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PHYSICAL SCIENCE AND THE CATHOLIC STUDENT

THE Catholic engaged in the study of natural science is in some ways less well placed than any other student for growing into a full-blooded Christian. His subject is not one which provides obvious stimulation for his Catholic conscience. Its content and presentations are unaltered whether its exponents are Christians or not, and the student lacks the stimulus of that constant need of criticism and re-interpretation, which is provided, for instance, by the study of history. And it is undeniable that natural science when studied intensively easily produces a person hypertrophied in some respects and gravely lacking in Catholic fundamentals. Laboratory work occupies long hours which others would spend on general Catholic reading, and it is too easy to become caught up into a routine which contains little but science. Prayer and spiritual reading do not thrive when they have to be fitted precariously into short intervals saved from the rush. Work is not readily sacrificed to them, for there is severe overcrowding and economic pressure in the lower ranks of scientific workers.¹ (This competition, incidentally, does not favour humility nor a true love of learning.) The manual work of the laboratory gives a certain balance to the scientist's life, and this again tends to obscure the deficiencies of the latter on the spiritual level. Further, there are certain intellectual obstacles. If a Catholic scientist is intelligent enough to begin thinking about the nature of his scientific knowledge and comparing it with Thomist philosophy, he is liable to be oppressed by certain superficial divergences between the principles of Thomism and

¹ Cf. Lovell, *Science and Civilisation*. (Duckworth, 1939).

of physical science. If he turns for help to philosophy as now taught in English universities, he often meets with views which depend upon a tradition of undue attention to the world of dead matter, and which tend to strengthen his incipient belief that Thomists are out of touch with modern knowledge.' As a consequence he may not take easily to the *philosophia perennis*, and this is liable to obscure the theological vision of life in Christ which ought to be growing clearer. The difficulties are increased by the fact that current literature on the interpretation of science is too often materialist or Marxist in tone, and that nearly all the literature of the last decade on the subject is hopelessly unsatisfactory from a philosophical (let alone a Catholic) point of view.²

As a result of these discouraging circumstances, it is often extremely difficult for a Catholic scientist to integrate his work with the other necessary elements of life, in particular with prayer. It is the purpose of this article, therefore, to contribute towards setting the study of the physical sciences (roughly, physics, chemistry and their application) in a Catholic framework. (Biological science and psychological science would need rather different treatments.) It will therefore sketch the method of physical science and consider its setting within a Thomist synthesis. It will then consider the pursuit of physical science from the point of view of Catholic scientists and their incorporation in Christ; and finally the significance of science from the point of view of society at large.

I

The fundamental way in which physical scientists get their information is by metrical observation of dead matter. They are not concerned with living beings as such, nor

² An excellent antidote, so far as it goes, to the amateur philosophising of the kind popularised by Jeans and Eddington is provided by Susan Stebbing in *Philosophy and Physicists*.

even with objects made by man (for instance, chairs and statues) as such, but with non-living being or 'dead matter' as such; and their examination of it is not theological, philosophical or aesthetic, but consists in measurements of certain variables (ultimately comparisons of lengths, or pointer-readings). Every other characteristic of the object is neglected from the start.

In the pursuit of physical science there are two converse processes at work; the one is the formulation by induction of empirical laws based directly on observation, and the other is the construction of an interpretatory 'theoretical' scheme, from which by deduction one may arrive at rules which agree with the empirical laws as closely as possible (i.e. a scheme which 'saves the phenomena').

A physical experiment consists (roughly speaking) in observing the concomitant values of two variables—say, the pressure (P) and volume (V) of a gas. The empirical law may then be formulated, by finding a functional relation ($P=f(V)$) which is approximately fitted by all the experimental pairs of values (in this case it will be $PV=\text{constant}$). This is an example of the basic kind of induction. It is important to note that it consists in writing an exact mathematical equation in place of a relatively small number of pairs of readings which fit it only approximately; or, what is the same thing, it consists in drawing a smooth curve which shall pass as close as possible to a relatively small number of points which all lie slightly off the curve. The generalisation therefore goes beyond the immediate evidence in two ways. First, in attributing deviations from the exact relation to 'experimental error'—this is relatively important because the observed readings are in any case only 'most probable' values. Second, in stating that the law holds for *all* values of the variables, although only a few have been investigated—this gives rise to the basic 'problem of induction' which is the problem of justifying such generalisations. The recent attempts (by Keynes and others) to justify it on the basis solely of formal logic and

the empirical data has led to a dead end,³ but we shall see later that a solution follows easily once the Thomist philosophical structure is accepted, and indeed it is not difficult to see that, without metaphysics, failure is to be expected.

These experimental functional relations are the raw material for theoretical interpretation, the aim of which is to provide a simple generalised scheme from which particular laws may be deduced which shall agree with experiment as closely as possible. The interpretatory scheme consists of a number of types of 'entity' (atoms, electrons, photons, etc.) and of laws (e.g. Maxwell's equations, Hamilton's principle). These are all mathematically defined. They may contain the observable variable, length, but also contain derived variables such as charge, mass, energy, entropy, which are chosen for the simplicity of the resulting scheme. (These derived variables are too often conceived in terms of misleading analogies such as muscular force and mental energy or inertia; but they are in truth intelligible only *via* their effect on directly measurable proportions. We are not directly acquainted with any intrinsic characteristic of dead matter. We have to use symbols with whose meaning we are not directly acquainted, though we can state the rules which relate them to other symbols, and ultimately define them in terms of lengths. We can say at once that physical science does not give us adequate definition of the essence of material being; and in principle cannot do so.)

Physical science, then, is restricted to the study of dead matter as such, in terms of its measurable aspect; its observations are metrical, and its interpretations correspondingly mathematical in form. This suffices to define the scope of physical science and its relation to the Thomist philo-

³ For a summary of the problem of these attempts, see Eaton, *General Logic*, Part IV.

sophical synthesis.⁴ Physical science can say nothing about living beings as such, and it cannot say everything about non-living matter. Now Thomist philosophy is not restricted like this. It claims to be a commentary on the fundamentals of all experiences (in so far as they are independent of Revelation); it is an ordered survey of all the hierarchy of beings and their relations. So far from being restricted to consideration of dead matter, it finds the world interesting primarily because of *life*, culminating in Pure Act. This is perhaps its outstanding characteristic, as against much 'modern' philosophy; and if it is approached from the standpoint of the latter or of physical science, it is essential to recognise that Thomist philosophy moves on a far more sublime plane. Its conceptions of substance, act and causality can only be fully grasped if it is realised that it rises to systematic treatment of living beings, placing God at its apex and being permeated with the thought of His action, and regarding dead matter as of least importance, the bottom of the hierarchical scale of being, the lowest stage of actual perfection. Because of the scale of perfection in beings (exemplified by a series, such as: dead matter, living organism, intelligent living organism, God) all change is conceived by Thomists as the communication of some perfection by a being which possesses it to a being which does not but might possess it; in other words as the fulfilment of a potentiality of the nature of some being, by the agency of a being which is already in act in that respect. Hence the notions of efficient and final causes, which are respectively the agent which communicates its perfection, and the term (or end) of the change. These are perhaps best illustrated by the case of artificial objects made by man. Consider a sculptor making a statue. The effi-

⁴ On the philosophical status of natural science, Maritain's *Degrees of Knowledge* (Chapters I and II) is indispensable. An essay on the *Mathematical Attenuation of Time* in *Theonas*, by the same author, is also helpful.

cient causes are multiple; they include God, Whose creative power upholds both sculptor and material, and Who is the primary efficient cause; and the sculptor (secondary efficient cause); and his tool (instrumental efficient cause). The final causes also are multiple; they include the actual fulfilment of the shaping of the statue to the sculptor's design (*finis operationis*), and the other purposes of the sculptor, e.g. to make a living (*finis operantis*). Such conceptions cannot be derived from the results of physics; they are legitimate because they are derived from experience in its fullness, and not from any specialised aspect such as that dealt with in physics.

On this basis we can show, in the first place, how Thomist philosophy provides the necessary basis for science by justifying induction. For, given a full doctrine of efficient causality, it is possible to demonstrate the existence of God, and to work out the relations of the world with Him—that is, to give an account of creation and conservation. From the doctrine of creation it must be concluded that there is some degree of *order* in dead matter. Now it is this metaphysical certitude of order in the natural world which is the justification for induction—for the otherwise unjustifiable generalisation to an empirical law from scattered and inaccurately observed instances of it. Modern attempts to justify induction have failed because they have not been based on metaphysics; but the legitimacy of inductive generalisation seems to be a valid deduction from the doctrine of creation; which is a part of the Thomist philosophical synthesis. Physical science is therefore subordinate to philosophy in the Thomist sense; it presupposes a justification of induction from philosophy before it can start at all. This brings us to the second point.

Physical science cannot contribute at all to the solution of philosophical questions. By its self-restriction to measurable phenomena it excludes from the start, for instance, everything characteristic of a human act, and so it

cannot possibly have any bearing upon human freedom of will; and, for the same reason, the general account of causality is beyond its reach. And although at first sight it seems to be a prolongation of philosophy, and to investigate the essence of material things, we saw previously that this is not the case, because the restriction to measurables compels the interpretatory scheme to use variables which are not directly accessible to observation. Physical science, then, cannot give answers to the questions of philosophy; and, in view of the widespread belief that changes in the leading notions of science ought at least to modify philosophy, this is an important conclusion. The distinction of science and philosophy (in the Thomist sense) is not to be found in some facile cleavage of objective and subjective, or of inductive and deductive thought. Both of them involve subjective activity while being concerned with objective things and events; both of them rely on experience and also upon the ordered interpretation of it. The difference is (once more) that in physical science the experience is limited to metrical observation, the objective reality is subjected to abstraction, and the interpretation is correspondingly mathematical in form. This brings us to the third point.

We can now see why physical science totally ignores the fundamental notions of Thomism—for instance, the analogy of being, potency and act, and causality. All beings as known to physics are described only in mathematical terms and differ only in complexity and dimensions, not in actual perfection or *esse*; so that the rich analogical concept of *esse* (being) is replaced by a flat univocal conception. Similarly it is impossible to represent in mathematical terms one being as more in act than another; indeed, it is a question whether substances can be identified in physical terms at all. Causality, again, is not invoked as such in physical science; the instrumental efficient causality, which must operate in dead matter, is dealt with in physics by *symbolising it by mathematical deducti-*

bility. And the same basic reason accounts for every other divergence of the principles of natural science from those of Thomist philosophy.

II

Having offered a sketch of the way in which physical science may be conceived within a Thomist philosophical setting, we can deal briefly with the more concrete problems which are presented by the pursuit of science and by its function in society. There is of course no specifically Catholic natural science, any more than there is Jewish or Nazi science,⁵ but there are Catholic *scientists*, and there is a Catholic *setting* for science.

The first group of questions is concerned with deciding how the pursuit of science can be made a consciously Christian work, and integrated into a fully Catholic life. On natural grounds alone we can find certain reasons for the attraction of individuals towards the study of natural science. Truth as such is always a reflection of God, and the simplicity and elegance of the theoretical physical scheme enhance the beauty of its truth. Again the combination of theoretical and practical work gives a certain balance lacking in other studies; in all scientific work the social nature of the enterprise is impossible to miss; further there may be some extrinsic end which is directly aimed at, some contribution to human welfare. But the full significance with which the pursuit of science may become endowed is to be found in terms of spiritual life; for science should be a means to holiness and an expression of holiness, like any other discipline. The inner reality of every Christian life, the unity which links together its external multiplicity, is *here and now to live in the intimate life of the Blessed Trinity, through union with Christ in the Church*. This sanctifying union with Christ implies a sharing in

⁵ *Pace* Herr Rust, Minister for Education; *cf. Nature*, Jan. 16, 1936.

His Priesthood; participation in Christ's redeeming act is our supreme adoration of God and effects our union with God. This participation in the eternal Priesthood is realised principally at Mass, in the Sacraments, in all prayers and in the apostolate; it is common to all Catholics, in degrees depending on their place in the hierarchical order of the Church and on the Sacraments they have received. Its public and official manifestations are the Liturgy and the hierarchical apostolate of the Church (including Catholic action). But it should also inform every part of the life of every Catholic, according to his particular vocation. Parents are apostles to their children, and this is a special way of participating in Christ's Priesthood; again, not all prayer is liturgical, but all prayer depends upon the unitive action of that Priesthood. In particular, this participation can, and must be, related to the material world which is, as it were, the garment of Christ's Mystical Body. The Incarnation does not leave matter un sanctified; '*Quapropter profusis gaudiis, totus in orbe terrarum mundus exultat*'; and if this application be questioned, the Liturgy itself supplies the answer: '*Quia cum Unigenitus tuus in substantia nostrae mortalitatis apparuit, nova nos immortalitatis suae luce reparavit.*'

Now matter can be dealt with by men for several reasons: either primarily for use; or primarily as a vehicle for beautiful forms, as in 'fine art'; or primarily for the sake of investigating the laws of its behaviour and the principles governing them, as in physical science. Each of these activities to a Christian implies a special way of union with Christ. 'To sweep a room as for Our Lord' is one way; to realise an aesthetic form implies a certain extension to inert matter of the redemptive act; and to investigate the laws symbolising the operations of God's creative wisdom in dead matter can likewise lead to a special participation in the life of God. Scientists have the particular job of gaining what knowledge they can about material nature as such, as an untouched work of God, in-

formed with an order which is a certain reflection of His Word; and of offering that knowledge back to God, Who created both themselves and dead matter. They are priests of nature. This priestly oblation of dead matter, in virtue of scientific knowledge, is a real element in a scientist's particular participation in the Priesthood of Christ. It is not sentimental extravagance which has led a recent writer to picture the scientist 'penché sur sa tâche comme le prêtre à l'autel, dans un élan d'adoration et de prière, conscient de son rôle sacerdotal, et contemplant la Verité dans chacun de ses reflets.'⁶ Science genuinely does allow a special fulfilment of the exhortation *Benedicite omnia opera Domini Domino . . .*, and this must be meditated and realised if the study of pure science is to be Christianised and saved from its present hopeless secularism. The dedication of all work to God and its rôle in a supernatural vocation must be practised and asserted, in face of the emptiness and pusillanimity of too many scientific workers. Scientists have their own special opportunities for self-giving, adoration, and apostolate. The endless perversity and intractability of matter and its reluctance to behave in ways which yield the information desired are a constant occasion for '*sainte abandon*.' The occasions when all goes well and order is manifested are constant reminders of God's creative act and providence (and laboratory practice affords a surprising number of occasions for gratitude and adoration thereat). And, apart from the unusual opportunities for personal apostolate arising from the intimacy of the laboratory, there is a specialised apostolate open to those who practise science and understand its Catholic setting, especially in view of the widespread belief that natural science stands in its own right as an alternative to philosophy and Revelation as a reliable road to truth.

The second group of questions is concerned with the

⁶ E. Rideau, *Philosophie de la physique moderne*. The last few pages of this essay are very useful.

place of science in society. At present this is the subject of intensive debate (in which Christianity is hardly mentioned, nor even the Name of God). It seems best to formulate such propositions as seem to be certain if the foregoing views are true. First, if natural science has a social function outside its place in the general body of learning, it is evidently to provide techniques for handling matter and subjecting it to human purposes. It is equally certain that science is powerless to provide principles which should direct its own application; it constitutes *instrumental knowledge*⁷ and clamours for direction by Christian theology (or at least by *philosophica perennis*). Further, it seems clear that the control of the material world is in itself good, in so far as it can be used to further God's Kingdom on earth; and that the curse on work due to the Fall does not forbid us to use means to lighten manual labour. It will also be agreed that the sudden development of science since the sixteenth century has taken place in an intellectual climate which is, openly or insiduously, naturalistic and anti-Catholic, and that science has been exploited for material gain by that 'acquisitive society' which has roots in Calvinism but none in Catholicism. Beyond this point there is a whole nest of difficulties arising out of man's tendency to the idolatry of wealth and comfort, which arouses doubts about the possibility of ever ensuring the wise application of science. It must be doubted whether, even in a Christian culture, man could ever divine the will of God well enough to direct large-scale operations of applied science towards it with reasonable consistency. It might seem that in a fully Christian society the rôle of science would be mainly in its contribution to learning as such, and that it would be necessary to restrict its application in many ways, and certainly to abolish all commercial inspiration and direction of research. For it seems inevitable that in modern Western civilisation material technique

⁷ Cf. Macmurray, *Boundaries of Science*. (Faber, 1939.)

shall be exploited for worldly ends; and work is degraded to serfdom when these techniques are used unscrupulously; and, worse still, they can provide destructive weapons by which a Christian culture might be utterly destroyed.

On the other hand, although the misuse of the powers conferred by science forms a sombre picture, we cannot lightly discard the system of research which has given society such genuine benefits as better crops, safer water, cancer research, safety in childbirth, flood drainage, and so on. Easier living is not a great part of Catholic aims, but reasonable material conditions are almost a condition of social sanctity. To boycott the application of science, therefore, in the belief that its use is imprudent when one aims at Christian poverty, does not seem a wholly satisfactory solution. Few investigations in science have a single clear-cut application; the majority are involved in a tangled skein wherein, for example, life-saving biochemical work depends upon other researches which could have appalling consequences if misapplied; so that limitation of the fields of research would not solve the problem, even if it were possible.

Worldliness is the enemy; power over matter too easily shuts out the things of God, and only when men think correctly about God will they think correctly about the use of material techniques. It seems well to remember that the Church has to work *in* the world; that in its human aspect it is always struggling and always imperfect; and that grace works gradually within disordered humanity. This world has been equipped, for better or worse, with natural science, which must therefore be captured by Catholics, and not cast out to become an enemy's weapon. When a society informed with a vital Christianity has been built, it will be capable of a wise use of science, as of philosophy, sculpture, drama, and every other discipline, for the sake of the Kingdom of God.

E. F. CALDIN.