guage; the impression he conveys is of one who seeks to rise in Olympian fashion above those foolish enough to question his judgment. Ehrlich and Holdren, on the other hand, fired by what they see as personal attacks on Ehrlich, are in there punching. "Preposterous evasion," "self-righteous philosophical ramblings," and "seductive misinformation" are a few of the qualities they perceive in the Commoner opus.

Both parties have sneered at each other's mode of calculations. The Ehrlich camp says Commoner simply does not have a grasp of figures, and even the fact-filled Ehrlich has been noted by one reviewer (René Dubos) as having endowed oysters with enough DDT that they could be chopped up and used as pesticide.

We then move on to the Stockholm Conference on the Human Environment and its main sideshow, the Environmental Forum. The forum, heavily attended by representatives of underdeveloped "third world" countries, was the place where subjects such as population and the Vietnam war, which were taboo on the main agenda, were noisily explored.

Ehrlich's assistant Growald says he did painstaking groundwork for a panel on population to be composed of Ehrlich, a Swede, and a Senegalese. When Ehrlich arrived, however, he was bombarded with demands to include more third world people. Five additional panel members were accepted, and Ehrlich found himself in a seven-to-one situation in which he was being showered with hostile questions from the floor.

According to Growald, the events had been masterminded by Commoner, who had stayed up planning until 3 a.m. the previous morning. Commoner sat secluded on a balcony overlooking the proceedings; from time to time, he retreated to write out probing questions to be relayed down for use by those on the floor.

Commoner ridicules this version. "It is scurrilous, absolutely scurrilous, to propose that the scientists in the third world did that at anyone's bidding." He points out that there was a great deal of spontaneous program organizing throughout the forum and that Ehrlich, being there for only 1 day, did not understand "the temper of the whole program."

Indeed, one reason the two men's views clash is that Ehrlich has been attempting to put the debate on a purely scientific basis, whereas Commoner considers politics to be very much part of the equation. When you're playing bridge and your opponent's playing poker, it's hard to agree on the rules.

—CONSTANCE HOLDEN

RESEARCH NEWS

Report on Astronomy: A New Golden Age

Very few people have never questioned what course they would follow if they were starting their careers over again, and the answer given frequently by physical scientists these days is astronomy. In a recently released report to the National Academy of Sciences, an eminent committee characterized the past decade as a "new golden age of astronomy" during which "an explosion in dramatic discoveries occurred." The pace of discovery has been so rapid that the unfolding story of astronomy has an excitement unsurpassed in the physical sciences, and many bright young men and women have been attracted to the profession.

The current era of new ideas, according to the Astronomy Survey Committee, chaired by Jesse L. Greenstein of the California Institute of Technology, started with the optical measurements of extremely large redshifts of quasars in 1963. Many discoveries, including quasars, pulsars, the cosmic background radiation, clouds of complex interstellar molecules, and the retrograde rotation of Venus, have been made with radio telescopes. Other discoveries—of x-ray stars and infrared galaxies (whose energy output in the infrared far exceeds that in optical and radio frequencies)—and the rocket ultraviolet discovery of hydrogen molecules in interstellar space, have been made with instruments newer than radio telescopes and capable of exploring virtually all the regions of the electromagnetic spectrum from the ground or space.

Not long ago, the study of the universe was the prerogative of a small number of men largely isolated from the rest of science, who were supported for the most part by private funds and were comfortable with projects that spanned decades. The profession has always been a consortium of colorful individuals, a community with a tradition of sharp, sustained, and, at times, personal debates. In the last two decades, however, federal support for astronomy has burgeoned, the ranks have swelled, and many scientists trained in other fields have become practicing astronomers. With typically measured pace, the deans of astronomy have discarded their 19th century style of doing science for the advantages of late 20th century organization and instrumentation.

The keynote of the Greenstein report is that modern instrumentation, used with great ingenuity, has made possible the exciting discoveries of the last decade, and many advanced technologies are now available or nearly available so that 11 new programs are needed to maintain the present rate of progress. The programs almost all feature new instrumentation. Four recommendations are given top priority and listed in order of preference.

The most urgent recommendation is the very large array (VLA) radio telescope that has already received initial funding in the 1973 budget of the National Science Foundation. With a design based on a theory called "aperture synthesis," the VLA can economically attain great resolving power comparable to that of optical telescopes. The concommitant recommendation of an expansion of research support for moderate-sized radio telescopes is one of many indications of a concern for the balance between research efforts at universities and the larger national facilities.

For optical astronomy, the committee recommended a major program to develop electro-optical detectors, which can multiply the light-gathering power of existing telescopes as much as 25 times. Most of the cost of the optical program, however, was designated for new optical telescopes, such as a prototype of a novel multimirror design, several telescopes of the 100-inch class, and a large multimirror telescope of

great light-gathering power or a standard telescope of the 200-inch class.

Solid state and low temperature technologies recently have developed to the point that infrared detectors when used in conjunction with large optical telescopes are sensitive to many distant objects. So much has been done with so little money, the Greenstein report notes, that a very large payoff can be expected from modest further investments.

Because of the extraordinary richness of new phenomena discovered in x-ray astronomy, the committee recommended funding of two further high energy astronomical observatories (HEAO's), which could be programmed from the ground to point to any object in space, in addition to the two nonpointable HEAO's already requested by the National Aeronautics and Space Administration (NASA).

The committee gave lower priority to seven other programs; among them are a large millimeter-wavelength antenna for further study of clouds of complex interstellar molecules, doubled support of aircraft, rocket, and balloon observations, three additional orbiting solar observatories, and an expanded program for theoretical investigations.

The most notable feature of the Greenstein report is that it succeeded in setting clear priorities, an achievement that few government advisory committees have been able to accomplish even when making recommendations for a subfield of science as small and relatively homogeneous as astronomy. Furthermore, because the VLA is already being funded, the current document will almost certainly have a better record than did its predecessor, the Whitford report of 1964. However, several points seem certain to receive careful scrutiny.

In spite of noting that the task of evaluating programs with greatly different costs "becomes an exercise in comparing incommensurables," the report nevertheless gave the highest priorities, on the basis of scientific potential, to the most expensive programs, with the exception of the infrared program. The total cost of the 11 recommended programs is very high; it amounts to $844 million over the next 10 years in addition to present funding. Although the report notes that the entire program could be funded if federal obligations increased at 5½ percent per year in real terms, closer examination of the allocation of funds shows that support for ground-based astronomy would have to grow at more than double that rate, while the growth rate for space research would be less. Such growth would seem to place an impossible burden on the National Science Foundation, which is designated as the key agency for ground-based research and which recently suffered a substantial cutback in the budget planned for 1973.

Approximately two-thirds of the costs of the top priority program is designated for space astronomy, but little attention is given in the report to analysis of the scientific effectiveness of various NASA programs. Some astronomers are worried about the small numbers of investigators who have access to data from satellites. In spite of the great expenditures, approximately only 15 percent of astronomers participate in space projects. Although the larger community of astronomers is likely to support the HEAO recommendation, one of the reasons cited for an expanded national astronomy program was the need to support a growing number of young astronomers.

The recommendation of an optical program that is almost as expensive as the VLA radio program is quite surprising. Although electro-optical devices that increase the light-gathering power of existing telescopes are quite cost-effective, most of the expense of the optical program is designated for new telescopes, even though two large telescopes recommended by the Whitford report are nearing completion and eight others are available in the United States. With the new additions, the total collecting area of large telescopes will be doubled, but many more are needed, according to the report. Optical telescopes are the workhorses of astronomy—there is no direct measure of distance in radio astronomy—and, in order to study new discoveries found at other wavelengths, the report continues, more large optical telescopes are needed because such new objects are invariably faint. "God doesn't give us naked eye quasars," said Greenstein in a recent interview. However, optical telescopes are well-refined and plentiful compared to large radio telescopes or space observatories.

In contrast to funding, which has leveled off in recent years, the manpower supply has risen dramatically, as the rate of production of new Ph.D.'s in astronomy increased by a factor of 10 in the last decade. As a result, the amount of federal funding per scientist has decreased. While the job outlook for new Ph.D.'s doesn't appear as stark in astronomy as in other sciences, the percentage of graduates who are able to find jobs at academic institutions has decreased sharply in recent years. At the same time, the number of physics doctoral degree holders practicing astronomy has grown to equal the number of Ph.D.'s in astronomy. Noting that "the quality, depth of education, and technological skills of those entering the profession are the highest they have been," the Greenstein report urges increased funding of modest research grants to young people.

Even though the VLA telescope has been approved, these are difficult times for ground-based astronomy. The NSF budget for basic research, which primarily supports university facilities, has stayed approximately constant for the past 5 years, while the Department of Defense budgets have declined. The only ground-based facilities that have rapidly expanding budgets are the national centers for astronomy, namely, the National Radio Astronomy Observatory at Green Bank, West Virginia, and the Kitt Peak National Observatory, Tucson, Arizona. Fears that the national observatories would dominate astronomy, to the point of squeezing out the university-based observatories, surfaced repeatedly during the meetings of the survey committee. The final chapter of the report is a painstakingly written essay on the need for balance between the two bases of research clearly implies that the present mix is not healthy.

University-based astronomers appear to be at a disadvantage in trying to develop new instrumentation, because the national observatories have large budgets and policies that encourage visiting investigators to use instrumentation available at the national center. On the other hand, most university-based observatories were built with private funds, and some large observatories derive as little as 20 percent of their support from federal agencies. Particularly in optical astronomy, Greenstein points out, the major technical advances have been made at the private institutions, but those contributors are in danger of being diminished by the present budgetary trends.

The conflict between astronomers at the universities and national centers turns on the styles of research, established traditions, and approximations of democracy at the various institutions. A revolution in research styles appears to be taking place, similar to the movement toward empire-building in physics that occurred with the coming of national accelerator laboratories, except that in astronomy the shift of funds

appears to be out of step with the shift of research facilities. The world's most sensitive optical telescopes are still in the private sector, and, according to the report, the majority of talented astronomers are at the universities. However, the size of the expenditures for most of the programs recommended by the Greenstein committee report is so great they would almost certainly be made part of national centers. Although 60 percent of the observing time at the Kitt Peak center is reserved for visiting scientists, namely, those based in universities, many astronomers fear that the obligation of a national center to accommodate all qualified observers will throttle opportunities for intellectually exciting observations that require large blocks of time. Only recently the Kitt Peak National Observatory formalized the procedure of including visiting astronomers as well as staff astronomers on the committees that allocate observing time.

No doubt the universities still hold the major national resources of manpower and technology, at least in optical astronomy. In radio astronomy, on the other hand, the preeminence of the National Radio Astronomy Observatory is widely acknowledged. But the arguments for balance in the Greenstein report seem more directed toward preserving islands of total freedom in the universities than improving the scientific payoff of the national centers. It appears that neither the distribution of funding nor research priorities between the public and private sectors has yet reached equilibrium.

The Greenstein report is an excellent presentation, so specific that it lays itself open to criticism. The recent developments on the frontiers of astrophysics are presented in a style that is quite readable for the layman, and the section on exobiology—probably the most optimistic assessment of the likelihood of intelligent extraterrestrial life ever presented by a committee of eminent scientists—is almost lyrical. Every recommendation, with the possible exception of the optical program, appeared to be well-justified by the reasonable hope for new discoveries and the timeliness for exploiting the advances of technology.

A few years ago, astronomers could observe the universe at only two wavelengths—optical and radio. The recommendations of the Greenstein report would allow them to tune-in to the stars at virtually any region of the electromagnetic spectrum. The only wavelength, in a manner of speaking, that the astronomers may have overlooked is the current mood of the Congress.

—WILLIAM D. METZ

Narcotic Antagonists: The Search Accelerates

Narcotic antagonists—nonaddictive drugs that block the euphoric effects of opiates—have long intrigued investigators seeking new answers to the problem of heroin addiction, but the development of such compounds has been hindered by the inadequacy of available research funds. Last year, however, the federal government initiated a concerted effort to conquer drug abuse and began prodding the drug industry to accelerate research programs directed at the development of such compounds. Earlier this month, the government signaled its own commitment to the antagonist concept by awarding more than $2 million in grants for preclinical and clinical testing of the most promising candidates.

The accelerating program has already produced some tangible results. Two once-heralded antagonists have been extensively tested and shown to be only marginally adequate for clinical use. A third compound has received less testing, but appears to be a more promising candidate for general usage. Several longer-acting and more potent antagonists are in the preliminary stages of testing, and promising new methods of administration are also beginning to be investigated. Most important, perhaps, it has recently been shown that one of the antagonists exhibits great potential for preventing abuse of such drugs as methadone and paregoric.

The first important narcotic antagonist was cyclazocine—3-(cyclopropylmethyl) - 1,2,3,4,5,6-hexahydro - 6,11-dimethyl - 2,6-methano-3-benzazocin-8-ol—developed by Winthrop Laboratories, New York City. A 1- to 4-mg oral dose of cyclazocine produces clinically effective opiate antagonism for at least 24 hours, but patients must be built up to this dosage gradually because of cyclazocine's unpleasant initial side effects, which include dizziness, headaches, and hallucinations. These effects are disproportionately intensified as the dose is increased, and they may also reappear when cyclazocine use is discontinued.

Several investigators have suggested that the side effects might be caused by *d*-cyclazocine in the racemic mixture normally used, but recently completed clinical testing at the National Institute of Mental Health's Addiction Research Center (ARC) in Lexington, Kentucky, indicates that the pure *l*-isomer also produces the side effects.

Efforts to avoid these side effects led many investigators to the use of naloxone (*N*-allylnoroxymorphone) and closely related compounds. Originally synthesized in the private laboratory of Mozes Judah Lewenstein and subsequently developed by Endo Laboratories, Garden City, New York, naloxone was the first "pure" narcotic antagonist; that is, it has no pharmacological properties of its own, but it abolishes or prevents the hallucinations, euphoria, respiratory depression, nausea, constipation, convulsions, and other effects produced by narcotics. It also abolishes such effects when they are caused by other narcotic antagonists.

Clinical studies at several institutions have shown that a 1- to 5-mg parenteral dose of naloxone produces opiate antagonism for 2 to 4 hours, and a 3-g oral dose provides antagonism for as long as 24 hours. Large oral doses are very expensive, however, since naloxone is synthesized from thebaine, an opium alkaloid whose importation is rigidly controlled. Parenteral doses are impractical because of the limited duration of action in such a form, and naloxone thus seems unlikely to find clinical use.

Some effort has been made to use naloxone to overcome the side effects of cyclazocine. Max Fink of New York Medical College (NYMC) has reported that a relatively small oral dose of naloxone blocks the adverse effects of cyclazocine for as long as 24 hours, but does not interfere with its antagonist activity. William R. Martin of ARC, however, has found that the cyclazocine side effects return after 4 to 6 hours; this discrepancy has not yet been resolved.

Even if Fink's results are confirmed,