

letters

on the overhead take place between the administration and the government, the scientist, who must pay the bill out of his grant, is unrepresented and must depend on the government representatives to keep the overhead allowance down. In many cases large computing centers and other facilities have been built by strong groups within the university and then are tossed onto the backs of all the other scientists to support, will they or not.

Even the NSF salary ceiling, which appears to bother university administrators, does not worry me much. Anyone paid that much is probably not going to be working very seriously on a grant; most grants support post-docs and the rest of the poorly paid proletariat of the universities. If the universities want to pay that much, they should consider the source of the funds before they commit the money.

The article points up the basic problem in sponsored research: University administrators look at it as a goose that lays golden eggs with which to hire more administrators; principal investigators must depend on the shrinking difference between limited and reduced awards and ever-increasing overhead and staff benefits to carry out their research. I am astonished to see PHYSICS TODAY and the scientific establishment taking a critical view of the new regulations.

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Cost benefit of radioastronomy

Rustum Roy, in his "Guest Comment" (January, page 9) compared radio astronomy to environmental chemistry in his questioning of the dogmatic value system of science. In his call for improvement in the national process of research money allocations, one could easily expect a damaging coincidence of budget-cutting mania and shallow cost/benefit analysis. Radio astronomers are certainly a relatively expensive breed of scientist to maintain, but we feel that the quality of the discoveries of our science (pulsars, quasars, the 3K cosmic background, and many other basic and unexpected facts about our universe) should justify such expenses in a prosperous and enlightened society. Nevertheless, in some quarters we are regarded as the epitome of rarefied scientific purity, and quantitative justification of our expensive instruments is then a difficult and subtle task. It is not easy to attach dollar values to ideas. It might be useful, therefore, to remind Roy of a few representative instances where radio astronomy has played a role that might even have consequences for environmental chemistry.

▶ NASA and NOAA alone have invested over 50 million dollars in applying radio-astronomy methods to global environmental measurements. Measurements of atmospheric temperature and water-vapor profiles, precipitation, sea state, soil moisture, and snow and ice cover can all be made by radio-astronomy methods worldwide, independent of cloud cover. An extensive operational temperature-sounding system is now being implemented by NOAA, and radio-astronomy techniques appear destined to play an even more central role in the next generation of operational meteorological satellites to be introduced in the mid-1980's.

▶ The ground terminals of satellite communications systems need calibration of their antenna gain, receiver sensitivity and pointing accuracy. The radio astronomers at Bell Labs pointed out that celestial radio sources were ideal for the purpose, and the methods of radio astronomy are now in use for checking satellite communication ground terminals. The alternative, a system of calibration satellites, would have been expensive (many millions of dollars), wasteful, and less reliable.

▶ A strong radio source outside the atmosphere was needed by Bell Labs communications engineers for predicting atmospheric effects over a wide range of frequencies. Again, the radio astronomers pointed out that the Sun was just such a source, and demonstrated its use for that purpose. Again, many millions of dollars were saved.

▶ When the Space Age arrived radio astronomers had already developed the large steerable paraboloids that were needed for tracking satellites. Both NASA and the military adopted these designs immediately. The 250-foot radio telescope at Jodrell Bank was the mainstay in the west for tracking the first Soviet Sputnik.

Many physicists would prefer, of course, to have their work judged by its intellectual value, but we can certainly claim that radio astronomers help to advance the frontiers of practical electronics and radio science. We are probably not inflationary, the public appears to enjoy hearing about our discoveries, and our total budgetary demands are about an order of magnitude smaller than the national expenditures on astrology. The more general message, however, should be that Roy's apparently common-sense proposal could, with careless formulation, cause enormous damage to the intellectual edifice of science, and would probably have unpleasant practical consequences for our country, which has enjoyed such great prosperity in large part because of our willingness to push science and technology to the frontiers.

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