

that the Institution of Civil Engineers did in fact promote science :—

"Substantially, as it seems to me, the whole of the Society's income is applied to the promotion of science. My Lords, I cannot conceive in what better way the promotion of mechanical science, and in particular of those branches of mechanical science which lie within the province of civil engineering, could be effected. I cannot doubt that by means of the discussions on the papers read at the ordinary meetings of the Society much new light has been thrown on scientific questions, and much knowledge, which would otherwise have perished, has been preserved. I see no trace of a selfish or illiberal spirit in the proceedings of the Society, nor do I find anything to lead me to suppose that its property and income are applied otherwise than *bonâ fide* for the promotion of science. The action of the Society may incidentally benefit the profession to which its members belong—I have no doubt that is so—but I agree with the Master of the Rolls in thinking that 'that which this Society does is something higher and larger than the mere education of students and others for the profession of civil engineers.'"

The admirable definition of the object of the Institution, embodied in the charter of 1828, was stated in the course of one of the judgments to have been drafted by Thomas Tredgold. The Institution, it says, is established for the purpose of

"the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in States both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation, and docks, for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns."

It is only right to say, in conclusion, that the utility of the work done by the Institution was admitted in the warmest manner by those judges who found themselves compelled to decide against its claim to exemption, now happily established.

#### PRINCIPLES OF ECONOMICS.

*Principles of Economics.* Vol. I. By Prof. Alfred Marshall. (London: Macmillan and Co., 1890.)

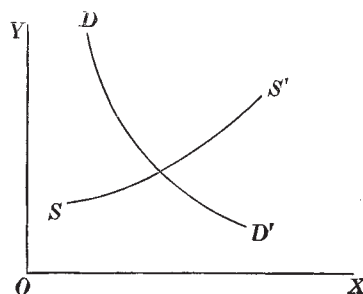
ECONOMICS admit of being reduced to principles more than other sciences dealing with human actions, for the reason which Prof. Marshall has thus expressed: "Wide as are the interests of which the economist takes account when applying his doctrines to practice, the centre of his work is a body of systematic reasoning as to the quantities of measurable motives." These measurable motives are not necessarily self-interested: "The range of economic measurement may gradually extend to much philanthropic action." Even now the supply of labour and of capital is largely due to the motive of family affection. The uniformities of action resulting from such measurable motives may be regarded as the laws of motion in what Jevons called *the mechanics of*

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*industry*—a science which Prof. Marshall has cultivated with more success than any of his predecessors, owing to an unexampled combination of antithetical powers, the comprehensive grasp of mathematical reasoning, and the careful handling in detail of the observed facts.

As in physical mechanics innumerable conditions may be comprehended under the principle of virtual velocity, so also there is a unifying principle in the mechanics of industry. "Most economic problems have a kernel relating to the equilibrium of demand and supply." It is the peculiar merit of Prof. Marshall's arrangement to treat the law of supply and demand generally, before applying it to particular "markets," such as that relating to labour. It is here that he differs most from Mill, who seems to put asunder what the nature of things has joined together under one law—distribution and exchange. If Prof. Marshall's conception does not come as a surprise to his readers, it must be considered that he himself, in published and unpublished writings, has prepared the scientific world to accept his view. The services of others, particularly Prof. Walras, in improving upon the old wooden conception of distribution are not to be forgotten. Still it is true that, as far as we know, Prof. Marshall is the first adequately to treat what he has elsewhere called the pure theory of domestic (as opposed to international) value; uniting in a comprehensive view the doctrine of final utility, which Jevons and other recent writers have made prominent, with the equally eternal verities relating to "cost of production," which are connected with the name of Ricardo. The "theorems of Ricardo and Marshall" are rightly coupled by Signor Pantaleoni in his masterly "*Principii di Economia Pura*."

The relation between cost of production and demand is thus expressed by Prof. Marshall, following Cournot.



In the annexed diagram the abscissa indicates the amount of a product, and the ordinate the price thereof.  $DD'$  is the demand curve, representing the quantity of the product which is demanded at each price;  $SS'$  the supply curve, representing the quantity which is offered at each price. The intersection of these curves determines the equilibrium of the *market*—a generic term used in a wide sense, covering the temporary equilibrium of a fish-market and those slow processes of competition which it requires a generation to work out.

From this point of view is apparent the inaccuracy of those who describe value as altogether an affair of final utility, and speak of Ricardo as being "preposterous" in the classic sense of putting the cart before the horse. To use our own illustration, these economists might be compared to a physicist who should insist that in the determination of the position at which a balloon reaches

equilibrium, the buoyant gas plays a more important part than the heavy car. To be sure balloons could not go up without gas; whereas they might, and sometimes do, without a car. Still, from a mathematical point of view, we submit, it is legitimate to attribute to the positive and negative forces a "fundamental symmetry"—as Prof. Marshall characterizes the equilibrating motives towards utility and from *disutility*. By parity of reasoning they also are to be condemned who, neglecting final utility, worship only cost of production. But it may well be doubted whether this form of what we may call the monophysite heresy in regard to the doctrine of value is attributable in a serious degree to Ricardo. It is tenable that "the older economists seem to have been rightly guided by their intuition when they silently determined that the forces of supply were those the study of which was the more urgent and involved the greater difficulty."

The theory of cost of production would be easy if all economic action were as simple as in the case of one who goes on picking and eating blackberries until the labour of picking just compensates the pleasure of eating. The concrete case is greatly complicated by the element of *time*. Under cost of production we must include the less direct efforts and sacrifices, such as that of the parent who, vicariously competing in the labour market, supplies an educated employer or artisan to that occupation where there appears to be the best opening. Before the education is completed perhaps the opening has ceased to be the best. The normal tendency to equilibrium is thus ever interrupted by the introduction of some new condition:—

"There is a constant tendency of the surface of the sea towards a position of rest, but the moon and sun are always shifting their places and always therefore changing the conditions by which the equilibrium of the sea is governed; and meanwhile there are ceaseless currents of the raging winds; the surface is always tending towards a position of normal equilibrium, but never attains it."

In this troubled scene everything is in flux, and subject to the theory of fluxions:—

"The amount of the commodity and its price, the amounts of the several factors or agents of production used in making it and their prices—all these elements *mutually determine one another* [we italicize words which convey a lesson which has never before been taught thoroughly], and if an external cause should alter any one of them, the effect of the disturbance extends to all the others."

If there is any of the economic variables of which it may be said that it is determined without determining, it might be the old Ricardian "inherent properties" of land, about which Prof. Marshall has much that is new to say. As for the quasi-rents which more recent theory has evolved, they are all affected with the fallacy which Prof. Marshall's scientific method is particularly adapted to guard against—the treating as constant quantities which are variable. The "margin" from which the remuneration in any skilled occupation is measured is itself a variable, varying with the remuneration; because the supply of competitors is dependent upon the prospect held out by the great prizes in that occupation. The apologist of the existing economic *régime* who defends the profits of the successful employer as being a rent of ability, the Socialist

who attacks the interest of capital as being a rent of opportunity, are alike building their insecure constructions upon the sands of a shifting coast-line.

We are prevented by the narrowness of our limits from exhibiting the important results obtained by the full treatment of the subject to which we have barely adverted—namely, the *simultaneous* determination both of the relative value of products, and the remuneration of producers, in a *régime* of free competition. We must hasten on to observe that the same methods of abstract reasoning are applicable, *mutatis mutandis*, to a *régime* of monopoly. This case is important, not only for itself, on account of the prevalence of trusts and monopolies, but also by reason of the analogy between governmental and monopolistic action. Prof. Marshall, by original methods, deduces the startling conclusion

"that it might even be for the advantage of the community that the Government should levy taxes on commodities which obey the law of diminishing return, and spend part of the proceeds on bounties to commodities which obey the law of increasing return."

This reasoning is, of course, very abstract; abstracting the indirect evils which governmental interference may produce. But it at least suffices to destroy the *a priori* presumptions in favour of "economic harmonies" and unqualified *laissez faire*. Prof. Marshall reaches these and other important conclusions by estimating the "consumers' rent"—that is, the advantage which consumers derive from a fall of price. In connection with this subject we should advert to his beautiful theory of the elasticity of demand. The more elastic or expansive demand is, the greater is the increase of consumers' rent due to a given fall of price.

We should like to dwell upon the practical importance of these conceptions. But it is impossible here to analyze a work almost every page of which presents a new idea. We must be content with indicating methods as distinguished from particular theories. The mathematical method appears to be established in its proper position by the precept and example of Prof. Marshall:—

"Our observations of nature, in the moral as in the physical world, relate not so much to aggregate quantities as to increments of quantities. . . . It is not easy to get a clear full view of continuity in this aspect without the aid either of mathematical symbols or diagrams." . . .

Prof. Marshall expresses some preference for diagrams:—

"Experience seems to show that they give a firmer grasp of many important principles than can be got without their aid, and that there are many problems of pure theory which no one who has once learnt to use diagrams will willingly handle in any other way."

Developing a metaphor suggested by our author, we might compare these mechanical aids to reason to the machinery employed in material production. Appliances useful to one producer will not be equally so to another. There is what Prof. Marshall calls the "law of substitution," according to which each producer selects the expedients most serviceable in his own case. Usefulness will depend much on familiarity. "It seems doubtful whether anyone spends his time well in reading lengthy translations of economic doctrines into mathematics that have not been made by himself."

By way of illustrating this character of intellectual

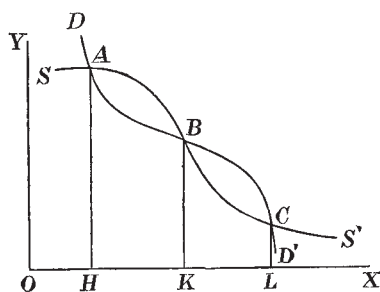
machinery, we shall advert to some passages which seem to us to contain things which some would rather have expressed otherwise. In the first note of his "Mathematical Appendix," Prof. Marshall, referring to the weakened motive power of distant or deferred pleasures, thus writes:—

"Let  $h$  be a pleasure of which the probability is  $p$ , and which will occur, if at all, at time  $t$ . Let  $r$  be the rate of interest per unit which must be added to present pleasures before comparing them to future, and let  $R = 1 + r$ ; then the present value of the pleasure is  $phR^{-t}$ ."

Should it not be more clearly expressed here, or elsewhere, that this formula holds only of marginal utility, and that it is not a general psychological truth irrespective of conditions imposed by a money market? For instance, I anticipate a series of pleasant hours extended over several weeks during which I shall be occupied in mastering this stupendous work. But I do not observe that the anticipated pleasure of the third week differs from that of the first according to an exponential law of variation.

Another verbal modification is suggested by the frequent use of the "law of substitution"; which, as above intimated, imports that producers will, as a rule, substitute the less for the more expensive methods of production. Might it not be well more often to substitute the simpler statement that the producer will seek to maximize his net advantages, considered as a function of different variables, *e.g.* labour, capital borrowed, &c.? From the principle that the partial differential of this function with respect to each of the variables is equated to zero follow, more easily perhaps than by verbal exposition, propositions of the form that "wages tend to equal the net produce of the worker's labour" (pp. 547-48). No doubt it is convenient to have a term which, as we understand, covers two distinguishable cases: where the maximum of advantage is pursued by varying the variable, or by discontinuously passing from one function to another. Indeed, this is a distinction on which Prof. Marshall, true to his motto, *Natura nil facit per saltum*, has, probably for good reasons, not insisted as much as might have been expected.

The condition above mentioned, that the first term of variation should be equated to zero, may of course indicate a minimum, as well as maximum, of utility. Prof. Marshall, following the analogy of physics, attributes to



a minimum the property of equilibrium. For example, in the case represented by the annexed figure, which

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corresponds to the author's Fig. 20 (p. 424)— $SS'$  and  $DD'$  being, as above explained, the supply and demand curves—Prof. Marshall says, "H and L are points of stable equilibrium, and K is a point of unstable equilibrium." This interpretation may appear doubtful, when we consider that the supply curve, when *descending*, is the locus of *minimum advantage* for the producer. At any assigned price, *e.g.* SH or BK, this locus represents the very worst arrangement for the producer, the very bottom of the trough, where he cannot, even theoretically, be supposed content to stay. If this view be accepted, some doubt will be thrown on the "theory of multiple positions of equilibrium" (*ibid.*). A solution of these little difficulties, consistent with the author's conclusions, will probably be found by those who follow out the hints afforded by his pregnant notes.

A comparison with the eminent mathematical economists Messrs. Auspitz and Lieben suggests one more scruple. Those theorists regard the demand curve as the *envelope* of a series of discontinuous curves, each of the sort contemplated by Prof. Marshall, corresponding to different scales of living. This conception, if accepted as important, might have some bearing on the theory of "consumers' rent."

But in dwelling on such technical points we should run the risk of conveying an unfair impression of the worth and accuracy of Prof. Marshall's work. The theoretical subtleties about which a difference of opinion is possible "have a very narrow range of practical bearing." Prof. Marshall is the first to admit of his theory, "when pushed to its more remote and intricate logical consequences, especially those connected with multiple position of equilibrium, that it slips away from the conditions of real life, and soon ceases to be of much service in dealing with practical problems." Besides, this is a subject on which, as Disraeli said, the author is much more likely to be right than the critic. In this sort of mixed mathematics the authority of one who is, above all others, conversant with both ingredients of the mixture is almost supreme. He, of all mathematical economists, has best complied with his own maxim that the economist, while he employs "systematic reasoning as to the quantities of measurable motives, . . . must never lose sight of the real issues of life; and these are all, with scarcely any important exceptions, affected more or less by motives that are not measurable."

Of the two parts of the economist's work we have here dwelt somewhat exclusively on that which best admits of being viewed synoptically, the more abstract side. We must be content with recording, without illustrating, the judgment that the moral and mathematical parts of Prof. Marshall's work are on a level of excellence. He not only applies the differential calculus to measure increments such as "a shilling's worth of happiness," but he also brings a higher faculty to judge of goods which cannot be measured by money, such as "the fulness and nobility of human life," "a pure heart, and a love towards God and man." He renders to the queen of the sciences the things which belong to her province, and to the spiritual side of our nature things which transcend man's power of calculation.

F. Y. E.