entertainment. We have lost many a distinguished visitor for several hours while he quarterbacked the Dartmouth football team in a highly realistic simulated game. And Basic itself has grown and matured. While we can still introduce the novice to Basic in 2 hours, today we also develop major new systems and large computer-assisted-instruction applications entirely in Basic.

Summary

We have learned that success can result in an entirely new set of problems. Our original DTSS, which seemed much too large for a small campus with very few computer users, soon proved unable to handle the demands of the same small campus where everyone seemed to be clamoring for computer services. By 1966 we were planning the second DTSS. With the cooperation of General Electric, we opened in the fall of 1967 a time-sharing system, based on GE-635 hardware, which can handle over 100 users. The NSF has helped us provide computer services to 23 secondary schools and 10 colleges, as well as expanding the local capabilities. This fall we will launch phase II, a fully general-purpose, large-scale, time-sharing system for the GE-635. Like the first DTSS, phase II is again being written by a faculty-student coalition at Dartmouth. It will serve everyone, from the novice to the research worker who needs large production runs. We hope that with our much more powerful hardware we will be able to provide these extended services to some 150 users simultaneously without compromising our basic philosophy of making the system as easy to use for the inexperienced as for our original DTSS.

The real test comes this fall. We are confident that the expert faculty user will be very happy. But will our students after a football game still take their dates to the Kiewit Computation Center to show off their prowess with computers?

University Integrity

Kenneth S. Pitzer

At the moment, there seems to be special need to discuss the internal logic of the university—the relations between its students, faculty, governing board, and administrative officers, and especially the factors which are essential to the university's integrity as an institution. The trials of Columbia University have been all too prominent in recent weeks. But many other American universities have suffered. And, as we look around the world, we note the troubles of one of the oldest and most prominent universities, the University of Paris. While the pressures leading toward disruption are not the same everywhere, it is true that some universities have been able to contend with these factors much better than others have. The problems here in Houston seem not to have been as severe as those in some other locations, but anyone who is sensitive to the thinking of various individuals can detect the presence of the same ideas, objectives, and frustrations.

In commenting on these problems I want to distinguish carefully between those cases where the institution suffered a real breakdown—where the educational activities were substantially disrupted—and those in which an expression of student opinion got slightly out of hand. So long as students respect the rights and privileges of others who may hold differing views or who may merely be uninterested in a particular topic, they certainly have the right to express their views on the public issues of the day. In some cases overenthusiastic picketing has been conducted in a manner that has somewhat infringed upon the rights of others, but the institution has been able to handle the situation with an appropriate firmness and compassion and then has been able to continue with no loss of integrity.

The Pressures

What are the pressures that are especially great today? What do the activists want? Some of you undoubtedly know better than I, but I hope you will accept the following brief summary. There is deep student concern over certain issues confronting our society, especially race relations and the war in Vietnam. This concern is combined with knowledge on the part of certain older students who have seen the technique of civil rights demonstrations yield the fruit of favorable congressional action. Recently the population in general and the governmental leadership have found these techniques less convincing. As a result there is, in these active student groups, a sense of frustration. Many students have shifted their activities to the political sphere by supporting their favorite candidate for the Presidency; this is most commendable. But a small hard core of extremists—those with the greatest arrogance and the least faith in their country—have escalated their demonstrations from the legal range to the level of kidnap and blackmail. Unfortunately, in a few cases substantial numbers of other students and faculty have supported these extremists or have opposed the use of feasible methods of dealing with them.

Joseph Shoben of the American Council on Education puts it in these terms (*1*):

(1) Like a great many other citizens of our republic, students in large numbers are sufficiently frustrated and distraught by the nature and entailments of the war and by the unhappy state of our race relations to act on their discontent. (2) Because they are primarily in contact with colleges and universities as institutional

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agencies of society, students are especially sensitive to ways in which the campus may appear to mirror what they regard as the American malaise of our time. As a consequence, they strike against the target that is most available to them whenever they *believe* they have cause to strike. (3) These attitudes of students—and it is crucial that we remember that students are not alone in the attitudinal positions that they assume—are shared in sufficient numbers to define a reality that cannot be ignored in the development of academic policies and practices.

It would be true but hardly adequate to say simply that the university is not the appropriate target for these frustrations since the university does not and should not have the authority to deal with matters of this type. We must go much further and emphasize what the proper role of the university is, what its proper response in situations such as these should be, and, very particularly, why the university as a corporate body should not seek political power.

Proper Role of the University

The primary function of the university is the transfer of the intellectual treasure of mankind to the next generation. In addition, universities seek to add to existing knowledge, to solve presently unsolved problems, and to assist their communities in applying this intellectual heritage to problems of current concern. Also, universities seek to provide a wholesome environment for the growth and development of their students as individuals; this responsibility is especially heavy for residential colleges and universities with respect to their undergraduates. But the role of transferring knowledge—the teaching role—is central, and, while in many cases it does not require all of a faculty member's time, it should have first priority for the time it does require. At the same time students should remember that the university is intended for those who want to learn from its faculty. There are some things which can be learned better in other places—in hospitals, in the ghetto, in artists' studios, in factories or business offices, and particularly in churches or in the home—and there are some important truths that come only with experience in life. It is not the purpose of our colleges to duplicate these forms of learning. Our colleges and universities, with their libraries and their laboratories and particularly through the guidance of the members of their faculties, offer a particular and very important opportunity for learning, but it is a special opportunity and it confers a special status both of privilege and of responsibility upon the faculty members. Students and professors are equal as citizens in the eyes of the law, but they are not equals within the framework of the university. The assumption is that the faculty knows more than the students and that there is an apprentice relationship between student and teacher.

While the student has the obligation, while learning, to respect the superior knowledge of his teacher, at the same time the teacher is obligated to listen as well as to lecture, to understand the interests and enthusiasms of his students, and to appropriately recognize these factors in his teaching. Also, professors must take the time to know their students as individuals, to discuss the current concerns of students. If changes are needed in the university the faculty should make those which lie within its authority and should urge administrative approval of any others. Professors should explain to students the proper role of the university and the nature of academic freedom and the way in which this relates to the citizen's freedom under the Bill of Rights. I believe that, in the United States at least, a real breakdown has occurred in a university only when most of the faculty have failed to talk with their students in this way—either because they have been diverted by excessive emphasis on research or professional activities or because they have failed to recognize this as one of their responsibilities. And it is the same faculty members who have failed in these responsibilities to their students who have, possibly from a sense of guilt, also failed to insist that students obey the law and respect the rights of others in expressing their opinions.

Proper Response of the University

If faculty members are to have a major role in university decision-making, as they should have, then they must accept a corresponding responsibility for institutional welfare. In particular, they should make every effort to prevent organized student groups from exceeding legal bounds in their efforts to influence either university or governmental authorities.

Another important principle, both on the campus and in the community at large, is that of tolerance and respect for an individual who honestly holds a contrary opinion. Faculty members and all others involved in university leadership should be spokesmen for freedom of speech and the tolerance of differing opinions which necessarily accompanies that freedom. While academic people have been quick to condemn those outside the campus who would limit freedom of expression, there have been a number of unfortunate episodes on college campuses in which unpopular speakers have been denied this freedom of expression and have been badly treated. For example, both Secretary Rusk and former Secretary McNamara have been denied a fair hearing at some very distinguished institutions. President Wallis of the University of Rochester has gone so far as to say, "concerning the freedom to present controversial views on campus, . . . on few campuses in America today does such freedom truly exist." I would not go that far; indeed, I think there is real freedom to present controversial views on many campuses, but this freedom needs to be reemphasized. And those colleges and universities where this freedom is not really present are suffering from a serious disease which deserves urgent attention.

At its most recent meeting the American Association of University Professors recognized these problems and the obligation of faculty members to play a major role in dealing with them. The resolutions of this association included the following:

> In view of some recent events, the 54th Annual Meeting deems it important to state its conviction that action by individuals or groups to prevent speakers invited to the campus from speaking, to disrupt the educational operations of the institutions in the course of demonstrations, or to obstruct and restrain other members of the academic community and campus visitors by physical force is destructive of the pursuit of learning and of a free society. All components of the academic community are under a strong obligation to protect its processes from these tactics.

The University and Political Power

In recent years it has been seriously advocated, not only by some student groups but also by an occasional faculty member and by other adults, that universities should take official positions on controversial subjects and campaign actively for their adoption by governmental authorities. Such action would

inevitably destroy academic freedom. For example, a professor or a student of economics would no longer be really free to advocate his solution to the gold problem if his university were to adopt officially a different position on this question. And a donor to the university could very legitimately object if his gift, intended for education and the search for truth, were used in an active campaign on a public policy question contrary to his viewpoint. Universities can advocate honesty, tolerance, freedom, and other ethical qualities both by proclamation and by example, but, if they are to defend these qualities and are to offer freedom to their members to discuss matters of current controversy, universities as corporate bodies must not seek political power.

Throughout history, universities have suffered whenever and wherever they became tools of political or ideological power. In voluntary or enforced betrayal of their central teaching role, these institutions ultimately helped undermine and even destroy the intellectual heritage they were designed to preserve and enlarge. In Europe and Asia in the 1930's and during World War II, many universities allowed themselves—either willingly or under dictatorial coercion—to become important tools of political power.

Fortunately, American higher education, so far, has been spared this supreme test of its integrity. However, this fact does not preclude the need for careful review of our principles and, where needed, even revision of our priorities. But neither review nor revision should ever affect the integrity of our colleges and universities.

Conclusion

Now you may ask what the individual citizen can do to help colleges and universities maintain their integrity. Whether or not you are professionally involved in education, you can encourage a proper emphasis on the teaching-learning function and the responsibility to recognize students as individuals. You can also help by understanding and defending academic freedom and by insisting, outside as well as within the campus, on tolerance for differing viewpoints. Finally, you can help maintain the institutional integrity of our colleges and universities through understanding, aid, and support.

Reference

1. J. Shoben, American Council on Education, unpublished report.

Molecular Basis of Visual Excitation

George Wald

I have often had cause to feel that my hands are cleverer than my head. That is a crude way of characterizing the dialectics of experimentation. When it is going well, it is like a quiet conversation with Nature. One asks a question and gets an answer; then one asks the next question, and gets the next answer. An experiment is a device to make Nature speak intelligibly. After that one has only to listen.

Backgrounds

As a graduate student at Columbia University, I was introduced to vision by Selig Hecht in a particularly provocative way. Hecht was one of the great measurers of human vision, like Aubert, König, and Abney before him. But he was not content merely to measure. He wanted to understand what lay behind the measurements, what was going on at the molecular level in vision.

There a door was opened for him while still a graduate student at Harvard, by the great Swedish physical chemist Svante Arrhenius. Hecht has told me of the excitement with which he read Arrhenius's new book *Quantitative Laws in Biological Chemistry* (*1*). It offered the hope of translating accurate measurements on whole organisms into the simple kinetics and thermodynamics of chemical reactions in solution.

In this vein Hecht applied his measurements and those of earlier workers to constructing a general conceptual model for the photoreceptor process. A photosensitive pigment, S, was dissociated by light into products, P + A, one of them responsible for excitation. In turn P + A, or a variant, P + B, recombined to regenerate S. In continuous light these opposed reactions achieved a pseudo-equilibrium, a photostationary state, that underlay the steady states of vision in constant illumination (*2*).

I left Hecht's laboratory with a great desire to lay hands on the molecules for which these were symbols. That brought me to Otto Warburg in Dahlem, where I found vitamin A in the retina (*3*). There were good reasons to look for it there, as I found out later, and that is the way I wrote my paper. Dietary night blindness, a condition already known in ancient Egypt, had been shown in Denmark during World War I to be a symptom of vitamin A deficiency (*4*); and Fridericia and Holm (*5*) and Tansley (*6*) had shown that vitamin A–deficient rats synthesize less rhodopsin than normal animals do. But vitamins were still deeply mysterious, and at that time one hardly expected them to participate directly in physiological processes. I think this was the first instance of so direct a connection, though Warburg and Christian were already analyzing the first yellow enzymes (*7*), and shortly their chromophore riboflavin would prove to be vitamin B_2 (*8*).

After that, things happened quickly.

The author is professor of biology, the Biological Laboratories, Harvard University, Cambridge, Massachusetts. This article is the lecture he delivered at Stockholm, Sweden, 12 December 1967 when he received a Nobel Prize in physiology. It is published here with the permission of the Nobel Foundation and will also be included in the complete volume of *Les Prix Nobel en 1968*, as well as in the series *Nobel Lectures* (in English) published by the Elsevier Publishing Company, Amsterdam and New York.