science news

Jan. 20, 1973
vol. 103, no. 3, 33-48

Quasars: Decade-long mystery
First results from Copernicus
Structure of tRNA molecule



# Getting proteins into mammalian cells

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# science news ®

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COVER: Amino acids ride sodium and ATP through the mammalian cell membrane. See p. 44. (Photos: Erich Heinz of Frankfurt, Germany, a pioneer in cell transport research, by Joan Arehart-Treichel; and mammalian cell membranes by John and Trudy Forte of the University of California)


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# to the editor

## Complacency on environment

I have been a constant reader of the SCIENCE NEWS since the early 1930's and even since my retirement last year can't do without it.

The veiled implication reflected in John Maddox's *The Doomsday Syndrome* (SN: 12/9/72, p. 371), indicating that we should approach the population-pollution problem with calm scientific analysis disturbs me greatly.

Do we need anything "more securely grounded in facts" than that—

> One-half of the world's population suffer from malnutrition and four million died of starvation this year.
>
> In Sweden 40 bodies of water have been closed to fishing and swimming.
>
> In Milan the smog has reduced the average life span by three years.
>
> In the city of Calcutta one-half million must sleep in the streets.
>
> In Tokyo oxygen is sold in vending machines.
>
> Our Lake Erie is a swollen, choked up mess of sewage.
>
> The Hudson River resembles a flowing sewer.

Must we first live like rabbits in a coop before we wake up to these truths?

*Gerrit Zwart, D.Sc.*
*Suffern, N.Y.*

**My own reaction** to *The Doomsday Syndrome* by John Maddox was somewhat less charitable than yours. To me the book was at best an unwarranted attempt to discipline an upstart rival, THE ECOLOGIST.

The role played by Mr. Maddox could be likened to that of a stodgy old Londoner, who when roused from a sound sleep by a noisy fire alarm, would petulantly label the good citizen who reported the fire an alarmist.

*The Doomsday Syndrome* is only the forerunner of the many pooh poohers which are sure to appear soon. For example, now that the birthrate in the U.S. is showing a decrease, many complacent reports are abroad that there is no longer a problem, if indeed there ever was one. It is always more profitable or more satisfying it seems, to detract or discount the efforts of those responsible for improvement than it is to compliment or credit them.

As a lifelong petroleum geologist who reads very widely and objectively, I found Mr. Maddox's work disappointingly shallow in many places and downright inaccurate in others. Time after time he attacks positions which are not even occupied by those he seems to be trying to destroy, thus doing great injustice by implication. In attempting to discredit a competitor or to build his own ego or for financial gain, he has introduced a dangerous element of complacency which will be accepted by a great number of unwary readers.

At this desperately critical time, the one thing we need least of all is complacency.

*Louis A. Bibler*
*Geologist*
*Kalispell, Mont.*

## Iron ivory tower

Regarding "Anthropologists and the glass bead game" (SN: 12/9/72, p. 374).

The trouble with intellectuals is surely not "ivory-towerism," but the opposite—whether one calls it "involvement" or "incitement" or *La Trahison des Clercs.*

Indeed, Julien Benda's description of the trouble seems much too mild. His phrase can be taken literally. Intellectuals betray not only the "ivory tower," though "ivory-towerism" is the only reason for calling anybody an "intellectual"—they betray everybody. The ivory tower is to be an iron one. They will *make* everybody play their glass bead game, and according to their rules, if they can agree on their rules. . . .

*Richard M. Hodgens*
*Glen Ridge, N.J.*

## Plaudits

I would like to congratulate you both on your scientific judgment in recognizing developments of fundamental significance and on the excellence and accuracy of your reporting. The service to science and to the public of the type of journalism that SCIENCE NEWS represents cannot be overestimated.

*Henry Paulus*
*Associate Professor*
*Department of Biological Chemistry*
*Harvard Medical School*
*Boston, Mass.*

## Countering doubts on the pill

Your readers of the excellent story "The pill: Confusion over cancer issue" (SN: 11/11/72, p. 308) may be interested in the related views and research of Dr. Charles B. Huggins (U. of Chicago 1966 Nobel laureate for physiology or medicine):

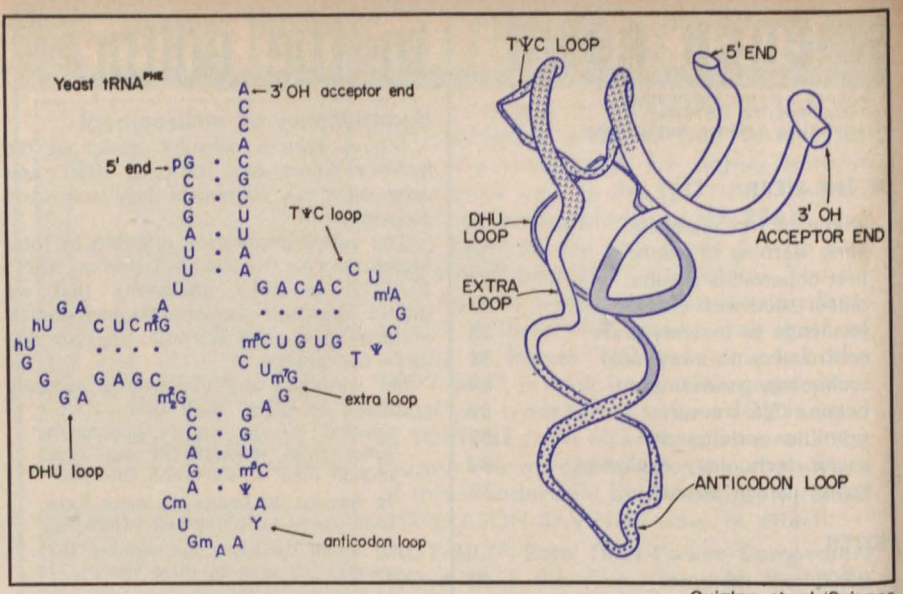
> ". . . Literally tons of estrogen have been consumed by women. There has been no epidemic of breast cancer. To the contrary, the incidence of breast cancer has declined. Conclusion: from the standpoint of clinical observation and experimental medicine, the combination of estrogen and progestational compounds has extinguished early cancer in animals. It has not been followed by an increased incidence of cancer in women.
>
> "The combination of these steroids has been worthwhile in the treatment of women with far-advanced cancer of the breast. In patients, the combination of huge amounts of progesterone and of estradiol, injected intramuscularly, induced measurable and worthwhile improvement in patients with far advanced disseminated mammary cancer, both in women and men. . . .
>
> "It is only fair, right, and just that this story emerge now and that women be reassured that contraceptive pills are not dangerous."

Huggins made that statement at Chicago on Oct. 11, 1971. He has held similar views and expressed them as early as his Nobel address in November 1966.

*Phillip E. Miller*
*Science Editor*
*News Service*
*Michigan State University*
*East Lansing, Mich.*

# The L-shaped double helix

**The three-dimensional structure of transfer RNA has been determined**




Quigley et al./Science

*The shape of tRNA: In the previous two-dimensions (left) and now in three.*

The past 30 years has seen an explosion in molecular biology, the study of living things at the subcellular level. Molecular biologists have learned that a large chemical molecule, DNA, carries the heredity code in each cell. This DNA molecule passes specific messages to other large molecules, the messenger RNA's. When an mRNA receives a message, it moves over cell bodies known as ribosomes, sort of as a conveyor belt moves over stepping stones.

As an mRNA moves along, still other large molecules, the transfer RNA's, intercept the mRNA message. The message tells how to line up certain amino acids. Each tRNA is able to recognize certain chemicals in the tRNA. Upon recognition each tRNA puts one of the 20 different kinds of amino acids into place.

As the tRNA's deposit one amino acid after another, in a chain, a protein is born. This production takes place continually in cells from the lowest to the highest life forms. Each of the 180 billion cells of the human body is estimated to be capable of making seven million different kinds of proteins.

The three-dimensional structures of some DNA molecules have been partially determined, by the technique known as fiber crystallography. So have the structures of some mRNA's. For some time scientists in the United States and abroad have tried to determine the three-dimensional shape of a tRNA. A team of biologists at the Massachusetts Institute of Technology has now done so. They used X-ray crystallography, which gives a sharper picture than fiber crystallography. Their achievement, reported in the Jan. 19 SCIENCE, should lead to improved scientific understanding of the role of tRNA's in life's universal protein-production processes.

First the MIT team looked at the yeast tRNA at a resolution of five angstroms, then at four, then at three. Each time they got a clearer picture of the molecule. Ultimately, G. J. Quigley, one of the researchers, told SCIENCE NEWS, "we could actually see the polynucleotide chain [that comprises the molecule]." They found that the chain makes two double-stranded helical regions oriented at right angles to each other in the shape of an L. The chain twists and turns to form the L.

The structure surprised a number of scientists who thought the tRNA structure would be clover-shaped. The nucleotide sequences of some 40 tRNA's are known; all would be capable of forming clovers. The MIT team already knew, from work by other researchers, what each end of the tRNA does. One end, the anticodon, contains chemicals that recognize certain chemicals in an mRNA. The other end, the acceptor, picks up an amino acid and puts it in place. "The interesting thing," says Quigley, "is seeing the three-dimensional structure that carries them."

Quigley and his co-workers will now try to link the structure they have determined with what is already known about the functions of tRNA's. How, for example, does a tRNA interact with a ribosome? Besides the anticodon loop of the molecule, what do the several other loops do, if anything? They will also try to determine the structures of some other yeast tRNA's that, like the one they studied, code for the amino acid phenylalanine. The molecules may look the same, or they may differ somewhat.

They will also try to determine the structures of some tRNA's from viruses. Viruses are known to use their tRNA's to get a host cell to make virus proteins instead of host-cell proteins. Knowing the structure of some virus tRNA's should shed light on the operation and could be particularly valuable for cancer virus research. Transfer RNA's, Quigley believes, are closely linked with changes in protein synthesis that take place in cancer cells. □

## Premonitory signals of large earthquakes

As the toll from earthquakes in populated areas grows, so does the list of geophysical phenomena thought to be associated with them. Hopes for prediction of earthquakes have been pinned on magnetic field changes, variations in pore pressure and even on the frequency of lightning. Now four researchers at the Lamont-Doherty Geological Observatory have found evidence for another precursor.

Yash P. Aggarwal, Lynn R. Sykes, John Armbruster and Marc L. Sbar used six portable seismographs to monitor a swarm of small- and moderate-sized earthquakes in the Adirondacks of New York. Earthquakes produce two types of waves that travel through the earth, compressional (P) and shear (S) waves. The Lamont scientists found large premonitory changes in the ratio of the P and S velocities of waves caused by small tremors that correlate with the occurrence and size of larger shocks. Before one especially large tremor, the ratio decreased 13 percent. The duration of the decrease (though not its magnitude) was longer for larger earthquakes. Because the phenomenon could be observed for such small quakes, the four suggest in the Jan. 12 NATURE that studies could be continued by creating tiny quakes with explosions. □

## The evolving story of star formation

The birth, life and death cycle of stars—"from dust to dust"—is central to an understanding of the evolution of the universe. Telescopes aboard the spacecraft Copernicus, launched Aug. 21 (SN: 9/2/72, p. 156), are now shedding light on this process. "The ultimate goal," says Lyman Spitzer Jr. of Princeton University and co-investigator with John B. Rogerson for the ultraviolet telescope, "is an understanding of how gas between the stars condenses to form new stars, and how dying stars eject heavier elements back into the gas."

This birth-death cycle will have to be pieced together carefully from the data now beginning to come in, astrophysicists say. At the meeting last week of the American Astronomical Society in Las Cruces, N.M., Spitzer, Rogerson, Jerry F. Drake, Donald C. Morton, Edward B. Jenkins and Donald G. York, all of Princeton, presented the first results from the new satellite. "There were two major shockers," says one of the participants. Copernicus found vast quantities of molecular hydrogen in all the denser, obscuring clouds of dust in the galaxy and surprisingly large amounts of deuterium in the hydrogen molecules between the stars.

Hydrogen is most frequently found in the atomic form. Drake reported, however, that "more than 10 percent of the hydrogen gas in the denser clouds is in the molecular form." But, says Drake, "the most surprising finding is that apparently one out of about every 200 molecules formed in these denser clouds contains deuterium."

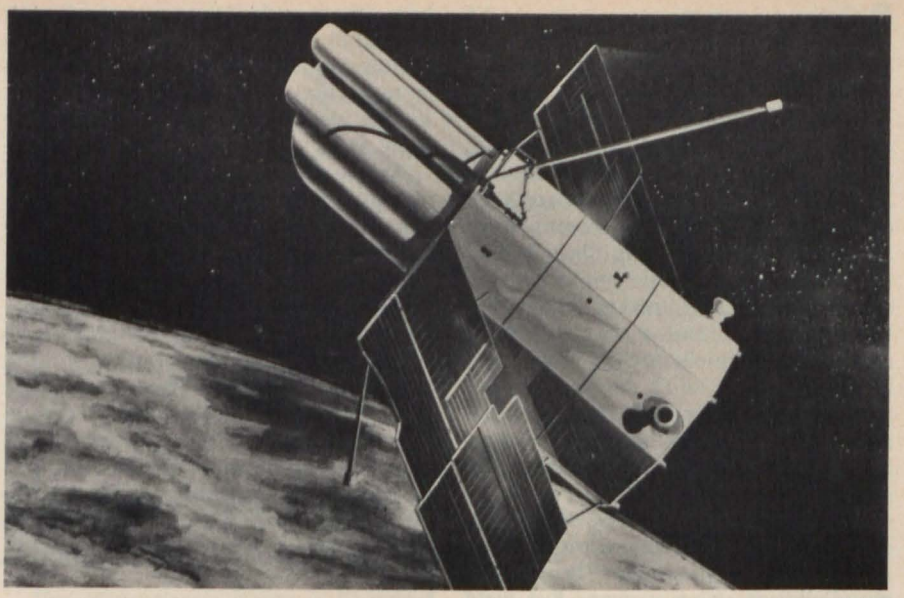
It would appear that since the molecular hydrogen is found in the dust regions, molecular hydrogen is formed on the dust grains themselves. Ultraviolet light from the stars dissociates some of these molecules, but most are shielded from the starlight by other hydrogen molecules. This "self-shielding" effect of hydrogen was figured into the new data. But the hydrogen-deuterium molecules are not plentiful enough to produce this self-shielding and are being destroyed. What the astrophysicists are not sure of is the formation rates. If the hydrogen-deuterium molecules are formed faster than the hydrogen molecules, it would upset the theoretical ratio of deuterium to hydrogen. "This will have to be looked into carefully," said Drake.

"If this high abundance of deuterium holds true in general for interstellar gas," Drake added, "previous theories on the formation of deuterium in the early history of the universe will have to be revised." Current theory holds that since deuterium is a basic element for fusion, most of the deuterium should have already been used up in forming more complex elements in the stars (SN: 1/13/73, p. 23).

The chemical composition of the dust clouds was also outlined from the new data. Morton cited abundances for phosphorus, chlorine, manganese, carbon, nitrogen, oxygen, magnesium, silicon, sulfur and iron. There is evidence, he said, that the heavy elements are depleted compared to abundances found in the sun. The data are firm for magnesium, phosphorus, chlorine and manganese, but others appear to be depleted as well. This suggests the heavier elements are accreting onto the dust, indicating a process of evolution occurring now in the clouds.

The gas between the denser clouds is more rarefied than previously assumed, Rogerson reported. The elements carbon, nitrogen, oxygen, silicon and argon have about the same relative abundance as in the sun. However, "the amount of gas present appears to be less than a third of the smallest value previously reported," he noted.

It is possible in radio astronomy to detect cold molecules in space only within special regions where the gas is known to be considerably more condensed than typical interstellar clouds. Copernicus enabled the astronomers to look at cold molecules in normal regions. Jenkins reported that carbon monoxide molecules are at very low temperatures of 5 degrees K. Since occurrence of the big bang (if indeed that is how the universe got started), the background temperature has been cooling down and is now about 3 degrees K. The carbon monoxide molecules were probably warmed up by collisions with other interstellar particles. □



NASA

*Copernicus: Hydrogen molecules and surprising amounts of deuterium.*

## Seeds for survival: Oldest plant embryo

Discovery of ancient seeds is nothing to shout about; paleobotanists have been unearthing them for years. But two University of Montana botanists have found some ancient seeds that are different: They contain embryo tissue. The two, C. N. Miller and J. T. Brown, found the seeds in a fossilized conifer cone in the Glass Mountains of Brewster County, Texas. The cone contained three complete seeds and fragments of two others. From the age of the rock formation where the fossil was found, the two estimate that the seeds are at least 280 million years old.

The fossils are the oldest plant embryos yet discovered. But the discovery has additional significance. The embryos had formed in the seeds before the seeds were dispersed from the cone. There is considerable evidence suggesting that in most plants in the Paleozoic era (230 million to 600 million years ago) the embryo did not form until the seed had been dispersed from the parent plant and had found a suitable bed for growth. In present-day plants, embryo growth is essentially complete by the time the seed is dispersed. The Glass Mountain seeds represent the earliest known occurrence of the modern sequence of embryo development.

The researchers suggest in the Jan. 12 SCIENCE that development of an embryo before dispersal gives a seed a better chance of survival in the cold and that the modern sequence of embryo growth evolved as an adaptation to a cooling climate. The seeds they found support this hypothesis: They are from a period when the earth's climate was getting cooler. □

## Being sane in insane places

Yossarian found out in Joseph Heller's *Catch-22* that the U.S. Army often confuses sanity with insanity. But the Army is not the only place where such confusion occurs. D. L. Rosenhan of Stanford University says that mental health professionals are guilty of the same mistake. To illustrate his contention, Rosenhan had eight normal or sane persons (including himself) gain secret admission to 12 different psychiatric hospitals. The goal of the experiment was to determine whether these individuals would be discovered to be sane and, if so, how.

Among the subjects were three psychologists, a pediatrician, a psychiatrist, a painter and a housewife. Three of the pseudopatients were women, five were men. All were considered normal and none had ever suffered symptoms of serious psychiatric disorders. Each of the pseudopatients called a psychiatric hospital for an appointment and was admitted after complaining of "hearing voices." Beyond alleging the symptoms and falsifying name, vocation and employment, no further alterations of person, history or circumstances were made. The significant events of the pseudopatient's life history were presented as they had actually occurred. Frustrations and upsets were described along with joys and satisfactions. If anything, says Rosenhan, these facts should have biased the subsequent results in favor of detecting sanity since none of the histories or current behaviors were pathological in any serious way.

In the Jan. 19 SCIENCE Rosenhan reports that not only were all pseudopatients admitted, but 11 of 12 cases were diagnosed as schizophrenic (one individual with identical symptoms was diagnosed as manic-depressive).

To gain release as soon as possible, each patient ceased simulating any symptoms immediately upon admission. Each was cooperative and attempted to convince the staff that he was sane. Despite this public show of sanity, says Rosenhan, the pseudopatients were never detected by the hospital staffs. But, he says, it was quite common for the other patients to detect the pseudopatients' sanity. During the first three hospitalizations 35 of a total of 118 patients voiced these suspicions saying, for instance, "You're not crazy. You're a journalist, or a professor. You're checking up on the hospital."

The length of the hospitalizations ranged from 7 to 52 days, with an average stay of 19 days. Each patient was finally discharged with a diagnosis of schizophrenia in remission. "Once labeled schizophrenic," explains Rosenhan, "the pseudopatient was stuck with that label. If the pseudopatient was to be discharged, he must naturally be in remission; but he was not sane, nor, in the institution's view, had he ever been sane."

To see whether this tendency to diagnose the sane insane could be reversed, another experiment was arranged at a research and teaching hospital whose staff knew the results of the first experiment. The staff was informed that one or more pseudopatients would attempt to be admitted to the psychiatric hospital. They were then asked to rate each incoming patient on the likelihood that he was a pseudopatient. Judgments were obtained on 193 patients who were admitted for psychiatric treatment. Of them, 41 were alleged to be pseudopatients by at least one member of the staff. Twenty-three were considered suspect by at least one psychiatrist. Nineteen were suspected by one psychiatrist and one other staff member. Actually, admits, Rosenhan, "no genuine pseudopatient (at least from my group) presented himself during this period."

The results of these experiments raise many legal, ethical and therapeutic questions. As partial solutions, Rosenhan suggests more emphasis be put on the community mental health movement and behavior therapies that avoid involuntary incarceration and psychiatric labels. Any diagnostic process, he says, that lends itself so readily to massive errors of this sort cannot be a very reliable one. □

## Coherent X-rays? Controversy over evidence

The successful development of an X-ray laser would lead to many important applications, such as X-ray holograms and the use of coherent X-rays in atomic and nuclear investigations. Thus there is great interest over the experiment reported last summer by John Kepros, Edward M. Eyring and William Cagle Jr. of the University of Utah which, they say, has produced coherent X-rays, an important first step toward an X-ray laser (SN: 8/19/72, p. 116). Now there is great controversy about it as well.

The experiment uses sandwiches of a copper-sulfate gel between plates of glass. These are subjected to bursts of laser light. This, says the Utah group, produces coherent X-rays. As evidence they cite spots on X-ray film they believe are caused by passage of the X-rays. Since the spots are the same size on films placed at different distances from the sandwich, the Utah group believes that the X-rays are collimated, evidence for coherence.

Thomas A. Boster of the Lawrence Livermore Laboratory alleges that X-rays are not responsible for the spots. If X-rays had caused the spots, he says, the spots on the first plate in a stack would be much darker than on the second, and so on lighter and lighter. In the Utah case the first emulsions had no spots. Kepros replies that Boster is overlooking work by Marguerite Ehrlich in 1956 that indicates there would be a bleaching effect on the first emulsion. Boster further says he can produce the effect shown on the films without any radiation source, simply by rubbing them. He ascribes the spots to electric charges brought about by rubbing, a triboelectric or triboluminescent effect. Boster does not deny that there may be some X-rays present, but he says the evidence cited does not come from X-rays.

Kepros responds that Boster's film packs were wrapped in Mylar, an electrostatic substance that might produce a triboelectric effect. Kepros says his films were wrapped in aluminum foil, which is not electrostatic. This week Kepros tried an experiment in which he tried to reproduce Boster's effect in Mylar- and aluminum-wrapped films. Very preliminary results indicate that triboelectric spots do appear on Mylar-wrapped film but not on aluminum-wrapped film.

Ray C. Elton of the Naval Research Laboratory, who has also tried to repeat the coherent X-ray results, describes himself as "neutral." Elton says he and his co-workers have tried to reproduce Boster's triboelectric results. but have been unable to. But Elton cautions that humidity might have canceled out electrostatic effects. Elton has been able, with a set-up similar to that of Kepros and associates, to produce similar spots on X-ray film. But when he puts on other kinds of X-ray detectors, photon counters, for instance, they do not respond. Elton hopes to do an experiment with both films and counters on the line.

Elton believes what is needed is a lot more work. The Kepros effect is a very delicate one to produce and the statistics are poor. But Elton says he is afraid people may lose patience and that funds for further work may be refused. Then "for the rest of eternity people will wonder whether Kepros really did have something there."

## Kennedy to chair TAB; Daddario seen for OTA

A chairman and two new members have been named for the Technology Asessment Board, the joint Congressional unit that will control the Office of Technology Assessment, recently established to serve the Congress (SN: 10/28/72, p. 279). Sen. Edward M. Kennedy (D-Mass.) has been voted the first chairman by a Senate caucus. Sen. Clifford P. Case (R-N.J.) and Rep. Olin Teague (D-Tex.) have joined the board to replace, respectively, Sen. Gordon Allott (R-Colo.) and Rep. Earle Cabell (D-Tex.); both left Congress as a result of the November elections.

A vice chairman of the 12-member board remains to be chosen by a House of Representatives caucus. (The chairmanship and vice chairmanship will alternate between the Senate and the House with each Congress—the Senate taking the higher post in each odd-numbered Congress.) A director for the Office of Technology Assessment may be named when the TA Board holds its first executive meeting Jan. 30.

Emilio Q. Daddario, former Democratic member of the House from Connecticut, seems likely to be appointed director. He introduced the original bill for a Congressional technology assessment body in March 1967. He promoted the theme vigorously until leaving the Congress late in 1970 to seek (unsuccessfully) the governorship of Connecticut. A spokesman for Rep. John W. Davis (D-Ga.), chairman of the House Subcommittee on Science, Research and Development, which Daddario formerly headed, says, "Daddario has it pretty much under wraps. He's the only one they're talking about for the job."

Davis is a fourth member of the TA Board. The others are Senators Hubert H. Humphrey (D-Minn.), Ernest F. Hollings (D-S.C.), Richard S. Schweiker (R-Pa.), and Peter H. Dominick (R-Colo.); and Representatives Mike McCormack (D-Wash.), Charles A. Mosher (R-Ohio), James Harvey (R-Mich.), and Charles Gubser (R-Calif.).

Daddario, a lawyer, has been working as a vice president with Gulf and Western Industries, Inc., a large conglomerate. Since leaving the Congress he has spoken frequently on college campuses about technology assessment, and has taught a course on science and technology issues at the Massachusetts Institute of Technology.

"Assessment is a form of policy research and is not technological forecasting or program planning," Daddario wrote while a Congressman. "It is a balanced analysis of how a technological program could proceed with the benefits and risks of each policy alternative carefully described. It incorporates prediction and planning but only to expose the potential consequences of the program. . . . Assessment is an aid to, and not a substitute for, judgment."

The act creating OTA says its assessment activities may be initiated upon the request of the chairman of any Congressional committee, by the TA Board, or by the director, in consultation with the board. It is expected to be at least April before any of these activities can get under way; funds authorized for OTA will not be available until a supplemental appropriations bill passes Congress. □

## Taking the Mid-Atlantic Ridge's seismic pulse

The Mid-Atlantic Ridge is Excedrin Headache #34 for many seismologists. The 15,000-mile-long underwater ridge is a well-known locus for seismic activity, but it is frustratingly difficult to study. Most of the earthquakes are too tiny to be pinpointed by existing arrays of seismometers, and a mountain chain lying under thousands of feet of water is not easy to place instruments on. Up to now, all that seismologists have been able to say is that the microearthquakes tend to straddle the median valley that splits the ridge lengthwise in some places and that the quakes are generally shallow.

Scientists at the Institute of Geological Sciences in England and the United Kingdom Atomic Energy Authority have developed a portable seismograph that can be plunked down on top of the ridge and later recovered. T. J. G. Francis and I. T. Porter now report results of the first experiments using it.

Two of the instruments were dropped along the ridge at about latitude 45 degrees north, one into the median valley and one about 30 kilometers away from it. Acoustic tracking of the instruments as they dropped, combined with a number of satellite fixes, enabled the researchers to pinpoint the positions of the sunken seismographs to within 0.1 nautical mile.

The data from the two sea-floor seismographs, the scientists report, show that the microearthquake activity along the Mid-Atlantic Ridge is largely confined to the median valley. The seismograph in the valley recorded 30 microearthquakes a day. The other detected only six, and from travel times the researchers deduced that even these six originated in the median valley. At the end of the recording period, an explosive bolt was fired, releasing the buoyant instruments from their sinkers and allowing them to float to the surface for recovery. □

## Uranium enrichment

Since World War II the processes by which uranium reactor fuel is enriched have been a Government monopoly. For the last two years the U.S. Atomic Energy Commission has been pursuing a program by which interested private firms have been progressively introduced to various parts of the technology to see whether they would like to engage in it. Early in 1972 the AEC was surprised and a little embarrassed by a bid from the Reynolds Metal Co. (SN: 4/8/72, p. 228). Now the AEC announces that it has accepted the proposals from seven private companies to engage in the work: Reynolds (for the gaseous-diffusion process) and Electro-Nucleonics Inc., General Electric, Goodyear Tire and Rubber, Jersey Nuclear, United Aircraft and Westinghouse (all for the gas-centrifuge technology). □

## GE-Soviet technology

An agreement for joint development of electric-power generating technology was signed last week between the General Electric Co. and the Soviet Government, specifically, the State Committee for Science and Technology of the Soviet Union. The accord provides for the exchange of specialists and of samples of turbines and other power equipment and for joint research and development projects. The exact amount of money involved is not stated, but a General Electric spokesman refers to a foundation that may lead to hundreds of millions of dollars worth of business between GE and the Soviet Union. □

## Soviet cancer viruses

The agreements on medical science and health signed by the United States and the Soviet Union last May 23 opened the way for, among other things, exchange of samples of viruses suspected of causing cancer in humans (SN: 6/3/72, p. 357). In November, American cancer scientists headed by John Maloney of the NCI went to Moscow to swap information on cancer virus research. Two weeks ago, the NCI received an unexpected present from the Soviets: samples of six possible human cancer viruses. The four American candidate human cancer viruses, in spite of initial downgrading by NCI scientists (SN: 9/18/71, p. 185), are still in the running and being checked out by NCI, Maloney told SCIENCE NEWS. "We'll put the Russian viruses through the same rigamarole." Elizabeth Priori of Houston, a discoverer of one of the American viruses, says, "We are curious about these Russian viruses." □

# behavioral sciences

## The mind is quicker than the eye

Perception is explained in two ways: as a passive acceptance of the world of sensed objects or as an active process of inferring the object world from sensory data. Until one of these models or paradigms is accepted, the discussion and evaluation of perceptual data will be confused and less than scientific, says Richard L. Gregory of the University of Bristol. Speaking at the meeting of the American Association for the Advancement of Science, Gregory opted for the active hypothesis and explained why.

The passive or empirical model, he says, does not adequately explain perceptual phenomena, such as illusions, where perception departs from the object world. Using a variety of visual illusions, Gregory showed how the mind actively infers and predicts from incomplete data. The classic example is the three-dimensional shape of an object seen with a single fixed eye. Gregory says such predictions, rather than direct acceptance of sensual data, control behavior. This, he goes on, "takes us quite away from a stimulus-response paradigm of behavior."

## Growing up feminine

Standard descriptions of the female sex role include such characteristics as passive-dependent, nurturant, attractive, emotionally responsive and socially poised. The key characteristics for men are usually independence, aggressivenesss and self-reliance. Psychologists and mental health experts have generally assumed that it is good for women to be feminine and good to bring up girls to be well adjusted to the feminine sex role.

Discussing sex role and sex-role identity at the AAAS meeting, Julia A. Sherman of the University of Wisconsin charged that raising girls to conform to the stereotyped characteristics of femininity produces immature, mentally maladaptive, physically unhealthy (a higher rate of spontaneous abortion) and socially incompetent individuals. It would be better, she says, to learn how to rear competent females than feminine ones. But, she goes on, "so long as the psychology of women remains a practically unknown field of research, so long as female professors constitute a mere handful in the major research institutions, it will be extremely difficult to begin the detailed research necessary."

## Developing and predicting aggression

A ten-year study of 427 children was made to determine which environmental variables function in the development of aggression. The children were interviewed and given psychological tests in third grade and again one year after they completed high school. Monroe M. Lefkowitz of the New York Department of Mental Hygiene, L. Rowell Huesmann of Yale University, Leopold O. Walder of the Organization for Research in the Behavioral Sciences in Greenbelt, Md., and Leonard D. Eron of the University of Illinois at Chicago Circle reported at the AAAS meeting that four classes of variables affect (in varying degrees) aggressiveness during childhood, and are reliable predictors of aggression in young adulthood. These are: punishment rendered to the child for aggressive behavior, instigation to aggression that the child receives (parental rejection and disharmony and low I.Q. are viewed as instigators), identification with parents and the sociocultural environment.

# earth sciences

## What the Phoenix tells us

Magnetic reversals are worldwide phenomena, so their records imprinted on the ocean floors provide a handy way to correlate events that occurred in different places. Roger L. Larson, Clement G. Chase and Walter C. Pitman III of Lamont-Doherty Geological Observatory have been doing some ambitious correlating.

Larson and Chase derived a chronology of magnetic reversals from magnetic anomaly patterns near the Phoenix Islands in the western Pacific. This sequence correlated with sequences found near Japan and Hawaii. They determined that when the three sequences were being imprinted on new ocean floor about 150 million to 110 million years ago, they were in the same relative positions, but the entire set was 4,500 kilometers farther south. The researchers inferred that there were five spreading centers joined at two triple junctions. The northern triple junction jumped southeast about 100 million years ago; the southern one migrated to the south-southeast.

* * * *

But that's not all. Larson and Pitman then correlated a reversal model for the Hawaiian sequence with a magnetic sequence that had previously been found for the Atlantic. Sediment samples had already enabled them to date certain points in the Hawaiian sequence, and when these dates were applied to the Atlantic, they forced revision of previous notions of when some events took place. For example, the opening of the Bay of Biscay, a point of some contention, apparently occurred 150 million to 110 million years ago. All sequences combined gave evidence of a global surge in spreading rate from 110 million to 85 million years ago. The Lamont scientists' reports appear in the latest GEOLOGICAL SOCIETY OF AMERICA BULLETIN.

## Vema on the Vøring

In the study of sea-floor spreading and plate tectonics, continental margins assume special significance, for it is there that plate interactions or early stages of spreading often occur. In the December GEOLOGICAL SOCIETY OF AMERICA BULLETIN, Manik Talwani and Olav Eldholm of Lamont-Doherty Geological Observatory summarize the results of geophysical surveys off the western coast of Norway from the research ship Vema. They report that, buried beneath the deep sediments of the Vøring Plateau is an escarpment that may mark the site where the Norwegian Sea opened. The sediments are up to 6 kilometers deep and as old as 250 million years. The two believe that the escarpment acted as a dam to trap the sediments and form the plateau.

## How much stuff in seawater?

Several studies have attempted to determine the kind and amount of suspended matter in seawater. Two British oceanographers, R. Chester and J. Stoner of the University of Liverpool, sampled surface waters in the Atlantic and Indian Oceans and the China Sea and submit their results in the Dec. 29 NATURE. They conclude that in open-ocean surface waters the amount of suspended matter ranges from 50 to 500 micrograms per liter. This is somewhat less than previous estimates. Along coasts and inland seas the values are higher; in the Irish Sea they average 1,680 micrograms per liter.

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**Bank Marketing Management, Feb., 1970.*

### About the Authors

**Martin J. Meyer** is president of the National Depositors Cooperative Association. He also serves as Vice President and Secretary of Intercept Tele-Communications, Inc., a new international cable and telegraphic interception and forwarding organization. Mr. Meyer has written numerous magazine articles on banking, thrift, and inflation.

**Dr. Joseph McDaniel, Jr.** was secretary of the Ford Foundation from 1953 until his retirement in 1967 and Dean of the School of Commerce at Northwestern University. His distinguished career includes President of World Health Foundation (U.S.A.) and government service with the Economic Cooperative Assn.

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# physical sciences

## Iron in the April 17 solar flare

The particles that reach the neighborhood of the earth from outbursts such as solar flares can provide information about the sun and about the means by which the particles were accelerated and propagated through interplanetary space. In the Jan. 1 PHYSICAL REVIEW LETTERS R. L. Fleischer and H. R. Hart Jr. note that until recently there were no data on such particles in the very-low-energy range from a few million electron-volts per nuclear mass unit (MeV per nucleon) down to a thousand electron-volts per nucleon, which is about the energy of particles in the solar wind.

That deficiency was eliminated by the flight of Apollo 16, which carried cosmic-ray detectors for solar and other particles. It happened that a solar flare occurred on April 17, 1972, and was recorded by the detectors.

Fleischer and Hart report that at low energies the flux of iron relative to lighter nuclei (carbon and heavier) is greatly enhanced. The fact leads them to suggest that heavy nuclei are more abundant in solar flares than in the surface of the sun.

## An eye on the sun's magnetic field

A new solar telescope is being built at Kitt Peak National Observatory near Tucson, Ariz. It will be the second solar instrument at Kitt Peak; the 60-inch Robert R. McMath Telescope is the first. The initial purpose of the new telescope will be to observe the magnetic field of the sun. From such studies information about the temperature, pressure and physical structure of outermost layers of the sun can be gained. Such information is especially important to knowledge of solar flares. The new telescope will have a 24-inch aperture. The new instrument is called a vacuum telescope because the sun's light passes through a vacuum tank to minimize distortion before an image is formed. The instrument will provide a solar image 13 inches in diameter for analysis with a magnetograph. Completion of the project is expected in June.

## Cross sections for heavy-ion fusion

A recent development in the realm of physical techniques is the acceleration of heavy ions, heavy atomic nuclei that have been stripped of some or all of their electrons. Special accelerators have been built and are being built for the purpose.

One of the experiments possible with accelerated heavy ions is to drive them against other nuclei in targets in the hope of making them fuse with the targets. Studies of this kind can learn much about the dynamics of nuclear fusion and perhaps produce ultra-heavy nuclei that were previously unknown.

A major question with regard to such fusion experiments is whether the cross section (probability) for complete fusion depends more on the properties of the nucleus produced or on the dynamics of the heavy-ion interaction that produces it.

In the Jan. 1 PHYSICAL REVIEW LETTERS J. M. Zebelman of York College of the City University of New York and Columbia University and J. M. Miller of Columbia report that study of three different reactions that produce ytterbium 170 indicate that the complete-fusion cross section depends on the dynamics of the interaction that produces the fusion.

# space sciences

*From our reporter at the meeting of the American Institute of Aeronautics and Astronautics in Washington*

## Heating up the solar energy question

Aden B. and Marjorie Meinel of the University of Arizona, known for their work in solar energy research (SN: 4/8/72, p. 237), told the AIAA meeting that it is time to stop thinking and talking about the use of solar energy and start acting. To illustrate the urgency for more direct work, they presented the timetable from start of intensive work to effective use by society: thermal heating of buildings, 3 to 5 years; biogenic methane, 5 to 10 years; photothermal power system, 10 to 15 years; photovoltaic land power systems, 15 to 20 years.

Although they assert that solar energy is *the* option for the future, they admit that it must first overcome feasibility hurdles: technical, operational and economic. Example: They cite the construction of the satellite power station concept of Peter Glaser. The station would use photovoltaic conversion to produce electric power, which would then be transmitted to earth via large microwave antennas. A 1,000-megawatt system would have to be carried into low orbit by 50 to 100 individual space-shuttle launches, assembled in orbit by astronauts, then space-tugged into synchronous orbit. If one could achieve a 20-year life for each station, and the United States needed one million megawatts, it would require the activation of 50 systems each year. This would mean 14 space-shuttle launches a day forever.

If the option chosen were solar power ranches, meeting the needs of the United States by the year 2,000 would require 7,000 square miles of collectors on about 14,000 square miles of land.

## Maneuvering in zero gravity

Skylab, scheduled for launch April 30 and May 1, will provide the first opportunity to test extensively a maneuvering unit designed to help the astronauts move around in weightlessness. Two such units were developed for Gemini, but only one received very limited evaluation, according to Air Force Major C. E. Whitsett Jr. He and P. S. Cramer of Martin Marietta Aerospace in Denver are in charge of the astronaut maneuvering research vehicle for Skylab. The AMRV consists of two parts: a backpack unit and a hand-held maneuvering unit.

## Seeing the sea from orbit

Although the sensors on the first Earth Resources Technology Satellite (ERTS 1) were designed primarily for observation of terrestrial resources, the imagery reveals an amazing amount of ocean detail, according to John R. Apel of the National Oceanic and Atmospheric Administration. Apel showed imagery taken of the New York Bight area Aug. 16. Two features can be seen about 15 miles southeast of New York City. One is ascribed to the legal dumping of acid wastes 8 to 20 hours before the overflight. To the north is a more obscure sewage-sludge dump. Nearby can be seen a train of ripples, either surface or internal, incident upon the continental shelf. They can be seen advancing in the deeper water over the submerged Hudson Valley. Sediment plumes from the Hudson River and from Barnegat Bay can be seen.

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# Getting protein into the mammalian cell

## Amino acids apparently get a free ride into the cell on a sodium shuttle powered by ATP

Joan Arehart-Treichel

*Heinz: Mammalian cells swap amino acids.*

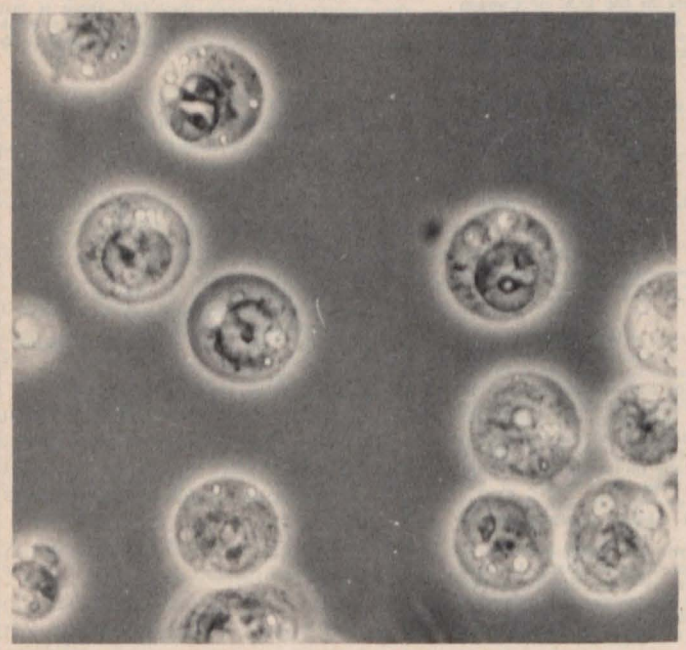
by Joan Arehart-Treichel

Protein is indispensable to man and animals. Skin, muscle, internal organs, nail, hair, brain, the base of bone are protein. Enzymes are protein. Antibodies are protein. Proteins provide energy, help keep blood pressure normal and ward off anemia. Proteins prevent the buildup of waste materials in the body. Overweight, protein-deficient persons can lose seven or more pounds of water the first week they go on a high-protein diet.

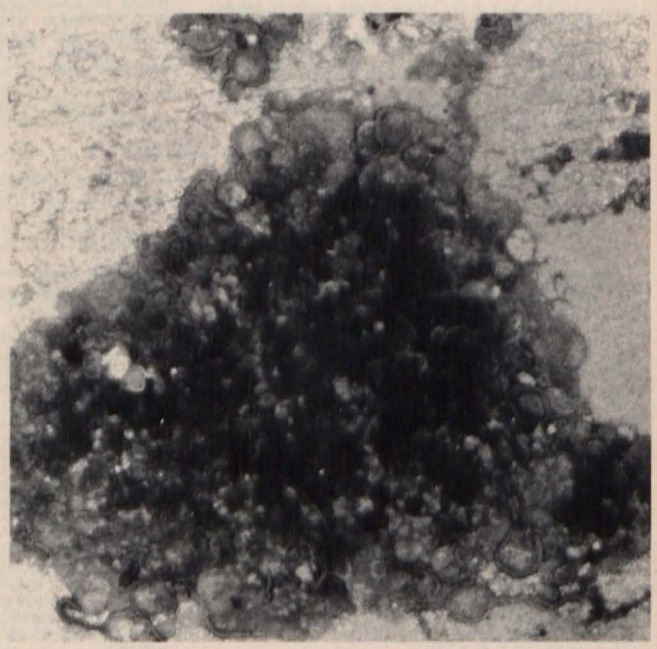
Maintaining a high-protein diet, however, isn't enough to stay healthy. The body must be able to use the protein made available to it. When proteins are eaten, the digestive processes break them down into amino acids. The amino acids pass into the bloodstream and throughout the body. Some 180 billion cells attempt to intercept those amino acids that they need. To get into cells, amino acids require energy, because there are more amino acids inside cells than outside, and newcomers must move against the concentration gradient. Amino acids have been found to use enzymes and lipids on bacteria cell membranes to get into bacteria cells (SN: 7/8/72, p. 28). Amino acids appear to use sodium in the bloodstream and ATP, the universal energy molecule of cells, to get into mammalian cells, Erich Heinz of the Johann Wolfgang Goethe University at Frankfurt am Main, Germany, has found. Heinz is a pioneer in cell transport research.

During the past decade or so, Heinz and other workers have acquired mounting evidence that sodium and amino acids move into the mammalian cell together. In recent months he has found, with John and Trudy Forte, American scientists working in his laboratory, that amino acids stimulate the ATPase enzyme on the mammalian cell membrane. This enzyme catalyzes ATP. In a recent SCIENCE NEWS interview in his lab, Heinz described how these items of evidence might explain amino acid movement into the mammalian cell.

First, he hypothesizes, an amino acid and a sodium ion couple outside the cell. Because there is less sodium inside the cell than outside the cell, sodium can enter without an outside energy source, by simple diffusion. And because the sodium ion is coupled with an amino acid, the amino acid gets a free ride into the cell. As the amino acid passes through the cell membrane, it may stimulate ATPase. ATPase in turn splits a molecule of ATP just inside the



*Mammalian cell membranes 880 times larger than life.*



Photos: John and Trudy Forte/U. of Calif.

*Each cell membrane contains smaller membranous units.*

cell, in the cytoplasm. The energy that comes from this ATP split drives some sodium out of the cell. (ATP is known to drive sodium out of the cell against a concentration gradient.) When sodium is forced out of the cell by ATP, it wants to get back in, where there is less sodium. So this sodium once again enters, giving more amino acids piggyback rides into the cell. Thanks to sodium and ATP, then, amino acids accumulate in the mammalian cell.

More experiments are needed to confirm this hypothesis. For example, it is known that sodium is not needed to get amino acids into most bacteria cells. So Heinz has to satisfy some skeptics in his field who have evidence that sodium, though clearly required to bring amino acids into mammalian cells, is not concerned with the supply of energy for this transport. He and his associates are trying to resolve how much energy for amino acid transport into mammalian cells comes from sodium and how much comes from ATP. Rigorous calculations have given him reason to believe that a third of the energy at most comes from sodium and the other two-thirds from ATP.

Since enzymes and lipids on the bacteria cell membrane have been shown to help amino acids into bacteria cells, Heinz must also explore the possibility that some mammalian cell-membrane chemicals other than ATPase help amino acids enter the mammalian cell. He must likewise clarify a seemingly paradoxical discovery he made several years ago: The more amino acids there are in the mammalian cell, the easier it is for more amino acids to come in. "It is possible," he says, "that amino acids in the cell may stimulate ATPase or another chemical in the membrane to bring in more amino acids."

What might his findings mean to protein intake? Heinz ventures several possibilities. He has found that mammalian cells can exchange certain amino acids they have taken in for needed amino acids that are outside. Because body proteins are being broken down by cell enzymes throughout a person's life, amino acid exchange may be crucial for immediate replacement of destroyed amino acids. "Abundant amino acids," he speculates, "may also be cheaply exchanged for rare ones."

Because Heinz has conducted most of his experiments on mouse tumor cells, he points out that cancer cells might take up amino acids more easily than do normal cells. So far he has no evidence to this effect, though. Still, he suspects that cancer cells might deprive normal cells of the protein they need. He would like to see some cancer researchers infect normal cells with a cancer virus and determine whether the transformed cells change their amino acid uptake. □

# Mystery of the cosmos

## A decade after their discovery, the fundamental questions about quasars still perplex astronomers

Hale Observatories

*3C 273: Simple by light but complex by radio.*

*Oh, quasar, you're not, but you look like a star*
*Won't you please tell us where and what you are?*

by Dietrick E. Thomsen

By now, quasars have been under observation for a decade or more, and yet astronomers have reached no consensus regarding what they are or where they are. The two questions taken separately or together have important effects on basic cosmological theory, and the attention quasars get is probably commensurate with their importance. For the time being, the question of where they are tends to overshadow the question of what they are.

The question of the distances to the quasars engages astrophysicists in an argument that ranges now beyond the quasars themselves to the beginning of a general questioning of Edwin Hubble's conclusions about redshifts. Hubble, in hypothesizing an expanding universe, noted that to any observer in any galaxy in an expanding universe all other galaxies would appear to be receding, and the farther away any galaxy was from the observer, the faster would its apparent recession be. This apparent recession would shift a galaxy's light to the red, and such redshifting was indeed found by Hubble and other observers of distant galaxies.

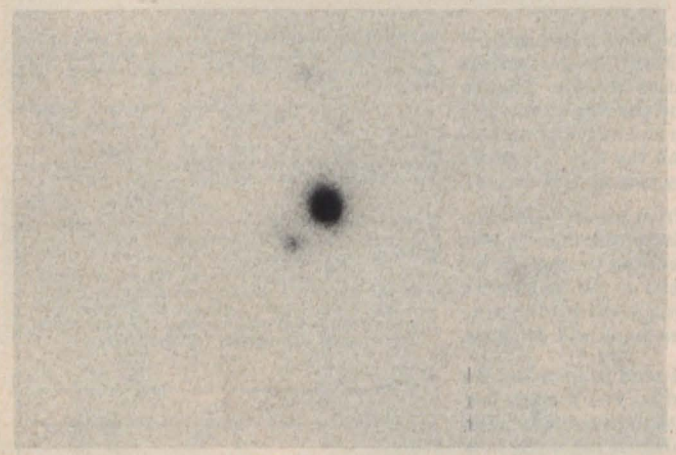
When quasars were discovered, some of them were found to have the largest redshifts of any known celestial bodies. Quasars look like stars, but they radiate light and radio in amounts similar to the radiation of whole galaxies. If these large redshifts are entirely cosmological (due to distance only), they make the radiated power of the quasars even more fantastic since the power output at the source has to be all the higher for the quasars to appear as bright as they do. Gradually some people began to suspect the quasar redshifts.

Then some quasars were found that appeared to be associated with clusters of galaxies, and yet they had redshifts substantially different from those of the clusters. It was argued quite strongly that some part of a quasar's redshift was contributed by factors not dependent on speed of recession. One of the astronomers prominent on the noncosmological side is Halton C. Arp of the Hale Observatories. In the last few years Arp has looked beyond quasars at various kinds of peculiar objects for other evidence of noncosmological redshifts. He has found instances of bodies that appear to be associated with one another (in some cases joined by bridges of matter), but which have widely different redshifts (SN: 5/29/71, p. 367). At the Sixth Texas Symposium on Relativistic Astrophysics in December, he reviewed half a dozen of these, all the while hoping that the assembled astrophysicists would not carry out the old custom of "shooting the messenger who brings bad news." Then he went a step further and cited discrepant redshifts for normal galaxies in a cluster.

The cluster is the one in the constellation Virgo. The redshifts of the galaxies vary according to the class a galaxy belongs to. They yield recession velocities of 900, 1,100, 1,400 and 1,800 kilometers per second. Discrepancies of a similar sort appear in the cluster in the constellation Coma Berenices also.

Thus it seems on the basis of these examples that even for relatively normal galaxies there is a contribution to redshift from some factor that changes with type or with galactic evolution. If this should prove generally true, it would put modern observational cosmology back on square one where Hubble found it.

A more positive attitude toward quasar redshifts is taken by Lodewyk Woltjer of Columbia University, who begins by asking: "What can one say is right with redshifts?" One of the things that should be right is what is called a Hubble diagram. This is a plot of apparent magnitude versus red-



Photos: Jerome Kristian/Hale Observatories

*Galaxies underlying two quasars, PHL 1070 and B 340, appear as diffuse elliptical images around the darker quasar.*

shift. The farther away something is, the fainter, in general, it should appear. One of the great supports of Hubble's hypothesis is that this plot, for galaxies, shows a general tendency for increasing faintness with increasing redshift.

Woltjer set out to see whether this could be done for quasars. Taking the general population of quasars, it cannot. No such relationship is evident. Woltjer then proceeds to divide quasars into three classes: those that have in the radio range the double-structure characteristic of radio galaxies and steep spectra, those that have flat radio spectra and those that appear optically as quasars but have no notable radio emission.

For the radio doubles, Woltjer says, there is "a definite tendency for redshift to increase with decreasing apparent magnitude." For those with flat radio spectra and for the radio-quiet group, no indication of a relationship between brightness and redshift comes out. One might conclude from this that the radio doubles are at cosmological distances while the other classes are local.

But the Hubble diagram works only for objects of nearly the same intrinsic brightness. Even galaxies, as Woltjer points out, "are not standard candles." They vary in intrinsic brightness, and as a result the Hubble diagram shows a certain smear. Perhaps with quasars intrinsic luminosity varies so much that the Hubble diagram is entirely smeared out.

If that is true, then it is still possible that the brightest quasars at any given distance may be of the same factual magnitude. According to Richard Hills of the Max Planck Institute for Radio Astronomy in Bonn, West Germany, if one divides the redshift range into small stretches and plots the brightest quasars in each stretch, a Hubble diagram results that does look rather like increasing faintness with increasing distance.

Considerable work has been done with very long baseline interferometry, combining signals received at telescopes in West Virginia, California, Puerto Rico, Sweden and the Crimea, to try to determine the internal structure of quasars. According to Kenneth I. Kellerman of the National Radio Astronomy Observatory, the results are ambiguous, and the conclusions drawn from them are very dependent on the model one brings to the data.

The difficulties stem from the fact the baseline between any two telescopes in the group gives a one-dimensional picture, a view along the projection of the baseline on the quasar. Most of the baselines used are east-west. What will be necessary in future is the addition of some north-south baselines to try to get the beginning of a two dimensional view. Ambiguities are also produced by differences and changes in the brightness of various components of one and the same quasar.

An example is 3C 273. This quasar may be composed of either six components or four. If one believes in six components, there is a symmetrical arrangement of three pairs. The other interpretation sees the inner pair and only one member of the two other pairs.

The structures also change with time, and if these changes represent motion, some of the motions are at speeds several times that of light (if the quasars are at cosmological distances, that is). One can get around this problem by hypothesizing that the changes do not represent motion but rather changes in brightness of components that are standing still. This is called the Christmas tree effect (Kellerman said that Europeans at the meeting had trouble grasping the term since European Christmas trees do not blink), and it brings troubles of its own: In some instances it requires very complex and seemingly fortuitous structures.

However the ambiguities may be resolved by future observation, enough is now known to say that quasars—though they may look like stars—are not point objects like stars, but have a complex structure including both compact and extended sources that change with time.

Quasars have often been linked to galaxies. Some astronomers think they may occupy a place on an evolutionary scheme that includes galaxies. Now comes Jerome Kristian of the Hale Observatories to suggest that they are events that take place in the centers of galaxies. To bolster this argument he went looking for images of galaxies under those of quasars. Most quasars appear to be standing alone, but Kristian reasons that they appear so because they are so far away that the underlying galaxy is too faint to be seen in competition with the quasar. By using very sensitive plates Kristian has found some instances where galaxies do appear to underlie quasars. Objectors accuse Kristian of playing loose with the definition of a quasar. The criterion he is accused of violating—rather arbitrary itself—is that the object should look like a star on plates taken with a 48-inch Schmidt camera. Kristian has included some objects that do not look stellar on such plates, say the detractors.

Whether the quasars are far or near, what relationship they have, if any, to galaxies, and what their structure may reveal about their astrophysics are all topics for future observation. Much has been learned in the past decade, but these fundamental questions still remain open. □

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