Letters

Heart Transplants: Treatment or Experiment

Time magazine (29 Dec.) quotes Christiaan Barnard, with regard to the Washkansky heart transplant, as follows: "I wouldn't like to call this operation an experiment—it was treatment of a sick patient. Although Washkansky died, I don't think we have any evidence that transplantation is not good treatment for certain heart diseases." There are serious reasons to question the validity of the first of these assertions; the second is not much more than a general expression of faith.

Two different kinds of problems must be solved before transplantation surgery may be regarded as treatment rather than experiment. The first is that of surgical technique. Given thorough preparation in animal surgery and the development of mechanical aids and supportive procedures, success is attainable and is largely dependent on the skill, daring, and general medical sophistication of the surgeon and his team. Although special problems are encountered in human surgery, the jump from animals to man is not large and the probability of surgical success can be estimated with reasonable certainty in advance. Actual performance of the Washkansky operation was not needed to know that Barnard and his associates, or Kantrowitz and his associates, or other similar groups, had reached the point in experience, skill, daring, and sophistication to carry it out with technical success.

The second problem, that of overcoming the genetic barrier to transplantation, is the more critical one. It is hardly likely, particularly in the case of heart transplants, that complete donor-recipient compatibility will be available in any particular case. While some organs may be more susceptible to rejection than others, all are subject to the action of histocompatibility factors. In the case of the heart, the relative susceptibility of the nervous conduction system is a special problem about which nothing is known. For the time being, therefore, reliance must be placed on the use of immunosuppressive drugs and radiation. These create difficult problems for patients who already are in a debilitated state.

There are ways, however, of minimizing the histocompatibility barrier. Matching of red blood cell types is elementary. Matching with respect to transplantation antigens is more pertinent to this discussion. This is most conveniently accomplished by the detection of individual leukocyte antigens with suitable isoimmune antiserums (leukocyte typing) or by the use of matching tests such as mixed leukocyte cultures (MLC typing). The results of both of these kinds of tests are at least partially predictive of transplantation success. Evidence is accumulating that there is a single major histocompatibility genetic locus in man, and that either of these types of tests can detect genotypic agreement for this locus [F. H. Bach and D. B. Amos, *Science* **156**, 1506 (1967)]. There is an excellent prospect that minor incompatibilities may be suppressed without heroic efforts provided donor-recipient compatibility for the major locus is assured [W. K. Silvers, D. B. Wilson, J. Palm, *Science* **155**, 703 (1967)]. An approach to this objective should not be impossible even where donors are rare, as in the case of heart transplants. The importance of these considerations are so great as to justify the delays that the performance of the tests would impose, particularly since many possibilities exist for the maintenance of recipient and donor through the period in question.

Although a full scientific report of the Washkansky case is not yet available, sufficient information has been provided by the press to make an evaluation with respect to this second problem. The importance of the sex difference between donor and recipient cannot be evaluated. Apparently red blood cell typing was performed in advance of the operation. Apparently, also, limited leukocyte typing was performed, but not until after the operation had been initiated. One may infer from press reports that MLC or other matching tests were not performed. Obviously no prior attempt was made to match donor and recipient with respect to transplantation antigens. There is every indication from available information that they were actually incompatible, as most unrelated donor-recipient combinations would be if chosen at random.

Under these circumstances massive immunosuppression and radiation were judged to be required and were applied. It is not surprising, therefore, that the patient died of pneumonia. One must conclude that the histocompatibility problem was not dealt with in the Washkansky case, even within available limits. The operation should not be justified as treatment, and if it was an experiment it must be judged as premature and poorly designed. Heart transplants in dogs succeed or fail for reasons that are completely unknown. It would seem imperative that the importance of histocompatibility and the problems of immunosuppression be clarified by animal experiments before human surgery be attempted. It should not be forgotten that while a patient who has lost a transplanted kidney may be maintained, the loss of a transplanted heart is irremediable.

Since the Washkansky case, there have been several other transplants, all receiving their measure of international publicity, which was so great as to generate irresistible pressures for additional attempts. I think that a frank and open discussion of the matters raised in this letter should occur within the scientific community before such attempts are continued. I would hope that both surgical and biological problems would be considered, as well as those of medical ethics and public information, and that a series of guidelines might be developed which could be applied to future attempts at human organ transplantation.

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Southeast Asian Book Publishing

Edward Booher of the McGraw-Hill Book Company paints a rosy picture of the future of publishing and allied fields of communcation and education ("The decades ahead from a publisher's view," 17 Nov., p. 882). It may be even rosier, internationally speaking, if one takes into account Southeast Asia, which is being dismissed these days as an area where "available funds" (meaning American federal money) are going in-

to military rather than educational purposes.

Southeast Asia is considerably larger geographically and demographically than the United States, yet its publishing and educational possibilities are not usually mentioned in the same breath with our own or those of Europe. In Hong Kong, the Cathay Press has for years been producing some of the world's most expert printing. And in Singapore and Kuala Lumpur, Far Eastern Publishers, led by a young Chinese executive, issues textbooks and books for children in press runs of more than a half million copies. Their biggest sales are to governments (Australia, for one); it publishes and prints, not only in English, but in Tamil and Malay, to allow for the possibility of mass sales. Its paper, color illustrations, and printing methods are excellent. Such developments push their way into the rosy picture although low labor costs may make problems for any contemplated cooperation or competition from Europe or the United States.

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Is Nuclear Power "Clean" Power?

Science and its contributor Nelson ("Thermal pollution: Senator Muskie tells AEC to cool it," 10 Nov., p. 755) missed an important opportunity to exorcise an irresponsible demon that has been invoked to plague the nuclear power industry. Nobody denies that power plants (except hydroelectric stations) need cooling water. Nelson's article, however, leaves the unfortunate impression that thermal pollution is a problem peculiar to nuclear plants. As nuclear engineers, we would like to know how conventional steam plants are able to circumvent the second law of thermodynamics!

Science can be more objective. It may be "ironic" to Nelson that nuclear power is advertised as "clean." We submit that clean air is preferable to dirty air. Further, inasmuch as most of the nation's hydroelectric potential is already in use, it seems that the real choice for the future is between "thermal pollution" and a shortage of electric power.

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Latin America: Dangers to Rainfall

So far, the discussion of the Amazon basin (Letters, 14 July, 1 Sept., 10 Nov.) has not covered one point that, in the long run, may prove to be of greater importance than the conservation of species of animal and plant life. The evapotranspiration of a dense evergreen tropical forest is practically equal to the evaporation of an open water surface of the same area. When the huge forests of the Amazon basin are replaced by anything else (except lakes), the water budget of the region will change in the sense that runoff will be increased and evapotranspiration decreased. At the present time, a great percentage (how great is not known) is carried away to the north where it falls as rain over Venezuela and parts of Colombia. It is also probable that part of the rains falling in central Brazil is caused by the evapotranspiration of the Amazon forests.

If the vegetation of the Amazon basin should be drastically changed by man, then, in the course of time, the rainfall rates of Venezuela, parts of Colombia, and central Brazil would decrease. Since large portions of these areas receive rainfall totals that are already rather small for tropical temperatures, a systematic reduction in rainfall would produce substantial changes in the habitability of those lands.

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Evaluating Dreams and the Dreamer

S. L. Washburn, in his review of *Social Communication among Primates* (27 Oct., p. 481), classes as "obsolete theories of behavior which . . . considered internal events as unascertainable in principle."

He is right, but for the wrong reason. The "internal events" which have been a stumbling block are not those which demanded specially subtle techniques, such as brain stimulation and telemetry, but those which are indeed unascertainable except through the subject's report. A class of such events exists because subjects are undeniably observers too: we can observe rapid-eye-movement sleep, but we cannot know except by asking the subject,