rise to the generator potential and it, in turn, to impulses remains one of the major problems in visual physiology—a problem still under intensive study in Hartline's laboratory and in many others.

One of Hartline's most significant contributions was his study, begun in the late 1930's, of the retinas of cold-blooded vertebrates. With an exquisite technique of microdissection, Hartline was able—this also for the first time—to isolate single optic nerve fibers of the vertebrate retina and record their activity. He found that the response of the whole nerve, observed a decade earlier by Adrian and Matthews, resulted from the summated activity of fibers whose individual responses differed markedly. Some discharged steadily in response to steady illumination, some in response to the onset and cessation, others only to the cessation, of illumination. Exquisite sensitivity to moving patterns of light and shade characterized many of these fibers. This demonstration that the processing of visual information begins in the retina with the specialized activity of diverse types of ganglion cells was fundamental.

Equally important for the modern theory of vision was Hartline's research on the "receptive fields" of optic nerve fibers (the term borrowed from Sherrington's analyses of reflex activity). He mapped these fields in detail, showing that a retinal ganglion cell can receive excitatory and inhibitory influences over many convergent pathways from many photoreceptors. The optic nerve fiber arising from the retinal ganglion cell is simply the final common pathway. As Hartline remarked in his Harvey Lecture (1942), "The study of these retinal neurons has emphasized the necessity for considering patterns of activity in the nervous system. Individual nerve cells never act independently; it is the integrated action of all the units of the visual system that give rise to vision."

The past decade or so of Hartline's research has been devoted mainly to this very problem. He found, in 1949, that even in the primitive eye of *Limulus* there is an interplay of excitation and inhibition. It was later found that this interaction molds the spatial and temporal patterns of activity so that information about certain significant features of the retinal image tend to be emphasized. For example, strongly illuminated receptors inhibit the activity of receptors in adjacent dimly illuminated regions more than the latter inhibit the activity in the former; thus border contrast is enhanced. The compound eye of *Limulus* has provided an especially favorable reputation for the analysis of the functional properties that arise from inhibitory interaction in a neural network. In recent years, these integrative interactions have been analyzed in detail by Hartline and his associates and expressed in quantitative forms.

These basic processes of integrative action observed in the eye of the ancient horseshoe "crab," although "far removed in evolution," are surprisingly like those in higher animals and man.

The study of vision is just as vital and organic a process as is vision itself, and Wald, Granit, and Hartline have always recognized the interdependence of their separate contributions and those of other workers as well.

They have also always been generous in sharing the credit for advances in the field with their many colleagues, co-workers, and students, who could not be mentioned in these brief notes.

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Federal Economizing: House Votes To Take It Out of R&D

The scene was the House of Representatives. At issue was no less an item than authority for the U.S. Government to continue to pay the bills of dozens of agencies whose appropriations were late in clearing Congress—among them NASA, the Department of Labor, the State Department, the Department of Health, Education, and Welfare, NSF, the foreign aid agency, and the Commerce Department. It was 3 October, and if approval did not come out of Congress by 23 October, there would be no choice but for the Treasury Department to turn off the check-writing machines for the above-cited agencies as well as a good many others.

And there, holding the floor, was Representative Wayne Hays (D–Ohio), telling his colleagues about his farm in Belmont, Ohio. "We have a policy there," he explained, "that we only save about two of the best bull calves for breeding purposes, and the rest of them are made steers and eventually wind up in the butcher shop. And while I was riding around thinking about this, it occurred to me that . . . if I were President of the United States I could not think of a better present that I would like the Congress to give me than a $5-billion goldplated castration knife—and do not think I would not know where to cut."

On that day, the House apparently visualized the implications of following Hays's metaphor to its conclusion, for when the vote came (on a procedural issue) it was 213 to 205 against so equipping Lyndon Johnson to cut $5 billion. But that was on 3 October, and, since then, the lower chamber of the U.S. Congress has put on a series of performances that, though assuring the financing of the affected agencies at least until mid-November, provide little ground for certainty as to what the U.S. Government will be financially able to support in the coming year. This uncertainty applies right across the board, with the exception of the Vietman war, which has a blank check. But, as it turns out, the uncertainty is thickest in the area of research and development, which, among all areas of federally supported endeavor, was singled out as especially ripe for vigorous chopping.

This became apparent on 16 October, when the House Appropriations Committee reported out House Joint Resolution 888, which was of dual-purpose intent: to keep the federal government going and to satisfy the demands of a dominant coalition of Republicans and Southern Democrats who want federal spending reduced as their price for supporting President Johnson's request for a 10-percent war tax surcharge. The vagaries of federal budgeting and the loose wording of the resolution produced speculations that, if put into effect, it would cut federal spending by from $2 billion to $8 billion. But the key point is that, though it was riddled with uncertainties of such magnitude, it went through the House on 18 October by a safe margin of 239 to 164. Two days later, however, it was sidetracked by the Senate Appropriations Committee, 16 to 4. So, at this point, no one has even the dimmest notion of the financial status of vast portions of the U.S. Government. In self-defense, or perhaps retaliation, the White House has instructed federal agencies to postpone every bit of postponable spending, and the results, in the government of the richest nation of all time, are wondrous to behold. Some federal agencies have put a blanket freeze on virtually all travel by their officials, and, in some federal laboratories, researchers trying to make routine purchases of laboratory materials have been told that not a cent for supplies may go out until further notice.

There are those who hold that it is reasonable to expect that, sooner or later, in one fashion or another, the legislative turbulence will subside and the financial uncertainty will be dispelled. There is no doubt, of course, that eventually the storm will be over, if for no other reason than plain weariness, which is in ample evidence at this prolonged stage of the congressional session. But the issue isn't whether the present chaos will end; rather, it is what will be left when it ends, and, on this point, the evidence is not pleasant.

Though House Joint Resolution 888 is now down and out in the Senate, the economizing sentiments that are incorporated into it still thrive full force in the House; and they are not without a substantial number of adherents in the Senate, where, prior to rejection of the House resolution, a somewhat qualified 5-percent across-the-board cut in federal spending failed by a 10-to-10 vote in the Appropriations Committee.

Thus, at this late stage of the congressional session, it is safe to assume that some big chunks of federal spending are likely to be excised before Congress goes home, and this brings us to the resolution that passed the House but was turned down in the Senate. The resolution's final section, "Research and Development," states that its purpose "is to save money and manpower at a time of fiscal crisis, force a reevaluation of research projects, the resetting of priorities, the deferral of projects not essential at this time, and the elimination of marginal projects." Noting that federal support of research and development has risen from an estimated $74 million in 1940 to $17.5 billion in the current budget, the resolution does not specify what should be cut. It does specify, however, that military-related R&D is not to be affected beyond previous congressional actions, and it then goes on to state: "It can be assumed, with reasonable assurance, that as a result of this section additional obligational authority will be withheld to the extent of about $325,000,000. House or Congressional action to date on the appropriations bills reflect reductions of just over $1 billion in obligational authority in R&D areas [This refers to earlier reductions, principally in the NASA budget for fiscal 1968]. Thus, if House actions can be sustained, and this section is applied, total reductions in research and development will approximate $1,325,000,000."

Just where this vast sum would come from is not clear. When one member sought to take it out of the supersonic transport program, he drew little support; when another expressed concern that money might be taken from the Veterans Administration, George Mahon, chairman of the House Appropriations Subcommittee, replied, "In respect to medical research, I doubt if the Director of the Veterans Administration knows exactly what would result on this point and, frankly, I do not know with such precision and assurance myself. But there is a reduction provided for, across the board, in research. We have gone in research funds since World War II from the sum of $800 million a year to over $17 billion a year. There is some effort in this resolution to make some reduction. But if the work of these people involves the safety of life and the protection of property, that could be excepted. That is a question of fact to be determined on a case-by-case basis." When other specific items came up in debate, similar sympathy for exceptions were offered, and, of course, this was especially the case when Representative Silvio O. Conte (R–Mass.) proposed that the House cut back on the support of its own staff. "We could easily do away with some of the House of Representatives' patronage by taking the elevator operators out of the many automatic elevators we have in the House of Representatives," he said. But Conte's proposal drew no support.

All of which leaves the question of where the cuts are to be made, if Congress insists on cutting. And the answer, of course, is that, if the traditional political processes apply—and there is no reason to expect that they will not—the knife will go deepest into the least-armored parts of the budget. And in the past, it should be recalled—especially while there is time before the blood flows—basic research and related activities have thrived in Congress on good will rather than on political strength. At present, however, there is very little good will in evidence in the U.S. Congress. Even less in evidence is any disposition on the part of the leaders of the American scientific community to speak out aggressively on the consequences that might arise from severe financial disruptions in government support of scientific research. In private they paint gloomy scenes, and in the relative privacy of congressional hearings they occasionally bare their souls, but if they are as concerned as they claim to be, it is curious that they are not shouting their concerns to the American public. Those in federal employ are, of course, bound by the rules of being a good team player. But there are scientific institutions outside the government that command the respect of the public. Yet, nothing is heard from them.—D. S. GREENBERG