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846TH ORDINARY GENERAL MEETING.

HELD IN COMMITTEE ROOM, 19, LIVINGSTONE HOUSE, BROADWAY, S.W.1, ON MONDAY, MARCH 23RD, 1942, AT 6 P.M.

PROF. S. NEVIN, M.D., B.Sc., IN THE CHAIR.

The Minutes of the previous meeting were read, confirmed and signed.

The CHAIRMAN then called on Dr. Walter Pagel to read his paper entitled "The Debt of Science and Medicine to a Devout Belief in God."

THE DEBT OF SCIENCE AND MEDICINE TO A DEVOUT BELIEF IN GOD.

ILLUSTRATED BY THE WORK OF J. B. VAN HELMONT.

By WALTER PAGEL, ESQ., M.D.

CONTENTS

I.—VAN HELMONT'S POSITION IN THE HISTORY OF SCIENCE AND MEDICINE.

VAN HELMONT (1579–1644) is a figure well known from textbooks of the History of Medicine, Chemistry and Biology which make due reference to his momentous discoveries, notably that of "Gas," to his quantitative experi-

ments, to his use of the balance, to his description of a thermometer.* van Helmont taught the indestructibility of matter. He demonstrated acid to be responsible for the digestion in the stomach and alkali for that in the duodenum. He demonstrated the vital importance of bile, hitherto regarded as a nocuous humour. A keen student of vital phenomena, van Helmont expressed his results in chemical terms and became the founder of biochemistry. He proposed a reform of time measuring by using the pendulum and devoted much experimental work to the investigation of kindred problems. He is the founder of modern pathology in that he based it on a study of the external agents and the anatomical changes of the organs, in diseases. Original anatomical, physiological and pathological research led him to a rejection of the " Folly of Catarrh," then the universal explanation of disease which was derived from a flow of mucus from the brain straight through the base of the skull to all parts of the body, notably to the lungs and joints, causing pneumonia, consumption, rheumatism. As a rule it is mentioned that van Helmont's treatises make dull reading as they are mixed up with theosophical speculation, the account of dreams and visions. The usual method is to extricate from these the scientific detail which is valid to-day or should be regarded as stepping-stones of scientific discovery. The rest is " excused " with the spirit of the age when it was customary to mingle matters scientific and philosophical, and when the scientist had to offer his new knowledge in a religious cloak in order to be read and believed. At best the famous catchword of the " two souls in the same body " or similar superficialities are applied to van Helmont, which should justify a summary dismissal of the " dark " chapters of his work.

While van Helmont's original discoveries and true scientific yearning are generally recognised among historians of science and medicine, van Helmont's position in the history of philosophy is still less adequate. Here not even an attempt is made to understand his scientific and medical achievements—yet one disapproves of them. What can be expected from a man who deprecated " ratio," *i.e.*, formal logic and mathematical patterns

* From the voluminous literature on van Helmont I mention only: Partington, J. R., *Joan Baptist van Helmont* (*Ann. Sci.*, 1936, i, 359), as an account of his achievements in chemistry; and for his medical, biological and philosophical aspects: Pagel, W., *J. B. van Helmont* (Berlin; Springer, 1930); Pagel, W., *Helmont, Leibniz, Stahl. Arch. Gesch. d. Medic.*, 1931, xxiv, pp.19–59.

in science? It has been said that van Helmont in no way belongs to the magnificent series of scientists and philosophers which the seventeenth century has produced, to Harvey and Glisson, to Willis and Boyle, to Bacon and Descartes. This has been based on the fact that van Helmont believed in alchemy ("hermeticism"), rather than on examination of his actual scientific knowledge and achievements.* To any student of van Helmont's work, his belief in the transmutation of metals and the therapeutical action of chemicals including metals such as gold, *i.e.*, his "hermeticism," is obvious. But is this sufficient evidence for deprecation, and is "alchemy" really the only or the predominant philosophy of van Helmont? Both these questions must be answered in the negative. Van Helmont was and is praised as an acute observer and most successful experimentalist, he is the admitted and admired predecessor of chemists such as Boyle, Stahl, and perhaps even of Lavoisier. In any case "hermeticism" has not prevented him from making his momentous discoveries. Belief in the transmutation of metals, in mighty "ferments" and "seeds," in spontaneous generation, in "spirits" and apparitions, in "palingenesy" was widespread in van Helmont's age. These subjects were seriously treated by the Royal Society, by scientists as well as amateurs and impostors, and this could not interfere with the foundation of science at this very period. Moreover, "hermeticism" is neither van Helmont's philosophy nor his religion. He had deep philosophical insight, of which I shall give evidence presently. Nor was "alchemy" the source of van Helmont's devout belief in God. There is no reason to doubt that his belief was genuine. It has been inferred that he professed it and used biblical language in order to propound his "hermetical" wisdom with impunity. But why, then, did he use biblical language and enlarge on theological arguments in almost *all* his treatises including the multitude of those which had nothing to do with "alchemy," for example, the purely medical works? One may assume the converse and hold that religion was the source of his "hermeticism"; van Helmont's universe consists of the "seeds" which are created by the living God and which owing to their divine origin make transmutation of matter possible. It is the Godfearing who will learn the hidden divine

* Nève de Mévergnies P., *Jean Baptiste van Helmont, Philosophe par le Feu*. Paris: Droz, 1935.

forces in nature. Not "alchemy," not "hermeticism," not goldmaking and the preparation of life-prolonging elixirs, but the search for "specificity," *i.e.*, the essential characters of objects in nature as the expression of divine grace and creation is the link connecting the various and apparently so disparate aspects of his work. It is true that this is based on his religious belief and in many respects empirical but, no doubt, "empiricism," *i.e.*, deprecation of theories in favour of observation and experiment such as practised by van Helmont, was much more akin to modern science than the formal logic disputes on natural objects and phenomena held at the universities of the sixteenth and early seventeenth century. It is bewildering that these scholastic exercises are regarded as "scientific" simply because they were propounded by the legitimate "schools" and that they are contrasted with van Helmont's "empiricism" and "hermeticism."*

In conclusion, "hermeticism" is but one of the many trends of thought which were transmitted and offered by van Helmont's work. His genuine belief in a living and creating God, however, is the link connecting the different aspects of his work which may be described as the search for the specific, *i.e.*, essential characters of objects in nature.

No attempt has yet been made to understand van Helmont's work as a whole and thereby to explain what strikes the present day observer as contradictions in his life and work, notably the union of religious and scientific thinking and the actual inspiration which the latter received from his devout belief in God.

I shall therefore follow a method directly opposed to the tendency to extricate scientific detail from the general philosophical and theological frame in which it is offered. It will then emerge that what has been regarded as purely scientific entity meant to its discoverer a cosmological or general biological notion which only a *religious* mind could conceive, and thus will be established the active rôle which religious motives played in the birth of modern scientific ideas in the seventeenth century.

II.—Van Helmont's Critical Platform.

It is Aristotelian philosophy and its petrification in the scholastic and jesuitic lore of the university which van Helmont

* de Mévergnies, *loc. cit.*

fiercely attacks. First of all the *method*: The sheer reasoning, "ratio," which pretended to make man omniscient by means of the art of discussion and combination, the formal-logic and mathematical interpretation of trivial facts such as that water is humid or light illuminates, instead of impartial search for *new* facts and observation of phenomena.

Generally ruling principles, formal logic figures and mathematical patterns, however, are in Van Helmont's opinion, alien to nature which deals with things as they really are, *i.e.*, with truth. Truth is a real thing, reason an "ens rationis," a mere product of mental activity and therefore a "non-ens." "Reasoning and truth," van Helmont says,* "are different at their very roots." Reason is by no means the highest function of the intellect, it is developed to a high degree of perfection in freaks of nature, in the mentally deficient and in animals, notably in foxes which outwit their enemies skilfully.† In the end reasoning and formal logic which is a dunghill ("defæcatissima") and a "worthless talker," are but arguing which serves to impress one's personal opinion upon an audience by special adaptation and composition of words.‡ Syllogisms are negations, science is positive and, against the mathematical patterns, it is not man who measures nature, but only nature itself.§

The "sermocinalia," formal logic and mathematical patterns, are particularly useless in the investigation of life. This, van Helmont says, beats the human intellect. It is a sort of "light" descending from the "father of light" and thereby outside the "mundus intellegibilis," a term wrongly used by the schoolmen for God.‖ Life resides in strata of the soul deeper than those of the intellect whose blotting out affects but little motion and life itself, and which is so easily overwhelmed by the life forces and affections such as syncope and epilepsy, which are not derived from the brain.

At van Helmont's time refutation of formal logic was widespread and felt to be a necessity for the building up of a scientific world; in van Helmont's case, however, it is actuated by *religious motives*. The domination of formal logic is, in his opinion, but an expression of the hybris of human intellect which feels itself

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* *Venatio Scient.*, 27.
† *Ibid.*, 34.
‡ *Logica inutilis*, 23.
§ *Caus. et init. natur.*, 41.
‖ *Confirmatur morborum sedes in anima sensit.*, 6.

capable of mastering God's creation. It is the heathen Aristotelian doctrine, refuted by St. Paul long ago, but stubbornly adhered to by the schoolmen.*

But van Helmont does not stop at the methods, the *substance* of pagan philosophy, so shamelessly adopted by the Christian schools, is still more the target of his attacks.

He shows that the four elements, the four qualities and the four humours of the Greeks, still the main pillar of seventeenth-century natural philosophy, either do not exist or do not constitute matter, or that where they are, their function has been misunderstood. Bile, believed to be a nocuous, chiefly pathological product, van Helmont proved to be of vital importance in digestion.† Van Helmont's rejection of heat, the most potent factor in ancient biology, is the keynote of his critical as well as constructive work. Heat, he says, is a companion of life, but not its essential requisite, since life is just as real in fishes and frogs as in the lion, in " cold " poppies just as in " hot " pepper.‡ There is no innate heat in the heart or essential for the maintenance of the pulse. Heat may favour the hatching of an egg, but it can never display any *creative* force, as thought by the schoolmen. This strikes van Helmont as an atheistic concept.§ God alone creates forms and substances. These differ from each other in principle as well as in their products. In other words they are *specific* in themselves and thereby completely different from heat which is a *general* medium and in no way specific.

Ancient thinking was materialistic and therefore atheistic. It recognised as the causes of natural processes only *quantitative* and *locative* changes in an ever identical and immutable matter. Hence the importance of the " too much " and the " too little," of polarity and " contraria," of attraction and repulsion, the combat of the qualities, hence the decay of medicine in which therapy was directed against the fictitious humours, elements and qualities and led to indiscriminate bloodletting and purgation with resulting decimation of mankind. All this was bound up with a revival of the ancient belief in the profound influence of the stars and the drawing up of diagnostic and prognostic

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* *Venat. scient.*, 37 ; *Logica inutil.*, 20.

† *Scholar. Humorist. Pass. Deceptio*, Ch. II., 8 and 24.

‡ *Blas Human.*, 15, *Vita* ed., Amster., 1652, p. 585 *Physica Arist. et Galeni ignara*, 7.

§ *Formar. Ortus*, 12.

tables. To van Helmont the stars are but time signals which "necessitate"; but how, he asks, can variety in nature and specificity be ever explained by uniform motion and its laws? Motion, by which Aristotle defined nature, must take place *in* something which exists and is the subject of investigation.* The stars, not possessing any "ratio causarum," can do nothing, nor can a Christian with impunity attribute to them duties other than to act as time signals.† The same opposition against materialism and atheism actuates van Helmont in his combat against the doctrine of the analogy of macrocosm and microcosm which formed the basis of the natural philosophy of Paracelsus and some of his followers, particularly Fludd.‡ If everything, argues van Helmont, in our organism is governed by forces identical with those acting in the outer world, if the phenomena observed in living beings are but replicas of what occurs in the celestial bodies, then no place remains for specificity in nature. This is vouchsafed by divine creation, which occurs but once, bestowing on every being the features essential for its *individual* life.§ Life, to van Helmont, means a modification of matter which the creator compels to act in certain ways varying with the individual. He thereby reserved for things vital the private right and privilege of specificity as opposed to the general—"public"—institutions such as the forces of the stars, attraction and repulsion, sympathy and antipathy, heat and cold, etc., of which *all* beings in nature partake. This vitalistic (and modern scientific) point of view leads him to reject symbolism and *monistic* concepts. He equally deprecates *dualistic* theories which create a gap between body and soul, thought and extension. He himself builds up a vitalistic *Pluralism*.

III.—Van Helmont's Original Work.

Van Helmont's pluralism sees the world composed of innumerable "seeds" which are neither spirit nor matter, but have something of both. Products of immediate divine creation, they are characterised by their *life*, *i.e.*, their *specific* form function and development—not unlike Leibniz's ultimate units

* *Phys. Arist. et Gal. ign.*, 2–3.

† *Form Ortus* 14; *Astra necess.*, *non-inclinant*, etc. *passim*; *De Tempore*, 33.

‡ *See* Pagel, W., *Religious Motives in Seventeenth Century Medical Biology*, *Bull. Inst. Hist. Med.*, 1935, iii, 97–312.

§ *Natura contrarior. nescia*, Ed. 1652, p. 126. Qualified recognition of sympathy in *De magnetica vulner. cur.*, 1 ff., and of generally valid forces in nature in his treatises on "Blas."

of being, the "Monades." They are the divine, *i.e.*, spiritual spark in every being, the entity which actually matters and forms the subject of his research. Yet van Helmont cannot agree with those who assume a gap between things corporeal and spiritual. In his opinion both form different aspects of the living being rather than a separable body and soul. It is thus that he represents the divine seed as a kind of "odour" which illuminates matter, conferring upon it a "disposition for transmutation." The "odour" is also called "ferment" or "image" of the thing which is to be formed or "notion of what has to be done."* The odour cannot, however, act on crude matter (in van Helmont's opinion this is nothing but water), unless there is an "Odorabile" present which is the "*gas*" of the object.† By its presence matter loses its coarse corporality and, as it were, meets the odour-like ferment half way, thereby becoming suitable for its reception.‡ "Gas" therefore is the entity which organises matter and makes it fit to become further organised, and only matter which has acquired a "ferment" or "odour" or a "seminal property" is called "gas." Each organised body in nature contains its gas, a spirit, under normal conditions "concrete" or "coagulated like a solid body" and thereby kept dormant. The whole body may become volatile, however, when it has combined with an appropriate ferment. This is seen, for example, in fermenting grapes, left lying about with their skin damaged. If the skin is intact, however, and the ferment thus prevented from access, they simply dry up without liberation of their "gas."§ As far as material is concerned, all bodies are eventually water and may be converted into it. But this will not occur unless they have lost their specific seminal property, their gas. If they are forced to give up their fixed condition, *e.g.*, by heating, gas develops. In other words gas is the thing which has lost its concrete shape, but not specificity. It has therefore lost nothing and will never be consumed, as can be seen when charcoal is heated in a closed vessel. It may be heated until domesday, yet will never substantially disappear, but it will be almost completely transformed into a "wild spirit."§ This is called "wild" because it cannot be held in an open vessel and solidified unless it loses specificity, *e.g.*, by

* *Imago ferm. impr. mass. sem.*, 12.
† *Magnum Oportet*, 36.
‡ *Ibid.*, 25.
§ *Compl. a. mist. elemental. figm.*, 14.

the action of cold in high altitudes or by an extremely long time interval when finally the thing is converted into water. *Gas is, therefore, unlike air and watery vapour, no volatile medium common to all things, but something specific.* It is the material carrier of specificity which van Helmont believed he had discovered and which should be present in every being in nature. The far-reaching significance of " gas " emerges from its rôle in living beings. Gas, containing " concrete semen," is capable of generation.* The " life spirit " in our blood is gas.† The chief vital principle in the body as well as the vital principles in the organs, *i.e.*, the " archei " are " gas " of the nature of balsamic salts " which can easily evaporate through the pores, such as seen in syncope, fainting, palpitation. *Gas is the vector of life.*

It is thus that van Helmont feels the great progress which is due to his work—not so much because of the import of his discovery for chemistry, but for the empirical solution which he offered for the perennial problem of the action of " spirit " on matter. In van Helmont's concept the immanence of the dynamic principle in matter is emphasised—as opposed to its external and accidental action on it. Spiritualisation of matter is the means by which van Helmont achieved this result, which is tantamount to a vindication of the exigencies of matter and its changes in biology. van Helmont's merit lies in the empirical justification of the concept of immanence. Gas was reality and truth, the elements, humours and qualities of the ancients were fictitious. Gas was an empirical and material entity on which safely to base specificity in a vitalistic sense ; not more than a mechanistic pseudo-explanation was to be derived from the ancient concepts of imaginary changes in the arrangement of the material atoms. Aristotle had deduced a specific vital force by philosophical *reasoning* and compared it with the creative idea of the artist ; van Helmont has found something of this idea in his *test tube.* He demonstrated how matter was enabled to unite with the divine spark of life ; the ancient theories did not require, nay, rejected, divine creation.

Gas has thus a meaning reaching much farther than that of a chemical entity. It embodies a notion of general cosmological and theological import. It is a genuine offspring of van Helmont's religious system of nature. It cannot be isolated from its historical and religious background and indexed like

* *Compl. a. mist. elem. figm.*, 34.
† *Ibid.*, 40–41.

a test book entity. In van Helmont's system there is no separate soul which acts from outside on a body devoid of any right and activity, on mere matter which would continually decay, but for the preserving power of the "anima" of Stahl and the "psychovitalistic" followers of Descartes. These preserving, "balsamic" powers were attributed by van Helmont to the "vital gas," for example, to the volatile and salty spirit which accounts for the conversion of venous into arterial blood because it keeps the latter free from crude residues. It can be isolated from the blood and successfully used, *e.g.*, in epilepsy. *Qua* "gas" it is the carrier of *specific* life forces and impulses.*

Van Helmont went out to search for the *divine spark in beings* and discovered a *chemical entity*: "gas." He found it chiefly, as we know to-day, in the form of carbon dioxide. His method has been that of chemical analysis, of "pyrotechnica," *i.e.*, by employing combustion. This meant to him at the same time spiritualisation of matter, an empirical approach to God and His designs in creating specific, *i.e.*, living entities. The discovery of gas must have met with keen interest not only in scientific circles, but generally and above all amongst the clergy. The question of "what kinde of bodies shall those be after they be raised" is one of the "Practicall Catechisme" and what, for example, H. Hammond describes as "spirituall bodies," thereby trying to render the doctrine of resurrection "reasonable"†—may well be brought in connection with the empirical notion of gas. This must have had a special appeal to those who under the auspices of the Royal Society investigated "palingensey," *i.e.*, the spiritual phenomena due to a material product which is thrown off like a film or membrane from the surface of bodies.

Space does not permit to give an account of van Helmont's actual influence on contemporary theology, medicine and philosophy, particularly on Leibniz's monadology. His *Ortus Medicinæ* (Amsterdam 1648) was early translated into English (by Chandler in 1664; some of the treatises by Charlton).

A few words must be said about van Helmont's reformation

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* *Complex. a. mistion. element. figment.*, 40–41; *Blas Human.*, 45 ff.

† *Pract. Catech.*, 5th edit., London, 1649, p. 302. It is noteworthy that the great Oxfordian anatomist of the central nervous system, Thomas Willie, quotes Hammond and Gassendi as his theological and philosophical authorities (*e.g.*, *De anima brutorum. Amsterod.*, 1674, at the end of the *epist. dedicat.*).

of medicine and his religious notion of biological time. *Medicine* at van Helmont's time largely followed the ancient theory which regarded man himself (*i.e.*, the mixture of his humours, his "temperament") as the chief cause of disease. Disease is nothing specific; it varies with the faulty humour or humoral mixture which, already in normal life, predominated in the patient. In other words, there were no such entities as "diseases," there were only incapacitated individuals and there was "disease," *i.e.*, a defect of the body impairing the harmony of form and function. van Helmont, however, said: "The supposition of the mixtures vanishes, the number of elements, qualities and temperaments has to go, and as liars are unmasked the futilities which the schoolmen have nourished stubbornly or ignorantly."* If objects and phenomena in nature are entities by themselves which owe their existence to the divine creation of a *specific* seed, diseases, van Helmont concludes, must be also such entities and due to a *specific* cause of their own, their seed. It is obvious that this conclusion opens up the view of the *external* causes, the "seeds" and "contagia" of diseases in contrast with the *internal* (constitutional) cause of disease which had been emphasised by the ancients. To van Helmont the disease-entity is something outside man, an "alien ferment" which impresses its own schedule of life on the "archeus," *i.e.*, the vital principle in the patient. It is thus an "idea morbosa" acting on our internal imagination, since all transmutations and indeed all action in nature are due to the imagination of a "form," or as Leibniz would have expressed it, to the internal perceptions experienced by the "monades." The "alien ferment" thus "contaminates" the vital principle, it acts as a "contagium." Diseases vary according to and become identical with their external causes. Such are: the morbid impression conveyed with the bite of a mad dog, metallic and silica dust inhaled in the mines, drink, pharmaka, poisons, suggested ideas (all these causes are covered by the ætiological notion of "recepta") and, above all, "retenta," *i.e.*, products of the disturbance of "digestion," *i.e.*, the sum total of processes of assimilation and dissimilation in the digestive canal and in the organs and tissues. *Ætiology* in the modern sense, *i.e.*, the search for the external causes of diseases, was thus the *first* fruit of the new orientation in pathology which was derived

* Terra, 10.

from van Helmont's general philosophical and religious view of nature.

The ability to dissolve is one of the noblest effects which nature achieves in mastering matter. The highest aspiration of the early chemist, notably van Helmont, was to invent a universal solvent, the "liquor alkahest." The main function of the vital principle, the "archeus" in the organs, is to dissolve material conveyed with the blood, to select specifically the material necessary for the organ, and to see that no crude residue is left. The archeus thus acts as a "custos" of the organ, working in its metabolic centre, its "kitchen," *e.g.*, in the root of the tooth, the bed of the nail, the basal layers of the skin, the splenic part of the stomach. Disturbed in its function by the illusions emanating from an alien ferment, the archeus will lack in its dissolving power, it will fail in its watchman's duties. Residues will appear. These are the *anatomical changes*. They indicate the *organ affected* and its importance in the development of the particular disease in question. This view of organ specificity had been neglected by the ancients and contemporary school pathology. The *second* fruit of van Helmont's religious natural philosophy is, therefore, *location of diseases, organ-pathology and morbid anatomy.*

Therapy of the ancients was directed against the wrong humours and qualities, *i.e.*, against man and his constitution. It aimed at restoring the material balance of the body by prescribing a special diet, by bloodletting or purgation. In van Helmont's view therapy is directed against the external pathogenic agent. After its removal the balance of the material constituents of the body will recur automatically. The "contagious" cause has to be "washed off" from the archeus so that it might recover the schedule of life which it has received when created by God as a seed with a specific scope. No diet, herbs, laxatives or venæsection will achieve this effect. Van Helmont bases his therapy on powerful chemical remedies, on the great "restaurativa et confortativa," as taught by Paracelsus, such as compounds of sulphur, antimony, mercury, metallic preparations. Not unlike Paracelsus, he by no means omitted purely empirical and "magic" remedies such as ram's testicle or animal blood, *e.g.*, against pleurisy. "Magic" therapy, in van Helmont's medicine, however, is bound up with immunological concepts which are far in advance of his own time, such as the knowledge of the beneficial effects of blood of conva-

lescents.* *Causal therapy* emerges thus as the *third* fruit of van Helmont's philosophy and religion.

I have endeavoured to show how it was the search for the traces of creation, *i.e.*, for the specific " seeds " of things, which actuated van Helmont's opposition to the ancients and led him to new ways in natural philosophy and all its branches, including chemistry and medicine. His ingenious anticipation of the modern concept of " *biological time* "† can be easily traced to the same motives. Aristotle had linked time with motion. There was nothing " specific " in time ; it simply counts motion, Aristotle said. In van Helmont's opinion, however, time is no less a specific entity than anything else in nature. Its specificity derives from the presence of " duration " in the " seeds " of everything in the universe from the first beginning of creation. This duration determines the length and intensity of the life of the individuals, their specific life-rhythm. It is the speed of their inherent motions which governs the specific variety of individual beings, of their development, form and function, and indeed of all changes in nature.‡ In other words, time as the life rhythm varies with the individual and governs its motions. Hours, days, years are conventional units of measurement of the motions of the stars, but not real time. This is gauged by the biological processes. It is essentially *immanent* in the objects of nature, whereas Aristotle's time is an " extera consideratio," something invented by the measuring human mind, an " ens rationis." True time, as liberated from succession and motion, is *eternal.* It is an emanation from the creating God, and therefore older than all created things. In spite of its inherence in individual objects, time has, therefore, a universal character and determines the life-time in the individual independent of and unapprehended by the latter.§ It is therefore the entity which gives and distributes everything to all beings according to their destined participation in eternal duration. Time is the eternal in everything, its true " quidditas " which is responsible for its specificity differentiating it from other beings. The undue emphasis laid by the ancients on motion, especially that of the stars, has secured the dominating position of the doctrine

* *De magnet. vulner. curatione*, 50.

† *See* Pagel, W., *J. B. van Helmont, " De Tempore " and the History of the Biological Concept of Time.* With notes on the Greek ideas referred to in *De Tempore* by Helen Weiss. (Osiris. In press.) This contains a translation of and a commentary on van Helmont's treatise " On Time."

‡ *De Tempore*, 18.

§ *Ibid.*, 46.

of the "critical days" and similar symbolism in medicine since early Pythagorean times. This is in van Helmont's opinion guilty of the conservative, "Hippocratic" attitude towards diseases which places all hope in "crises," *i.e.*, the healing power of nature, which by itself will effect the cure. Here again van Helmont finds the fault with the neglect of the *specific* rhythms and life-times of the different diseases in favour of *general* regularities such as the constellation of the stars, the critical days, etc., which were studied by ancient and seventeenth-century medicine.

It is thus that van Helmont links up time with the divine spark of life in the individual, with its time of life and the quality of its biological processes. In doing so he uses the same arguments as Bergson and biologists and sociologists who deny that time has the purely quantitative character of astronomical time.† Indeed, the speed of biological processes varies, for example, with the size of an animal or with its age. As Joseph Needham puts it: "Mouse time must bear the same or a similar relation to elephant time as mouse spatial magnitudes to elephant spatial magnitudes."‡ The calendar of primitive people differs in agricultural, hunting and pastoral groups (Sorokin and Merton§). Biological processes form a clock by themselves which gives more and truer information about time than the ordinary conventional time units. These indicate "empty," quantitatively equal periods which are unequal biologically and sociologically.

Nothing shows the whole character and scope of van Helmont's work as impressively as his treatise *De Tempore*. All that van Helmont designs, finds and teaches, he does for the sake of research on life, for biology in the widest sense. For to him life is a direct emanation from the creating God, and therefore not only the noblest but also the only subject which opens the way to scientific and at the same time to eternal truth. *Van Helmont's biological bent is due to his religious zeal, and his scientific achievement a fruit of his religious conviction.*

IV. Summary.

The religious considerations which were in my opinion instru-

† Bergson, *Time and Free Will*. Transl. by F. L. Pogson. London, 1910, p. 107.

‡ Needham, J., "Chemical Heterogony and the Ground Plan of Animal Growth," *Biol. Review*, 1934, ix, 79. *See also* Lambert, R., and Teissier, S., *Ann. Physic. and Physiol. Chem.*, 1927, ii, 212.

§ "Social Time," *Am. J. Sociol.*, 1937, xlii, 615.

mental in the building up of Van Helmont's scientific world may be *summarised* as follows :

(1) Predominant use of " ratio "—reasoning—in research on nature, and particularly on life, is due to hybris of the human mind which believes itself capable of mastering God's creation. Reasoning and logic have nothing to do with reality ; they lead the mind in a circle, teaching nothing that is new. God in particular and His immediate offspring, Life, can be in no way tackled by the human intellect.

(2) Contrary to ancient and seventeenth-century belief, constant changes of material elements and humours cannot explain the specific properties of the individual, *i.e.*, " forms " and " substances." These have been attributed to the action of heat in particular. Heat, however, can only *support* creative evolution ; it cannot create by itself. God alone *creates* " forms " and " substances." These are different from each other in principle, they are " qua " created entities, *specific* in themselves, whereas heat, humours, elements are *general* media and in no way specific. van Helmont, actuated by religious motives, thus opposes ancient and seventeenth-century materialism and its offsprings, astrology, mysticism of numbers, symbolism (analogies of macrocosm and microcosm). Nature is not governed by one force (monism), nor by the antagonism of two forces (dualism), but is a system of innumerable created and therefore specific " seeds " or " monades " (pluralism). It is the object of science to search for these " seeds " in beings, whereby truth and an approach to God and the realization of His will in creation are obtained.

(3) Divine illumination, experienced in dreams and visions, on the one hand, and observation, particularly experimentalism, on the other, are the methods adequate for the search for the divine " seeds."

(4) The ultimate motive of research in nature is religious pragmatism, the endeavour to detect and open up the hidden resources in nature which God has created for the benefit of suffering humanity.

(5) van Helmont believes that divine emanation confers on every being its essential characters, *i.e.*, specificity. He succeeds in discovering, by scientific methods, the material carrier of specificity. This is the new entity which van Helmont called *Gas*. In contrast with watery vapour and air, which are *general* media, gas is *specific* for the individual being and for its species,

and therefore the suitable basis for the vital impulses *immanent* in living matter. In this sense body and soul are not separate entities one of which governs the other (as in the various "animistic" or "materialistic" theories), but form a living unit with physical and psychical aspects. This concept comes very near to modern biological insight.

(6) van Helmont's pluralism in many respects equals that of Leibniz, the personal friend of Franciscus Mercurius, van Helmont's son, a devout pupil of Cabbalah and theosophy.

(7) van Helmont's achievements in physiology and pathology can be traced to his religious and philosophical conviction: divine emanation confers specificity and governs and explains the phenomena of life. *Specific* principles are responsible for digestion in its different phases, not simply heat or a process similar to coction. van Helmont thus discovers the ferments, notably the action of acid in the stomach and of alkali in the duodenum. Each organ has its "archeus," which selects specifically the substances necessary for the particular organ from the blood and lymph which passes through all organs and tissues. The archei act specifically on matter to be digested, in a different way in the mouth, in the stomach, in the gut, in the liver, etc. Pious contempt and scepticism towards the complacent human intellect lead van Helmont to an advanced appreciation of the vegetative impulses and the subconscious faculties. He localises the central regulatory mechanism in the stomach, and the investigation of this organ becomes in his opinion the first task of the physiologist and pathologist. He thus collects invaluable data, *e.g.*, on the function of the pylorus and the motion of this "rector of digestion."

In pathology the search for specific causes of diseases (instead of the ancient purely quantitative faulty mixture of humours) leads van Helmont to modern views on the causes (ætiology), to location of diseases in certain organs (morbid anatomy), to classification of diseases as entities (ontology), and to causal therapy.

(8) An ingenious anticipation of the modern concept of biological time is found in his treatise *De Tempore*, which is based on a refutation of the Aristotelian—numerical and mathematical—concept of time, on theological and biological grounds.

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[*The Author's reply, following, refers to a brief discussion not recorded. The chief points therein can be readily inferred from the references made thereto.*]

AUTHOR'S REPLY.

DR. PAGEL: I agree with Mr. Leslie that one might wonder if an anti-rational attitude could possibly have led to results in scientific discovery and progress in medicine. We must remember, however, that "ratio" at van Helmont's time meant hairsplitting formal-logic. "Ratio" in the sense of sound scientific thinking and reasoning was employed by van Helmont himself. Judged by present-day standards van Helmont certainly erred in many points and became a victim of his credulity. He shared, however, his errors, for example in the Physiology of Respiration and his belief in Spontaneous Generation, with the great contemporary scientists such as Harvey, Willis, Hales, Highmore, Bartholinus and others. It has been said that van Helmont's influence on his time and the development of science was negligible. This is certainly not so. He was often quoted by contemporaries and later up to Haller, van Swieten and Virchow, and not only by medical men and scientists, but also by philosophers such as Henry More and Leibniz, and by theologians such as Richard Baxter. His opinions and discoveries were accepted or refuted, but in general treated with due consideration, although not always with respect. van Helmont's position in the history of science is unique in that it demonstrates the *active* part which Neoplatonism (especially Plotinus' criticism of Aristotle) played in discovery, research and medical progress. Mutual inspiration rather than incidental personal union marks the relationship between religious conviction and scientific research in van Helmont's case.

I am very grateful for Professor Nevin's complimentary remarks. It is difficult to answer his question as to what lines van Helmont would have taken if he were alive to-day. His attitude was deeply bound up with the contemporary view of the world and the actual—political and economic—history of his time. Opposition to scholasticism was actuated by the hostility of the Flemish nobleman to the Jesuits who had come to Flanders in the train of the Spanish conqueror. I cannot see, however, why he should not have followed his bent to-day, when scientific endeavour is just as much based on the view of the world and the personal convictions of the scientist as it was 300 years ago.