

placed wherever there happens to be some space that can be occupied. The whole problem of space and buildings at the museum is in urgent need of review, preferably by an independent body since the Trustees seem to be unable to see the wood for the trees.

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1. Halstead, L. B. *Nature* 288, 208 (1980).
2. Halstead, L. B. *Nature* 275, 683 (1978).
3. *Report on the British Museum (Natural History) 1972-74*, 75 (HMSO, London, 1975).

SIR—Halstead¹ has criticized the current exhibition policy of the British Museum (Natural History) on the grounds that the new dinosaur and fossil man exhibits are vehicles for the didactic presentation of a cladistic interpretation of evolution and taxonomy. He goes on to suggest that cladism and a saltationist interpretation of the history of life provide support for a Marxist view of history by progressive revolutions.

The political argument was questioned by Hughes-Games² and Rothman³ and is, really, a diversion from the main issue. Marxists and creationists may find support for their ideas in cladism and punctuated equilibria, but the interpretation placed on fact or hypothesis by people with a particular axe to grind should not affect the development of primary research.

Patterson⁴ presents some arguments on the validity of cladism and its relationships to evolutionary theory. This is an area that will probably continue to be discussed for many years (no doubt to the amazement and disgust of all non-participants).

However, the main issue is the exhibitions policy of the Museum. This question can be split into two: "Are the new exhibits balanced reflections of current scientific opinion?" and "Do the exhibits satisfy the public?"

The first point is answered with a resounding "no" by Halstead, and, I think, a partial "yes" by Patterson. Patterson states that "amongst scientists in the Museum there are many different viewpoints on the value and generality of cladistic methods", but this is not reflected in any exhibit yet. Is there any plan for a presentation of the views of "classical taxonomists" who regard cladism as an important analytical tool, but not as the sole aim and guiding principle of their research, or of numerical taxonomists (again with provisos as to applicability)?

The second question has not been asked yet. The new exhibition policy was started in the mid-1970s with the important aim of presenting a dynamic view of biological processes and it was stated that "... the scheme will be worthily carried out only if we can provide instruction and pleasure to the population as a whole ...".⁵ Is this aim satisfied?

I will comment only on the dinosaur exhibition. This occupies the prime gallery of the Museum — the main entrance hall. Large skeletons attract the visitor and strategically placed stalls market books, postcards, badges and models. The alcoves on either side contain the teaching parts of the exhibit and show examples of contemporaries of the dinosaurs and the much-criticized presentation of cladism. However, the interested visitor will search fruitlessly for information about life-style, function and physiology of dinosaurs. My experience from presenting lectures to school children, natural history societies and

adult education classes is that all these groups of laymen want to know if dinosaurs were warm-blooded, why they were so big, how they used their horns, spines and frills, how we collect them, why they died out, and so on. When I mention taxonomy there is a general glazing of eyes, fidgeting and covering of mouths. This may be an indictment of my teaching methods, but I think that it is also a reflection of what people consider interesting.

If the Public Services Department plans displays on dinosaur biology (functional anatomy, ecology, behaviour), I apologise for these remarks. If not, I don't.

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1. Halstead, L. B. *Nature* 288, 208 (1980).
2. Hughes-Games, M. J. *Nature* 288, 430 (1980).
3. Rothman, H. *Nature* 288, 430 (1980).
4. Patterson, C. *Nature* 288, 430 (1980).
5. *Report of the British Museum of Natural History, 1972-74*, p.76 (Trustees of the British Museum (Natural History), 1975).

Halstead replies

SIR — In view of the seriousness of the criticisms¹ levelled against the Natural History Museum, it seems a little surprising that they failed to elicit any response from the Director or even the Head of the Public Services Department. The only letter from the museum was from a senior member of the Palaeontology Department², who appears to be concerned with roundly condemning the very policies which were the subject of my initial protest.

Patterson² insists that "cladistics is not about evolution" and that there is "no connection between cladistics and one view of the evolutionary process". The "cladistic literature" to which he refers to support these assertions comprises only papers by Platnick³ and himself⁴, and these deal with what is known as "transformed cladistics". This is most definitely not the kind of cladistics being portrayed in the public galleries of the Natural History Museum, to which Patterson appears to be resolutely opposed. The museum's Public Services Department in fact accepts the classic version of cladistics as set out originally by Hennig in *Phylogenetic Systematics*⁵. The title of his book is frequently taken as a synonym of cladistics⁶, a term which refers specifically to the importance of the branching process (speciation) in phylogeny⁶. Hennig's view of the origin of new species involved the splitting of the ancestral species as a consequence of geographical isolation (allopatric speciation)⁵.

The long recognized (in spite of Patterson's contrary assertion²) connection between cladistics and punctuated equilibria, a fundamentally "leap" or saltation view of the process of evolution, has recently been emphasized by Cracraft⁷ and noted by others^{8,9}. Eldridge and Gould¹⁰ formulated the theory of "punctuated equilibria: an alternative to phyletic gradualism" by applying the concept of allopatric speciation, as used by Hennig, to the fossil record. In a subsequent review of the topic and the controversy it had engendered, Gould and Eldridge¹¹ contrasted the concept of gradualism "embedded in the modern history of Western cultures" with that of the "official 'state philosophy' of many socialist nations" where the "laws of change are explicitly punctational", quoting Engels and the official Soviet Handbook of Marxism—

Leninism to this effect. Their basic Marxist approach to evolution has been generally recognized as such, by *inter alia* Gray¹² and Hughes-Games¹³. The latter and Lewin¹⁴ hold the view that the concept of punctuated equilibria is on the way to becoming the orthodoxy of the future. This being so, it is not unexpected that many of its new-found adherents may well be unaware of the philosophy behind the cause they are espousing.

The major controversy regarding the process of evolution and the fossil record concerns the notions of the origin of new species by sudden splitting (Hennig⁵, Eldridge and Gould^{10,11}) — the Marxist model, as against the gradualist model associated with Darwin¹⁵, Mayr¹⁶ and Simpson¹⁷. I am associated with the latter model, not from uncritically accepting the authority of Mayr and Simpson but on the basis of my own research experience.

The death of scholarship in the Natural History Museum is not in my opinion marked by the advocacy of cladistics or even Marxism in the public galleries, as Patterson² seems to imagine, but rather in the manner of the advocacy. The exhibits on dinosaurs and fossil man together with their accompanying books avoid any discussion of the gradual evolutionary versus the revolutionary "leap" concepts, by the simple expedient of accepting the basic assumptions of one and ignoring those of the other¹⁸. It is this crude partisanship which is indeed the unacceptable "strident voice of authority".

The insistence on a chosen received dogma, such as that no fossil species can be considered ancestral to any other, has led the Public Services Department into its obvious differences of opinion with the museum's Sub-Department of Anthropology over *Homo erectus*. That "there is not any serious doubt about *Homo erectus* being ancestral to *Homo sapiens*" is contrary to the rules of the cladistics as applied in the exhibit but is in fact the considered opinion of the scientific staff of the museum's own Sub-Department of Anthropology, and certainly the literature that immediately comes to hand appears to agree with this, including as it does cladistic analyses¹⁹⁻²⁴. The most telling evidence, however, comes from within the covers of the museum's own book, *Man's Place in Evolution*²⁵. I have already drawn attention¹, in this context, to the vitally important Petralona skull, the phylogenetic position of which was recently discussed in detail by Stringer, of the Natural History Museum¹⁹ and by others^{26,27}. The skull figures in the book, but curiously has been excluded from the exhibition itself. It would have served as a dramatic illustration of a transitional form exactly intermediate between *Homo erectus* and *Homo sapiens* but would at the same time have destroyed the credibility of the cladistic dogma being promoted. In the museum's public galleries, it now transpires that, unlike elsewhere in science, "ugly facts" are not to be permitted to "slay beautiful hypotheses".

The Director in his preface writes that, like the exhibit, the book "was planned with the guidance of Museum experts, particularly from the Museum's Sub-Department of Anthropology"²⁵. This gives the entirely misleading impression that what is on display and published by the museum represents the considered views of the museum's own anthropologists. This is most certainly not the case and one cannot help but wonder whether

the Director is actually aware of what is going on in the institution which he heads.

Finally, lest it be thought that my previous letter might be construed as "dangerous to the unfettered development of science"²⁸, in my estimation it is the current policies of the Public Services Department of the Natural History Museum that are already having just such an effect. I am not opposed to the public presentation of a reasoned case for cladistics, be it transformed or classical, as I have demonstrated by employing cladistic analysis in my own research²⁹; nor have I any objection whatsoever to the presentation of a Marxist interpretation of the history of life, if done in the open and scholarly manner of a Stephen Jay Gould.

My objection is to a major public scientific institution, renowned internationally for its scholarship, to be seen to be abusing its authority by attempting to impose on the general public, against the scientific judgement of its own experts, controversial concepts not by argument or discussion but simply by unsubstantiated assertion.

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Science and values

SIR—Between November 27 and 30 1980 I attended, as an observer, the 9th International Conference on the Unity of Sciences (ICUS) in Miami Beach. It was host to 640 participants from 85 countries. The consensus of the overwhelming majority of those who attended

was that the conference, under the banner "Absolute Values and the Search for the Peace of Mankind", was a great success. Imagine, then, the consternation with which I read your editorial comment (*Nature* 27 November p.310) on ICUS "Best not to attend on Mr Moon", which launched scathing broadsides on the founder, seemingly, the aims of the conference, and, indirectly on the integrity of the participants themselves.

Science and values, naturally, reside in different worlds. One cannot understand man's spiritual quest (for liberty, truth, beauty etc.) by empirical laws nor can one restrict scientific endeavour with religious dogma. Yet who can pretend, in a world exhibiting both desperate physical need and social disintegration, that they have nothing to do with each other? This is where I consider the ICUS makes its unique contribution — as an interdisciplinary forum where scholars can freely exchange ideas developed in their own fields about the pressing needs of the world. Few would consider this an "extraneous cause". Are we to understand then, that in referring to Moon's addresses as "vacuous", and implying the term "values" to be meaningless, the editorial policy of *Nature* is to preserve the steps up the ivory tower of scientific learning unsullied by the muddy boots of morality and social responsibility?

Another point of contention is the assertion that "the participants . . . are (not) the group ideally suited for the discussion of the broad themes . . .". If eminent academics in the fields of science, philosophy and the humanities are *not*, then who is?

The conclusion of one committee chairman at the end of the Miami conference was that probably more questions had been raised than answered. I would agree with this. The aims of a body like the ICUS are not easily achieved but the challenge to the academic community to work towards the unity of the sciences can only have positive results, more than satisfying merely an intellectual appetite.

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NSF and cryptology

SIR — In view of the extensive recent discussion of the respective roles of the National Science Foundation (NSF) and the National Security Agency (NSA) in support of cryptological research (see, for example, *Nature* 4 September, p.2), I believe it may be useful to restate the foundation's established policy in this area.

The essential points of our policy with respect to cryptological research are these:

(1) Since mid-1977 we have routinely referred proposals with relevance to cryptology to NSA for review. We will continue to do this. The practice serves to keep NSA informed of NSF's activities in this area, and gives NSA an opportunity to make technical comments on proposals which can be useful in making funding decisions. It is not a "clearance" process; whatever comments NSA may make are advisory.

(2) NSF has long had a policy of encouraging other agencies to support basic research in areas relevant to their missions. We have specifically encouraged NSA to establish an unclassified basic research programme, and stand ready to assist that agency in this effort. We believe it is fundamentally healthy to have alternative sources of support in important areas of science, and anticipate no difficulties

in maintaining close coordination between NSF and NSA.

(3) In cases in which alternative sources of support are available, we routinely encourage principal investigators to apply to such sources as well as to NSF. However, if an investigator prefers to apply only to NSF, we will consider the proposal in the usual manner, without prejudice, and reach a decision on funding using our usual criteria and peer review process.

(4) NSF does not expect that the results of the basic research which it supports will be classified, except in very rare instances. NSF does not currently have classification authority, but it has responsibility, under routine executive orders issued by both the current and previous administrations, to refer any information which it believes might require classification to the agency with appropriate subject matter interest and original classification authority. For cryptological research, that agency is NSA. The important point here is that it makes no essential difference, in terms of the likelihood of classification, whether research is supported by NSF or NSA. This policy is of long standing, and applies to all areas of research.

(5) NSF has long-established reporting requirements which allow it to meet its responsibility for prudent use of public funds. These might not be adequate in all cases where research might have special relevance to national security, and in such cases we may consider special reporting requirements. We have not done this in the past, and we may not have to do it in the future. If we did have to establish such reporting requirements, however, we would regard this not as a change in policy but simply as a change in administrative procedure necessary to apply a long-standing policy to a changed situation.

In summary, the foundation will continue to support cryptological research, will continue to coordinate such research with NSA, and will continue to encourage NSA to develop its own basic research support programme. The results of such research have not been classified in the past, and we do not expect them to be in the future, but we will ensure that our reporting requirements are adequate to allow us to meet our responsibilities with respect to possible classification. Most importantly, the foundation has a basic policy of supporting the best research it can find in all areas of science and engineering, with the fewest possible restrictions on investigators.

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Behind the fridge

SIR—It is highly likely that the reservoir at the back of a self-defrosting refrigerator provides an excellent breeding ground for microorganisms (*Nature* 20 November 1980, p. 208). However, your correspondent's suggestion that these organisms might cause pulmonary infections such as Legionnaires' disease neglects to consider that they would first have to be dispersed in the form of an aerosol. It is difficult to imagine how this might happen other than when the machine is subject to violent movement.

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