at this particular time on this particular scientific effort. Such determinations, like almost any government decision, are always based, in part at least, on political considerations.

Dyson's conclusion seems to rest on the premise that it is natural, if not imperative, that government normally support any scientific effort which is soundly conceived, is useful from the standpoint of government objectives, and advances science. Although the government's commitment to science is a relatively new phenomenon, many leading members of the science-government community have come to speak and act as though this premise were an axiom of government. It should, however, be obvious that in our form of government science activities must compete at the political level for limited government resources with many other activities, and that particular science projects must likewise compete with other science projects for the share of public resources allocated to science programs.

It is indeed distressing that Dyson's view of the science-government relationship is such that he would view the "murder" of Orion, even for political reasons, as a "suppression" or as unique.

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It is important for scientists to point out, as Dyson does, that when political factors are used as bases for supporting or discontinuing support of scientific experiments or technological projects, it is likely that decisions which are scientifically wrong will be made. I agree that choices between alternative approaches to a technical problem should be made solely on the basis of scientific merit—as long as such a choice is not clearly inconsistent with human welfare.

The success of the Orion project, culminating as it would in the explosion of a number of nuclear bombs in outer space, would have a disastrous impact on people and governments throughout the world. The fact that the project was secret and sponsored by a U.S. military agency would certainly increase the likelihood of a violent negative reaction. Given the delicate balance of international relations today, and given the precarious instability in the magnitude of nuclear military preparations in the U.S.S.R. and in the U.S., the reaction to such an experiment might well cause increased distrust among nations. It is almost irrelevant, considering the lack of scientific sophistication on the part of most people in the world, to state that such nuclear explosions would cause no damage to the earth or to the people on it. The world public reaction would unquestionably remain violently opposed.

That the Orion project is "sweet" should not blind its scientists and engineers to the realization that larger issues of human welfare must take precedence over pursuance of the best techno'ogical approach to the problem of space propulsion. That scientific efforts in general, in an ideal world, should be independent of political considerations should not blind us to recognition of the negative effects of particular experiments in the real world of today.

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I wonder if Dyson is not underestimating the technical problems associated with an Orion-type vehicle. While the project may have been killed because of political issues, there are also good reasons for its elimination based solely on technical considerations. Although theoretical analysis and laboratory tests have substantiated the propulsion concept, the major problems associated with the complete system, including those of materials, structures, and operational characteristics, have not been considered in the detail necessary for establishment of an engineering design. Since the system is only as reliable as its weakest component, the demise of Project Orion can also be attributed to the unrealistic objectives expected of a first-generation plant and to the concentration of the entire effort on proving out the propulsion concept while important engineering and safety problems are essentially neglected.

Dyson believes that it is of vital significance to use nuclear weapons directly for peaceful applications and thereby remove some of the moral stigma associated with their use during the war. He goes so far as to blame the scientific community for not lifting a finger to save Project Orion, which is grossly unfair since the majority of scientists have never heard of the program. However, I for one was very happy to see it canceled at the present time. A vehicle containing a very large number of nuclear bombs to be lifted into space by a ground-based booster represents a potential hazard that we can do without. The radiation environment and fission-product release associated with normal operation of Orion are not desirable.

We have recently had an example of the SNAP 10A power reactor which, although thoroughly tested on the ground and launched successfully into orbit, shut itself down for an unexplained reason. A SNAP reactor is a toy compared to the complex machinery of a proposed Orion vehicle. Where could sufficient tests be carried out to provide the engineering information for successful design and operation of Orion? The number of nuclear tests required to achieve the reliability necessary for such flights as the manned Mercury and Gemini flights, for example, could give rise to an atmospheric pollution problem which in itself is sufficient reason for terminating the project. It would appear that when bases are established on the moon, a site would be available for testing the Orion concept without posing a direct hazard to people on earth, although the consequences of large-scale nuclear detonations upon the space environment would have to be evaluated.

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Endorsement of H.R. 5191

On 2 July, the board of directors of the National Society for Medical Research adopted statements of policy in three areas. Two of the statements—referring to state laws and student study of animals—reaffirm long-standing policies. The third—dealing with national legislation affecting animal research—announces endorsement of legislation for the first time. This statement follows a unanimous vote by the representatives of association members of NSMR for endorsement of H.R. 5191 (see Letters, 23 July). The NSMR believes that in this bill a way is pointed out to the Congress in which laboratory animal care can be improved without impeding the health progress on which human welfare depends.

The NSMR has thus adopted a pol-

icy of supporting legislation which will be helpful in its overall effect. However, we would rather see no action than compromise action that would open the way to censorship of science. If damaging amendments were to be added to H.R. 5191, NSMR would oppose its passage, because *human* welfare is our first concern.

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Homo habilis

All anthropologists will be grateful to Tobias for his lucid article, "Early man in East Africa" (2 July, p. 22). A great deal more study will be required, however, before it will be possible to arrive at any agreement on the probable status and affinities of *Homo habilis*. Tobias believes that *H. habilis* stands in a position intermediate between the australopithecines and the pithecanthropines. It is a reasonable conclusion. But to judge from the available data, it would be equally reasonable to conclude that *H. habilis* was, in fact, an early pithecanthropine. There is nothing in the published data that would not conform to the requirements of the latter hypothesis. Applying Occam's razor, *H. habilis* could perhaps more appropriately be regarded as an early representative of *Homo erectus*. Such a ligature can allow for the slight morphological differences that exist between *H. habilis* and *H. erectus* and for the recognition of any other differences that may exist between them, without separating them into distinct species. These are matters that can only be resolved by further study.

Tobias writes, "Since they are contemporary with *H. habilis*, the australopithecine populations represented by the actual fossils recovered to date are clearly too late—and possibly slightly too specialized—to have been on the actual human line . . ."

Tobias suggests specialized large teeth. But large teeth represent a persisting ancestral trait, not a late specialization. In *A. boisei*, the teeth were in process of undergoing reduction. The anterior teeth are small, while the molar-premolar series are large.

Tobias' statement that the fossil australopithecines "are clearly too late . . . to have been on the actual human line" is, as it were, putting the chart before the horse. That some australopithecines were contemporaries of some habilines does not necessarily imply that the former could not be ancestral to the latter. Tobias' statement has no more validity than would the statement that a grandparent could not be a contemporary of his grandchildren—or put more generally, that ancestors and descendants cannot be contemporaries. Or put in still another way, that the descendants preserving an ancestral morphology cannot be the contemporaries of descendants of that ancestral type presenting a somewhat different morphology. The coelocanth constitutes an outstanding example to the contrary, and the coexistence of Przwalski's horse and the modern horse constitutes yet another.

It would be difficult at the present stage of our knowledge to designate any of the known australopithecines as ancestral to later hominines, but there is nothing in the morphology of any one of them that would preclude their standing in the direct line, as ancestors, of such later hominines.

One last point: An article so well illustrated that does not include a photograph of the skull of *H. habilis* is akin to a production of *Hamlet* without Hamlet.

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The suggestion that *Homo habilis* be classified under *H. erectus*, proposed as well by D. R. Hughes of Cambridge (*The Times*, London, 10 June 1964), goes further than I believe the available evidence permits. Between the two extremes of this view and the opposite one, that we should call the hominid *Australopithecus habilis*, the interim solution of a lowly species of *Homo* seems a reasonable compromise. Only the discovery of more specimens and refined statistical comparisons can resolve these slightly diverging viewpoints.

Montagu accepts that large teeth represent a persisting ancestral trait. I believe a better case can be made that enlargement of the cheek-teeth was a secondary specialization. The fact that *A. boisei* had enlarged cheek-teeth proves nothing, because we do not know for sure if he was older than the smaller-toothed australopithecines of Taung and Sterkfontein Lower Breccia. It would seem that moderate-toothed *H. habilis*, large-toothed *A. africanus*, and massive-toothed *A. boisei* were roughly contemporary: which was ancestral to which? When we look back to the Mio-Pliocene hominoids, we find support for the idea that the modest dentition of *A. africanus*, with front and back teeth in harmony, was closer to the possible ancestral dentition—if Simons' view on the facio-dental affinities between *Ramapithecus* and *Australopithecus* is correct [*Proc. Nat. Acad. Sci. U.S.* **51**, 528 (1964)]. On these and other grounds, enlargement of the cheek-teeth in some australopithecines is a departure and a specialization.

My point that the fossil australopithecines were too late to be ancestral related specifically to the Lower Pleistocene *populations* of australopithecines, not (as Montagu seems to imply) to the taxon *Australopithecus*. All evidence certainly points to *Australopithecus* as an ancestral taxon. I was concerned specifically with the populations represented by the known fossils. Previously, it could be averred that the Lower Pleistocene populations of *A. africanus* moved forward by phyletic evolution to become the Middle Pleistocene populations of *H. erectus*. Now that we have found a hominine in the Lower Pleistocene, we must infer that earlier populations than those represented by the known fossils moved forward phyletically to become *H. habilis*—unless we hold to a polyphyletic evolution of *Homo* at several time-levels. These earlier populations must have dated from a period earlier than the Bed-I habilines—that is, from the first half of the Lower Pleistocene or even from the Pliocene.

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Teaching by Research Fellows

Having read John Walsh's report on the effects of federally supported research on higher education (News and Comment, 2 July, p. 42), I would like to offer a suggestion. The government, perhaps in collaboration with the universities and colleges, should offer, to qualified individuals, teaching-postdoctoral fellowships of 3 to 5 years' duration that would require the recipient to devote a part of his time to teaching. (Alternatively, the present fellowship and grants programs could be