distinguished Soviet physicist Peter Kapitza spoke out against the intrusion of Marxist dialectics into science (with special reference to biology) and the harm which its uncritical acceptance had done to Soviet science. Kapitza's voice did not carry the full weight of the Soviet Academy of Sciences, but it was indicative of the fact that responsible Soviet scientists were becoming increasingly concerned about the extent to which Lysenkoism had damaged Soviet biology, the plant-breeding program, and agriculture in general.

It remained for the president of the Soviet Academy of Sciences, M. D. Keldysh, to deliver the *coup de grâce* several months ago when he announced the removal of Lysenko as director of the Genetics Institute, and stated: "The exclusive position held by Academician Lysenko must not continue. His theories must be submitted to free discussion and normal verification. If we create in biology the same normal scientific atmosphere that exists in other fields, we will exclude any possibility of repeating the bad situation we witnessed in the past." Keldysh's action and forthright statement suggest that the new political leadership in the Soviet Union will not permit Communist fanaticism to injure the best scientific interests of the Soviet state.

An Instructive Story

The rise and fall of Lysenkoism is a sad and instructive story. The rise of Lysenko was due to an unfortunate combination of circumstances: the existence of the philosophical dogma of the Soviet state—to wit, dialectical materialism—with its strong convictions concerning human heredity; the existence of a strong national tradition in empirical plant breeding, founded on the Lamarckian approach to genetics (Michurinism); the desire for rapid transformation of Soviet agriculture; and, finally, the presence of a powerful dictator, Stalin, able and willing to throw the full resources of his government behind a specific ideological position. To this potent brew was added an extraordinarily ambitious and ruthless scientific adventurer named Lysenko.

The final downfall of Lysenko can be attributed to a continuous relaxation of all these factors since the death of Stalin. The political and economic tenets of Marxism have been increasingly separated from dialectical materialism as the supreme arbiter of all scientific concepts and procedures; Michurinism has been placed in its proper historical perspective; it has been recognized that the neglect of classical genetics has been in good part responsible for the lack of productivity of Soviet, as compared to Western, agriculture; and finally Khrushchev and, to an even greater degree, Brezhnev and Kosygin have been more reluctant than Stalin was to use the authority of the government to decide questions of scientific doctrine.

The tragedy of Lysenkoism is that so much precious time has been lost for the biological sciences in the U.S.S.R. The consolation is that once the Soviet Union takes a major decision to develop a scientific area (as it did several years ago in mathematical economics and econometrics), lavish provision is made for laboratories and equipment, Western ideas are widely introduced into the educational system, and no effort is spared to attract talented persons into the new field. The recent removal of Lysenko implies unequivocally that such a major decision has been taken with regard to molecular biology and the biological sciences generally. We can only applaud this decision and state our earnest hope that Soviet biologists will soon take their rightful place on one of the great frontiers of modern science. And without much prescience we can predict that at the next International Genetics Congress, to be held in Tokyo in 1968, the non-Lysenkoists will be well represented in the Russian delegation!

News and Comment

Money for Research: Congress and Scientists Have Different Ideas On How the System Should Operate

From the public utterances of the leaders of the scientific community, it can be surmised that when they contemplate a utopian relationship between science and government they see something like this:

At the apex of the federal involvement with basic research is the National Science Foundation, endowed with ample wealth (say, about $530 million for the current fiscal year, and an annual increase of at least 15 percent). The function of the Foundation is to assure unquibbling and generous support for a large proportion of the nation's creative basic researchers. It provides money for research facilities, and with fellowships and other devices it brings promising recruits into the scientific professions. In addition, to giving the public a better understanding of science and to help develop a farm system for the professions, the Foundation assumes responsibility for teaching some science to the couple of hundred thousand persons employed as high school science teachers. As the utopian design has it, political interference and social and economic considerations are nil in the Foundation's operations. The well-being of science —as determined by scientists—governs the money decisions. The Foundation is an organization exclusively of and for scientists, supported by a public that at least appreciates science even if it doesn't understand it.

Nearby in the utopian table of organization is the National Institutes of Health, operating in a fashion somewhat similar to NSF, but limiting itself to health-related research and, of necessity, taking into account public pressures to come up with cures. And at the lower levels of sicentific purity

are the so-called mission-oriented agencies, principally the Atomic Energy Commission, the space agency, the Department of Agriculture, and the Department of Defense. As far as research matters are concerned, the main objective of these agencies is the development of hardware, but they also put substantial sums into basic research. According to the utopian plan, their motivation for this investment is the realization that they can better perform their missions by keeping abreast of the latest fundamental findings. Also, it is useful to have a diversity of support for basic research as a hedge against political misfortune striking any one part of the system.

Still lower down is the U.S. Office of Education, passing out enormous sums of money to put at least some sort of science into every school in the land. In the utopian design, this is a worth-while investment once everything else has been attended to.

A Self-Adjusting System

The whole system is bound by an automatically applied self-correction principle—namely, that, whenever nonscientific motivations cause a mission-oriented agency to reduce its support for basic research, NSF automatically receives an increase in funds to deal with the problem. In the utopian metaphor, NSF is not only the "keystone" of the basic research system; it is also the "balance wheel." It supports areas neglected by other agencies, and it makes certain that whims, fads, and political exigencies do not distort the well-being of science.

In the utopian vision, the system would work this way because Congress would at least have been persuaded, as the Executive is now almost completely persuaded, that only the scientific community itself is competent to judge how much money should be spent on research. And this judgment would be governed by two simple criteria: (i) no competent scientist or promising science student shall lack support, and (ii) it is in the national interest to exploit fully and rapidly the nation's potential for conducting scientific research.

Now, a casual and not necessarily cynical observer might say that if this is the utopia desired by the statesmen of science, they should recognize that it has arrived. In a sense this is true, and only a particularly perverse sort of ingrate could deny that the federal government has been extraordinarily benevolent toward scientific research and related activities. Nevertheless, within the context of an affluence that is the envy of scientists around the world, the American scientific community is beset by a sense of misunderstanding and troubles that are real and painful, even if the scientists of other ages or nations would happily settle for them.

Consider, for example, what happened earlier this month to the budget of the "keystone and balance wheel," NSF. The administration's science advisers persuaded the White House that NSF's growth should be accelerated to compensate for a decline in basic-research spending by the mission-oriented agencies. This was an extremely tight budget year, but the Great Society couldn't say no to science. Therefore, NSF was authorized to go to Congress in quest of $530 million for the fiscal year that began 1 July—an increase of $109.6 million over its previous budget. The House, which has traditionally been the tighter of the two chambers on NSF funds, cut out $50 million and voted a budget of $480 million. It then went on to do something that might easily cause crepe to be hung at the Cosmos Club: the politicians specified how the scientists were to use large portions of the budget. Despite the cuts, the House decreed, the Foundation was not to reduce the $40 million originally budgeted for the Science Development Program—a congressional favorite designed to spread the wealth to less affluent institutions; it was further specified that $43 million ($5 million more than the Foundation had planned) was to be spent for training secondary school teachers of science and mathematics; and no more than 10 percent of the Foundation's fellowships were to be granted to applicants from any one state. Thus, by reducing the budget $50 million and earmarking the use of $83 million, the House, in effect, was telling NSF to reduce its ambitions for other programs. In a sense, NSF still wouldn't be coming out too badly, since the annual budget, in the House version, would rise $60.6 million above that of the previous year. But to absorb the difference between the increase that was voted and the $109.6-million increase that was sought, NSF decided that it would have to cut back on various plans, mainly on its projected expansion of support for basic research grants—an area that had remained relatively static in recent years. NSF had hoped to raise project grants from a total of $120 million to $191 million. If the House cuts remained in effect, NSF concluded, project grants would have to be budgeted at $154 million, a figure which, relatively speaking, isn't as large as it may seem, since NSF estimates that the cost per scientist annually rises 5 to 7 percent.

As the legislative money process goes, NSF then went to the Senate to seek the original budget, as well as elimination of the restrictions on the use of the budget. With two exceptions, throughout NSF's 15-year history the Senate had always exceeded the amounts voted by the House and it had never voted less. Furthermore, it had usually sympathized with the Foundation's desire to be free of congressional directives on use of funds. This year, however, the Senate appropriations committee voted to go along with the House cuts, and, in fact, even cut the House version $1000—which was the sum the administration planned to take from the NSF budget to finance the President's Committee on Equal Opportunity. (The Senate committee also snipped these funds from all other agencies, an act which can be interpreted as a slap at the administration's civil rights efforts or an indication of displeasure at the backdoor method of financing these efforts.) The Senate committee offered NSF some consolation by voting that the Foundation would have to spend no more than $37.6 million for the high school teacher programs; and it recommended deletion of the 10-percent rule on distribution of fellowships; otherwise it went along with the House.

Reversal Unlikely

The differences between the two houses will be resolved in conference, probably later this month, but it is not likely that the outcome will match NSF's desires.

Now, while the appropriations subcommittees that deal with NSF were performing this surgery on the keystone and balance wheel of the system, the House subcommittee that handles Defense appropriations was whacking away at military support of basic research. The Defense budget is so vast that it is difficult to ascertain just how much the military put into what comes under the heading of "basic research," but, according to NSF, the Defense Department spent a total of $208 million on basic research in fiscal 1964; about $100 million of this sum went to

educational institutions, including federal-contract research centers operated by universities. The House committee report recommended that a total of $46.9 million be cut from the military sciences budget—and it specifically directed the cuts at basic research. "The Committee," it reported, "fully understands that the 'military sciences' program is expected to provide foundational work for weapons systems and military equipment of the future. However, the Committee points out that such foundational work is supported not only by the Department of Defense but by many other departments and agencies of the federal government as well as by industry and by colleges and universities. There is a broad national base of support for scientific and technical investigations. The advancement of scientific knowledge is not dependent upon a continuing increase in the financial support of such efforts by funds appropriated to the Department of Defense. . . . In fact, considering the huge amounts of resources being devoted to the space program, the increasing amounts of research being funded in other Government agencies, and the effort being supported by the private sector of the economy, there seems to be less and less need to increase each year, or even to continue at the present level, amounts appropriated to the Department of Defense to support basic research efforts."

While the leaders of the scientific community argue that an expansion of support for research can only prove beneficial, the committee took a different view. "Continued yearly increases in the Department of Defense efforts in this area could detract from, rather than add to, the sum total of national scientific knowledge to the extent that excessive competition for the interest of capable people, and the frequent job changes which result therefrom, create unnecessary instability in vital programs. There is also reason to believe that research effort, like other forms of human enterprise, is subject to the law of diminishing returns to the extent that it may well be possible at this time, by means of a critical selection process, to curtail or eliminate many lines of investigation already pursued too long without significant or useful results or contributions."

Apparently taking a cue from a theme that is much in the air—namely, that emphasis on research can be injurious to teaching—the committee added: "a retrenchment might, so far as colleges and universities are concerned, have a corollary benefit of making the best faculty more available for the purpose of teaching students." And the committee then endorsed another popular theme by stating that "there is also some evidence that the high level of support of basic work is producing scientific and technical information at such a high rate that it cannot be effectively digested, interpreted, disseminated, or put to useful purpose."

There may be some question about the content of the utopian dreams of the leaders of the scientific community, but their nightmares are undoubtedly taken directly from appropriations reports.—D. S. GREENBERG

Curriculum Reform: Success Hasn't Spoiled NSF Program, But Biology Study's Status Reflects Problems

The curriculum reform movement, largely underwritten by the National Science Foundation, has wrought remarkable changes in what is taught in classes in physics, mathematics, chemistry, and biology in American high schools. These science improvement projects, as NSF calls them, have been highly imaginative and effective ventures in science education, but now the agency appears to be passing through a season of irresolution over what to do next.

NSF is not thinking of abandoning the field. On the contrary, the agency is supporting an increasing number of projects ranging from elementary school to college level. The question bothering NSF concerns the future of the groups which have substantially completed their original objective of fashioning new courses for high school students. In oversimplified terms the NSF's dilemma is one of deciding whether in a specific project it should prime the pump or sponsor a long-term irrigation project.

Formulation of such policy is not an easy task. The major course improvement projects are all based on the same principle—the collaboration with school teachers of able university and college faculty interested in curriculum reform, and a process of classroom testing and revision (*Science*, 8 May 1964, p. 642). But the groups are organized differently, operate under differing managerial arrangements, and deal with different situations in their subject fields.

First into the schools with a course prepared by an NSF-supported group was the Physical Sciences Study Committee (PSSC), whose textbook and accompanying materials became generally available in the 1962–63 school year. NSF does not deal directly with PSSC. The grantee is Educational Services Incorporated, at Watertown, Massachusetts, a nonprofit organization which was originally formed to handle administrative and financial details and produce films for PSSC and which now administers a number of other curriculum and educational research projects as well.

The School Mathematics Study Group (SMSG), which has operated under the wings of Yale and Stanford, is the largest of the math revision projects. SMSG has devoted its main efforts to developing sample text material for grades 7 through 12. Paperback versions are available, but the intent of the group has been to provide models which commercial publishers could draw on. It is understood that the SMSG policy is being reappraised because the degree of emulation by commercial publishers has been considerably less than was hoped for.

BSCS Productivity

At the other extreme, probably, in terms of attitude toward preparation of materials is the Biological Sciences Curriculum Study (BSCS). Activated in 1959, BSCS has produced a remarkable flow of materials, notably three versions of a modern high school biology course, with laboratory manuals and teachers' guides to go with them. While publication rights have been negotiated with commercial publishers on this and other material, including films, BSCS has insisted on maintaining tight control over text and illustrations and on such things as revision arrangements.

BSCS has built up considerable momentum and is involved in, or contemplating, a number of projects which would normally extend into the future. BSCS, therefore, is probably the most heavily affected by the current NSF examination of its relations with established groups.

The BSCS situation is clouded by a major management problem. BSCS was originally established, with NSF funds, under the aegis of the American Institute of Biological Sciences, the major national organization of biology's scholarly societies. In 1963 the rapidly growing AIBS was put under sanctions by NSF for misuse of NSF funds (*Science*, 25 January 1963, p. 317). Under a tri-