

10. H. K. Hartline, *Amer. J. Physiol.* **121**, 400 (1968), *ibid.* **130**, 690 (1940); *ibid.*, p. 700.
11. ———, *Harvey Lect.* **37**, 39 (1941–1942).
12. Examples from this extensive and rapidly growing field: S. W. Kuffler, *J. Neurophysiol.* **16**, 37 (1953); H. B. Barlow, *J. Physiol.* **119**, 69 (1953); H. G. Wagner, E. F. MacNichol, Jr., M. L. Wolbarsht, *J. Gen. Physiol.* **43**, 45 (1960); G. Baumgartner, *Neurophysiologie und Psychophysik des visuellen Systems*, R. Jung and H. Kornhuber, Eds. (Springer, Berlin, 1961), p. 45; G. A. Horridge, J. H. Scholes, S. Shaw, J. P. Tunstall, in *The Physiology of the Insect Nervous System*, J. E. Treherne and J. W. L. Beament, Eds. (Academic Press New York, 1965); C. A. G. Wiersma and Y. Yamaguchi, *J. Comp. Neurol.* **128**, 333 (1966). See also (26); see Granit (8) for review of his contributions and references.
13. H. K. Hartline, *Fed. Proc.* **8**, 69 (1949) (abstr.).
14. ———, H. G. Wagner, F. Ratliff, *J. Gen. Physiol.* **39**, 651 (1956).
15. Reviews of this work, in detail, may be found in (16) and (20).
16. H. K. Hartline, F. Ratliff, W. H. Miller, in *Nervous Inhibition*, E. Florey, Ed. (Pergamon Press, New York, 1961), p. 241.
17. F. Ratliff, H. K. Hartline, W. H. Miller, *J. Opt. Soc. Amer.* **53**, 110 (1963).
18. R. L. Purple, thesis, Rockefeller Institute, New York (1964).
19. ——— and F. A. Dodge, *Cold Spring Harbor Symp. Quant. Biol.* **30**, 529 (1965).
20. F. Ratliff, *Mach Bands: Quantitative Studies on Neural Networks in the Retina* (Holden-Day, San Francisco, 1965).
21. H. K. Hartline and F. Ratliff, *J. Gen. Physiol.* **40**, 357 (1957).
22. ———, *ibid.* **41**, 1049 (1958). See also H. K. Hartline, F. Ratliff, W. H. Miller (16) for restriction on the equations.
23. R. B. Barlow, thesis, Rockefeller Univ., New York (1967).
24. W. Reichardt and G. MacGinitie, *Kybernetik* **1**, 155 (1962); K. Kirschfeld and W. Reichardt, *ibid.* **2**, 43 (1964).
25. G. von Békésy, *Sensory Inhibition* (Princeton Univ. Press, Princeton, N.J., 1967).
26. J. Y. Lettvin, H. R. Maturana, W. S. McCulloch, W. H. Pitts, *Proc. Inst. Radio. Eng.* **47**, 1940 (1959); H. R. Maturana, J. Y. Lettvin, W. S. McCulloch, W. H. Pitts, *J. Gen. Physiol.* **43**, 129 (1960); U. Grüsser-Cornehl, O.-J. Grüsser, T. H. Bullock, *Science* **141**, 820 (1963); H. B. Barlow, R. M. Hill, W. R. Levick, *J. Physiol.* **173**, 377 (1964); H. B. Barlow and W. R. Levick, *ibid.* **178**, 477 (1965). For discussion of these and related papers see Ratliff (20), chapter 4.
27. Recent papers on the dynamics of the inhibitory interaction in *Limulus* are: F. Ratliff, H. K. Hartline, D. Lange, in *The Functional Organization of the Compound Eye*, C. G. Bernhard, Ed. (Pergamon Press, Oxford, 1966), p. 399; D. Lange, H. K. Hartline, F. Ratliff, *ibid.*, p. 425; see also (16, 17, 35).
28. F. Ratliff, in *Sensory Communication*, W. A. Rosenblith, Ed. (MIT Press and Wiley, New York, 1961), p. 183.
29. T. Tomita, *J. Neurophysiol.* **21**, 419 (1958).
30. F. A. Dodge, Jr., B. W. Knight, J. Toyoda, in preparation.
31. See discussion by R. Granit (8) for relation of "off" responses to post-inhibitory rebound.
32. F. Ratliff, B. W. Knight, J. Toyoda, H. K. Hartline, *Science* **158**, 392 (1967).
33. C. F. Stevens, thesis, Rockefeller Institute, New York (1964).
34. R. L. Purple and F. A. Dodge, Jr., in *The Functional Organization of the Compound Eye*, C. G. Bernhard, Ed. (Pergamon Press, Oxford, 1966), pp. 451–464.
35. D. Lange, H. K. Hartline, F. Ratliff, *Ann. N.Y. Acad. Sci.* **128**, 955 (1966).
36. F. Ratliff and C. G. Mueller, *Science* **126**, 840 (1957).
37. F. Ratliff and H. K. Hartline, *J. Gen. Physiol.* **42**, 1241 (1959).
38. D. Lange, thesis, Rockefeller Univ., New York (1965).

NEWS AND COMMENT

Congress and the Military: Many Members Take a Harder Look

In the intense cold-war atmosphere of the 1950's the United States developed a large semipermanent, high-technology military establishment which has enjoyed truly generous and easy treatment at the hands of the U.S. Congress. The relationship of the congressional committees on military affairs to the military has been less that of an overseer than that of a partner eager to press on with the enterprise. Funds have been laid on by the tens of billions, and when questions have been asked, as they were during the "bomber gap" and "missile gap" controversies, they usually have led to greater military spending and faster buildups of sophisticated weapons systems.

However, the Vietnam war, increasingly regarded as a quagmire by congressmen and the public at large, recently has caused many senators and representatives to take a more skeptical view of the military than they have ever taken before. Also, the huge cost overruns of weapons programs, plus the disappointing performance of many new systems, has added to this erosion of congressional confidence. The current skepticism about the military is contributing to the development—especially in the Senate—of a new

attitude, which holds that defense budgets and programs should undergo congressional scrutiny no less rigorous than other federal budgets and programs.

Bland though this prescription may seem, it is radical in terms of past congressional practice. The defense budget falls principally within the purview of the Senate and House committees on armed services and of the appropriations committees and their defense subcommittees. These committees—led by such men as Richard B. Russell of Georgia, chairman of the Senate Appropriations Committee, and John Stennis of Mississippi, chairman of the Senate Armed Services Committee—clearly have operated on the assumption that the country must prepare for the worst conceivable enemy threat, and that, if the Congress should err, let it be in giving the military too much rather than too little.

This is an attitude that may come naturally to anyone who, year after year, constantly hears top-secret testimony about real or suspected threats. Understandably, the members of these committees, seldom having much technical background themselves, have often listened in awe as Pentagon ex-

perts have discussed U.S. and Soviet advances in sophisticated weaponry. Usually they seem to have felt that to question "military judgment" in these matters would be beyond their competence. Alarming events such as the Berlin crisis in 1961 and the Cuban missile crisis the following year no doubt have encouraged them in this acquiescent spirit.

In 1962, Representative Carl Vinson of Georgia, who is now retired but who was then chairman of the House Armed Services Committee, observed in a letter to a colleague: "I personally am reluctant, and indeed refuse, to substitute my judgment on a military matter for the judgment of those so much more qualified to make decisions of a military nature." So the job of members of the committees on military affairs, as earnest track attendants in the arms race, has been to rush out during pit stops and fuel the war machine with money.

Putting their trust in the Pentagon, the military committees have paid little attention to the substantial and growing body of literature on arms control. Nor has any administration, Democrat or Republican, pressed hard and persistently to have the committees consider the arms-control implications of weapons deployment decisions. Former Secretary of Defense Robert McNamara—himself one of the defense intellectuals—sometimes spoke out against the arms race, saying that to seek national security through such competition was illusory. McNamara's position was ambiguous, however.

In the speech containing his most memorable plea for control of the arms race (given in San Francisco in 1967) he announced plans to deploy the anti-ballistic missile (ABM). Moreover, in his appearances before the military committees, McNamara repeatedly emphasized the wide edge in missile deployment that the United States had gained over the Soviet Union during the Kennedy and Johnson administrations. In so doing, he was telling the committees what they wanted to hear, and was doing his bit to reinforce the "nuclear superiority" syndrome. Even so, his successful efforts to kill some of the more clearly dubious weapons projects, such as the B-70 bomber program, were resented by many committee members as unwarranted and dangerous civilian interference in decisions that should be left to the military.

The military committees have also been encouraged in their freehandedness by the fact that their members, especially the more senior, have been wooed, flattered, and deferred to by the military as honored patrons. Further, a number of committee members, including three of the chairmen, represent areas that have lush military and defense-industry payrolls. This circumstance is invariably cited in support of the "military-industrial complex" thesis, and, while it is perhaps sometimes overstressed, it cannot be ignored.

The Big Stick

Another factor not to be overlooked is that the military committees strongly attract senators and representatives whose approach to international relations emphasizes the big stick. Recently, when the Nuclear Nonproliferation Treaty came up for Senate ratification, nearly half the members of the Armed Services Committee voted against it, partly because they were less afraid of the spread of nuclear weapons than of the prospect that some worthy U.S. allies might be without such weapons. Within the committee's ranks are such noted cold-war hardliners as Strom Thurmond of South Carolina and Barry Goldwater of Arizona.

Except for their implicit trust in the military, the military committees might have been expected, out of ordinary prudence, to devise some kind of adversary system and call regularly upon leaders of the Department of Defense and the services to defend weapons programs against the criticisms of independent defense and arms-control spe-

cialists from the universities and elsewhere. But this they have not done. The usual committee practice has been to invite testimony only from the military establishment.

Further, under these circumstances the military committees have developed a strong tradition of bipartisanship. By and large this has meant that committee reports, sometimes recommending billions of dollars' worth of new weapons, have gone to the floor of the House and Senate with the general support of committee members, Republicans and Democrats alike.

There have been dissidents, as in the case of several relatively junior members of the House Armed Services Committee who opposed the majority on such issues as the B-70 and the ABM; but too much nonconformity has made one a candidate for the leper colony. There also have been efforts by some nonmembers of the military committees to make percentage cuts in the military budget or to kill certain weapons proposals; but these too have been unavailing, although the near-miss last year of an attempt by Senator John Sherman Cooper of Kentucky to do in the ABM may have given the Pentagon a foretaste of bad trouble.

In general, most senators and representatives seem to have trusted the military committees and assumed that they were on top of defense problems. Some have suspected the contrary but have been unwilling to run the political risk of possibly acquiring an "antimilitary" label. Charles L. Schultz, former director of the U.S. Bureau of Budget and now a professor at the University of Maryland, recently observed: "The general attitude of the American people is that if you wrap it in a flag and call it 'national security,' you can't question it." The members of Congress who have regularly disregarded such assessments have come mostly from districts where the peace movement is strong, or from areas which, for a variety of cultural and historical reasons, produce such maverick politicians as Senator William Proxmire of Wisconsin, a persistent Pentagon critic.

But now, with the Vietnam war still dragging on, with the defense budget at \$83 billion, and with ABM's, MIRV's (missiles with multiple warheads), and other costly new systems warming up for the arms race, the attitude in Congress is changing. Many senators and a growing number of representatives have become convinced that Congress must raise a restraining hand. "The Senate

as a whole has a responsibility to look at the requests of the military and to be more gimlet-eyed and less open-handed than in the past," Senator Mike Mansfield, the democratic majority leader, told an interviewer from *Science* recently. "I think this will be done this year, and it is long overdue. No longer will it be simply a matter of 'Ask and you shall receive'."

House Majority Leader Carl Albert of Oklahoma, on the other hand, sees little truth in allegations that the military committees have failed in their oversight of the Pentagon. He believes that the House, when it acts this year on the military budget, will give President Nixon and the Pentagon essentially what they have asked for, including the ABM. Yet, while Albert probably is right in so predicting, there nevertheless are stirrings within the House which may, in time, lead to major changes in that body's treatment of the military.

Challenge in the Senate

Clearly, though, it is in the Senate that the old established practices in handling defense matters are being overturned. Consider the following.

- The Senate Foreign Relations Committee, which for more than 2 years has been criticizing U.S. policy in Vietnam, is now attacking the ABM program with crusading vigor. Its subcommittee on disarmament, chaired by Albert Gore of Tennessee, already has heard testimony from about a dozen academic scientists and arms-control specialists—people of precisely the kind the military committees have largely ignored all these years. Nearly all of these witnesses (*Science*, 21 March) have spoken against ABM deployment.

Secretary of Defense Melvin R. Laird and Deputy Secretary David Packard, also called as witnesses, have faced hostile cross-examination. In his testimony Packard identified Wolfgang Panofsky, a Stanford physicist, as one of the university scientists whom he had consulted about the ABM. But Panofsky later said that his only discussion with Packard was during a chance encounter in the San Francisco airport; further, he told the subcommittee that plans for the ABM deployment were unsound. When Laird testified that the Soviets were establishing a "first-strike" capability by building a large force of SS-9 missiles, Senator J. W. Fulbright of Arkansas, chairman of Foreign Relations, accused him of

NEWS IN BRIEF

● **NUCLEAR POWER STATION IN INDIA:** India's first commercial nuclear power station, located about 60 miles north of Bombay near Tarapur, is reported to be generating electrical power to the western states of Gujarat and Maharashtra. The power plant, estimated to cost about \$114 million, is being built from money borrowed in part from the U.S. government. The Agency for International Development is loaning about \$75 million, and the Indian government is investing about \$40 million in the project. The U.S. Atomic Energy Commission has agreed to supply about \$100 million in enriched uranium to the power station over a 30-year period. The plant, which has a total capacity of nearly 400,000 kilowatts, is said to be one of the first commercial nuclear power stations in Asia.

● **STATION BANS CIGARETTE ADVERTISING:** For the first time in history, a major public broadcasting station has officially agreed to ban cigarette advertising. In a letter to the chairman of the Federal Communications Commission (FCC), the head of the Post-Newsweek television and radio stations has said that Post-Newsweek will ban new cigarette advertising after 1 June 1969. Station officials say that the action results from a February FCC proposal, which recommends that radio and television cigarette advertising be barred for public health reasons. It is estimated that Post-Newsweek's income from cigarette advertising in 1968 was about \$700,000. Post-Newsweek stations are affiliated with CBS and owned by the Washington Post Co. in Washington, D.C.

● **HOUSE GOVERNMENT OPERATIONS REORGANIZES:** House Government Operations has abolished its Research and Technical Problems subcommittee, chaired by Representative Henry S. Reuss (D-Wis.), who has accepted the chairmanship of another subcommittee, Conservation and Natural Resources. In disbanding the subcommittee, Government Operations has cut the only subcommittee which handled broad, interagency research matters. The committee plans to reassign some of its functions to other subcommittees which have individual agencies under their jurisdiction. Capitol Hill

sources say that the new Reuss subcommittee will conduct an in-depth study of government pollution research and development activities. A special studies subcommittee, chaired by Representative John S. Monagan (D-Conn.) is expected to handle some of the functions of the disbanded subcommittee. The Government Operations Committee's organizational change, which resulted in a reduction in the total number of its subcommittees from 11 to 8, follows criticism last year by the House Administration Committee, which charged that Government Operations had too many subcommittees, some of which were relatively inactive and expensive to operate.

● **PLANNING AHEAD:** A group concerned about the harmful effects to the earth of pollution, the depletion of resources, overpopulation, and wars of mass destruction is preparing a document on a desirable and attainable system of world order for the 1990's. The policy group, known as the North American Group, has such distinguished members as natural scientists George Kistiakowsky of Harvard, Joshua Lederberg of Stanford, Lyman Spitzer of Princeton; social scientists Kenneth Boulding of the University of Colorado, Amitai Etzioni of the Bureau of Social Science Research in Washington, Harold Lasswell of Yale; and former Defense Department officials, Robert McNamara and James Gavin. North American Group was established in 1968 as part of an international group, the World Order Models Project, which is co-sponsored by the World Law Fund in New York and the Woodrow Wilson School at Princeton. The group, which has nearly 40 members, plans to have its proposal for a world order ready by 1 July 1970.

● **"RADIOACTIVE DAISY":** Scientists at the University of Minnesota last week staged a series of discussions called "Radioactive Daisy," patterned after the 4 March research stoppage at M.I.T. They met to discuss national scientific priorities, the anti-ballistic missile (ABM) system, and "currently under-funded" government research areas, such as pollution control, public health, and urban housing and transportation. An estimated 750 persons were involved in the 2-day meeting.

using scare tactics. Senator Stuart Symington of Missouri pointedly observed that, a few months earlier, another defense official had described the SS-9 as a "second-strike" or retaliatory weapon.

● A new foreign relations subcommittee, on U.S. security commitments abroad, has been set up under Senator Symington and instructed to explore such matters as military aid, bases and troop deployments overseas, and their effect on foreign policy. This, too, promises to be an aggressive public inquiry once preliminary staff work is completed and hearings get under way. Symington, a former secretary of the Air Force and the only member of foreign relations who is also on the Armed Services Committee, describes himself as part hawk, part dove.

● The Armed Services Committee, criticized in last year's ABM debate for not inviting independent scientific witnesses to its hearings, now seems disposed to alter its procedures. Chairman Stennis has promised that, in considering the ABM issue this year, the committee will hear testimony from independent scientists. This step is regarded as overdue even by some members of the Armed Services Committee. Indeed, if the committee is to hold its own in debate when the Senate takes up the ABM question sometime hence, it had best be boning up on the subject. The Foreign Relations Committee is not the only rival claimant to expertise on the ABM. Senator Edward M. Kennedy of Massachusetts has his own experts (Jerome Wiesner of M.I.T., among others) preparing an anti-ABM treatise.

● The heir apparent to the chairmanship of the Appropriations Committee is Senator Allen J. Ellender of Louisiana, who has long been denouncing the Pentagon as a spendthrift organization committed to policies impeding progress toward world peace. He views wryly the interest members of the Foreign Relations Committee are now showing in military questions. "I've got a lot of followers now," he told a recent interviewer, shaking his finger for emphasis. Though Senator Russell, the chairman of Appropriations, remains active in Senate affairs, he has told his constituents that he is undergoing cobalt treatment for a lung tumor which he says is probably malignant.

In the House, while a tightening up on the military may not be imminent, there are at least these indications of change:

● The Democratic Study Group (DSG), in which 100 or more House

members are active, recently has set up a task force on international affairs and defense policy and named Lucien N. Nedzi of Detroit, a dissident member of the Armed Services Committee, as one of its leaders. The first task force study will be on the ABM. According to Donald M. Fraser of Minneapolis, DSG chairman, sentiment within the DSG is running strongly against ABM deployment.

The DSG study is one of several efforts aimed at giving House members new perspectives on defense issues and freeing their minds of the shibboleths of the past. Thirty-eight House members and 14 senators recently sponsored a 2-day conference in which a number of academicians participated, including Schultz of the University of Maryland, Herbert York (a former director of Defense Research and Engineering) of the University of California at San Diego, and John Kenneth Galbraith of Harvard. In Galbraith's view, members of Congress who try to hold down defense spending and restrain the arms race need not fear repudiation at the polls; for, he said, such is the current state of public opinion that the Pentagon's congressional "sycophants and second lieutenants" are the ones most likely to lose out with the voters.

Whether or not Galbraith is correct, various members of Congress are promoting activities at the grass roots that aim to prove him a prophet. For example, some of Senator Kennedy's political allies are engaged in a New York-based effort to encourage formation of anti-ABM groups, especially among the young who last year sup-

ported senators Eugene McCarthy of Minnesota and the late Robert F. Kennedy of New York in the presidential primaries.

• The Foreign Affairs Committee has recently activated a long-dormant subcommittee on national security policy, a group in some respects analogous to the new Symington subcommittee in the Senate. In its first hearings witnesses such as Wiesner, Herman Kahn of the Hudson Institute, and George B. Kistiakowsky of Harvard testified on defense technology, including possible trends of the future. The subcommittee chairman, Clement J. Zablocki of Milwaukee, has generally supported U.S. policies in Vietnam, and he favors current plans for ABM deployment. Nevertheless, in an interview with *Science*, Zablocki said the committees on military affairs have been doing an inadequate job of overseeing the military. He indicated that, for one thing, greater attention should be given problems of arms control.

In sum, many members of Congress, in both House and Senate, and including some hawks as well as doves, have finally come to believe that the defense budget and programs are matters too costly and serious to be left to the Pentagon to decide. Attempts to build neat jurisdictional fences have produced results sometimes bordering on the ludicrous. For example, the Senate Armed Services Committee has held hearings on the "military implications of the treaty on nonproliferation of nuclear weapons," while the Foreign Relations Committee has taken up the "foreign policy implications of the anti-

ballistic missile system." Increasingly, senators and representatives are realizing that defense questions often are partly political in nature and fall as much within their competence as within that of the military.

Of course, a mere willingness on the part of members of Congress to undertake a more rigorous review of military budgets and proposals does not ensure success of the undertaking. For instance, to look at the situation in the Senate, there is no clear evidence yet that the doves of the Foreign Relations Committee are doing much more than exchanging propaganda blows with the hawks of the Pentagon and the Armed Services Committee.

In order for the various congressional committees to cope successfully with military questions, they may have to go to great lengths to improve their staff work and to anticipate key issues with special studies in which all policy questions are delineated and all relevant viewpoints are set forth. In fact Congress may have to establish a special new staff of defense consultants, in the Legislative Reference Service of the Library of Congress or elsewhere; or it may want to go still further—establishing a special commission of nongovernmental advisers (drawn from science and other fields) on defense policy, or perhaps a joint House-Senate committee on national security analogous to the Joint Economic Committee. Greater fact-finding and analytical resources should help the congressional committees to examine military-political issues more deeply and judiciously.

—LUTHER J. CARTER

Germany: Booming Research Effort Turning to Space and Computers

Bonn. Science and technology in West Germany are now going through the sort of growth-rate boom that characterized their American counterparts around the beginning of this decade. Funds provided through the Bonn government have been rising over the past few years at an annual average of 16 percent, for a current research total from all sources of about \$3 billion.

New activities are springing up throughout the country, and Germany never lacks for money when it comes to cooperative endeavors with her European partners, some of whom, particularly the British, would just as soon drop out of commitments that have burgeoned far beyond original estimates.

But the Germans, with an economy so buoyant that it rocks its neighbors'

economies, are looking for new endeavors. And now that the country is well past the postwar reconstruction period and atomic power—heretofore the focal point of German advanced technology—appears to be en route to commercial success, the Germans are inevitably looking to fields that are becoming increasingly important for international trade, politics, and prestige. These, of course, are space, computers, and oceanography, fields into which the Germans are going on a scale that is impressive by European standards.

Thus, starting from near zero in 1961, West Germany is currently spending about \$90 million a year on space activities, and this amount is scheduled to rise to approximately