Radio Astronomy: FCC Proposes Compromise to Share Frequencies with UHF Television Broadcasters

Though science and society are constantly affecting each other in profound ways, it is a rare occasion when their needs or preferences are in direct conflict. Science pays constant homage to society, and society is most repectful of science, but cases are few when one must yield an important interest to the other. Thus, the current plight of the nation's radio astronomers (*Science*, 1 February 1963) is of particular interest, for it tells a great deal about how seriously the nonscientific world takes the needs of a relative handful of specialists whose work means a great deal to science but—let's face it—literally nothing to the average man.

At issue is space on the ultrahigh-frequency (UHF) band, which radio astronomy had pretty much to itself until Congress last year required all television manufacturers to equip their sets to receive UHF. The result has been a rush to broadcast all along this spectrum, including the 608- to 614-Mcy/sec portion of it, which is the piece utilized for radio astronomy.

On the TV dial, 608–614 comes out as channel 37, and, according to the Federal Communications Commission's long-standing channel allocations, Paterson, New Jersey, is in one of the areas that may use channel 37 for TV broadcasting. In other parts of the country the FCC has been able to juggle its allocations to protect radio astronomy, but in Paterson it has run out of maneuvering room, and the issue is a clear-cut one—television or radio astronomy, specifically the observatory at Green Bank, West Virginia, which is close enough to Paterson to be affected by its TV transmissions.

Also affected by TV's interest in channel 37 is the University of Illinois radio telescope at Danville. The University has, accordingly, asked the FCC to protect Danville, as well as all other radio astronomy observatories, by reserving channel 37 on a nationwide basis for radio astronomy.

The final decision is yet to come, but earlier this month the FCC issued a "notice of proposed rule making," which seeks a compromise arrangement that is not causing any noticeable joy among radio astronomers. The proposed rule, on which interested persons are invited to comment to the FCC by 1 May, would do the following:

1) Prohibit television from using channel 37 within 600 miles of Danville until 1 January 1968. Presumably, after that date channel 37 would be made available for television in the Danville area.

2) Limit channel 37 TV broadcasting, in all parts of the country, to hours between 7 A.M. and midnight, thus leaving that part of the radio band for the exclusive use of radio astronomy during the remaining hours.

From the FCC's point of view the proposed solution is not ungenerous to radio astronomy. Infinitely more citizens are interested in the late show than in the crackle of static from the heavens, and in the politically volatile business of assigning TV channels, any government agency would be hard put to defend upholding the interests of a few score radio astronomers at the expense of those of the mass of citizens who look to TV for entertainment and information. But it is interesting to speculate on what would have happened with channel 37 if the exclusion of TV had been presented as a military necessity.—D.S.G.

M.I.T.: Prime Contractor Contends with Problems Produced by Solving Government's Problems

There is a temptation for the visitor to Massachusetts Institute of Technology who sees the striking evidence of growth and change there, much of it financed through federal support of research, to remember the doctrine of the separation of school and state and to wonder, "Will success spoil M.I.T.?"

The visitor is also likely to take away the impression that M.I.T. represents the future for university research in science and technology in the United States; that at M.I.T. the scale is larger, the pace swifter; that this is where the trends begin.

Though neither federal agencies nor universities arrange their bookkeeping in a way that makes comparisons easy, the payment to and through M.I.T. of something on the order of $80 million a year in federal funds puts M.I.T. with the leaders among universities in which, in matters of research and development, the government puts its confidence and money.

As to experience in adjusting work in the national interest to the needs of the institution, M.I.T. has few rivals; and on the record of results, perhaps no other university has been more useful to the nation. This experience and success, and the problems which they have produced, really date back to World War II, when not only were Tech faculty members engaged in highly productive war research but the Institute managed many projects and M.I.T. administrators took a decisive hand in making wartime science policy.

After the war, reconversion for M.I.T. meant a reconstruction of graduate education to reconcile educational purposes and the demands imposed by the federal government's new reliance on the universities for research. M.I.T. faculty members were prominent among the scientists and engineers who began commuting to Washington to give advice to the military, the science-oriented agencies, and the White House. What men like Karl T. Compton, Vannevar Bush, and Edward L. Bowles had begun in working close to the seats of power in the war era, other M.I.T. men like James R. Killian, first science adviser to President Eisenhower, and Jerome Wiesner, first director of the new Office of Science and Technology, have carried on.

The question of why M.I.T. was so ready and able to plunge successfully into the war effort seems answerable, at least in part, by noting that M.I.T. historically has devoted itself to getting results. As one senior faculty member recalls, "at least until the 1930's the engineers were in the saddle here," and engineers stand for the useful application of knowledge. Their tradition is not of the ivory tower. A generation ago at M.I.T. there was an assumption that a capable faculty member could double his salary through consulting. Many of them in fact belonged to prosperous firms in Boston and were as much at home in the board room as in the lab.

But what is now recognized as the M.I.T. touch seems to have developed only when the scientist reached parity with the engineer. This new partnership in research was hastened by the urgencies of wartime, and nowhere was it more dramatically exemplified than in the Radiation Laboratory at M.I.T.

The Radiation Lab was a civilian laboratory located on the M.I.T. campus and managed by the Institute, but with a staff recruited from among scientists and engineers from all over the country. The lab's main assigned task was microwave research, and its great work was in the development and applications of radar on the basis of a British invention, the magnetron.

The name Radiation Laboratory, with its suggestion of atomic research, was a misnomer and a deliberate one, but it had an ironic appropriateness, since a number of distinguished physicists worked in the lab. Lee DuBridge was director, and such names as Rabi, Ridenour, Bainbridge, and Alvarez were listed on the steering committee.

While the development of radar was at first thought to be a job primarily for electrical engineers, it proved to be otherwise, since, as Peter Elias, now an M.I.T. professor of electrical engineering, points out, "engineers didn't know electromagnetic theory and the physicists did."

Just as the extraordinary achievements of the Radiation Lab during the war transformed postwar electronics research and development, so the cooperation of scientists and technologists at the Radiation Lab and on other projects in M.I.T.'s backyard had considerable influence on organization for research at the Institute after the war.

As for the Radiation Lab itself, it lasted only for the duration. By 1945 the lab was employing nearly 4000 people, and when the war ended, although the government was sold on R&D and on M.I.T., there was a strong feeling at Tech that the tail might indeed wag the dog, and the lab was disbanded.

Neither M.I.T. nor its peers in the university research community, however, dissolved the bonds with the agencies which funded wartime research, and M.I.T. proved to be among the most flexible and resourceful in responding to the postwar demands and opportunities. Out of its wartime experience M.I.T. seems to have chosen two operating principles to follow with special vigor: (i) to separate applied and classified research from the regular educational program, and (ii) to emphasize the interdepartmental, interdisciplinary approach.

In an effort to keep government in its place, Tech drew a sharp distinction between "on campus" and "off campus" activities. "Off campus" in general denotes contract laboratories where applied research and development in military and space technology is carried on under government sponsorship.

The prime example is the Lincoln Laboratory in nearby Lexington, which is financed out of federal funds but managed by the Institute. Lincoln Lab, an indirect descendant of the Radiation Lab, was established at the behest of the military services during the Korean War. Its purpose is to perform advanced electronics research for military and space uses. About 40 percent of the lab's staff and half of its budget—some $40 million last year—are committed to research on ballistic missile defense for the Air Force.

M.I.T. supervision of the Lincoln contract is governed by an agreement which brings no funds to the Institute beyond those paid for management, but there is obviously considerable neighborly interaction. Lincoln Lab was originally staffed largely from M.I.T., and interchanges of M.I.T. faculty and Lincoln staff are frequent. Some of the lab's sophisticated equipment is available for use by M.I.T. faculty, and the lab offers summer work for qualified Tech graduate students and a special "staff associate program" for students who can meet requirements for employment at the lab and graduate study at M.I.T.

Located on the fringe of M.I.T.'s Cambridge campus is the Instrumentation Laboratory, which has a wartime record of accomplishment comparable to that of the Radiation Lab. From productive work on aircraft instrumentation before World War II, the Instrumentation Lab went on to apply the gyroscope to wartime problems of fire control (with spectacularly deadly results for hostile planes) and then, after the war, carried forward work on inertial guidance techniques which is credited with having made the Polaris and Titan missile systems possible.

To the Moon

The man who has presided over the development of the Instrumentation Lab, Charles S. Draper, heartily disagrees with those who call the lab an "off campus" operation. Draper regards the Instrumentation Laboratory as an "integral working part" of the M.I.T. department of aeronautics and astronautics, of which he is also head, and is primed with figures to show how many undergraduates and graduate students are profitably involved in the work of the lab and also to illustrate how the work of the lab is translated into improved teaching in the department. The Instrumentation Lab has the contract for developing the navigational system for the Apollo moon landing project, and this work Draper sees both as furnishing a wealth of thesis material and also as providing a training ground for students "to accept responsibility for getting results."

Because, however, of the federal sources of its budget, which will top $30 million in the next fiscal year, and the character of its work, the lab is classed administratively, along with Lincoln Laboratory, as one of the "Defense Laboratories" which are the responsibility of M.I.T. vice president James McCormack, Jr., a 52-year-old retired Air Force major general. McCormack, who rejected a career in industry, where his knowledge and associations would have had premium value, came to M.I.T. upon his retirement, for reasons of health, from the Air Force. Much of his Air Force career was spent as a technical administrator, and this experience gave him a close familiarity with the government-university relationship on research.

Keeper of the Keys

As vice president, McCormack is keeper of the keys in respect to federally sponsored research, and he has been quoted as saying that there is a problem in keeping down the amount of work the government would like M.I.T. to do—that in the last 2 years, for example, Tech has turned down more than $100 million in projects, a lot of it in space engineering work of questionable educational value.

Recently a decision that the point of diminishing educational returns had been reached led to the cutting loose of the Operations Evaluation Group, another of the M.I.T.-managed Defense Laboratories.

The O.E.G. dated back to the war and the first organized effort in the United States at operations analysis. The Navy financed the group in the years after the war, and the background to the Navy decision to move management of the group to the Franklin Institute in Philadelphia is somewhat cryptically described in the vice president's portion of the M.I.T. president's report for 1962. According to the report, M.I.T. "joined with the Navy in examining the possibility of consolidating its operations research efforts in several fields, including Naval plans and policy, which we and the Navy agreed went beyond the proper province of a university."

Federal support of the Defense Laboratories amounted to some $66 million for operating expenses in the academic year 1961–62, but it should be noted that perhaps half of this sum was paid directly to subcontractors for goods and services. Federal sup-

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port, furthermore, by no means ends at the "on-campus" line. Last year the dollar volume of federally sponsored research on campus amounted to $21.5 million of the $45.8 operating budget of the Institute.

Work on the on-campus federally supported research projects is to an increasing extent carried out in interdepartmental laboratories, to which the improvisations of wartime gave strong impetus. The oldest and perhaps best known of these labs is the Research Laboratory of Electronics, which shares the ancestry of the Radiation Lab and continued its working relationship between electrical engineering and physics. The entrée has been broadened until now faculty, graduate students, and undergraduates from 11 departments are on the R.L.E. rolls.

The need for equipment and for more extensive financing and organization has pushed the development of the interdepartmental labs to the higher form of the "center," which School of Science dean George Harrison Russell calls an "attempt to overcome the effects of overspecialization."

M.I.T. president Julius A. Stratton, in describing the new center for materials research, said, "We conceive the center to be a federation of many individual projects, each consisting of a professor or a few closely associated professors, with their graduate students, postdoctoral research workers, and so on. In conformity with university traditions, these individual projects are essentially autonomous, determining their own programs and to a large extent handling their own business, and the center is a coordinating body whose main function is to pass information back and forth, as well as to supply the convenience of central facilities which are too large for any one project to handle itself."

Monuments to the center idea seem to be rising all over the M.I.T. campus. Tech is in the process of raising a minimum of $66 million for development, and a substantial portion of that is being allocated to the construction of five new interdepartmental centers: Aeronautics and Astronautics, Communications Sciences, Earth Sciences, Life Sciences, and Materials Sciences and Engineering.

The center principle, which has developed great momentum at M.I.T. and has been widely applied elsewhere,

is not, however, an object of unreserved approval at Tech. Some faculty members regard the center idea as inapplicable in many fields, and one senior professor observed wryly that "a new idea sells better" in getting support money and projects. Some feel that the center threatens departmental divisions, and deeper misgivings are expressed by those who fear that projects may become the main concern at the centers, rather than students.

Concern over the implications of the centers is only one instance of the qualms fairly generally admitted at M.I.T. over the effects of the expansion of research under federal support. M.I.T., moreover, has a history of organizing its self-criticism, and the place abounds with working committees and study groups.

The curriculum is under permanent review, and the relationship of the Defense Laboratories to the Institute proper is apparently another subject of constant consideration. Currently under study is the extremely complicated and touchy matter of faculty conflict of interest. Outside consulting has always been a faculty prerogative, regularized on a 1-day-a-week basis, but the search for standards now focuses on such cases as that of the professor who sits on a government panel making a decision on military hardware, information on which would be useful to a company that the same professor serves as a consultant or an officer.

At M.I.T. and elsewhere the working assumption is that government support of research is here to stay and that such dilemmas will only grow more difficult. In the dynamic area of government-university relations, therefore, M.I.T. is a leader in a changing game for which the old rules will not serve.—JOHN WALSH

A View from the Pork Barrel: Congress, PHS, Haggle Over Proposed Health Center Site

There is at least one way in which Congress, its critics to the contrary, has not failed to keep up with changing times. The old tradition of the federal pork barrel has been reshaped, and Congressmen now haggle over the location of scientific facilities with all the energy once spent in pursuit of rivers and harbors projects for their own districts.

A case in point is the Public Health Service's proposal for a National Cen-