

of arbitrary energy (from slow electrons to fast  $\alpha$ -particles). As yet this has only been carried out for the first approximation, and so gives no account of the more detailed diffraction effects. This calculation thus yields a single expression for the Rutherford deflexion formula and the cross section of the hydrogen atom for electrons in the range studied explicitly by Lenard. The same method leads to a calculation of the probability of excitation of the H-atom by electronic collision, but the calculations have not yet been completed.

It would be decisive for the theory if it should prove possible to carry the approximation further, and to see whether it furnishes an explanation of the departures from the Rutherford formula.

Even, however, if these conceptions stand the experimental test, it does not mean that they are in any sense final. Even now we can say that they depend too much on the usual notion of space and time. The formal quantum theory is much more flexible, and susceptible of much more general interpretations. It is possible, for example, to mix up co-ordinates and momenta by canonical transformations, and so to arrive at formally quite different systems, with quite different wave functions  $\psi$ . But the fundamental idea of waves of probability will probably persist in one form or another.<sup>3</sup>

<sup>3</sup> Compare the article of Dr. P. Jordan, "Philosophical Foundations of Quantum Theory," to appear in a later issue of NATURE.

### Benedictus de Spinoza.

By Prof. G. DAWES HICKS.

FIFTY years ago a memorable gathering of distinguished men assembled at The Hague, under the presidency of Prince Alexander of the Netherlands, on the occasion of the two-hundredth anniversary of Spinoza's death. They met in a building which was only a few yards away from the house in the Paviljonensgracht where the philosopher had spent the last few years of his life, and where on Feb. 21, 1677, he died. The principal speaker at that gathering was Ernest Renan; and, having in mind the monument about to be erected, and referring to the humble dwelling hard by, Renan exclaimed: "From his granite pedestal Spinoza will teach us all to follow the way which he found to happiness, and, centuries hence, men of learning, crossing the Paviljonensgracht, will say to themselves, 'It is perhaps from this spot that God was most nearly seen.'" The statue was finished in 1880; and now, on the two-hundred-and-fiftieth anniversary of Spinoza's death, it is proposed to complete the memorial by acquiring the house, to be called the *Domus Spinozana*, and equipping it as a home for research and as a meeting-place for scientific workers of various nationalities. It will be a fitting tribute to one of the world's greatest minds.

The story of this lonely thinker's life has frequently been told. Born at Amsterdam, whither his father had migrated from Portugal about thirty years previously, on Nov. 24, 1632, he spent the whole of his days in Holland. His mother died when he was barely six years old, and his father when he was twenty-two. Two years after his father's death he was excommunicated by the Rabbis; and from that period onwards he lived in modest lodgings, supporting himself at first partly by teaching and partly by grinding lenses for spectacles and optical instruments, in which latter occupation he persevered to the end. Until 1660 he remained in Amsterdam, where he became the leading spirit of a small circle of friends, who after his departure met periodically to discuss philosophical papers which he sent to them. From 1660 until 1663 he resided in Rhynsburg, near Leyden, and there he wrote the "De Intellectus Emendatione," part of his exposition of Descartes'

"Principia" with the appendix, "Cogitata Metaphysica," and perhaps a portion of the "Ethics." In 1663 he removed to Voorburg, near The Hague, and stayed there until 1670. At Voorburg he was at first occupied with the "Ethics," but laid it aside in order to devote himself to the "Tractatus Theologico-Politicus," which seemed to him to be the more urgently needed, and which was published anonymously in 1670. In 1670 he removed to The Hague, where he remained until his death in 1677. Here he finished the "Ethics" and wrote the unfinished "Tractatus Politicus," both of which were published in the "Opera Posthuma," that appeared before the end of the year 1677. Nearly two centuries later there was discovered and published the Dutch text of a work of Spinoza's which appears to have been called "Tractatus de Deo et homine ejusque felicitate," written about the year 1660.

At the beginning of the treatise "De Intellectus Emendatione," Spinoza relates the circumstances that led him to devote himself to philosophical inquiry. The ordinary objects of human pursuit—sensuous enjoyment, wealth, station—had all evinced themselves, even when attained, as incapable of yielding real and lasting happiness. The reason seemed to him to be due to the fact that, while these objects are invariably transitory and fleeting in character, in making them ultimate ends men take them to be permanent and self-sufficing. True blessedness (*beatitudo*) could come only from being in possession of a changeless and abiding object of love, and there is, he was assured, no way of obtaining that possession save by knowing things as they actually are. For it was because in everyday experience our apprehension of things is fragmentary and piecemeal, because we contemplate them in isolation and from a limited point of view, that we are misled into desiring some of them as though they could constitute for us the supreme ends of life.

Scientific knowledge would, on the other hand, reveal the interconnexion of finite events, their dependence upon each other, and upon reality as a whole. The Whole alone could be perfect and eternal; and love of it could alone satisfy the

soul's yearning. But the soul can only love what it knows; in order to be in harmony with the Whole, the mind of man must gain a more or less clear insight into its nature. To have a conception of the Whole would amount to having a conception of the eternal and necessary order of the universe; and, since "we needs must love the highest when we see it," would mean the attainment, on our part, of full and complete satisfaction of desire. It was, then, because he was convinced that knowledge is the way to blessedness, that Spinoza set forth upon the intellectual quest, and did not touch the problems of ethics until he had first sought to unravel the general structure of reality.

Spinoza's philosophy takes its start from the fundamental distinction between 'substantial' or self-dependent being and 'modal' or dependent being,—the distinction, in other words, between that which is 'in itself' (*in se*) and is conceived 'through itself' (*per se*) and that which is 'in another' (*in alio*) and is conceived through that other (*per quod etiam*). It had been, indeed, a cardinal principle of the Aristotelian philosophy that what Aristotle called primary substance was marked off from other kinds of being in virtue of the fact that in a proposition it could only stand as the subject, and never as the predicate, or as the quality of anything else. But, in Aristotle's view, finite individual entities were substances in this sense, whereas Spinoza's contention is that, when we have regard to its antecedents, there is no finite individual entity that does not forfeit its supposed substantive character and turn out to be itself predicable as a phase or modification of something else. Consequently, there can be but one self-dependent Being or Substance, namely, Reality, in its absolute entirety and completeness. What we take to be independent, substantive entities, whether physical or mental, must ultimately evince themselves as derivative 'modes' or states of the one absolute Being, ways in which that one absolute Being expresses or manifests itself.

The originality of Spinoza's thought comes strikingly to light in his determined and resolute effort to work out this conception. Substance, as that which is self-dependent, as *causa sui*, or the Unconditioned, must, he argued, be conceived as necessarily existing; in regard to it, that is to say, the question of origin or genesis cannot be raised. The existence of one finite event may legitimately enough be accounted for as the effect of another finite event, and that again as the effect of another, and so on in a never-ending series. But Substance is not an event, not even one colossal event, overlapping all others. It is that which must be presupposed in order that happenings or events should be at all. There can only be a coming-to-be *within* the realm of being. Accordingly, whoever admits the existence of any event, even that of his own act of thinking, is bound to admit the existence of that without which the existence of events would be inconceivable; and, since coming to be and ceasing to be form no part of the content of the Self-existent, this means that Substance must be 'eternal,' *i.e.* timeless, in character, that the Self-

existent must be regarded as an eternal truth, which cannot be explained in terms of time or duration, even though that duration be thought of as unbounded in both directions.

Further, from the notion of the Self-existence there follows that of the infinitude of Substance. For as self-existent, Substance must, so Spinoza argues, be unique, and its uniqueness would be destroyed were it limited or restricted by other Self-existents. Just, however, as the term 'eternity' does not properly mean endless duration, so the term 'infinity' does not properly mean endless extent. Substance is infinite in the sense of being the self-contained, the self-complete; its infinity is involved, that is to say, in its unconditioned nature. So, too, Substance is one or a unity, not however in the numerical sense of being a member, even the single member, of a class, but in a sense in which ideas of number are inapplicable. Once more, Substance as complete, is perfection, yet again not in any sense that would imply the gradual realisation of a plan, the unfolding of something not yet actual, but in the sense that it is throughout all that it has in it to be.

Lastly, Substance is the cause of all things, and, indeed, ultimately the only cause. Still, the term 'cause' carries with it, in this context, no implication of producing or creating. To say that Substance is the cause of all things is to say that all things flow from the nature of Substance with the same timeless necessity as the equality of its three angles to two right angles follows from the nature of a triangle. By the term 'cause,' when used in reference to Substance, Spinoza understood, that is to say, logical ground or reason. As a logical ground involves its consequents, so the consequents of the supreme ground are not to be thought of as independent of it but as implicated essentially in it.

The supreme ground, thus conceived, is called by Spinoza indifferently 'Substance,' or 'Nature,' or 'God'; and by each of these terms he means simply Being in its fullness and completeness, that which comprises within its indivisible unity all the positive characteristics in which reality is expressed. What, in fact, he was concerned to maintain was that the notions which we apply legitimately enough to parts of the universe— notions of temporal sequence, change, producing cause, evolution, and so on—become unintelligible and meaningless when applied to the universe as a whole. To speak, for example, of 'cosmic evolution,' if by that be intended the evolution of the totality of things, is, he would have urged, a contradiction in terms. For evolution implies not only that which is evolving, but also an environment with which it is in interaction, and obviously there can be no environment of the totality of things. Not only so. Whoever pictures the universe in its entirety as evolving must inevitably be pulled up before the *impasse* of a first beginning. He would have to start with something, such, for example, as Herbert Spencer's 'indefinite, unstable homogeneity,' that 'once upon a time' appeared upon the stage of being. But, in that case, the philo-

sophic problem centres precisely there; and so long as the 'something' remains unaccounted for, not a step has been taken towards the solution of that problem. Against all such ways of regarding the system of things, Spinoza insists upon conceiving it as an organic Whole, consisting of unconditioned and conditioned, of supreme ground and dependent consequents.

With this conception of God, or the Absolute, Spinoza had evidently left the somewhat halting conclusion of Descartes and the Cartesians a long way behind. It was no longer possible to ascribe to material things on one hand, and to minds on the other, the separate and independent existence which these thinkers had claimed for them. Material things and minds could be no other than 'modes,' phases, states (*affectiones*) of the one ultimate Reality. If, now, we proceed to inquire how the modes are related to one another and to Substance, we come upon the notion of 'Attribute,' concerning the significance of which much difference of opinion prevails. One interpretation, at any rate, it seems to me, merits unreserved rejection. Spinoza could not have meant that the Attributes are real forces or kinds of energy (*Urkräfte*, as Kuno Fischer has it) of which God or Substance is the bearer. For that would have been palpably inconsistent with wellnigh everything he had laid down with respect to the nature of Substance. What could one make, for example, of the 'eternity' of Substance (in which "there is no *when*, no *before*, and no *after*") were one to conceive of its essence as being constituted by potencies or powers of this description? And how, again, could the unity of Substance be retained, if its essence is to be thought of as made up of various kinds of energy—physical, mental, and possibly many others—operating along distinct, though parallel, lines of activity? If Substance be prior to and more universal than these streams of energy, then the latter would become, according to Spinoza's definitions, 'modes,' for each would have something in common with the others, and could not, therefore, be conceived through itself and in itself, in such a way that its conception did not involve the conception of anything else. If, on the other hand, Substance be not more universal than the Attributes, then, on the interpretation in question, it would inevitably resolve itself into a plurality of independent powers, which could only be externally connected.

No doubt any interpretation of Spinoza's meaning is exposed to criticism, but probably Sir Frederick Pollock's suggestion that the Attributes were intended to be taken as 'aspects' of Substance is most nearly in accord with the statement that "Attribute is what intellect apprehends of Substance as constituting its essence." As has often been pointed out, this statement implies by no means that the Attributes are merely our subjective ways of conceiving Substance. For that which is grasped by the 'intellect' (as contrasted with 'imagination') would be, according to Spinoza, objectively real. What, then, I take him to mean, is that there are not two realms, a realm of Exten-

sion and a realm of Consciousness, but that it is one and the same reality which manifests both aspects, that everything extended is at once also conscious, and everything conscious is at once also extended. All *res particulares* are, that is to say, regarded from one point of view, modes of Extension, and, regarded from another point of view, modes of Consciousness; all are, as he expresses it, *animata*, although in different degrees.

It is perfectly true that in tracing the descent from the Unconditioned to the Conditioned the idea of agency has at some stage to be introduced, and equally certain that then the crucial difficulties of Spinoza's philosophy are full upon us. Adopting a familiar device, Spinoza endeavoured to effect the passage from the infinite to the finite, from *Natura Naturans* (Nature as ground) to *Natura Naturata* (Nature as consequent, or as a system of modes), by inserting a number of intermediary terms in order to bridge the gap. He introduced, in fact, two grades or classes of what he called 'infinite modes'; first, those which follow immediately from the Attributes, and secondly, those which follow from the Attributes when already modified. On the side of Extension, motion and rest, on the side of Consciousness, the absolutely infinite intellect, are the immediate infinite modes, while the mediate infinite mode on the side of Extension is 'the form of the whole universe' (*facies totius universi*), that on the side of Consciousness not being named. Under cover of these intermediaries the element of activity enters full fledged upon the scene, though how it is supposed to emerge is veiled, it must be confessed, in obscurity. Motion follows, we are told, directly from extension. But does it? Motion may no doubt be said to depend upon extension, but in what sense can it be said to follow from it? If extension be extension simply, it cannot give rise to what is more than itself. Nor would the difficulty be surmounted by identifying extension with physical energy, for physical energy already involves motion, and there would be, in that case, no transition from Attribute to infinite mode.

The attempt not only to conceive an ultimate unity in which all determinate existents have their ground, but likewise to work out logically the conception, was, indeed, a tremendous undertaking, and Spinoza's philosophy will always stand as one of the most sustained efforts in the history of human thought to solve its deepest problem. No one would be concerned to claim that he actually accomplished the whole task which he prescribed for himself. Few would now, I take it, venture to dispute the judgment that in the long run the modal system and the supreme ground fail to come together in one coherent view, that the temporal existence of modes obstinately refuses to fit into the timeless being of Substance. On one hand, it is contended that all things which follow from the absolute nature of any Attribute of Substance must exist eternally and be infinite, and that that which is finite and has a determinate existence can not be produced by the absolute nature of any such Attribute. On the other hand, it is maintained that a deter-

minate existent thing cannot be determined to exist or to act, unless it be so determined by another cause which is also finite and has a determinate existence, and so on *ad infinitum*. That is to say, a determinate existent thing has a positive reality in so far as it expresses the eternal essence of Substance, but in so far as it is finite, in so far as it is limited and restricted, it has not. Yet it is precisely in this latter capacity that modes function as causes in the modal sphere, and thus serve to account for the existence of each other. Modal

existence has to be recognised as a fact, though it falls apart from substantial existence, and the chasm widens as the character of the former comes to be more closely scrutinised. But criticism is comparatively easy, constructive thinking is difficult. When criticism has in this connexion said its last word, there will remain in Spinoza's constructive achievement amply sufficient to entitle him to the lasting gratitude of those who in his spirit strive to carry on the work of philosophical inquiry.

### Obituary.

MR. J. J. LISTER, F.R.S.

WITH the death of J. J. Lister on Feb. 5 in his home at Grantchester, there passes away one of the band of younger zoologists who, under the leadership of Francis Maitland Balfour, helped to build up the reputation of the Cambridge school of zoology. Although he was most widely known for his important researches on the morphology and reproduction of the Foraminifera, he was a man of liberal interests in many branches of zoology and a keen and accomplished naturalist. Those of us who were his friends and colleagues in the 'eighties vividly remember not only his charm of manner but also the bright and stimulating conversation with which he enlivened our social meetings. There seemed to be few subjects within the wide range of natural history about which he had not something interesting to say. At the same time he was to the undergraduates of his generation a hero in the athletic world. As stroke of the first boat of the Lady Margaret Boat Club from 1878 until 1882, he led his men to many victories both on the Cam and at Henley, and later he was often seen on the river as stroke of the "Ancient Mariners."

Born at Leytonstone in 1857, Lister was the son of Mr. Arthur Lister, who was himself a fellow of the Royal Society and brother of Lord Lister. From an early period of his life, therefore, he must have been associated with men of scientific tastes and initiated into some of the mysteries of biological problems. His father was an authority on the Mycetozoa and published many important papers on this group of organisms. J. J. Lister and his sister took part in these investigations and added materially to the common stock of knowledge that the family possessed. It was not surprising, therefore, that when he wrote the article on Mycetozoa for Lankester's "Treatise on Zoology," it was rightly appraised as the most authoritative summary of our knowledge of the group in the language. But Lister was destined to achieve great personal fame for his work on another group of protozoa. The dimorphism of the species of Foraminifera was already known, but Lister showed, by the most careful investigations of the *Polystomella* of our own seas, that the two forms are not male and female respectively as had been suggested, but that each produces free swimming spores and that the spores of one of them may be sexual spores, although he failed to prove that the process of conjugation actually took place. His

researches on Orbitolites, Quinqueloculina, Polytrema, and other Foraminifera also produced valuable additions to our knowledge of the group.

After taking his degree Lister entered St. Bartholomew's Hospital with the intention of entering the medical profession, but owing to ill-health he abandoned the idea and travelled for some years, first in a sailing ship to Australia and afterwards in H.M.S. *Egeria* in the Pacific Ocean. During this voyage in the surveying sloop, when he had the opportunity of visiting several remote and interesting islands, his ability as an accomplished man of science showed itself in the records of several important observations he made on various subjects. A short paper on the birds of Phoenix Island, in which he described the nesting habits of the frigate birds; an account of the natives of Bowditch Island; and the important conclusion he reached by his study of the islands of the Tonga Group, that, contrary to the Darwinian hypothesis of subsidence, coral reefs and atolls are formed in some regions where the land is undergoing elevation, were some of the varied contributions to knowledge that resulted.

Among the collections he brought home were some specimens of the coral *Millepora* beautifully preserved in spirit with the zooids expanded, and these he most generously handed over to the writer of this article for further study. They are undoubtedly the only specimens in which the expanded zooids have been seen in Great Britain, for in all the other material that has been collected the zooids are so tightly contracted as to be useless for demonstration purposes. He also brought back some specimens of the young stalked form of the coral *Fungia*, described by Stutchbury in 1830, and wrote a paper on the strobilisation of the genus.

During the later years of his life, long and continuous ill-health led to a retired life in his home in Grantchester, and his visits to the University Museum and Laboratory became more and more infrequent. But his interest in natural history never waned, and he devoted his energies to a searching investigation of variation in British Lepidoptera.

Lister was made a fellow of his College (St. John's) in 1899, and elected to the fellowship of the Royal Society in 1900. He was president of Section D of the British Association at the York meeting in 1906, and for many years an active member of the council of the Marine Biological Association.

S. J. H.