

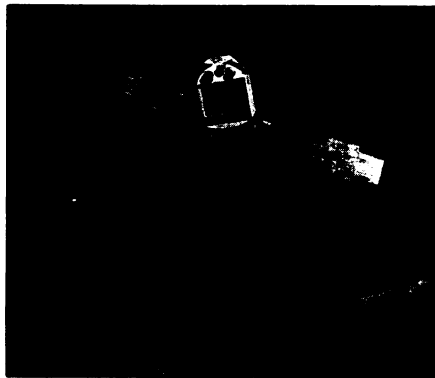
Intergalactic Gas: Toward a Closed Universe

Is the universe open or closed? Will the expansion someday stop and reverse, or will it continue forever? This is perhaps the number one question in cosmology (it is certainly the biggest), and it has been endlessly debated, because the answer depends on things that cannot be seen.

All estimates of the amount of visible matter in the universe agree that it is not enough to close the universe; it is in fact only a small fraction of the amount necessary. The debate over closure continues because of the suspicion of many cosmologists that there is many times as much invisible as visible matter. That view is now supported by the report of a group of X-ray astronomers led by Riccardo Giacconi of the Harvard-Smithsonian Center for Astrophysics. They say they have found evidence for previously unknown matter in the space between galaxies that "could represent a significant percentage of the so-called 'missing mass' needed to close the universe."

While compiling the *Fourth Uhuru Catalog of X-Ray Sources* from observations made by the satellite Uhuru during the early 1970s, the group found evidence for sources associated with clusters or even superclusters of galaxies. Analysis of the data from these sources by Stephen Murray, William Forman, Christine Jones and Giacconi indicates that the radiation comes from extremely hot gas (more than 60 million degrees K). The mass required to produce the recorded intensity is five to ten times all the mass seen at other wavelengths. Giacconi suggests that this gas pervades the space of the clusters and even of the superclusters (it is too much mass to be associated with any single galaxy), and that it is "primordial material," hydrogen and helium that remain from the explosion in which the universe was created. The high temperature of the gas would put most of its radiation beyond the blue end of the visible spectrum and account for the impossibility of seeing it.

Such a huge mass of gas is not only a significant fraction of the amount required to close the universe, it also bears on a subsidiary question: whether the clusters and superclusters of galaxies are gravitationally bound. Galaxies are known to come in clusters, and astronomers who study the statistics of galactic distribution see evidence for associations of clusters into superclusters. The question is whether these associations are bound together by the force of gravity or merely random and momentary associations of galaxies passing in the eternal night of the cosmos. If the clusters are bound, they form an important feature of the structure of the universe. Again, the visible mass of the



Uhuru satellite has found evidence for large amounts of gas in intergalactic space.

galaxies in the clusters and superclusters is not enough for the binding. But, if the observations are correct, the newly found intergalactic gas would provide enough.

Whether enough mass will eventually be found in these all-pervading X-ray clouds to finally settle the debate over universal closure remains to be seen, although the present Uhuru observations suggest that enough may be found as more and more regions are sampled. The Uhuru group suggest that a confirmation of the proposition could come from observations by the soon-to-be-launched High Energy Astronomy Observatory satellite (see p. 38).

U.S.-USSR scientific agreement renewed

The United States and the Soviet Union have renewed for another five years their Agreement on Cooperation in Science and Technology, originally agreed upon during President Nixon's visit to Russia (SN: 6/3/72, p. 356). The renewal was signed July 6 by Frank Press, Director of the U.S. Office of Science and Technology Policy, and by Academician V.A. Kirillin, Chairman of the State Committee of the USSR Council of Ministers for Science and Technology.

No details were announced concerning possible changes in the ongoing program of information exchange and joint research, but Press told reporters after the signing that modifications will closely follow those recommended in a National Academy of Sciences report on the agreement. The only specific research area he would mention as a candidate for increased emphasis was the study of corrosion.

The Academy report, released in May, was based on interviews with many of the 250 U.S. scientists and technologists who have participated directly in the program. They praised the "helpfulness and warmth of the individual Soviet scientific or technical person at the working level," but contrasted this to the "layers of stifling bureaucracy" of the Soviet government. The U.S. government was also criticized for not providing more support to American researchers, including translation and transcription services, procedures for hosting conferences in the United States, briefing scientists before they visit the Soviet Union so they know what to expect and debriefing them on return so their knowledge is disseminated.

Of numerous specific projects covered by the agreement, electrometallurgy was singled out as an example of success, having "stimulated a considerable amount of rethinking of technical ap-

proaches in the U.S." A program in the application of computers to management has produced "a better understanding of Soviet views and procedures in planning and management." But in the microbiology project, "the amount of exchange work was practically zero." In physics, "no exchange or substantive interaction has taken place." A source close to the negotiations said the Soviets seem willing to help cut through some of the bureaucratic red tape, while in the United States the "problems are already being remedied." □

Biologists oppose DNA research bills

The turmoil over recombinant DNA research is now four years old. It was at the 1973 Gordon Conference on Nucleic Acids that biologists first called public attention to possible hazards of the gene-splicing research. In the last month at two of the 1977 Gordon conferences, many of the same scientists made an attempt to dam what they see as an impending flood of unjustifiable regulations.

Scientists attending the conference June 13 to 17 in New Hampshire, besides hearing and discussing the latest DNA research results, drafted an open letter to Congress. The authors of the statement are Walter Gilbert of Harvard University, Fred Blattner of the University of Wisconsin, David Botstein of the Massachusetts Institute of Technology and Howard M. Goodman of the University of California Medical Center in San Francisco. Goodman was one of the team who recently inserted rat insulin genes into bacteria.

The letter expresses concern that the legislative measures under consideration would "set up additional regulatory ma-

Documentation of alleged Soviet mishap

chinery so unwieldy and unpredictable as to inhibit severely the further development of this field of research." It contrasts "the dramatic emergence of new fundamental knowledge" reported at the meeting with the absence of indications of "actual hazard. Under these circumstances, an unprecedented introduction of prior restraints on scientific inquiry seems unwarranted," says the letter, which was printed in the July 15 SCIENCE. Finally, the statement urges that if standards are legislated, they be made uniform throughout the country.

A stronger statement emerged last week from another conference, which included some of the same biologists. During the intervening three weeks, Fred Blattner told SCIENCE NEWS, the scientists became aware that the bills in Congress were not simply going to extend the NIH guidelines to private industry, as well as government funded research, but might severely inhibit research. "I think there was a willingness of people at this second meeting (the Gordon Conference on Biological Regulatory Mechanisms) to realize that they've got to fight these bills," Blattner says.

The second letter, signed by most of the 160 biologists at the meeting, states: "The experience of the last four years is important. Despite an increasingly vigorous search to identify precisely the degree and nature of any actual public health or environmental hazard, no indication of actual danger has been uncovered. Instead, many conjectured dangers have been shown not to exist." The letter concludes, "It would be unwise to legislate hazard where hazard has not been shown to exist and indeed [has been] shown to be improbable. We believe that the proposed legislation might well deprive society of needed improvements in public health, agriculture, industry and environmental protection on behalf of fears that are not rationally based on concrete risks." Much of the important research progress reported at the meeting, Blattner says, relied on recombinant DNA techniques.

The second statement, Blattner points out, explicitly opposes both bills before Congress. Both bills would allow local areas to apply for exemption to set stricter regulations. The bills also provide for fines of \$5,000 to \$50,000 per day for experimentation that does not meet the standards. The House bill would give the regulatory power to a committee under the Secretary of Health, Education and Welfare and temporarily would give the NIH guidelines the force of law, whereas the bill before the Senate would establish a permanent national regulatory commission with the chairman appointed by the President. Support for the House version with modifications has come from officers of several research organizations, including the American Society for Microbiology. The Senate bill should come to a vote late this month, and the House bill will be debated later in the summer. □

Referring to a large area in the Soviet Union that was allegedly contaminated by radioactive nuclear waste, a noted biochemist claims to have found abundant indirect documentation of the extensive damage involved.

Zhores Medvedev, a Russian immigrant now at the National Institute for Medical Research in London, claimed last November that about 1957 an accidental dispersal of buried nuclear waste had contaminated hundreds of square miles in a southern Urals region. Since his revelation, the contention has been a lively topic for debaters, who are variously surprised, confused or skeptical.

Medvedev's account was subsequently supported by Lev Tumerman, former head of the biophysics laboratory at the Institute of Molecular Biology in Moscow, now living in Israel. He had toured the tainted region in 1960. Except for his eyewitness account, there has been a dearth of firsthand information about what actually happened. Instead, official Soviet secrecy, reckless speculation and hearsay have overwhelmed the subject.

Now Medvedev describes in the June 30 NEW SCIENTIST what he believes is a definitive verification that the alleged disaster indeed did occur during late 1957-early 1958 and that its aftermath left indiscriminate high-level radioactive contamination of soil, soil animals, plants, bodies of water and their inhabitants.

He infers most of this using information gleaned from more than 100 academic-journal articles that report on numerous experiments generally dealing with effects of a radioactive environment on the biology of a large variety of plants and animals.

Except for a single instance—a censor's slip-up, according to Medvedev—the contaminated locales were never identified in the articles. Many authors described them simply as confined areas specially polluted for research purposes. Medvedev contends these references to "experimental" compounds are all really the southern Urals site.

Medvedev noticed that reports published at later dates systematically referred to data accumulated over a longer time. So 1968 articles typically

referred to their 10-year studies, 1971 ones to their 14-year studies and so forth: They all seem to have begun their studies during 1957-58. Medvedev believes this is not coincidental, but surrogate evidence for pinpointing the date of the mishap.

He locates defense in a 1966 article by F. Rovinsky in *ATOMNAYA ENERGIYA* (18:379) for the prevailing belief (also his own) that nuclear waste was definitely to blame. Rovinsky describes the intense radioactivity, mainly from strontium 90 and cesium 137, contained in two "experimental lakes" that are 11.3 and 4.5 square kilometers large. One expects the lingering presence of Sr-90 and Cs-137, because they are the longest-lived radioisotopes (each with about a 30-year half-life) found in typical nuclear waste material. Medvedev also expresses skepticism that two such large lakes would have been deliberately contaminated.

Based on information in a pair of papers published during the 1970s in *VOPROSY ICHTIologii* (10:1127 and 12:174) by A.I. Il'enko, Medvedev surmised that a third lake, also unidentified, was contaminated with a total of 50 million curies of radioactivity (approximately equal to that given off by 50 million grams of radium 226). Medvedev obtained this estimate via a sequence of scientific deductions—an approach that generally pervades his article.

To estimate the areal extent of the nuclear pollution, Medvedev used two 1968-70 studies of contaminated mammals published in *ZOOLOGICHESKII ZHURNAL* (49:1370) and *ZHURNAL OBSCHEI BIOLOGII* (31:698). Medvedev noted the studies' quoted sample of 21 deer and guessed that the total contaminated deer population involved was probably about 100. Typically, this many deer require at least 100 square miles, he reasoned. The radioactivity—presumably over this large area—was described in the two articles as varying from 1.8 to 3.4 millicuries per square meter. (Normal background radioactivity is roughly only a millionth as great.)

Medvedev cites an "accidental acknowledgement" in one paper by Il'enko and collaborators that specifically reveals "that the animals for their work had been collected in the Chelyabinsk region." Furthermore, the peculiar "mixture of [200] European and Siberian species" of plant and animal cumulatively referred to in the journal articles "point to the Urals," concludes Medvedev.

The subject, plagued as it is by official Soviet secrecy, has been open season for freewheeling speculation. Nuclear scientists and engineers have collectively scratched their heads and better succeeded in eliminating possible explanations than establishing them. Elementary nuclear physics immediately ruled



Site of possible radioactive mishap.