The open world

Three lectures on the metaphysical implications of science

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I God and the universe

6-7 LA SCIENCE S'ÉLOIGNE DES INTUITIONS PREMIÈRES

The ideas the more modern science, especially physics and mathematics, strives to recognize nature as it is in itself or as it comes from God, the more it has to depart from the human, all too human ideas with which we respond to our practical surroundings in the natural attitude of our existence of strife and action. And the more strange and incomprehensible it must necessarily becom to thosee who cannot devote their entire time and energy to the development and readjustment of their theoretical thinking; herein lies the actual and inevitable tragedy of our culture. For the philosophal and metaphysical import of science has not declined but rather grown through its estrangement from the naïve world of human ceonceptions.

II Causality

32 LA SCIENCE S'ÉLOIGNE DE L'HUMAIN PRAGMATIQUE

If I just now stated that the circumstance that 2+2=4 exercises a power over my actual judgment, I did not thereby mean to imply a spiritual realm of facts or of Platonic ideas having an independent existence above reality, but I wished to emphasize that we are here dealing not with a new realm of existence but only with meaning—meaning which finds its fulfilment in reality.

35-7 PAS BESOIN DE MÉTAPHYSIQUE

The transformation of the metaphysical question of cause into the scientific question of law is taught by all great scientists. The discovery of the law of falling bodies is the first important example; Galileo himself says about it in hi s *Discorsi*: "It does not seem to me advantageous now to examine what the cause of acceleration is." It is more important to investigate the law according to which the acceleration varies. Again, Newton says:

I have not yet been able to determine from the phenomena the cause of theses properties of gravitation, and I do not invent hyotheses (*Hypothesis non fingo*). It is sufficient that gravitation axists, and that it is capable of explaingn all motions of heavenly bodies and of the sea. (End of *Principia*.)

Dynamics, according to the doctirnes of d'Alembert and Lagrange, require no laws which extends to the causes of physical phenomena and to the essence of such causes; it is closed in itself as a representation of the regularities of phenomena.

[…] I believe it necessary to state this with full clarity: the law of nature offers as little evidence for or against a metaphysical-teleogical interpretation of the world as it does for or against a metaphysical-causal one.

38 CAUSALITÉ SELON HUME

The necessity of the casual bond which is commonly postulated, and which is taken over from the idea of fate, is, according to Hume, no capable of a clear-cut empirical interpretation. He therefore replaces necessity by repetition and permanence; that is, whenever the same circumstances recur, the same effect will follow the same cause. But even with this nothing is gained, as an event happens in its full concretion only once. It is thus necessary that certain demands of continuity be added, stipulating that causes differing sufficiently little from one another have effects also differing but little, that sufficiently remote bodies or events have a negligible effect, and so on. The phenomena must be brought under the heading of concepts; they must be united into classes determined by typical caracteristics. Thus the causaul judgment, "When I put my hand in the fire I burn

myself," concerns a typical performance described by the words "to put one's hanf in the fire," not an individual act in which the motion of the hand and that of the flames is determined in the minutest detail. The causal relation therefore does not exists between events but between types of events.

39-40 TROIS ASPECTS DE LA RECHERCHE SCIENTIFIQUE

I do not intend to go into the details of analysis of nature, but shall direct attention to only two or three points. (1) One does not hesitate to decompose hypothetically things that are irreducible simple elements from a perceptual standpoint, as, for example, the white sunlight into the spectral colors, or the acceleration which the earth acquires into the partial acceleration which the sun and the planets separately impart to it. (2) In scientific investigation one does not stop with the perceived qualitites of a body which directly appeal to the senses, but one introduces "concealed characters" which only manifest themselves through the reactions of that body with others. Thus, for example, the inertial mass is no perceivable characteristic of a body, but can only determined by allowing the body to react with others and then applying the impulse law to theses reactions. […] It is only through this law [conservation de la quantité de mouvement totale] that the concept of momentum, and with it that of mass, attains a definite content; separated from it thery are simply suspended in the air. […] (3) It is typical of the mathematizing sciences (in contradistinction with the descriptive ones) that they pass from the classification of given examples, like Liennaeus' classfication of the actually occurring plants, to the ideal, constructive generation of the possible. Instead of classifying the perceivable colors, phyiscs sets up the concept of ether waves, which may differ only in direction and wave length.

41-2 SIMPLICITÉ CROISSANTE DES LOIS

The assertion that nature is governed by strict laws is devoid of all content if we do not add the statement that it is governed by **mathematically simple** laws. […] One cannot help but admit this working principle [of what simplicity became in natural sciences] has stood the test well. Euclidean geometry, for example, as a science concerning the metric behaviour of rigid bodies, was gained from very rough experience as their simplest interpretation. In later precise geometrical and astronomical measurements this geometry proved to hold much more exactly than we could have anticipated from its origin. Analogous cases are continually encountered in physics. The astonishing thing is not that there exist natural laws, but that the furthuer the analysis proceeds, the finer the details, the finer the elements to which the phenomena are reduced, the simpler—and not the more complicated, as one would originally expect—the fundamental relations become and the more exactly do they describe the actual occurences.

42-3 HUME : L'HABITUDE FONDE LA CONFIANCE

the principle, "under the same circumstances the same results will follow" (no matter how on may interpret it), does not hold as something verifiable by experience. […] It is rather **a norm whose validity we enforce in building up our experience**. […] The fact that we do not find but enforce the general principles of natural knowledge was particularly emphasized by the conventionalism of H. Poincaré.

45 DÉTERMINISME INTENABLE

physics has never given support to that truly consistent determinism which maintains the inconditioned necessity of everything which happens. Even from its most extreme standpoints, including Newton's physics of central forces as well as modern field-theory, physics always supposed the state of the world at a certain moment in a section t=const. of the world. This perhaps suffices to reconcile mechanical necessity with Divine Predestination. [*comment*: ça reste fâcheux, une fois fixé l'état dans une section, de déterminer tout ce qui suit !]

49 LES PROBAS FLÈCHENT LE TEMPS

in the world of exact laws time is reversible; chaging t into $-t$ makes no difference. On the other hand, the definite direction of flow from past to future is perhaps the one outstanding mark of subjective time. This uniqueness of direction enters into physics not through its functionnal laws, but through our probability judgments; from a state at a given moment we deduce the probable state at a subsequent moment according to computed probabilities, and not the state at a previous one. Thus probability exposes a part of the causal idea which was quite suppressed in the exact laws.

54-5 THE OPEN WORLD

We may say that there exists a world, causally close d and controlled by precise laws, but in order that I, the observing person, may come in contact with its actual existence, **it must open itself to me**. The connnection

between that abstract world beyond and the one which I directly perceive is necessarily of a statistical nature. This fact, together with the new insight which modern physisc affords into the relation between subject and object, opens several ways of reconciling personal freedom with natural law. Il would be premature, however to propose a definite and complete solution of the problem. One of the great differences between the scientist and the impatient philosopher is that the scientist bides his time. We must await the further development of science, perhaps for centuries, perhaps for thousands of years, before we can design a true and detailed picture of the interwoven texture of Matter, Life and Soul. But the old classical determinism of Hobbes and Laplace need not oppress us any longer.

55-6 LOIS LOCALES ET COMPRÉHENSION GLOBALE (LIFE IS BACK)

Another feature of quantum mecanics is worth mentionning. […] the state of a system consiting of two electrons determines the states of both electrons, but the converse does not follow. […] We find here a definite and far-reaching verification of the principle that the whole is more thant the sum of its parts. […] According to vitalism the living organism reacts as a whole; its functions are not additive. The manner in which its structure is preserved through growth, in spite of all outside influences and perturbations, is not to be explained by small scale causal reactions between the elementary parts of the organism. Now we see that according to quatum physics the same applies even to inorganic nature and is not peculiar to organic processes. It is out of the question to derive the state of the whole from the state of its parts. This lead to conditions which may most plainly if not most correctly be interpreted as **a peculiar non-causual "understanding"** between the elementary particules, that is prior to and independent of the control exercised by differential laws which regulate probabilities. The rule of W. Pauli that two electrons may never be found in the same quantum state is of the best illustrations. It seems therefore that the quantum theory is called upon to bridge the gap between inorganic and organic nature; to join them in the sense of placing the origin of those phenomena which confront us in the fully developped organism as Life, Soul and Will back in the same original order of nature to which atoms and electrons also are subject. So today less than ever do we need to doubt the objective unity of the whole of nature, less than ever to despair of attaining unity of method in all natural sciences. [end of lecture]

III Infinity

81-2 POTENTIEL DANS LES ACTES, ACTUEL DANS LA FORME

My opinion may be summed up as follows: if mathematics is taken by itself, one should restrict oneself with Brouwer to the intuitively cognizable truths and consider the infinite only as an open field of possibilities, nothing compels us to go farther. But in the natural sciences we are in contact with a sphere which is impervious to intuitive evidence; here cognition necessarily becomes symbolical construction. Hence we need no longer demand that when mathematics is taken into the process of theoretical construction in physics it should be possible to set apart the mathematical element as a special domain in which all judgment are intuitively certain; from this higher viewpoint which makes the whole of science appear as one unit, I consider Hilbert to be right.