The promoters of gene transcription

		A		B	
T7 A3	AAGUAAACACGG	UACGAUG	UACCA	CA	UGAAACGACAGUGAGUCA
fd	UGCUUCUGAC	UAUAAUA	GACAG	GG	UAAAGACCUGAUUUUUGA
SV40	UUUAUUGCAGCU	UAUAAUG	GUUAC	AA	AUAAAGCAAUAGCA...
Lambda P_L	CCACUGGCGGU	GAUACUG	AGCAC	AU	CAGCAGGACGCACUGAC
Tyr tRNA	CGUCAUUUGA	UAUGAUG	CGCCC	CG	CUUCCCGAUAAGGGAGCA
Lac w.t.	CUUCCGGCUCG	UAUGUUG	UGUGG	AA	UUGUGAGCGGAUAACAA

Pribnow/PNAS

Gene promoters: (A) homologous sequences; (B) where promoter transcription starts.

The transcription of DNA molecules (genes) into molecules of messenger RNA, and then into molecules of protein goes on in viruses and every living cell, whether it be the one-celled bacterium *Escherichia coli* or in the trillion cells that make up the human body. How this elegant transcription process takes place is being feverishly scrutinized by molecular biologists throughout the world.

Biologists have discovered that in viruses and bacteria, the transcription of a particular gene (DNA molecule) is assisted by two strips of DNA that adjoin the gene. One of these strips is known as an operator. If a so-called protein repressor hops on the operator, translation cannot occur; if the repressor hops off, it can. The other strip is known as a promoter. Once an enzyme known as RNA polymerase binds to the promoter, the enzyme proceeds to transcribe the functional gene into a molecule of mRNA.

Although there is evidence in one microorganism that the promoter lies next to the operator, then the operator lies next to the functional gene, biologists believe that there is no reason that the operator couldn't come first, then the promoter, and then the gene.

While some biologists—notably Walter Gilbert, Allan Maxam, Mark Ptashne and Tom Maniatis of Harvard University (SN: 1/19/74, p. 40)—are probing the chemical structure and action of operators, others are studying the structure and action of promoters—notably David Pribnow, a graduate student in Gilbert's lab.

Pribnow's research, reported in the March PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, sheds considerable light on the chemical structure of the half dozen or so promoters that have been worked out, and how this structure probably leads to the transcription of a functional gene into a molecule of mRNA.

First Pribnow isolated a promoter from the DNA of a particular virus (bacteriophage T7). He then determined the exact chemical structure of the promoter. It was 44 bases long. Bases are the building blocks of DNA. There are four different kinds—A, T, G and C. A molecule of RNA contains the same bases, except that U substitutes for T.

Pribnow then compared the base sequence of this viral promoter to that of the half dozen or so other viral or bacterial promoters that have been worked out. He found that all of them were about 44 bases in length.

Even more intriguing, Pribnow's comparison shows that a sequence of seven bases is almost identical in each of the promoters. So Pribnow concludes that this stretch is probably the critical stretch in each promoter that allows an RNA polymerase to bind to the promoter. Or as he puts it, "There must be some specific sequence within all promoters that is involved in the stable binding of polymerase molecules."

Finally, Pribnow's research and that of other investigators reveals that after an RNA polymerase binds to the promoter, it begins transcribing the bases in the promoter from the 22nd base on. In other words, the enzyme binds the left half of the promoter, then it transcribes the right half of the promoter, and then it continues to transcribe the functional gene. The genetic information from both the right half of the promoter and the gene are then packaged into one mRNA molecule. □

Nuclear debate to be televised

The great debate between proponents of nuclear power and opposing environmentalists of various persuasions is heating up again. Pending before Congress is legislation to declare a five-year moratorium on all atomic power development, or to prohibit use of plutonium as a reactor fuel, or alternatively, to give electrical utilities government subsidization in their push to "go nuclear." A lively televised debate on these and other issues of atomic power is now being syndicated to stations across the country by the American Enterprise Institute for Public Policy Research. The program was taped last week in Washington.

AEI's national energy project chairman, Melvin R. Laird, moderated the two hour-long segments, which pitted nuclear advocates Ralph E. Lapp, a private consultant and writer, and former congressman Craig Hosmer against consumer advocate Ralph Nader and Daniel Ford, executive director of the Union of Concerned Scientists. Laurence I. Moss, a nuclear engineer and former president of the Sierra Club, represented a more or less intermediate view of cautious nuclear growth.

Viewers will be able to tell immediately that this is not the first time these combatants have debated. Lapp has even written a book about Nader's views on nuclear energy, calling him a "modern Luddite" who "seeks to head an antitechnology movement." For the most part the panelists either talk past each other or fall to bickering over claims of distortion and misrepresentation, but a wide spectrum of vital issues is eventually covered, and what the debate lacks in reasoned judgment it gains in drama.

Nader takes the traditional environmentalist position that nuclear energy is unsafe and unnecessary—that conservation of the 40 percent of all energy now wasted in this country would tide us over until solar and geothermal energy could be utilized. Ford emphasizes the newer argument favored by nuclear opponents, that atomic energy isn't all it was cracked up to be economically: Many nuclear power projects have been postponed, the capital cost of building a plant has in-

John H. Douglas

Nuclear debate panel, from left: Hosmer, Nader, Laird, Moss, Lapp and Ford.

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creased 10-fold over a decade, and the credibility of the governmental regulatory agencies has declined. He says the latest study of nuclear energy conducted by the American Physical Society (SN: 5/3/75, p. 286) shows that a serious accident involving thousands of deaths is expected to occur every couple of decades.

Not so, counters Lapp; Ford is mistaking probabilities for major and minor accidents, and the APS study actually predicts less than one death a year from nuclear accidents. As for the economic arguments, Lapp cites an Arthur D. Little study showing nuclear costs—including building the expensive plants—to be about half those of conventionally powered electric generation. In just the next five years, he concludes, the United States will save $13.7 billion because of the reactors already on line.

Several times Laird turns, after one of these acrimonious confrontations, to Moss, whom he met years ago as a White House Fellow. Yes, nuclear energy does have unresolved safety problems, Moss says, but so does coal. The current economic problems of reactors have mainly to do with the recession and a reassessment by the utilities of future growth, he continues. Since adequate energy conservation will not likely follow from altruism, new policies must "make sure that the user of energy pays the full cost of the energy he uses." Specifically, Moss recommends repealing the Price-Anderson Act that limits private liability in event of nuclear accidents, and also favors levying emission charges for users of coal and holding coal mining companies responsible for the $1 billion a year paid to victims of black lung disease.

The purpose of the program is to open the nuclear debate to a wide audience, freeing it from the specialists who have been the most vocal so far. "What is the comparison of risks?" asks Hosmer—but no consensus is reached. □

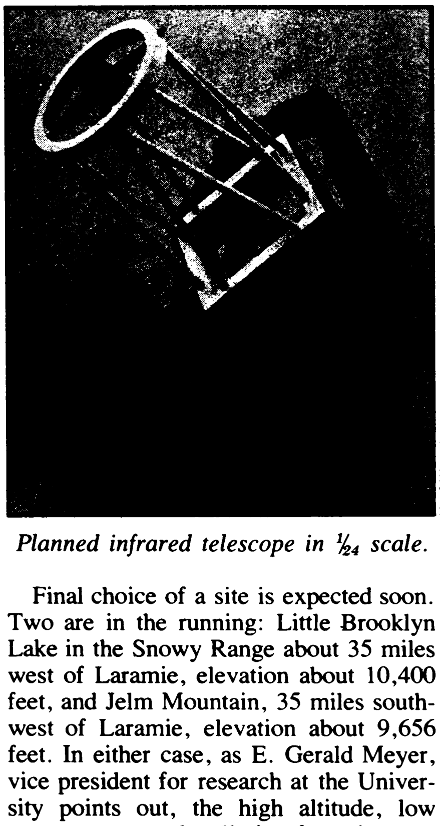
Wyoming site for 84-inch IR telescope

Infrared is a range of the electromagnetic spectrum little used by astronomers until very recently. Water vapor in the atmosphere absorbs infrared very heavily so most of the early work was done from balloons and rockets. But if you get to high enough elevation, the atmosphere gets thinner, and now with highly sensitive equipment it is becoming practical to do ground-based work. (An example is reported on p. 332.) That's where Wyoming comes in.

Wyoming: the bucking horse on the automobile tags, the Union Pacific chugging up Sherman Hill, the wide open spaces where the deer and the antelope—and very few people—play. And some very tall mountains.

"Laramie is a nice place to live," says Robert Gehrz of the University of Wyoming. "Right in the middle of the mountains." In those mountains an infrared telescope will be built that with a reflecting surface 84 inches in diameter will be the largest in the continental United States. The only larger one in the country is a 120-inch installation being built on Mauna Kea in Hawaii. The Hawaiian telescope is especially designed for planetary studies so the Wyoming instrument will be the largest in the country for stellar and galactic infrared observations.

The new telescope will be a national facility administered by the University of Wyoming. Funding, in the amount of $1.6 million, will be by the National Science Foundation and the State of Wyoming. It is rather unusual for a state to contribute to such a fund except through the budgets of universities, and in this case the state's contribution will be the larger share: $975,000 or almost three dollars per inhabitant. The state and other users will bear the operating costs.



U. of Wyoming

Planned infrared telescope in 1/24 scale.

Final choice of a site is expected soon. Two are in the running: Little Brooklyn Lake in the Snowy Range about 35 miles west of Laramie, elevation about 10,400 feet, and Jelm Mountain, 35 miles southwest of Laramie, elevation about 9,656 feet. In either case, as E. Gerald Meyer, vice president for research at the University points out, the high altitude, low temperatures and pollution-free sky produce the extremely dry atmospheric conditions that will enable observations in several infrared windows inaccessible from most existing observatory sites.

Construction is expected to begin this summer. Completion of the telescope, which has been designed by Astro-Mechanics Inc. of Austin, Texas, is planned for 1977. Gehrz, J. A. Hackwell and W. T. Grandy Jr., all of the University's Department of Physics and Astronomy, will supervise construction. □

A hole in ionosphere for astronomy

When the last of the Saturn 5 rockets carried the Skylab workshop into orbit in 1973, its passing left a huge, temporary "hole" in the ionosphere—a region about 2,000 kilometers across, swept nearly clean of its usual population of free electrons (SN: 2/1/75, p. 71). Now two Boston University researchers are proposing that such holes be made on purpose, with the promise of offering radio astronomers a new window to the sky.

It is those free electrons, replenished by photodissociation, that make the ionosphere "a nearly impenetrable barrier" for ground-based radio astronomy at low frequencies, point out Michael D. Papagiannis and Michael Mendillo. Yet the portion of the radio spectrum below about 30 megahertz carries important information about the heavens, from Jupiter's remarkable decametric bursts to the 3-MHz peak in the radio intensity of the whole galaxy.

At night, the number of free electrons drops sharply in much of the ionosphere—the so-called D, E and F1 layers—due to natural processes that cause the electrons to recombine with readily available ions. Higher up, however, in the F2 layer, such processes are far less active. And here is where what Papagiannis and Mendillo call the "Skylab effect" could be a valuable discovery.

The 1973 hole occurred when the hydrogen and water vapor in the exhaust of the Saturn rocket's second-stage engines combined with oxygen atoms in the F2 layer to form positively charged ions, which then combined with the negatively charged electrons. The effect could be easily duplicated, the astronomers point out in the May 1 NATURE, by deliberately injecting molecular hydrogen into the region from an inexpensive sounding rocket. It becomes merely a matter of injecting the hydrogen over the site of a radio telescope. "This artificial ionospheric window," they report, "should allow radio astronomical observations to be carried out from the ground between 1 and 6 MHz, and possibly at even lower frequencies."

At present, low-frequency radio astronomy is almost entirely limited to what can be done from satellites. This means, among other drawbacks, that angular resolution is almost inevitably poor because the wavelengths at such frequencies are usually longer than the satellite antennas. A single 1-MHz wave, for example, is 300 meters long. Ground-based observations allow not only larger single antennas, but also the possibility of interferometry through multiple antenna arrays.

In the mid-1950's, pioneer radio astronomers G. R. Ellis and G. Reber at-