and Doves who had not reached agreement on a 'party line' before setting out for Geneva. The reason for this probably lay in Eisenhower's belief in consensus and dislike of controversy and of having to decide between contesting parties. The meetings of the western delegates were often difficult. Most of those present were interested in assessing Russian intentions and motives, but the Hawks were primarily concerned to prevent any kind of agreement with the USSR. They even maintained, for a while, that atmospheric tests could not be sufficiently monitored because the wind might blow round and round in circles and never carry the radioactive debris out of Russia. By confining himself to published sources and Presidential papers the author has missed the details of these interesting controversies. He seems not to have discussed the negotiations with any of the participants.

The breakdown of the negotiations for a complete test-ban came in the political talks late in 1958. The US withdrew its support for the conclusions of the 'experts' concerning underground tests, introduced hastily analysed data from recent tests and declared that the technical matters must be discussed *de novo*. This interesting situation is very inadequately discussed and no references are given to Russian views; for example, to the detailed discussions by Ryznichenko.

Throughout the book the discussion of technical matters is marred by an apparent lack of interest in the meaning of numbers. For example, on page 103 it is stated that Willard Libby calculated the amount of Sr-90 in the atmosphere to be 24 megatons. It is doubtful if every reader will understand this oracular statement. Much more confusing are the two values given for the amount of Sr-90 in the soil of the US in 1958 (pages 263 and 272); these differ by a factor of a million. The larger of them is a factor of 1000 less than that given by the AEC for 1961 in *Effects of Nuclear Weapons*. This muddle may be connected with the author's belief that m is the abbreviation for micro.

Perhaps I have been unduly severe, the book is about American politics and my complaints are that it is not about other aspects of the subject. It does unearth some fascinating things, such as a remark made in 1958 by a member of the President's Scientific Advisory Committee. He (who was he?) is said to have said: "These men who don't want a test moratorium are like a kid you are trying to put to bed. First he wants a drink of water and then he wants to go to the bathroom, but what he really wants is not to go to bed". □

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Commitment to logic

Aaron Novick

Origins of Molecular Biology: A Tribute to Jacques Monod. Edited By A. Lwoff and A. Ullmann. Pp.246. (Academic: New York and London, 1979). \$17.50; £11.35.

MOLECULAR BIOLOGY had its origins in several centres which served as gathering places for people from around the world. In the very beginning, it was Cold Spring Harbor in New York and soon after the Institut Pasteur in Paris and the MRC Laboratory in Cambridge, among others. These places developed for a variety of reasons not the least important of which was the presence of some of the leading figures in this new field. At the Institut Pasteur it was André Lwoff, Jacques Monod and Francois Jacob. Jacques Monod died in 1976 and a number of his colleagues and disciples have contributed to this *Tribute*, a volume which describes from a number of points of view an exceptional person who played one of the major roles in the development of our present understanding of the control of gene expression. From its title, it seems to be a companion volume to *Phage and the Origins of Molecular Biology*, edited by J. Cairns, G.S. Stent and J.D. Watson (Cold Spring Harbour Laboratory, 1966), a volume dedicated to Max Delbruck on his sixtieth birthday.

The personal accounts in volumes such as these provide descriptions of important and fascinating details in the development of scientific ideas never reported in the usual forms of publication. Because of its memorial character, the present volume includes many personal details in its descriptions of a man of great spirit whose life outside the lab as well as in it was of heroic scale, whose friends included scientists and public figures throughout the world.

Of particular interest is the collection of personal statements from most of the people involved in the series of discoveries which culminated in the giant step represented by the Jacob-Monod model for gene expression and regulation. The reports provide a fine illustration of the development of a great scientific idea, but one must recognise that the picture is limited by the modesty of some of the participants in this memorial volume. André Lwoff and Francois Jacob were no less important both to the exciting and creative spirit at the Pasteur and for their own remarkable scientific contributions. As a history, the volume does not make it adequately clear that the critical experiments which showed that control of the *Lac* gene occurs through action of an endogenous repressor could be done only

because of Jacob's timely development of the necessary genetic technology.

It is also fascinating to follow the development of Monod as a scientist. Here is a man for whom science was a great personal adventure and a means of personal expression, yet a man fervently dedicated to logic and reason. He exulted in the power of deduction and was known to shout after an observation verified one of his deductions that this was again proof that Descartes was right and Kant wrong. Despite his commitment to logic, he had a remarkably successful intuition for how things must be, and he could present these pictures with great force. Even when he was later proved wrong, the vehemence and sharpness of his argument expedited the clarification of a problem.

Some of the authors also note his audacity. He never limited himself to the disciplines of his education nor did he ever restrict himself to minor objectives. In his crowning work, the development of the allosteric model for regulatory proteins, despite being trained as a zoologist he used modern physical chemical ideas with no inhibitions to formulate a remarkably original and innovative theory. "It is no longer a question of right or wrong", one of my colleagues in the field remarked. "The Monod theory has changed the style of thinking among the biochemists."

An impressive feature of the volume is the honesty of some of the reports which describe the personal faults as well as the greatness of Monod. His enthusiasm and pursuit of fundamental problems inspired the people he worked with. His candour came as an exciting surprise when it was first encountered by his disciples. This lack of stuffiness along with his generosity and the confidence he placed in his students created love and great loyalty. But he also had personal faults, and these too are reported. He could be vain and arrogant in a pointless way. Surely it is because they held him in such high regard that his colleagues were free to describe these faults so honestly.

As occasional allusions in the volume indicate, Monod's life outside of science was also remarkable. He was aware, wise and, when he felt it necessary, active in the world of politics. During the hysteria in the United States in the early 1950s, when foreign visitors were required to sign non-communist affidavits, the *Bulletin of the Atomic Scientists* published statements by a number of European scientists; I recall that by far the best of these was the one by Monod, who with characteristic perception saw the larger implications of US policy. Again, on the occasion of the Nobel Prize, rather than basking in the adoration and pride the French have for their Nobel Prize winners, he took advantage of the public attention to improve the support of science in France by making a strong public statement severely critical of his government's science policy,

a statement which apparently infuriated DeGaulle.

Some contributors make reference to Monod's service during World War II in the Resistance and later in the re-established French Army, but the volume's guidelines prevented fuller description of these parts of his life, for the same reasons the authors say little about Monod's significance as a public philosopher, illustrated by his book, *Chance and Necessity*, which was a sensational bestseller in France.

The essays are generally of exceptionally high quality, and they will bring back memories of great times for the large number of scientists throughout the world who have spent time with Jacques Monod and his colleagues in those laboratories

built originally for Louis Pasteur. It will also bring the pleasure of enlightenment to many others who were not directly involved. In addition, for those totally outside of molecular biology, it is a worthy addition to the developing literature on the origins of this field which has so revolutionised biology. And this appearance of a memorial volume ought to stimulate interest in a more complete biography of this impressive man whose life touched so many of the important developments of the middle decades of this century. □

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Challenge to promissory materialism

Anthony Flew

The Human Mystery. By John C. Eccles. Pp. 255. (Springer International: Berlin, Heidelberg and New York, 1979.) DM34.

EVEN had Sir John Eccles not begun this his own first series of Gifford Lectures with quotations from "My great master, Sherrington" (page 2) any sympathetic reviewer would have been bound to refer to the fitting facts that it was just 40 years earlier, under the same foundation and in the same University of Edinburgh, that that "great master" himself gave the lectures which were later to become *Man on His Nature* (Cambridge, 1940). *The Human Mystery*, though thoroughly worthwhile, lacks the magic of that predecessor: how could it not? The present Eccles project, of which we have here only the first and probably less distinctive half, is strictly in accordance within the terms of Lord Gifford's will: "... to promote and diffuse the study of Natural Theology in the widest sense of that term — in other words the knowledge of God".

The aim is to mount a challenge to what, following his friend Sir Karl Popper, he calls "promissory materialism", a challenge along the entire front but with the main weight concentrated in the sector of his own lifelong concentration, the human brain. Promissory materialism is defined as the "claim that science is so powerful and pervasive that in the not too distant future it will provide an explanation in principle of all phenomena in the world of nature including man, even human consciousness in all its manifestations" (page 7). So, after a first

introductory lecture, Eccles proceeds through the "Origin and Evolution of the Universe", the "Planetary System and Planet Earth", the "Origin of Life and Biological Evolution", to "Human Evolution: The Story of Cerebral Development". It is in the second half that we come to the real speciality of the house: "Cultural Evolution with Language and Values: The Human Person"; "The Creation of a Self"; "Structure of the Neocortex: Conscious Perception"; "Learning and Memory"; and "The Mind-Brain Problem".

To the scientific layman the story which Eccles tells in his first half is fascinating, though here and elsewhere to follow him closely requires frequent consultation of those handy Penguin dictionaries of the sciences: if he has succeeded in his attempt "to present scientific material . . . with a minimum of technicality", then one must pray to be spared the failures.

The Gifford aspect appears at once in "the Big Bang story as suggesting the operation of a supernatural Creator" (page 15); although it is curious that Eccles mentions only in an aside the notion of a Creator upon whom — whether or not, He, or She, 'in the beginning' also started the Universe off — it continues to be always absolutely dependent. After all, it was precisely and only continuous creation in this theological sense which St Thomas insisted could be known on the basis of natural reason, without benefit of revelation.

Two other Gifford points stressed in the first half are the unpredictable chanciness of the emergence of life, and of the actual course of biological evolution; and the fact that the whole cosmological story would have had to be very much as it has been if beings capable of knowing that story were going to become part of it. About the former Eccles maintains, and surely he is right, that "There is no predictable line of evolutionary development" (page 49). It seems to be as true of the evolutionary biologist as of the human historian that most of his most

important explanations are of how something was possible, rather than of why it was inevitable. No doubt other readers will share my own pleasure in two pieces of Eccles mischief: the suggestions that the most primitive mammals "brought about the dinosaurs' downfall by preying on their eggs" (page 58); and — of "the attempt to communicate with super-intelligent humanoids in our galactic system" — that it is "highly likely that this romantic project will be killed by boredom" (page 73).

In wondering what to make of the second of the two points stressed in the first half we must give some weight to the point, which Eccles does not notice, that these conclusions are derived only for a Universe obeying the same fundamental laws of nature. The argument is that "If we economise and have the Big Bang producing the mass for one galaxy of 10^{11} stars, which is still an immense universe", then, given what we now know of the fundamental laws of the actual Universe, "the time from Big Bang to Big Crunch is reduced to one year" (page 28). But a Creator, having it in mind to furnish his creation with potential knowers, would not, presumably, be restricted either to or by any actual or possible natural laws.

In his rather longer second half Eccles is at least equally fascinating. In lecture 6 he begins by contending, as is surely correct, that "cultural evolution is exclusively human" (page 98). This and much of the later discussion is presented in terms of Popper's distinction between "three Worlds: World 1, the matter-energy of the cosmos; World 2 of all subjective experiences; and World 3, which is the cultural heritage of mankind" (page 98). The reader needs to be aware always, as their spokespersons so often are not, that the second and third of these can be identified only as aspects of the first. We have, that is to say, no knowledge of any kind of consciousness other than the consciousness of organisms; and perhaps we cannot even give sense to talk of any consciousness that is not thus rooted in the matter-energy of World 1. The whole cultural achievement of World 3 is likewise embodied in, and inseparable from, such incontestably World 1 objects as buildings, books and computer tapes.

In the rest of this lecture Eccles considers the enormous importance of language and — what could not exist without language — the self-consciousness which is so much more than mere consciousness. As one expression of his constant and most welcome concern to resist the 1984 which is "engulfing more and more of our planet" (page 237), and after crediting to the Sumerians the two incomparably important inventions of both writing and the wheel, Eccles remarks that for most of its history Sumer "was an amazingly open and tolerant society" (page 114); though it does not occur to him that those market