the latter, we would arrive