TELEOLOGY AND THE ANATOMIST: I[1]

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TO some, no doubt, the two terms that constitute the title of this paper will seem to make strange bedfellows. Teleology, one might think, is a curious speculative anachronism, a remnant of a long outworn system of metaphysics, the discipline that it has been the fashion, at least until recently, in philosophical circles in this country to decry as meaningless vapourings on an unknown and in essence unknowable theme. In complete contrast to this speculative science of abstraction, anatomy, one might think, is essentially of the earth, earthy. It is unhappily true that many otherwise intelligent and well-informed members of academic circles still look upon anatomical science as one that of set purpose limits and confines itself to studies in the mortuary, describing in ever more bewildering detail the relationships one to another of the myriad structures that comprise the embalmed human corpse. Such descriptive study is not, of course, without its own intrinsic interest and value —'know thyself' has from time immemorial been the maxim that points the way to the beginning of wisdom, and no one can deny his body a significant place in the constitution of whatever it is one calls 'oneself'. But if pure description of the details of the inner recesses of the human body were all that constituted anatomy, as some of those not engaged in it still seem to suppose, then such a study, exercising the essentially *sub*-human faculties of visual perception and memory-storing, would lead inevitably to intellectual stagnation; being devoid of theoretical and experimental content it would not indeed even warrant the dignity of the name of science. This sort of anatomy, it is true, was pursued with great vigour in the Scottish schools of the nineteenth century, and if continental anatomists paid little heed to this local phenomenon, it did have a lamentable if temporary effect in England and the Commonwealth; so much so that a Professor of Anatomy said, in a University Address in Adelaide in 1923, that

1 A paper read to the Cambridge University History and Philosophy of Science Club on March 4, 1957.

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'Of all the members of this little community less is expected of the Professor of Anatomy than of anyone else. He is not expected to be a scholar, he need not be a philosopher, or one erudite, or deeply versed in any branch of abstract learning. So long as he is acquainted with the structure of the human body, as a cabman knows the streets of the city in which he plies for hire, and can impart some of this familiarity to his students, but little more is asked of him.'[2] Now most emphatically this cabman qualification was not *always* the only one required of anatomists, and the last thirty or more years have seen something of a return in this country to the original concept as to what anatomy really is. There was a time, in fact, well on into the nineteenth century, when anatomy was a towering scientific discipline, the central pillar of the Faculty of Medicine which itself is by many centuries the oldest of all the scientific faculties in the universities of Western Europe. It would be true to say that the seeds of virtually all the modern biological sciences were contained originally within the one discipline, anatomy, and that it is the anatomist who has given birth to each in turn of the main biological disciplines, zoology (comparative anatomy), pathology (morbid anatomy), and physiology (functional anatomy).

The second half of the twentieth century seems likely to see the increasing development of a *synthesis* of the biological sciences, and the question is, which of the present specialties is to constitute the central discipline of the New Biology. Recently a claim has been made by Professor Baldwin the biochemist that his own subject should provide 'a reunification of the biologies', as he puts it.[3] Well, biochemistry is an obvious claimant, and the professor's hopes may well be fulfilled. But I think I am on far firmer ground, and not only because much more firmly rooted in history, in suggesting that, in fact, at the centre of the forthcoming synthesis there will be found the anatomist, paterfamilias of his family of biology, now having gathered together again all his many scientific offspring. The logic of this development of the future is not hard to seek. It was not without reason that anatomy was the first of the biological disciplines, nor that it has been so prolific of others. The first thing that must be done in any

2 F. Wood-Jones, address on 'Anatomy and a Life Principle', printed in a volume entitled *Life and Living* (London, Kegan Paul, 1939), p. 111.
3 In *What is Science*, edited by J. R. Newman. (London, Gollancz, 1957.)

scientific enquiry (at least in the science of the macrocosm) is to discover and describe *what* it is one is studying, and so far as animals including man are concerned this means anatomy in the strict sense. But such analysis of the physical make-up of man and other creatures is clearly shot through with questions of a truly scientific nature as to the causes of the features described. The modern anatomist is drawing new strength from his ancient roots, established long before the fragmentation and specialization of the biological sciences in the nineteenth and early twentieth centuries, and he is actively preparing for the new era. Research subjects today are legion in schools of anatomy. A recent survey in American schools[4] enquired as to what constituted the major and the minor research-interests of the members of the schools. Of ninety Schools of Anatomy, the following listed these subjects as being of *major* interest to their groups: cytology (studies of the cell) 52 per cent, electron microscopy 23 per cent, tissue-culture 22 per cent, histochemistry 53 per cent, radiobiology 23 per cent, embryology 44 per cent, experimental embryology 38 per cent, physical anthropology 18 per cent, morphology 47 per cent, experimental morphology 33 per cent, endocrinology 53 per cent, neuro-anatomy 74 per cent, neuro-physiology 40 per cent. Sceptics and unkind critics will say that anatomists are interested in all these subjects because there is no longer any intrinsic scientific interest in their own. But what in fact is happening in anatomy today is biological synthesis with a vengeance, and an air of confidence is everywhere manifest. Meetings such as the quinquennial International Anatomical Congress are from this point of view alone amongst the most exciting biological gatherings available today.

If then I have by now convinced the reader of the significance of the second of the two terms in my title, and of the interest of the modern anatomist in many if not all of biological problems, what now are we to make of 'teleology'? The word is usually taken to imply 'design and purpose' in the universe, and for very many years in scientific circles the term was, and often still is, a term simply of abuse. To be accused of advancing a 'teleological argument' is often to be judged in orthodox circles to be guilty of some heinous crime. This was why E. S. Russell, whenever he

4 *The Teaching of Anatomy and Anthropology in Medical Education.* (Chicago: Association of American Medical Colleges, 1956.)

gave expression to his rather daring views about what he calls 'The Directiveness of Organic Activities', found it necessary to introduce his thesis with an apologetic phrase such as 'at the risk of being labelled a teleologist'.[5] So too the late Professor Wood-Jones, who was in some ways one of the more outstanding amongst British anatomists of this century, says[6] with regard to his main thesis in his book *Design and Purpose*, 'From most it is almost certain to receive condemnation as representing an out-of-date harking back to the natural theology of Paley and the days of the outworn doctrines of teleology'. Again, the same author, in *Habit and Heritage* (1943), quoted a review in the *Journal of Anatomy* in which the reviewer says he 'believes such teleological approach to be sterile' (this being on the question, essentially, of the inheritance of acquired characters). Wood-Jones comments:[7] 'The word "teleology" has been for so long a term employed to connote everything that is misguided, old-fashioned and stupid in the interpretation of nature's happenings, that by now, after near a century of this usage, it has somewhat lost its sting, and it is almost refreshing to meet it again in 1942 employed as a stigma of the unpardonable sin'. Now if emotive expressions such as these are to be bandied about by scientists it is clear that we shall here be swimming (or drowning) in pretty hot water. Let us look at what teleology actually means.

To most people it means Archdeacon Paley, that eighteenth-century divine whose book entitled *Natural Theology; or, Evidences of the Existence and Attributes of The Deity, collected from the Appearances of Nature* had such a remarkable effect, mostly as I believe for ill, on the development of a proper understanding of these problems. Paley's argument was that all things in nature but especially living creatures were *designed* in the greatest detail by an omnipotent Designer in much the same way that all the complex parts of a watch are designed by the watchmaker. Paley was struck, as every observer of living things must be struck, by the phenomenon of 'relation' as he called it, what today in a somewhat different sense we call 'adaptation': every organism seems to be adapted in its physical make-up to the particular environment in which it lives. This suggests at first sight

5 E. S. Russell, *The Directiveness of Organic Activities* (Cambridge University Press, 1945), p. 3.
6 F. Wood-Jones, *Design and Purpose* (London, Kegan Paul, 1942), p. 75.
7 F. Wood-Jones, *Habit and Heritage* (London, Kegan Paul, 1943), pp. 57, 58.

that there is a most intricate and beautiful design manifesting itself everywhere in the quite remarkable mutual 'fitness' observed between organisms of widely differing kinds and their respective environments. Paley saw everything in these terms, and sometimes the argument seems somewhat strained today. So, for instance, he describes the eyes of the mole, eyes which today we call 'degenerate' and which we think are degenerating because this particular organ of perception no longer has survival-value to a creature that has taken to burrowing its way through the ground and which lives in almost perpetual darkness. Paley sees instead evidence of the wisdom of Providence, that has given eyes to the creature but has caused them to be sunk deep in the head and covered over with skin 'in order that' they should not be damaged by the earth in the process of burrowing. He even says[8] that it is the eyes which 'I have always most admired in the mole', and when he asks what it was that brought together eyes like these and feet designed for burrowing in the ground, he answers:[9] 'that which brought together the barrel, the chain, and the fusee, in a watch; design'. Such design as this is what many people still understand by teleology. But let us look at the word a little more closely.

The first part of the word is derived from the Greek τέλος which means 'end' or, in the adjectival form, 'final'. Now in Aristotle's analysis of nature, there were four conditions considered to be necessary before anything at all could 'be'. Each of these four conditions he called *αἰτία* and it has been most unfortunate that this word has traditionally been translated as 'cause'. The word 'cause' has got a very restricted meaning today, and a much better rendering for modern ears of what Aristotle meant by *αἰτία* would be 'reason' or 'condition'. There are then four conditions which must be present if anything is to exist, and these are termed the material, formal, efficient and final 'causes' or 'conditions'. W. D. Ross, the Aristotelian scholar, comments[10] that of these four only the efficient and the final 'answer to the natural meaning of cause in English' because, he says, these are 'the two *external* conditions which naturally suggest themselves, the efficient cause or *vis a tergo*, and the final cause or *vis a fronte*'. Now it seems to me probable that, for most people,

8 W. Paley, *Natural Theology*, sixteenth edition (London, 1819), p. 243.
9 *Op. cit.*, p. 244.
10 *Aristotle* (London, Methuen, 4th Edition, 1945), p. 73.

the word 'cause' could only be properly applied to the former, the efficient, which precedes in time the effect one is considering. The word 'cause' has, for modern ears, undoubted temporal overtones. I suspect that to most people the idea of a *vis a fronte*, of something in the future being a 'cause' of some process now in operation, would seem a contradiction in terms. Whereas it does not, perhaps, seem quite so patently absurd if we speak of a final 'reason' or 'condition' for things. In fact, if specific causes produce specific effects, then somehow the effect is inherent and 'anticipated' in the preceding causal network. Aristotle's analysis here provided for medieval philosophers the fundamental basis for belief in the existence of order in the universe, that presupposition which all scientists make before setting out on a programme of research: the assumption that all is not chaos, that there are regularities to be observed and laws to be discovered. As to Aristotle's two other 'conditions', the material 'cause' is the very stuff of which things are made, and the formal 'cause', at least in the elaboration of Aristotle's philosophy achieved by the medieval schoolmen, is the 'principle of organization' of the 'stuff', the organization which determines that it is *what* it is and not something else. Perhaps one of the reasons for the current revival of this philosophy of 'hylemorphism' is that it clearly suits so well the modern physical analysis of all things in the universe in terms of 'energy' (the matter or stuff) and its 'organization' (or form).

Dr Needham, in his analysis in 1931 of this and other philosophies as they relate to the causal factors involved in the development of embryos, says: 'In Harvey's thought the four causes were still supreme; his *De Generatione Animalium* is deeply concerned with the unravelling of the causes which must collaborate in producing the finished embryo. But the end of their domination was at hand. . . . Bacon demonstrated that from a scientific point of view the final cause was a useless conception; recourse to it as an explanation of any phenomenon might be of value in metaphysics, but was pernicious in science, since it closed the way at once for further experiments. To say that embryonic development took the course it did because the process was drawn on by a pulling force, by the idea of the perfect adult animal[11], might

11 I must here interject to observe that this is only one of the many meanings that have been given to the word *telos*—indeed, as here expressed, the notion is not Aristotelian but Platonic, which is a very different outlook indeed.

be an explanation of interest to the metaphysician, but as it could lead to no fresh experiments, it was nothing but a nuisance to the man of science. Later on, it became clear also that the final cause was irrelevant in science owing to its inexpressibility in terms of measurable entities. From these blows the final cause never recovered.'[12]

Dr Needham perhaps took too sanguine a view (for his purposes) of the death of teleology in science. Previously in 1882 Dr Ogle, in a brilliant introduction to his translation of Aristotle, *On the Parts of Animals*, described the very beginnings of the conflict between the teleologists and the mechanists as they came eventually to be called. Aristotle of course was the teleologist, arguing against that distinguished predecessor of nineteenth-century materialists, Democritus. Aristotle argued that the mechanist view, accounting for everything on the basis only of matter and chance, was inadequate as an explanation of things. He persistently maintained that, as well as material and efficient 'causes', the formal and the final were also necessary. For Aristotle not one could be dispensed with; and no single one or combination of two or three of his αἰτίαι constituted by themselves an adequate explanation of *anything*. All four are always essential. But it is certainly true that in developing his argument against the materialists he was given to stressing the final cause more than the others. And, further, his habit of citing biological structures to illustrate his argument led him often away from the central truth of his own position. Thus he acquired a 'bad' reputation amongst scientists of the last three centuries, a reputation which is largely unjustified from both the scientific and the philosophical points of view. Dr Ogle comments[13] on this battle between Aristotle and Democritus: 'So began, and so was carried on, that venerable strife, which ever since has divided thinking men into two factions, and which still, though twenty centuries have passed away, is fought with unchanged weapons, and with increasing bitterness, and in which neither side has ever succeeded in reducing an opponent to submission, while each has never failed to claim complete victory.' Dr Needham, then, was not the first, in 1931, to think or hope that the theory of final causes had died the death in biological science. But if it had indeed died

12 J. Needham, *Chemical Embryology* (Cambridge University Press, 1931), p. 12.
13 W. Ogle, Ed. *Aristotle on the Parts of Animals* (London, Kegan Paul, 1882), Intro., p. iii.

by then, it had taken an unconscionable time about it, and since 1931 it has undergone a remarkable resurrection. In recent years, while there has been no lack of publications written by orthodox 'mechanists', there has also been a veritable spate of books by eminent biologists in which the concept of teleology has been re-introduced into the very centre of the science. However, as we shall see, there are a number of different ways in which different authors have used the concept of teleology. This seems to me to be one of the major sources of confusion about it, a confusion which I hope we can go some way towards clearing up.

We have already mentioned books by E. S. Russell and Wood-Jones. As long ago as 1913 there appeared that most remarkable work, *The Fitness of the Environment*, by L. J. Henderson. The author concludes his argument as follows,[14] 'In short, our new teleology cannot have originated in or through mechanism, but it is a necessary and pre-established associate of mechanism. Matter and energy have an original property, assuredly not by chance, which organizes the universe in space and time.' In 1942 Sir D'Arcy Thompson, in the second edition of his book, *Growth and Form*, says,[15] 'Time out of mind it has been by way of the "final cause", by the teleological concept of end, of purpose or of "design", in one of its many forms (for its moods are many) that men have been chiefly wont to explain the phenomena of the living world; and it will be so while men have eyes to see and ears to hear withal'; and, lest we think this an expression simply of the frailty of the human mind, he later says (*op. cit.*, p. 7): 'Still all the while, like warp and woof, mechanism and teleology are interwoven together, and we must not cleave to the one nor despise the other; for their union is rooted in the very nature of totality.'

H. J. Muller, in a significant volume entitled *Science and Criticism: the Humanist Tradition in Contemporary Thought*, published in 1943, says,[16] ' "Purpose" is not imported into nature, and need not be puzzled over as a strange or divine something else that gets inside and makes life go; it is no more an added force than mind is something in addition to brain. It is simply implicit in the fact of organization, and it is to be studied rather

14 New York, Macmillan, 1913, p. 307.
15 Cambridge University Press, 1942, p. 4.
16 New Haven, Yale University Press, 1943, p. 109.

than admired or "explained".' This is pure Thomism, though I am sure the author would be surprised if he knew.

R. S. Lillie, in *General Biology and Philosophy of Organism*, says,[17] 'The tendency, which still lingers in scientific circles, to deny that teleology exists as an effective factor in nature, or to subordinate it completely to purely physical factors, is largely a survival of the Laplacean or Victorian belief in the completeness and all-sufficiency of physical methods of explanation'. But Lillie's view, in contrast to Muller's, is essentially dualist, because he thinks of the 'end' in terms of a 'preconceived plan' as he puts it; preconceived not, it is true, in the mind of an omnipotent watchmaker (though Lillie would probably allow for this too), but rather preconceived in the psyche of living organisms themselves. New ideas, or 'blue-prints for action', are supposed to crop up from time to time in the history of the evolution of species as the result of psychic events (ideas) in the organism. These 'blue-prints' then, in Lillie's view, are carried into production as in a factory according to what Lillie conceives of as mechanistic causality. Eventually, therefore, when the processes are repeated, they are thought to lose their teleological content. Thus he says (*op. cit.*, p. 129), 'But in order that any preconceived plan, having at first only a mental existence, should have this result, two conditions are required. First, the plan itself must have a sufficient definiteness and persistence; and second, its presence must in some way influence the course of the physical action without infringing the general physical conditions always present, such as those defined in the laws of energy. The first requirement is the general one of stable factors in all events. The second requirement presents an especially difficult problem, i.e. of how psychical factors can have a directive influence on physical events; here we have the essential problem of teleology, and I know of no way to make this problem entirely simple or easy.' But he eventually concludes that 'the ultimate *locus* of psychical control, in the psychophysical system which is the living organism, is situated *internally to* or behind the elementary physical events (ultimately quantum transfers) which determine the direction of action in the physical field'. Now obviously this is a different sort of teleology from that of Muller. Muller in fact protests against this dualist form of thinking in the following terms (*op. cit.*,

17 Chicago, University of Chicago, Press, 1945, p. 125.

p. 106): 'Their' (biologists') 'thinking was long distracted by such antitheses as heredity versus environment, structure versus function, teleology versus causation—antitheses that do not exist in nature but only in our ways of describing nature, and that as subjects of debate are about as pointless as the question of which came first, the chicken or the egg. And behind all such purely verbal issues was the flat opposition between vitalists and mechanists. The vitalists insisted that some altogether new principle—an entelechy, an *élan vital*—was necessary to explain life; the mechanists insisted that the principles of physics were not only adequate but essential. Both tended to lose sight of the living organism in their logical dispute over explanation. Both could have profited by the common sense of William Hunter in the eighteenth century: "Some physiologists will have it that the stomach is a mill, others that it is a fermenting vat, others again that it is a stew-pan; but, in my view of the matter, it is neither a mill, a fermenting vat nor a stew-pan but a stomach, gentlemen, a stomach".' I might perhaps be forgiven for pointing out that William Hunter was an anatomist of the original school!

(*To be concluded*)

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