The "Two Cultures" within Biology

The Virus Laboratory makes a notable effort to contact biologists and laymen outside the walls.

Garrett Hardin

The explosive growth of molecular biology during the last decade has been greeted with cries of joy by most professional biologists, whether or not they are personally engaged in this type of research. Though molecular biology is clearly in its infancy, it is already well enough developed to make it apparent that the intimate and necessary interrelations of structure and function are going to be revealed with a profundity scarcely dreamed of a generation ago. Molecular biology is unquestionably a genuine frontier—not a mere fad—and it deserves generous support.

But every advance creates problems, and this one is no exception. Those who take an interest in the sociology of science have noted, with concern, the widening gap between the biology of research laboratories and the biology of educational institutions. Of course, such a gap exists to some extent in the physical sciences as well, but it is not as threatening. The inhabitant of the physical research laboratory has a historical connection with educational chemistry or physics, for he was trained in university departments of physical science. But the inhabitant of a biological research laboratory often has quite a different sort of relation to the academic world. Examine the roster of any notable laboratory devoted to the study of cancer, viruses, biochemical genetics, or the other branches of molecular biology, and you will discover not only that many, and in some cases the vast majority, of the principals do not have a connection with academic biology but that they have never had one. They may have been trained as physicists, chemists, mathematicians, or astronomers; few of them have ever had even one course in biology.

Is this bad? Considering the magnificent advances in biology which have recently been made by such men, it would be ridiculous to say that their training is inadequate. The danger is rather of another sort, a danger that academic biology, if too long cut off from the most vigorous growing points of biological research, may atrophy. If we move toward a system in which almost all of the workers in certain fields of biology neither receive nor give courses in biology, the result will surely be bad for the academic part of biology (however it may be for the research branch). Within the framework of biological science, we seem in danger of developing "two cultures" reminiscent of the larger ones to which Snow so persuasively called our attention in *Two Cultures and the Scientific Revolution* (Cambridge University Press, 1959). A recognition of this danger is implicit in Commoner's recent paper "In defense of biology" [*Science* **133**, 1745 (1961)].

What is to be done? Possibly planning within universities can put a brake on the speciation process by requiring physical scientists to take at least one biology course (this course must, of course, be respectably difficult in their eyes). There is also a need to get some of the laboratory workers out of their labs now and then and onto figurative soapboxes to tell the rest of the world what they have been doing.

One Lab's Soapbox

Something of this sort happened recently at the Virus Laboratory of the University of California at Berkeley. The result has now been published in two forms, first as a book, **Viruses and the Nature of Life** (Dutton, New York, 1961. 224 pp. $4.95), and second as a series of eight half-hour films with the general title **Virus** [individual film titles are: (i) *Between the Living and the Non-Living;* (ii) *Giant Molecules;* (iii) *The Stuff of Life;* (iv) *Viral Genes;* (v) *How a Virus Kills*; (vi) *Threads of Life*; (vii) *Killers and Carcinogens*; and (viii) *Cancer*]. The films are marketed by the Audio-Visual Center, Indiana University, Bloomington (rental per film, $5.25; purchase, $125 per film). Authorship of both book and films is given as Wendell M. Stanley and Evans G. Valens, with spot credits given to H. L. Fraenkel-Conrat, C. A. Knight, A. B. Pardee, H. Rubin, G. S. Stent, and R. C. Williams. Both book and films are by-products of a series of educational television programs first presented by station KQED in San Francisco.

There are many problems connected with getting busy research men to abandon their work for awhile to do their bit for education (understood in the widest sense). Money is by no means the only problem. At least equally important is the assurance that what they do will have a reasonable chance of being effective. The present effort implicitly offers a formula for maximizing the probable effectiveness: a "package deal," in which a single large effort produces messages over several different channels, namely TV shows, educational movies, and books. The review that follows is concerned not only with the content of these messages but also with my estimate of the present and future success of such package deals.

One of the educational assets of a large enterprise like this is that the producers can "think big." Splendid models of viruses were produced at a magnification of 65 million. On the cinema set these dwarf the human speakers, which is rather a good way to give a feeling of being at an intracellular level. An understanding of size is created by a carefully graded series of photographs ranging from the whole tobacco leaf, through hair cell and macrocrystal of tobacco mosaic virus (TMV) down to TMV particles seen under the electron microscope. The operations involved in isolating viruses are pictured and described with great clarity and economy by Robley Williams. Other workers discuss viruses as organisms, how viruses reproduce and undergo mutation, how genetic information is coded, and how

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viruses affect metabolism and cause disease. Stanley gives a restrained discussion of the possible relationship of viruses to cancers.

Pros and Cons of Success

How successful is this venture into multiple publication? Speaking generally, I think the result is good and sets an example that could well be followed by other laboratories, to the benefit of both science and the public. The stature of the participants vouchsafes the accuracy of the presentations; interest and clarity are high throughout. Without tendering more well-earned praise, let me now offer a few adverse criticisms, on the assumption that the example here set will be followed by other laboratories, which will not want to make the same mistakes.

The principal shortcoming of the book is what one would expect of a work written by many busy men: looseness and repetition. The word *plaque*, for instance, is defined on page 80 and again on page 115. On page 124 we are informed that "more than 200 previously unknown viruses causing disease in man have been discovered since 1955 . . ." only to be told the same thing again 18 pages later. The organization and writing is somehow unliterary (or unbooklike, at least) and reveals its "stagey" origin. It reads in places almost like a TV script, which some readers will no doubt find annoying. On the other hand, this same origin is no doubt responsible for the unusually close and beautiful integration of text and illustrations, which can stand as a model of excellence. In sum, the shortcomings are minor, and the book can be warmly recommended to intelligent laymen, to high school students, and to both students and faculty, at the college level, who are not in close contact with research in molecular biology.

Evaluating the films is a bit more difficult, because of my uncertainty about their intended use. For TV, one should highly recommend them as a great improvement on the bulk of television fare. Even so, the films have their weak points. The exhibition of the giant models is repeated in more than half the films, and we are told repeatedly that, on this scale, the whole TMV molecule would be six stories high. Once, or possibly twice, would surely be enough. Some anemic chamber music is used as a background theme for the beginning and the end of all eight films. I found this music positively allergenic, and $2 \times 8 = 16$. Some of the art work is quite poor. That the dog in the first film appears to have been drawn by James Thurber at the age of four may not matter much, because everyone knows what a dog looks like; but the diatom is another matter. In the fifth film the animations of the assimilation of food by a cell will surely lead to misconceptions. Admittedly, good animations are expensive; but they should be done well or not at all.

The films were made initially for TV. Are they satisfactory for the college classroom? Yes; but they need further editing. Such statements as "Last week you saw . . ." are out of place here. And the opening few minutes of all but the first film should be deleted to minimize repetition. There is great variation in the stage competence of the speakers, but this is not entirely a shortcoming. Some awkwardness conveys an air of authenticity. The individuality of attire (coats, lab coats, and shirt sleeves) also says, "These are the men who did the work, not actors." That's good.

Probably not many institutions will care to use all eight films, but two at least should see wide use: No. 2, which shows the basic physical procedures involved in virus study, and No. 8 (on cancer), which ends dramatically with a listing of unanswered questions.

Stanley and his group at the Virus Laboratory deserve praise for so ably making their findings available to other scientists and to the general public. Let us hope that other laboratories follow their lead—and that they do even better.

Garbled Information

Human Heredity. Jean Rostand. Translated by Wade Baskin. Philosophical Library, New York, 1961. 139 pp. $4.75.

For a small book, this one packs a powerful lot of misinformation and misconception. Responsibility must rest mainly with the author, but to some extent it also rests with the translator, Wade Baskin of Southwestern State College, and with the publisher, the Philosophical Library, whose bad judgment it was to produce an English edition. The book appeared as *L'Hérédité humaine* in Paris in 1952. Between 1952 and 1961 the field of human genetics advanced perhaps as much as during all the period prior to 1952. Some of the misinformation arises from failure of the translation to take account of the advances of the last decade, but other misinformation and most of the misconception had no excuse for their existence even in the original book in 1952. It is interesting to contrast this with Penrose's beautiful little *Outline of Human Genetics* (1959). Rostand's book falls short of its avowed objective: "to introduce the greatest number of people into the sovereign dignity of knowledge." Penrose's fulfills this purpose quite satisfactorily.

Beginning on page 14 where it is stated (and it is later repeated many times) that the chromosome number of man is 48, misinformation piles up in great mounds. Inadequate compensation is provided by the translator in fine print in the appendix: "It has recently been established that there are only forty-six chromosomes." Several times serious reservations are raised, and discussed at some length, concerning the existence of the Y chromosome in man. The reader is told that the founder of modern genetics was Johann Mendel—correct since the full name was Johann Gregor Mendel, but certainly unusual.

Men with many daughters will be intuitively suspicious of the view repeated on page 126 that "there is probably a correlation between the tendency to produce boys and the virility of the father." On page 132 we read "out of ten stillborn children, three are victims of maternal syphilis" —a statement which simply is not true and probably never has been, at least not in recent decades. Historical and genetic information alike are garbled on page 78 where the now famous story of Queen Victoria's transmitting hemophilia is related. "Victoria received it from her mother, who had received it from her mother." Haldane has investigated the matter most closely and thinks there is no evidence that the gene existed in the lineage before Victoria and that she was a carrier by virtue of new mutation. "Victoria's husband, Prince Albert of Saxe-Coburg-Gotha belonged to a progeny of carriers, though he himself was probably illegitimate." Irrelevant and probably untrue!

The grossest misconception conveyed by this and unfortunately by several other popular and semipopular