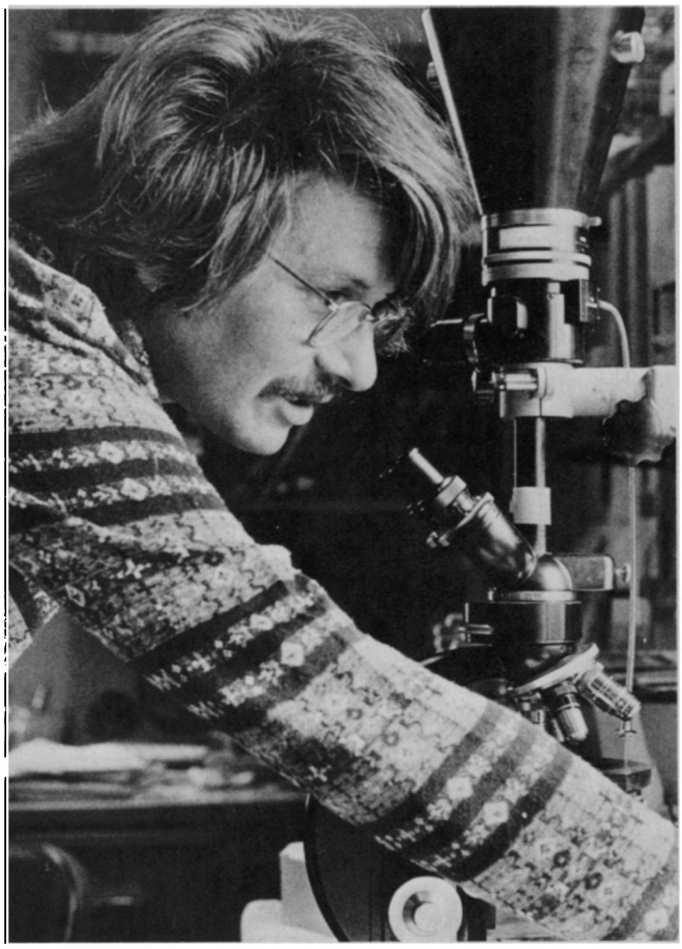
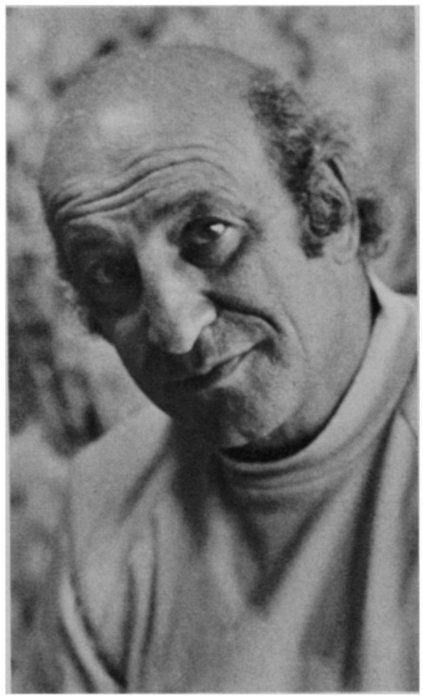




Left to right: Radin, Fogel,

GENE

A science that

by John H. Douglas

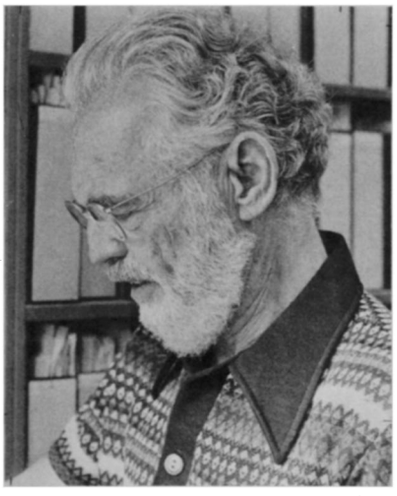
When the 13th International Congress of Genetics was held in Berkeley this fall without the attendence of the Nobel laureates that once made the field so glamorous and without producing spectacular announcements like those that graced so many earlier congresses, some news reports strongly suggested that genetics was over the hill. Science and Society Editor John H. Douglas visited with several members of the Berkeley genetics community and came away with a very different impression.

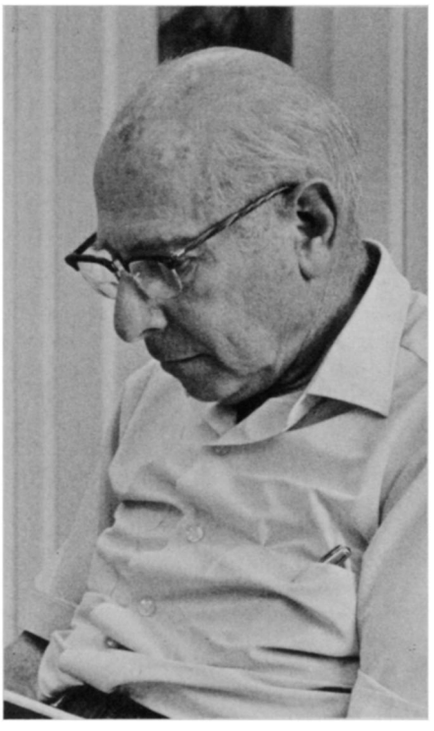
No one is going to win a Nobel Prize for anything he said at the latest International Genetics Congress. The meetings are held every five years and this one featured no excitement to match the discovery of DNA or celebrations to equal those that greeted the solving of the genetic code. But wandering through the genetics laboratories at the University of California, Berkeley, one hardly gets the impression that the science is dying, as some have suggested. Rather, one meets a generation of scientists who have, in their own lifetimes, brought a whole new field of knowledge through its birth pangs and are now consciously passing on to their juniors the task of seeing it through a difficult adolescence. Ahead lies an unmistakable period of accountability for the awesome powers genetics has given mankind, and a time of transition for integrating genetics with other, more established disciplines.

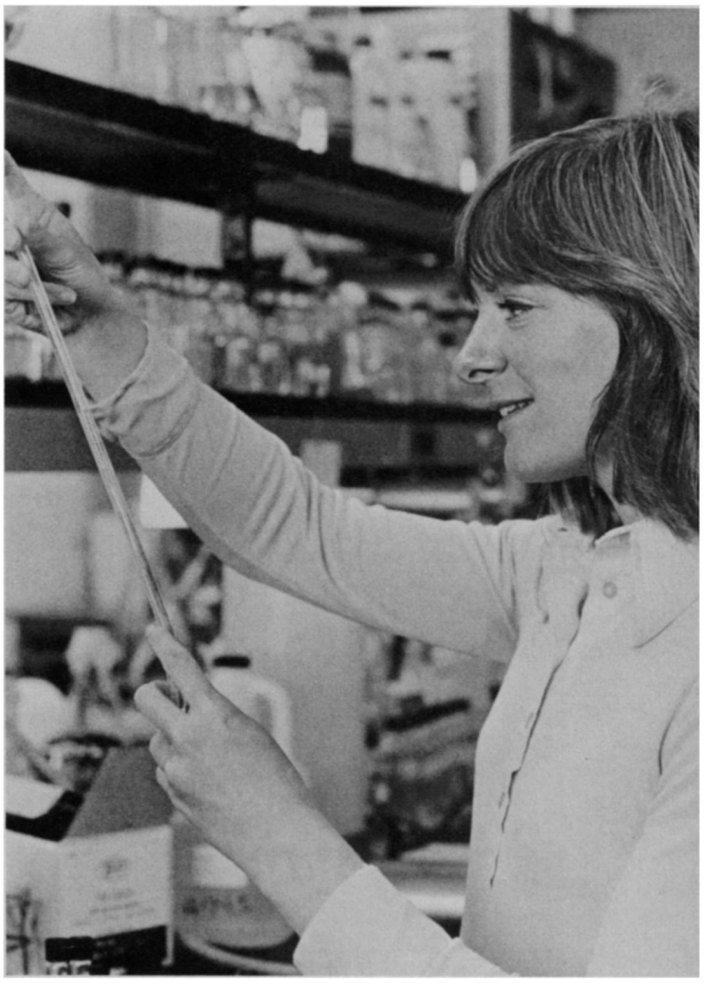
This tone of transition was set in an address by the president of the congress, Curt Stern, the dean of American geneticists. He wished to talk, he said, to the young scientists in his audience, to tell them of the intellectual heritage being passed on to them and to encourage them to pursue their work in a science that was still "fun."

In the tight-knit fraternity of geneticists, the word "fun" is often heard. Geneticists generally work in small lab rooms that are a far cry from the giant, government-run installations that now dominate some sciences. But the main reason for the spirit of youthful enthusiasm in the discipline is the relative ease with which the young scientists to whom Stern addressed himself can make significant contributions and often present papers to professional society meetings even before finishing their doctorates.

"What does it matter if all the Nobel laureates of genetics didn't show," thunders Seymour Fogel, chairman of the UC Berkeley genetics department. "The congress was distinguished from others in the past by the number of young people that participated. There was a deliberate attempt on the part of the organizing committee to seek out younger scientists who had already made significant contributions and had something to say." He talks enthusiastically about how his graduate students volunteered to hold a barbecue in a campus picnic area for the 2,700 visiting scientists, then continues: "There was nothing in the way of a shattering pronouncement, like the genetic code; but there were many controversial things dis-







Photos: John H. Douglas

Palmour, Dempster, Stern, Mackay

TICs

is coming of age

cussed openly and a new awareness of social impact."

Some of Fogel's graduate students organized an adjunct program of social consciousness for the congress, with discussion focused on the Green Revolution and the theories of genetically inherited intelligence. The sessions turned out to be the best attended of the congress. The Green Revolution—the development through applied genetics of highly productive new strains of agricultural crops—was presented in the sessions as a mixed blessing, requiring many developing countries to buy expensive equipment, pesticides and fertilizers to handle the new crops. The theories of Arthur Jensen and William Shockley—that intelligence is mainly an inherited, rather than an acquired, characteristic—were disputed by scientists who claimed that other studies showed that a 46-point I.Q. difference could result by giving special training to ghetto children. Jensen and Shockley were invited to participate but neither appeared.

"Geneticists have been passively used," says Berkeley graduate student David N. Radin, one of the organizers of the adjunct program. "They should begin to speak out, for now there is much more potential effect on society. They should speak out as geneticists and as citizens."

But scientists are not given to "speaking out" at public debates. Hardly a voice was raised during the congress in defense of Jensen and Shockley, though many geneticists say in private that their work should continue, but through using different methods.

One of the most qualified men to comment on the Jensen-Shockley controversy is Everett R. Dempster, a population geneticist at Berkeley. He emphasizes that I.Q. differences between races are being exaggerated; that I.Q. measures only one component of mental function and that many other components—creativity, equilibrium, perspective—may be just as important. I.Q. *may* be largely inherited, he says, but the hypothesis has not been proved and those that clamor for more research to be done—in hopes their prejudices will somehow be justified—may be in for quite a shock: the genetic superiority in America, anyway, may well not belong to "whites" but to Jews and Orientals. But to do the research properly would require much more sophisticated techniques than Jensen and Shockley used. A "genetic index" would have to be developed, Dempster says, to distinguish racial characteristics on some basis other than whether an individual passes for black or white; and even then environmental effects would be hard to weed out.

Dempster laughs at suggestions that the really exciting discoveries in genetics have already all been made. "I don't think we are nearly as close to understanding everything, even in principle, as those people are inclined to think," he says. Discovery of the basic principles of genetics has opened new pathways for exploring old questions, he says, such as how does mutation work to drive evolution? Mutations are al-

most always harmful; and if some important characteristic of an organism vitally depended on each of the millions of genes that would fit into a DNA molecule, something would always be going wrong. It now appears that the number of really necessary genes is comparatively quite small, he says, which leaves the function of the remaining DNA unknown. The situation has been described in terms of "printing out" all the information on a human chromosome: the information would fill 2,000 volumes of 1,000 pages each. But only about five of the volumes appear to be necessary. From this problem of "genetic loading," as well as others, Dempster foresees plenty of excitement left for future geneticists.

If genetics has progressed far enough to aid other disciplines intellectually, it has also developed practical techniques that will almost certainly change the course of human history. "Fantastic things have been done in human genetics," says Roberta M. Palmour, who has just begun teaching the subject at Berkeley. Already more than 50 genetically transmitted human diseases can be diagnosed in an infant before birth by studying its chromosomes. Other researchers have described their successes in some of the early stages of "genetic engineering"—changing defective genes within a cell. Within a couple of years she expects such experiments to be well established in test-tube cultures and she says most researchers hope to successfully manipulate genes in living organisms "within a generation."

The art of cloning has also progressed rapidly. In this process, embryonic cells are separated so that any number of identical twins could theoretically be produced from one fertile egg. The process has been successfully tried in lower animals but Palmour says that work in mammals, mainly rats, has not been able to progress beyond keeping the embryo alive through early differentiation. National Academy of Sciences President Philip Handler has suggested that cloning could help developing countries build herds of prime quality farm animals quickly.

Palmour talks of other new developments in genetics that may have more immediate effect. "We keep coming up with racial differences," she says, "which could be manipulated terribly easily in the wrong hands." Especially important are apparent enzyme variations between races or ethnic groups that cause them to have different susceptibilities to various drugs. Some ethnic groups in the Mediterranean, for example, are susceptible to a compound in fava beans, a staple in the diet of the area, and develop hemolytic anemias from eating them. The grim prospect this raises, of course, is that of selective biochemical warfare. But Palmour prefers to look at the positive aspects of new discoveries. New knowledge for example, could allow physicians to warn persons ahead of time whether they or their children are likely to develop certain susceptibilities, including a weakness for hypertension and athersclerosis, in time for preventive measures to be taken.

She disagrees with those who say scientists should avoid publishing data the world "isn't ready for." The implications, she says, are already obvious to anyone who wishes to misuse them. Better to take an active effort in seeing that discoveries are applied to positive goals: "Teaching has an important input," she says. She devotes many discussion sections to talking about implications of new work.

What effect will the transitions in genetics have on the young scientists just launching their careers in the field? One such scientist is Vivian MacKay, who is well into her first year of postdoctoral work at Berkeley. "Genetics is understood well enough now to use it on something else," she says excitedly. "For the last five years we've been in the fantastic process of putting the cell back together again, rather than just having to study one part of it. Geneticists are becoming biologists again!" Her own contribution to this effort is an attempt to develop a model of how cells respond to hormones through her studies in yeast genetics.

She agrees with Roberta Palmour that scientists should not cease research just to counter possible abuses of their discoveries, but rather that they should take a more active role in influencing society to use the discoveries wisely. "I'm not going to stop what I'm doing," she says; "but I must be aware of the implications."

To talk with Vivian MacKay is to see Curt Stern's "fun" of genetics personified. "There is a very great blossoming now," in genetics, Stern said. When he started work in the field in the twenties, no one knew just what a gene was. Now, in his own valedictory before the congress that elected him its president, genetics has progressed far enough for him to say with confidence and understanding, "The eggs or sperm of a lion are the lions themselves, stripped of all ephemeral attributes."

By "fun," he says, he means that "companion of creativeness which, at different levels, is a tribute of all mankind." Scientists are subject to all the self-seeking motives of other men, but he says, "There remains a residue of purity in their search for attainable truths. It is this residue from which arises the exalted 'fun' of science."

Hardly an epitaph of a dying discipline! □