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III. -- THE RATIONALE OF EXCHANGE.

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The phenomenon which I attempt to analyse is not the property of a market which Professor Jevons¹ has formulated, the unity of price, but a still more elementary property, the fact of price; the circumstance that one thing is exchanged for another *at so much per piece*, that the total quantities exchanged are just as much as it is the interest of both parties to give and take *at a certain rate*. For example: at the rate of 9*d.* an hour an artisan might be willing to give just six hours work a day; at the rate of a guinea an hour a professor might be willing to give just two lectures a day. Under a *régime* of perfect competition it is improbable that these workers would do twice as much, or half as much, work for the same multiple of pay. It is impossible that they should accept now one now another of the indefinite number of contracts, which are constituted by substituting in the last statement instead of *two* or a *half* any intermediate factor. But the latter arrangements would be quite possible if we could abstract the differentia² of a market, under a *régime* of compact between combinations, or other socialistic corporations²; supposing that artisan and professor would rather accept those terms than give up their work altogether (seek a new occupation or country perhaps, or be supported by charity).

The origin of this property appears to be twofold. There is first, and probably foremost, mere convenience, the difficulty of otherwise conducting complicated commercial transactions. The obvious advantage of ready reckoning is supplemented by a more subtle action of self-interest. It is deducible *à priori* that, if there be two (or *mutatis mutandis* more) groups of dealers, trafficking in two commodities, each of one group free to make any bargain with each one or any number of the other group, the final³ settlement

¹ *Theory of Political Economy*, p.99

² See the writer's essay on *Mathematical Psychics*.

³ *Ibid.*

towards which the play of competition tends, is precisely that which has been above stated. We do not here with Professor Jevons start from the fact of price and make a short step to the unity of price; but starting higher up from the abstract definition of the economic man we reason down to the fact as well as the unity of price.

Now the *rationale* of this deduction, the reason why the complex play of competition tends to a simple uniform result -- what is arbitrary⁴ and indeterminate in contract between individuals becoming extinct in the jostle of competition -- is to be sought in a principle which pervades all mathematics, the principle of limit, or law of great numbers as it might perhaps be called. In virtue of this principle, throughout the most varied fields of physics it continually occurs that from whatever initial circumstances we [p.165] start, and it may be often added by whatever steps we move, we arrive ultimately at the same position. Nor is the principle confined to physics; it finds a conspicuous illustration in what is called, *par excellence*, the law of great numbers, the law of error, which is at least as applicable to social as physical phenomena. As the law of error has been sometimes improperly identified with the law of competition, it will not be irrelevant to observe that the points of union between them are derivation from the mathematical principle of limit and application to complexities of human life. For the rest they are not in *pari materiâ*. The law of error is derivable from a differential⁵ equation, which is familiar to the physicist; the law may be compared to the theorem in the science of heat⁶, that if a given quantity of heat be distributed according to *any* law of distribution; expressed by the same function as the law of error. The analysis and analogues of the law of competition are less familiar. The field of competition may be compared to a fanciful system consisting of two groups of particles in a plane, each particle tending to its own position of maximum (kinetic, minimum potential) energy, and so peculiarly constrained, that the sums of the resolved paths of one set of particles, are respectively equal to the sums of the⁷ resolved paths of the other set; and that, while no particle of one set can move without one or more of the other set, no work can be done *against* any particle. Equilibrium, which is indeterminate in the case of a finite number of particles, becomes determinate in the limit. Such is the far-fetched derivation of our second cause.

How far the first cause has been in primitive times, or is at present, supplemented by the second cause it would be difficult and it is unimportant to determine. The only corollary which may possibly be of practical importance is that where the indefinite plurality essential to a market fails, as in the *régime* of federation which some of our socialists aim at, there may fail not only, as is now generally⁸ discerned (not perhaps without the

⁴ Ibid., p.25, top.

⁵ $\frac{du}{dt} = k \frac{d_2 u}{dx^2}$. See *Philosophical Magazine*, October, 1888, article on the *Law of Error*, and observe that the right hand member of the fundamental equation (1) there given reduces to the right hand member of equation (2) given above, when the limits of the elementary errors are *small* (mean powers above square neglectible); the essential condition of the generation of the received law of error. (See *Philosophical Magazine*, February, 1884, p.138.)

⁶ Fourier, *Théorie de Chaleur*, Art. 377.

⁷ Say, $Sx = S\xi$ and $Sy = S\eta$.

⁸ Marshall's *Economics of Industry*, p.200. Sidgwick's *Principles of Political Economy*, p.355.

instrumentality of mathematics), the determinateness of price, but also what is less conceivable, the fact of price.⁹

It remains to inquire whether the connection between mere convenience and the more refined calculation of expediency is [p.166] accidental. No, I submit; the connection is that laws of limit are apt to be simple, and simplicity is apt to be convenient. May we push the inquiry one step further, and explain the connection between the mathematical simplicity of nature, and human convenience as a result of evolution?

⁹ Cp. Walras's *Elements*, p.352