science news

1 March 1969 25c
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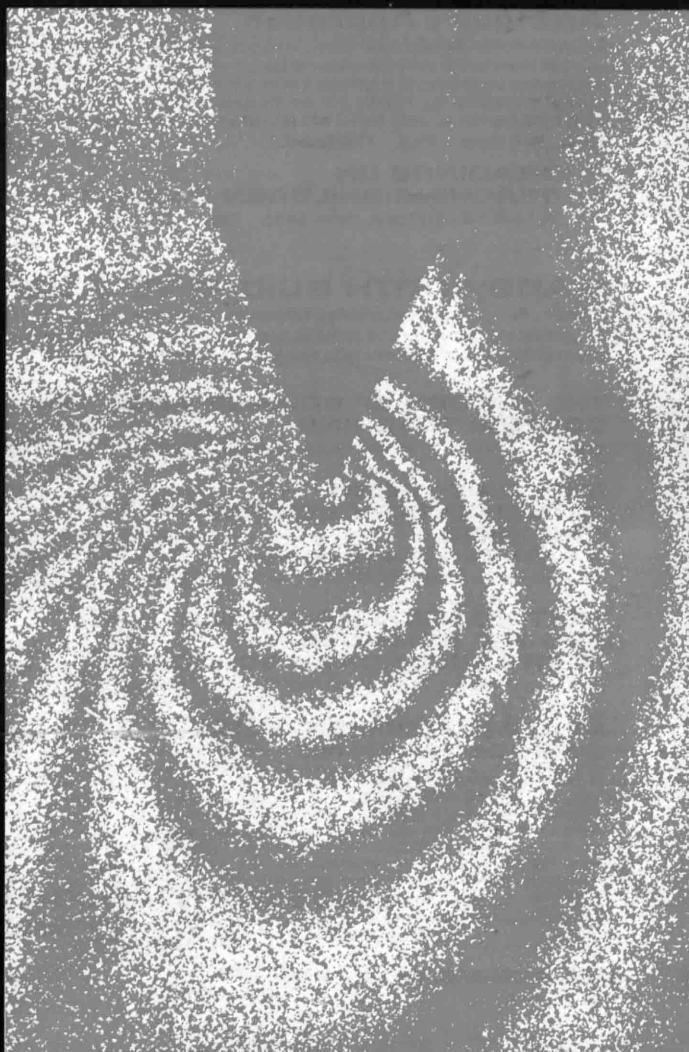
SEARCHING for STEEL'S RESEARCH

Flying the moon lander

Letter from Tokyo
backing the computer effort



Science news®

OF THE WEEK

FROM ABROAD

IN SCIENCE FIELDS

Investigators doing research in steel are armed with an impressive panoply of instruments. The photo of metals under strain is one of the devices offering researchers a peek at the unseen phenomena in steel. p. 220 (Photo: Bell Telephone Laboratories)

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films OF THE WEEK

Listing is for readers' information of new 16mm and 8mm films on science, engineering, medicine and agriculture for professional, student and general audiences. For further information on purchase, rental or free loan, write to distributor.

THE BEAT GOES ON. 16mm, color, sound, 28 min. Photographed at the police training school at Camp Kilmer (N. J.) Job Corps center, film shows the rigorous, demanding program that has been set up by the Corps under the supervision of the National Police Conference on PAL and Youth Activities. Young men who are admitted to the school are taught defense skills, marksmanship and classroom courses, leading to a high school equivalency degree. The school has been cited as one of the most effective in the Job Corps program, and according to a PAL official, every trainee has been assured of a job with a major police department if he successfully completes the course. Audience: general. Free loan from Association Film centers or information from Association Films, 600 Madison Ave., New York, N. Y. 10022.

FREEZING AND DEEP FREEZING PROCESSES SEEN UNDER THE MICROSCOPE. 16mm, color or b&w, English sound, 18 min. Shows the phenomena of crystallization in aqueous and non-aqueous solutions cooled under microscopic control. Development of the freeze-drying process under direct microscopic control. Some instances of application are shown. Audience: high school, college, professional. Loan for $5 service charge from Society for French American Cultural Services and Educational Aid, 972 Fifth Ave., New York, N. Y. 10021.

GIFT OF LIFE. 16mm, color, sound, 15 min. Tells the story of "Jeff Winston" who is stricken with kidney disease and subsequent permanent loss of kidney function. He goes on to treatment with an artificial kidney, and is able to lead a normal, active and useful life. Twice a week he is connected to an artificial kidney machine in his home to have his blood purified. Without such treatment, he would not live. Shown are several actual sequences shot at the modern artificial kidney center at the D. C. Administration Hospital, Washington, D. C., with an explanation of how the artificial kidney works. Audience: schools, universities, civic and voluntary health groups, professional organizations. Free loan from National Medical Audiovisual Center(Annex), Chamblee, Ga. 30005.

THE GOLDEN MOUNTAIN ON MOTT STREET. 16mm, color, sound, 34 min. Over 100 years ago, Chinese peasants by the thousands came to this country. They steadfastly devoted much of their lives to keeping alive the old customs and languages for an ultimate return to their homes. With the Communist accession to power, this has become impossible. Now, century-old ethnic and family ties are breaking in the face of fast-changing urban life. Discusses the complex problems that the Chinese and their children have inherited as an ethnic minority. Audience: high school, college, adult. Purchase $360 from Carousel Films, 1501 Broadway, New York, N.Y. 10036.

MANAGEMENT, MOTIVATION, AND THE NEW MINORITY WORKER. 16mm, color or b&w, sound, 45 min. Presents the frustrations and problems when the so-called "hard core" employe comes to work in a department for the first time. A first-line supervisor describes how Tommy, a young Negro recently from the "hard core" has been put into his unit, and how he finds Tommy sleeping on the job, taking half-hour coffee breaks, doing poor work, and showing interest and motivation. A psychologist then asks the supervisor to role-play the problem he has described with one of the members of a panel of experts. The resulting session demonstrates not only the supervisor's frustration, but the apathy and hostility facing nearly every supervisor of newly employed minority workers. The panel of experts then takes up a number of problems such as: "Has the supervisor made his expectations clear?" and "How can the supervisor get through to someone from a different cultural background?" Audience: supervisors, managers. Purchase $450 color or $275 b&w, rental $60 per week color or $40 per week b&w from Roundtable Films, 321 S. Beverly Dr., Beverly Hills, Calif.

RIVER OF POWER. 16mm, color, sound, 29 min. The story of what petroleum is, where it comes from, and how it is processed for commercial purposes is viewed in terms of the social and economic development of America. Traces the biography of the petroleum industry, detailing such milestones as the discovery of oil in Pennsylvania, the growth of the infant industry with the introduction of kerosene as a means of illumination, and the advent of the internal combustion engine. Audience: high school. Purchase $210 from Journal Films, 909 W. Diversey Parkway, Chicago, Ill. 60614.

SCIENCE NEWS

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to the editor

Genetic accuracy

SCIENCE NEWS (1/11, p. 31), contained a report of the symposium on Genetic Technology at Dallas, in which I participated.

I commend the accuracy of your reportage (were it so in all magazines!) and the manner in which you managed to condense a lot of the ideas into an informative article. I should like to add that I found the whole issue of SCIENCE NEWS informative and topical.

Antonie W. Blackler
Cornell University
Div. of Biological Sciences
Ithaca, N. Y.

Any day in May

The possibility that infrasonic oscillations may significantly influence human behavior is indeed interesting (SN: 1/11, p. 42). However, from a passing acquaintance with the attitudes of both school children and automobile drivers, I have a suspicion. It is that similar statistics would be obtained not only from Chicago but also from Chico, Cherokee and Chattanooga if the observations were made during "the first 28 days" of any May!

J. G. Olson, M.D.
Ogden, Utah

Burden to share

Mr. Munz in your "Letters" Column (SN: 1/4, p. 4) comes on strong in support of Betty Frieden and against sexual discrimination in this country. However, he becomes absurd and illogical when he argues that abolition of discriminatory practices against women should be made contingent upon abolition of the military draft of men, or, alternatively, the joint draft of women with men. After all, women have been exempted from the draft largely because of their childbearing function, and Munz has made no offer to relieve women of that burden.

I, too, will favor the military draft of women when women share equally in the control of the defense and foreign relations establishments in this country. In the meantime, men might well occupy themselves with lifting some of the burdens of prejudice and discrimination from women rather than looking for new burdens to impose on them.

Jeanne Richie
Honolulu, Hawaii
(See p. 206)

Letters from p. 205

Names askew

Thank you for the article on killer whales; I enjoyed reading it (SN: 1/18, p. 74). A personal experience that I had with one of those intelligent animals at the Public Aquarium in Seattle, Wash., may interest your readers. It shows an amazing degree of confidence on the part of the keepers in the friendly disposition of the whale. At the end of the show, during which the animal responded to simple commands like a well-trained dog, the girl trainer asked if anybody among the spectators would like to volunteer for a kiss from the whale. Eager for the experience I went over to her. She told me to bend down to the whale who lingered right before me in the pool. He met me halfway and touched my face gently with his massive tongue. Would you believe what he confided to me in that intimate moment? He was quite upset about the bad reputation of his species and asked me what they could do in order to get a more decent name. After all, he said, man calls himself *Homo sapiens,* though *Homo ferox* or killer man would be much more appropriate. Thinking of the whaling fleets which go after the last remaining whales, of the mass slaughters of seals and of the shooting of big and small game for the sake of trophies, I felt that his plea for a change of name deserves consideration. What do your readers think?

Hans U. Weber, Ph.D.
Foundation for Nutrition and Stress Research
Redwood City, Calif.

Protest

One thousand brickbats for your article on "Tribal Lands and Cattle" (SN: 11/2, p. 450).

An aborigine is a member of a native race; the Australian aborigine is the Aboriginal.

"Walkabout" is a term applied to the periodic wanderings of the nomadic tribes comprising the Aboriginal race. When one goes walkabout, therefore, he is performing an act directly opposite to a sit-down strike.

Other less important facts which you used incorrectly in an endeavor to add authenticity: a lubra is a native woman, not necessarily a wife, and Aboriginal mythology is called the "Dream Time."

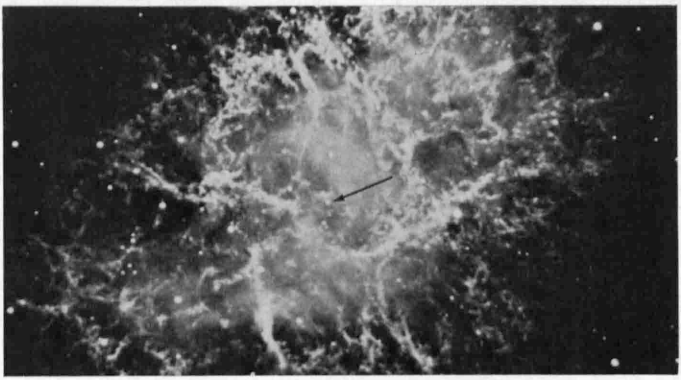
Mrs. C. R. Hubiak
Ventura, Calif.

(The walkabout and strike parallel refers to the ends, not the means. Ed.)

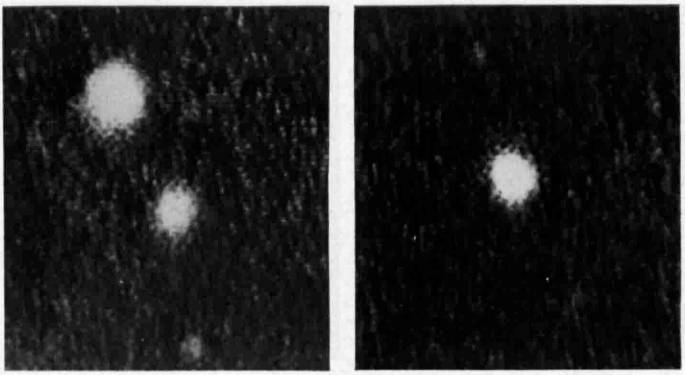
Address communications to Editor, Science News, 1719 N Street, N.W. Washington, D. C. 20036

Optical Pulsars

Theorists explain light from dark neutron star



Arrow shows location in Crab Nebula of first optical pulsar sighting.



Lick Observatory

Optical pulsar close up. At left it is flashing; at right it is dark.

The problem that optical pulsars (SN: 2/1, p. 111) present to theorists is that current models of pulsars tend to favor neutron stars over any other contenders. But neutron stars are not supposed to emit visible radiation. If they emit electromagnetic radiation at all, it should be in the X-ray wavelengths.

To make neutron stars compatible with the observed radio emissions of pulsars, theorists have had to adopt various schemes in which neutron stars are surrounded with clouds of charged particles and magnetic fields; these particles acting under the influence of the fields would produce the radio waves.

Usually such a system should not produce visible light. Visible light is normally the product of electrons operating within the confines of an atom. Electrons acting over large distances in stellar plasmas would radiate instead at lower, radio frequencies.

Now, however, by setting up a hypothetical plasma in which electrons mimic the conditions under which they exist in atoms, three theorists show how a plasma surrounding a neutron star can yield the optical as well as radio emanations of pulsars.

The new model is drawn by Drs. Hong-Yee Chiu and Vittorio Canuto of the Institute for Space Studies in New York and Dr. Laura Fassio-Canuto of the State University of New York at Stony Brook.

Electrons in a magnetic field will move in circles around the direction of the field. In classical plasma theory these circles are large, and the electrons will emit various frequencies of radio waves as they spiral from one circle to another.

What Drs. Chiu, Canuto and Fassio-Canuto propose, in the Feb. 8 NATURE, is to imagine a plasma in which the field strength and electron energies are such that the electron orbits have dimensions about equal to those of electrons in atoms. In this situation the same constraints would apply to the electrons in the plasma as apply to those in an atom; they could move only in certain of an array of possible orbits and not in others.

When the electrons move from orbit to orbit, they would do so in sudden jumps, and on the jump they would emit bursts of radiation. This radiation would be in the visible or ultraviolet range.

The electrons in the hypothetical plasma would act in analogy with the way electrons are known to act in atoms. Theoretically this would be the case in the postulated environment of a neutron star, an environment that cannot be reproduced experimentally.

If the theory holds, light from the plasma, like the radio waves emitted by the plasma, would go off in the direction of the magnetic field and would be held in a fairly well defined beam. Since the field in this and other current models is assumed to be directed along radii of the neutron star, the Chiu, Canuto and Fassio-Canuto model follows some others in explaining the flashing as the effect of sweeping the beam across the line of sight.

Finally, the new model must also explain the brightness of the pulsars. Some method is needed to pump energy into the plasma electrons. Collisions among the electrons alone would not knock enough of them into higher energy states to give the intense emission that is seen.

So the authors postulate that the electrons are continually pumped into higher energy states by oscillations of the neutron star. The oscillations would not have to be large; a few centimeters back and forth would do. Such small oscillations could be quite chaotic, like waves on an ocean, and the three authors suggest that the random subpulses that are seen to underlie the main pulses of the pulsars may reflect the randomness of these oscillations.

While the theoreticians are thus having their first inning with the optical pulsars, observers have been busy refining the observation. Drs. J. S. Miller and E. J. Wampler have used a kind of stroboscopic arrangement in which

the pulsar was observed through a slitted wheel that could be synchronized with the pulsar period. The signal that came through the slits was fed to a television camera with an image intensifier to build up an image of the pulsar.

Drs. Miller and Wampler have made photographs that show the pulsar when it is on and when it is off. They conclude "that the southwest central star [of the Crab] is in fact responsible for the optical light pulses discovered by Cocke, et al." And they go on to say that "because the field [background] stars do not vary, the possibility that the observed flashes are produced by spurious electronic signals may be eliminated."

Meanwhile, from University College, Dublin, Prof. Neil A. Porter reports that two observers, Drs. D. M. Jennings and E. P. O'Mongain, working at Qrendi in Malta, have seen optical pulses coming from the directions of both NP 0532 and NP 0527, another pulsar near the Crab Nebula. The width of these pulsations is only a few billionths of a second. Those so far seen in NP 0532 are a few thousandths of a second wide.

The Irish report is preliminary. ◇

MUSKIE AND HICKEL

Shaping the Clean Water Act

Hickel: No limit on liability.

Muskie: Oil, vessel and heat.

The Missouri runs muddy into the Mississippi. Beer cans bob in the Potomac, while Lake Erie chokes on its own plant life. Fish wash ashore dead in Arkansas and New York, and the beaches of Santa Barbara bear black splotches from oil still coming in. Three years ago former President Johnson told Congress, "Today, virtually every river system in America is touched by pollution. This menace grows more serious each day."

The situation doesn't look any better now. Not only are there holes in existing law, money to fund existing provisions like the construction of waste treatment facilities is not being made available.

Senator Edmund S. Muskie (D.-Me.), chairman of the Subcommittee on Air and Water Pollution, and sponsor of much recent pollution control legislation, is presently holding hearings on a new bill. His latest effort to plug the holes, the Water Quality Improvement Act of 1969, attacks three major sources of water pollution not now covered by recent legislation: pollutions from oil, vessels and heat.

In the case of oil pollution, under the Muskie bill, the company that through negligence spills oil, be it from an offshore or onshore installation or vessel, would be required to notify the Secretary of the Interior and clean up the mess. Failure to notify could mean a fine of up to $5,000 or a year in jail. Failure to clean up the oil, leaving it for the Government to do, could cost an oil company or ship owner up to $15 million.

Muskie's bill will not be the only one to go before Congress. A new challenger is expected in the lists this month when Secretary of the Interior Walter J. Hickel will present the Nixon Administration's version of what to do about water pollution. Although Hickel has kept the wraps on, most of the heavy betting has been on the side of a much weaker bill than Muskie's. Hickel has indicated (SN: 2/1, p. 110) that pollution control should stress Federal aid, not Federal regulation.

Nevertheless, last week Hickel surprised his critics by issuing an order holding oil companies responsible for pollution damages from operations on the outer continental shelf, beyond the three-mile limit.

He went a step further than Muskie and declared that negligence need not be a factor; any spill, regardless of cause, was enough to make the oil companies liable. Unlike the Muskie bill, Hickel's order sets no ceiling on the amount of liability oil companies must pay.

These features of absolute responsibility and unlimited liability are similar to earlier Muskie oil pollution legislation which the Senator tempered after it was rejected in the House.

The Muskie camp doesn't feel its thunder has been stolen. Muskie sees the Hickel order as an endorsement for his bill. The Hickel order, which is a regulation based on existing law, is narrower than the Muskie bill because it is limited to Federal lessees and permittees and doesn't apply to companies operating under state leases in state waters.

Other elements of the Muskie proposals, on which Hickel has not yet been heard, include:

- On vessels, establishment of acceptable performance standards for onboard sanitation devices that treat sewage discharged from commercial or pleasure craft.
- On thermal pollution, certification before a nuclear power plant is constructed that it will meet water quality standards. Under the present system, the Atomic Energy Commission must issue a permit or license without determining beforehand whether plant activities will violate such standards.

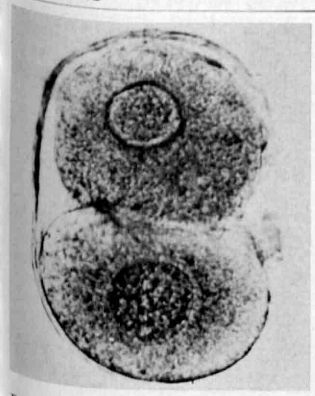
Under the Muskie bill, certification would come from an interstate or state agency. The provision applies to federally regulated activities, including the discharge of wastes into navigable waterways, which comes under the purview of the Corps of Engineers. Nuclear power plants would be mainly affected, but also included would be dam construction, some fossil fuel plants that are built under Federal permit and industries that used navigable waterways for cooling.

In addition, the bill emphasizes three new research areas: acid mine drainage, lake eutrophication (oxygen depletion) and oil pollution removal.

In the current hearings, the oil industry has not objected to the principles behind the proposed legislation, but has balked at paying the bill. Industry witnesses regard the $15 million clean-up fee as being too high and possibly unnecessarily burdensome. Several marine insurance underwriters also objected.

Organizations such as the Manufacturing Chemists Association and power companies were critical of the thermal pollution section, which would require the issuance of Federal permits to users of the waterways for coolant. ◇

Human eggs in a test tube



Fertilized human egg, 60 hours old.

Last December Dr. David G. Whittingham of Sydney, Australia, reported the first successful attempt to get sperm to penetrate and fertilize mouse eggs outside the female's body (SN: 12/14, p. 591). Those eggs, transplanted to a foster mother, developed into nine mouse fetuses.

Previously, Dr. C. R. Austin and his colleagues at Tulane University in Covington, La., had discovered that the fluid secreted by follicles in the ovary is essential to help human eggs mature outside the body. Follicles are tiny structures that hold a woman's supply of eggs, which is complete at birth, and release mature ones monthly.

Between them they laid the groundwork for experiments by three British researchers who report in the Feb. 18 NATURE the successful mating of seven human eggs and sperm in a test tube. The next step will be transplanting such an egg to a woman who is unable to conceive; the fertilized eggs cannot survive and grow outside a natural womb, for which no substitute has yet been developed.

To achieve in vitro fertilization of a human egg, Drs. R. G. Edwards and Barry Bavister of Cambridge University, with Patrick C. Steptoe of Oldham General Hospital, created in a test tube an environment that closely matched that of a female uterus. From women who were undergoing hysterectomies for medical reasons, they collected eggs and placed them in a solution rich in ovarian fluid.

After the eggs matured in the test tube, the researchers introduced sperm to the mixture. Of 56 eggs that were inseminated, 34 continued to mature. But only seven of these were truly fertilized 31 hours later. Of these seven, five were abnormal.

One explanation of the abnormalities is that the eggs may have degenerated somewhat before they got to the test tube. Another is that the proportion of abnormalities may be no higher than occurs naturally. Though there is no way to be sure, the researchers suggest they observed a natural process of selection. As early as one day after normal conception, it may be, half of all naturally fertilized eggs are aborted, unnoticed, because of some abnormality. A third possibility is that the experimental techniques themselves damaged otherwise healthy eggs.

In future trials, Dr. Edwards and his colleagues plan to collect eggs from young, healthy volunteers during the fertile period of the menstrual cycle when fresh eggs, partially matured by natural means, are available. This, he points out, will reveal the cause of the abnormalities. Before going ahead with plans to transplant an artificially fertilized egg into a woman, he must know whether his techniques or defective eggs are the source of the problem.

Transplanting a fertilized human egg is by no means even a potential solution to most cases of infertility, but it might be valuable to the one to two percent of women who fail to conceive because their follicles are blocked and, therefore, cannot release an egg. In about half of such cases, the egg-bearing follicles can be opened, but in the other half, treatment is impossible. Now, it might be possible to remove those blocked eggs by surgery, fertilize them in a test tube with the husband's sperm, treat the woman with hormones to make her ready for pregnancy and then implant the developing embryo.

In any case, at present, and as far into the future as any scientist can see, test-tube fertilization does not raise the specter of test-tube babies. That possibility remains "pure science fiction," declare the British scientists. After conception, a fertilized egg floats freely in the uterus for six or seven days, but then it embeds in the uterine wall through which its nourishment is channeled. Until scientists create an artificial womb, a test-tube baby is inconceivable.

The significance, rather, is for basic research. In spite of all that is known about reproduction, there are enormous gaps in understanding because fertilization and embryonic development are ordinarily hidden from the scientist's scrutiny. Much of what is clear about the process comes from work with sea urchins—creatures whose eggs are normally fertilized outside the female's body where development can be observed. But the jump from sea urchins to man is a risky one.

Test-tube fertilization of human eggs, therefore, offers researchers a window on a phenomenon they have not observed before and with it the promise of new insights into problems of infertility, contraception and the initial stages of life.

RUBELLA

Vaccines may be licensed by fall

With a possible epidemic of German measles (rubella) expected by the U.S. Public Health Department in 1970 or 1971, scientists are bringing together information from the latest tests all over the world in the hope that a vaccine or vaccines can be licensed by this fall. There are competitors; there may be more than one licensed.

So far there have been about 100,000 tests made with the two principal vaccines being prepared for approval.

The largest number of tests to date has been made with the HPV-77 weakened rubella virus strain developed by Drs. Paul Parkman and Harry Meyer Jr. of the Division of Biologics Standards of the National Institutes of Health, which licences vaccines for use in the United States.

The other vaccine is based on the Cendehill strain, and has been given to 25,000 persons. It is used in the vaccine offered by Smith Kline and French Laboratories, whose Belgian subsidiary, Recherche et Industrie Therapeutiques, began its development in 1964. It has had clinical trials in the U.S., most western European countries, Asia, Africa, Puerto Rico and Jamaica.

Smith Kline and French claims that fewer and milder arthritic-like symptoms result from its strain.

The Public Health Service is hoping to promote mass inoculation of some 20 million children before 1970, the date of the predicted next epidemic. The mass inoculation would cost the Government about $25.6 million to finance and would be carried out by state health departments.

So far, the test vaccinations have been good for three years, but it will take some time to prove that a girl vaccinated at the age of six will be immune if exposed when she gets pregnant. Rubella in a pregnant woman can cause defects in her child.

No vaccine will be given to pregnant women.

Tragedy and delay

Navy

Aquanaut Cannon in Sealab III.

Sealab III, the most sophisticated of the Navy's Deep Submergence Systems Project underseas habitats, has had more than its share of trouble (SN: 2/15, p. 161). An accident last week that took the life of one of Sealab's most experienced divers brought the trouble to a climax. It could be the equivalent, for the man-in-the-sea program, of the space program's 1967 Apollo fire in which three astronauts died.

Late in the week doctors still were waiting for the results of laboratory tests which might settle the cause of aquanaut Berry L. Cannon's death. In the meantime the Navy was running tests of Cannon's equipment and his breathing gas mixture to see if a malfunction might have caused the accident.

At first it appeared that Cannon might have suffered a heart attack. But an autopsy performed by San Diego County's chief pathologist Dr. Joseph Luibel and observed by Sealab's Capt. George F. Bond left neither physician satisfied that a heart attack was the cause of death. Death was attributed simply to cardiac arrest, the autopsy was termed inconclusive by Dr. Luibel, and further tests were ordered.

When Sealab was lowered into 610 feet of ocean earlier this month, leaks showed up. It was in an attempt to fix them that Cannon, Robert A. Barth, and two other divers were lowered last Monday.

Barth was the first to leave the capsule. Cannon followed him. Both were

breathing through umbilical tubes attached to the transfer capsule in which they were lowered to Sealab. The umbilical tubes also carried hot water to heat their prototype wet suits.

Cannon had what appeared to be a seizure two minutes after leaving the capsule and was seen by Barth to be struggling with his breathing gear. Barth pulled him back to the capsule and gave him closed chest heart massage and artificial respiration while the aquanauts were being hauled back to the surface support vessel, the USS Elk River. Cannon was pronounced dead in Elk River's decompression chamber.

If the leak had been repaired Monday, Cannon and several other aquanauts would have started a 12-day stay on the bottom last Tuesday. In view of the accident it was decided not to send other divers down to fix the leaks until the cause of Cannon's death has been determined. So Sealab III has been returned to the surface, where the Navy says it will be easier to fix the leaks anyway. The two leaks are located in stuffing boxes where electrical cables enter the habitat.

The effect on the Sealab III experiment of Cannon's death will have to be determined after the cause of death is known. If the accident was the result of a freak malfunction or some hidden physical problem of Cannon's, then the experiment presumably can go ahead with little delay. It will be another matter if an equipment failure or a little-understood effect of the breathing mixture, helium spiked with oxygen and a little nitrogen, is the culprit.

SOLAR OVENS

Hot spot in the Pyrenees

Attempts to utilize the sun's heat by focusing it through a powerful lens have not been very successful—at least beyond the level of starting a fire with a magnifying glass.

The French have been in the forefront of what research there is in large-scale solar ovens, as they are called. Since 1951 they have had an installation in the Western Pyrenees at Montlouis, where the sun's rays, reflected off a movable plane mirror, are concentrated by a large parabolic reflector onto a target area. The Montlouis device yields a thermal power of 50 kilowatts.

By April 15, the French National Center for Scientific Research (CNRS) will have operating a much bigger, more powerful station, also in the Pyrenees. The new oven will produce about a megawatt of power, and is expected to reach temperatures of 3,800 degrees C., making possible a number of experiments in fundamental and applied high-temperature physics, as well, perhaps, as producing energy for industrial consumption.

The problem with reflecting ovens is that the sun's light must come in parallel to the axis of the reflector. Since the position of the sun shifts, and the bulky, fragile parabolic mirror is difficult to move, a plane mirror is used to direct the sun's radiation onto the concentrating device.

In the new installation, located between the towns of Odeillo and Font-Romeu, the problem will be solved by 63 heliostats. These are remote-controlled clusters of 180 plane mirrors, each 50 centimeters on a side, giving a total of 45 square meters of reflecting surface per heliostat. The clusters are placed on a series of terraces which surround the big parabolic reflector, allowing an uninterrupted sheet of solar energy to be reflected onto it.

The concentrating surface itself is constructed of 9,000 small plane mirrors arranged so that they form a parabolic surface of 2,500 square meters.

Among the principal objectives of the Odeillo installation are the production of:

- Large, ultrapure crystals, as well as ultrapure metals and alloys. A technique known as zone melting can evaporate impurities from solid samples. A sample is drawn across a spot where intense heat is concentrated and melts and refreezes by sections.
- Compounds containing very precisely known quantities of impurities which determine physical, chemical and mechanical properties, thus permitting the creation of highly specific substances.
- Extremely heat-refractory materials (and the forming of these into shapes by rotating such material in the solar oven, which serves as a kiln).
- Accurate high-temperature thermal shocks.
- Precision purifications, absorptions and dissociations.

SCIENTISTS' SALARIES

Trying to keep up

The pay scale for scientists in Government has long been lower than that in private industry, and still is. Even with the increase scheduled next July for Federal white collar and postal employees, which for some grades will average as high as nine percent, many Government pay rates will lag behind those of private industry.

By law, Federal employees next July should earn salaries equivalent to those their counterparts in private industry earned in June, 1968. The final determination of these levels is up to the Civil Service Commission and the Bureau of the Budget, and neither agency has as yet set any policy on salaries.

As a guideline, however, economists at the Bureau of Labor Statistics have compiled a table of calculated pay rates for annual average salaries in private industry, along with a schedule of authorized salary rates for Government employees.

Despite the law, which flies in the face of budget realities, a graduate with a chemist's or engineering degree entering the business world without experience will still be likely to earn more than his Government counterpart. The latter now comes into Federal service at up to $7,456, while in industry he was last June paid an average of $8,061 for chemists or $9,023 for engineers. Even if the new Government pay line matches that of industry for last June, it is quite likely that salaries for college graduates hired by private enterprise will be higher than in 1968.

For positions equivalent to the head of a major division of a research laboratory, the salary for an experienced chemist or engineer would average about $22,000, compared with an average of $25,416 and $23,280, respectively, for those working at jobs of equivalent responsibility in industry.

Meanwhile, based on an entirely different kind of survey, the National Science Foundation has issued an early report on 1968 salaries of the 298,000 scientists answering a questionnaire circulated annually by the National Register of Scientific and Technical Personnel. The survey did not include engineers.

For scientists responding to the questionnaire, the median annual salary was $13,200, with 10 percent earning more than $21,500 and another 10 percent less than $8,500. Self-employed scientists earned the highest salaries. Next were those employed by industry and business, and by non-profit organizations, earning $14,700.

Federal Government scientists reported a median salary of $13,500, $1,200 less than in industry.

About one-third of the 298,000 registrants were primarily engaged in research and development during 1968, with 15 percent in basic research and 13 percent in applied research. Teaching was reported as their primary work by 21 percent.

Educational institutions employed 40 percent of the scientists; industry and business, 32 percent; and the Federal Government, 10 percent. However, more than two-fifths (43 percent) of the registrants were involved in some work supported by Federal funds.

Future reports will include cross-tabulations that should provide additional insights into such manpower dynamics as geographic mobility, work-history patterns and career development.

Long-lived rodent for research

A long-lived animal of the hamster family, being used in leprosy research for the first time, promises to allow the slow-growing human leprosy bacillus a chance to grow to a useful size. A problem in leprosy research has been laboratory models for study.

Dr. Chapman H. Binford of the Leonard Wood Memorial for the Eradication of Leprosy observed the animals, mystromys, on a trip to South Africa while visiting the laboratory of Dr. H. S. D. Davis, who first adapted them for use from the wild. Dr. Binford had several pair shipped to his laboratory at the Armed Forces Institute of Pathology in Washington, D.C.

Now the pairs have multiplied until there are several hundred of them. In addition to the work Dr. Binford is doing, the AFIP is using mystromys to test the effects of radiation, and the Woodard Research Laboratory in Herndon, Va., is using them for cancer research.

Dr. Binford originally produced a mild type of leprosy in the mystromys; he has now begun efforts to produce a more severe disease by suppressing the animal's immune system.

Just as a person rejects an organ transplant without an immune suppressant, an animal rejects the leprosy bacillus or any other foreign bodies. Techniques of immunity suppression include the removal of the thymus, total body irradiation and lately the use of anti-lymphocyte serum which reduces the number of lymphocytes.

Dr. Binford based his leprosy work with the mystromys on similar work done with mice by Dr. Richard Rees at Mill Hill, England, headquarters for the British Research Council. Dr. Rees produced larger lesions in mice than are ordinarily seen in humans.

The mice and hamsters customarily used in leprosy research usually die in two years, but the mystromys have lived more than five years in Dr. Binford's laboratory, giving the disease a chance to progress and be studied.

Basic research is still necessary to get at the cause and ultimate cure of leprosy. Although the sulfone drugs, including DDS, are keeping it under control, especially when diagnosed in early stages, leprosy is not yet conquered.

There are some 20 million cases of leprosy in the world; it is relatively common in Vietnam as well as in Africa, India and northern Latin America. Possibilities of contagion from person to person are extremely low, contrary to popular belief, but if the disease is allowed to spread in an untreated person, it is difficult to control.

medical sciences

BIOCHEMISTRY

Apocrine sweat and emotion

Colored sweat—purple—has appeared in a 37-year-old woman in Defiance, Ohio, a small town southwest of Toledo. The rare condition recalls a waiter exuding purple sweat who was described by Ernest Hemingway in his novel "The Sun Also Rises."

"The waiter who served us was soaked through," Hemingway wrote. "His white jacket was purple under the arms . . . he must drink a lot of wine or wear purple undershirts."

The Feb. 3 issue of the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION gives the opinion of two physicians, who believe the condition is due to chromidrosis in which sweat of some color, often purple, is secreted in the armpits.

Dr. Milan Jirka of the pediatrics faculty at Charles University in Prague explains the condition as being related to a condition of darkening urine, called alkaptonuria.

Both Dr. Jirka and Dr. Walter Shelley of the University of Pennsylvania School of Medicine in Philadelphia say apocrine sweat glands should be considered. These apocrine glands are usually localized in the armpits and genital areas, and are controlled by nerve fibers. During emotion they are stimulated by the hormone epinephrine, secreted by the adrenal gland.

FAMILY MEDICINE

A new specialty

Making a specialty of family medicine has been a meaningful move, says the president of the American Academy of General Practitioners.

Identification as a specialist is expected to increase the attractiveness of primary medical practice to young doctors. One of the main shortages of physicians has been among family doctors.

The trend toward specialization began after World War II. Before that most doctors were general practitioners. Now the American Medical Association's Council on Medical Education, the AAGP and its Advisory Board for Medical Specialties have officially recognized family medicine as a specialty.

Dr. Maynard I. Shapiro of Chicago, AAGP president, says this is not just old-time general practice with a new name. The old-fashioned family doc will have to take an examination based on 300 hours of accredited post-graduate study, including behavioral science. But he still won't be making house calls.

TOXICOLOGY

Common chemical causes cancer in mice

A widely used industrial chemical called diethylene glycol has been found to result in the formation of malignant tumors as long as seven months after exposure.

A Soviet researcher, J. P. Sanina, writing in the journal OCCUPATIONAL SAFETY AND HEALTH ABSTRACTS, published by the International Occupational Safety and Health Information Center in Geneva, Switzerland, describes his inhalation experiments on female mice exposed to the vapors.

Ten of 16 experimental animals showed tumors of the mammary glands, and one developed a leucosarcoma of the cervical lymph glands.

His research showed that cancerous tumors appeared when the animals were exposed to small concentrations.

Diethylene glycol is used in antifreeze solutions for sprinkler systems, water seals for gas tanks and as a lubricating and finishing agent for wool, worsted, cotton, rayon and silk; as a solvent for vat dyes; in composition corks, glues, gelatin, casein and pastes to prevent drying out.

Experiments on rats conducted in the U.S. under the auspices of the National Cancer Institute failed to turn up such results.

FRACTURES

Plastic acts as splint

Damage to the jawbone, which commonly occurs in combat, can hopefully be repaired soon by Army medical corpsmen through application of a new dough-like mixture.

The presently used arch-bar technique of splinting fractured jawbones and other facial injuries is time-consuming, damaging to tissues and requires highly trained personnel as well as specialized laboratory techniques.

Dr. G. M. Brauer, research chemist at the National Bureau of Standards, and Dr. E. F. Huget of the U.S. Army Dental Corps at the Walter Reed Army Medical Center, reported the development to a regional meeting of the American Chemical Society in Washington, D.C.

The plastic, a mixture of an acrylic resin and calcium carbonate, can be manipulated easily into any desired shape, and hardens in seven minutes to make a tough, rigid splint.

PARKINSON'S DISEASE

New drug may be on market soon

With the imminent approval of the new drug against Parkinson's disease, L-dopa, which could be as early as next summer, a "new era of therapy of chronic neurologic disease may be opening," the Feb. 13 issue of THE NEW ENGLAND JOURNAL OF MEDICINE says editorially.

Accompanying a second report on L-dopa by Dr. George C. Cotzias and his co-workers in the journal, the editorial calls the work of the Brookhaven National Laboratory team "the most important contribution to medical therapy of a neurologic disease in the past 50 years."

The editorial says the "remarkable contribution of Cotzias and his group is the clear demonstration that L-dopa can effectively reverse most of the disabling symptoms of Parkinson's syndrome and that it can be given over a long period at an exceedingly high dosage if levels are increased slowly."

Until the first of the year it was expected that the National Institute of Neurological Diseases and Stroke would spend $3.3 million on extensive tests in 20 centers of the U.S. (SN: 12/21, p. 623), but this is now considered unnecessary.

physical sciences

NUCLEAR PHYSICS

Muons and nuclear polarization

The presence of a muon, or mu meson, in an atom in place of an electron should cause electrical polarization of the nucleus of that atom. That is, some imbalance between positive and negative charges should occur.

To check this possibility a group including Drs. H. L. Anderson of the University of Chicago; C. K. Hargrove, E. P. Hincks, J. D. McAndrew and R. J. McKee of the National Research Council of Canada, and Dan Kessler of Carleton University in Ottawa studied the X-ray emanations of a lead atom in which there were muons.

Comparison of these data with those from atoms containing only electrons should permit them to calculate the presence and amount of nuclear polarization. They report, in PHYSICAL REVIEW LETTERS for Feb. 10, that they have seen an effect that looks like nuclear polarization, but what they see is not entirely compatible with theoretical predictions.

They urge more accurate theoretical calculations, and conclude, "While it is still too early to consider this analysis as an actual measurement of nuclear polarization by the muon, it tends to show that the possibility of studying this elusive effect is just around the corner."

PARTICLE PHYSICS

Weak interaction and self energy

One of the problems in the theory of the weak subatomic force involves the self energy or self mass of the particles subject to it.

The self energy arises because the force to which a particle is subject exerts itself also on all parts of the particle, and will tend to collapse or explode the particle depending on whether the force is attractive or repulsive.

In order for a particle to maintain any structure or spatial extent, it must resist these tendencies, and the tension that results engenders an amount of latent energy known as the self energy or the self mass.

The problem in weak force theory is that theory would make the self energies of the weakly interacting particles infinite. In fact, of course, this is not the case, and the infinities represent a flaw in the theory.

To repair the flaw Dr. Hidezumi Terazawa of the University of Tokyo suggests a new particle as carrier or mediator of the weak force in addition to the one, the intermediate vector boson (SN: 11/16, p. 500) already proposed. To this Dr. Terazawa adds an intermediate scalar boson, a particle with different mathematical properties from a vector boson. With this, he says in PHYSICAL REVIEW LETTERS for Feb. 10, the infinite self energies become finite.

RADIO ASTRONOMY

New Cambridge telescope

Cambridge University's Mullard Radio Astronomy Observatory is to begin constructing a three-mile interferometric array of dish antennas, thus ending, as NATURE puts it in its Feb. 8 issue, "the hiatus in the building of large radio telescopes in Britain."

The array will consist of eight 42-foot paraboloids. It will be able to make maps as detailed as a three-mile-wide single dish might do and will be used to extend the program on quasars and radio galaxies now under way with Mullard's one-mile array. The new facility will cost two million pounds (about $5.6 million) provided by the Science Research Council.

One reason for investing in the new instrument is that maps made with the present one-mile array suggest that the objects covered have structural complexities that are too fine to be resolved by the limited capabilities of the one-mile instrument.

PARTICLE PHYSICS

New detector

Prof. Robert Hofstadter of Stanford University's high energy physics laboratory reports development of a new particle detector for which he claims universal applicability.

Speaking at the meeting of the American Physical Society in New York, Dr. Hofstadter stated that this new form of crystalline detector could record everything that happens in a particle interaction, even at energies in the hundreds of billions of electron volts. Most current detectors are not big enough to see complete events at very high energy.

Further advantages include high-speed counting and timing, good energy resolution, application to all types of particles, discrimination among particle types and detection of both large and small energies.

The detector is made of large cylindrical crystals of sodium iodide, which can be up to 30 inches in diameter. Crystals a few inches thick may be stacked to make a detector up to five feet long.

THEORETICAL PHYSICS

Two kinds of gravity waves

Einstein's theory of gravitation, which is generally accepted by physicists nowadays, predicts the existence of waves involving gravitational forces. They are analogous to the waves involving electric and magnetic forces that show up as light and radio.

Prof. Joseph Weber of the University of Maryland has been looking for such gravitational waves for a long time (SN: 5/27, p. 408).

But there may be two kinds of gravitational waves instead of only one. Drs. David C. Robinson and Jeffrey Winicour of the Aerospace Research Laboratories at Wright-Patterson Air Force Base in Ohio show, in PHYSICAL REVIEW LETTERS for Feb. 3, that a theory of gravitation put forward by Drs. Carl H. Brans and Robert H. Dicke (SN: 6/1, p. 532) predicts a second kind of gravitational wave that can exist beside the Einsteinian one.

Furthermore, Drs. Robinson and Winicour figure that formation of a neutron star inside the earth's galaxy would produce only the second kind of waves and such waves could be detected by Prof. Weber's equipment. Such a detection would serve as evidence in favor of both the Brans-Dicke theory and the Robinson-Winicour derivation from it.

engineering sciences

CONSTRUCTION

Irradiation for stronger concrete

A combination of concrete and plastic tests out four times stronger than ordinary concrete, according to the Atomic Energy Commission's Brookhaven National Laboratory in Upton, N.Y.

The concrete-polymer material is made by soaking ordinary hardened concrete in a bath of monomers, the single molecules that, linked together, form polymer plastics. Then the mixture is irradiated with cobalt 60 for several hours. The monomer, which seeps into the pores of the concrete, then hardens into a plastic, which fills the interconnecting spaces that comprise 14 percent of ordinary concrete.

The plastic prevents water from seeping in and reduces the effects of abrasion, erosion and corrosion. Complete penetration increases the weight of the material by less than seven percent.

CYBERNETICS

Talking to a computer

The idea of talking to a machine and getting a response is coming alive at Purdue University. The prototype of a completely voice-controlled teaching machine is being tried out by Dr. Ronald J. Swallow of the School of Electrical Engineering.

Dr. Swallow relies on a sound detection device to identify words based on the frequency of their sound waves. When a student answers a question, the sound wave pattern is matched to the correct answer in a computer's memory bank. The computer types out a reply telling the student that he is correct, wrong or that he should try again. The computer might even take him back through a series of steps to arrive at the correct answer.

HIGHWAYS

Water impact device tested

A way to reduce fatalities from auto crashes into fixed obstacles has successfully been tested at Brigham Young University. The principle is to place a water-filled cushion around a post, guardrail or wall to slow the car gradually.

The cushion incorporates a device designed to keep the rate of water ejection constant, regardless of the weight of the car.

Dr. Charles Y. Warner of Brigham Young reports that repeated impacts show high reliability, low maintenance and continued protection.

WATER PURIFICATION

Oil cleans water

An industrial purification process using small quantities of oil to remove soot from water is being considered for removing solid particles from effluents in general, including municipal sewage.

Developed by the Royal Dutch-Shell Group of Companies in Amsterdam, Holland, the process works by directing a stream of oil at sooty water in a mixing device that makes the soot and oil mass together in an agglomerate. The agglomerates are in the form of pellets which are easily removed from the water.

In this way, 99.5 percent of the soot is removed and the resulting pellets can be used as fuel. By reversing the process, soot could remove oil from water (SN: 2/22, p. 184).

HOVERCRAFT

Noise overboard

A big objection to hovercraft is its noise. A new model which employs ventilation fans instead of huge propellers for propulsion and lift, promises quieter service.

A 390-horsepower gas turbine drives two 42-inch-diameter centrifugal fans, one on each side and each contained in a spiral casing. These fans provide jets of low pressure for propulsion as well as for lift by drawing air in and then forcing it in a horizontal direction for thrust and a downward direction for lift.

The craft is also amphibious for travel over swamp, snow and ice and costs $100,000. It could be used as a river patrol boat, harbor and pilot cutter and a crash tender for airports near water.

THEATER DESIGN

Movies in the lobby

Tests conducted by the Research Center of the Association of Motion Picture and Television Producers in Hollywood show that for viewing 35-millimeter and 70-millimeter (wide screen) film, different sized images should be shown.

Petro Vlahos, chief scientist for the center, explains that using the wide screen for 35-millimeter film impairs the clarity, or resolution, on the screen. Since resolution depends on the number of silver grains in the film, when blown up on a wide screen, the image loses sharpness.

The tests find that most movie goers viewing 35-millimeter film prefer to sit from four to seven picture-widths from the screen. If the smaller film is displayed on the full wide screens, this would mean the best seats would be back in the lobby.

ULTRASONICS

Boiler scale prevention

Boiler scale, calcium deposits responsible for dangerous heat build-up, normally requires costly treatment and control measures involving chemicals, evaporation and filtering.

Soviet scientists A. P. Sevcenko and A. T. Pacuk claim an ultrasonic method of treating the water for boilers that not only prevents boiler scale formation but flakes off exising scale as well.

The Russian engineers tried out the high-frequency sound method on boilers that generate up to 2.5 tons of steam per hour; these are relatively small boilers. Scale prevention is considered the most critical phase of operation for a boiler.

meteorology

Gathered at the American Meteorological Society's Symposium on Observations and Instrumentation in Washington, D.C.

ATMOSPHERIC EFFECTS

Jets cause clouds

Cirrus clouds often grow from a few wisps of airplane contrails to cover the sky totally in a few hours. These white, filmy clouds usually form at altitudes between 20,000 and 40,000 feet.

Over Boulder, Colo., for days at a time the sky is covered with cirrus clouds. Virtually all of them, on careful examination, are found to have their immediate origin in expanding, persistent jet airplane contrails, Dr. Walter Orr Roberts, president of the University Corporation for Atmospheric Research in Boulder, reports.

Jet planes do not always leave trails that expand into broad cirrus cover. That happens only when temperature and moisture conditions are right. The effects of such clouds on the amount of solar radiation absorbed by the atmosphere can be quite significant, he believes, possibly raising the temperature of the troposphere as much as one degree C. per day.

Since past records of cirrus cloud cover are inadequate, Dr. Roberts urges expanded observations.

INSTRUMENTATION

Sound waves for measurements

Sound waves could be used to make atmospheric measurements in much the same way as radar, says Dr. C. Gordon Little of the Environmental Science Services Administration in Boulder, Colo.

The refractive index of sound waves in air—how much the speed of the waves varies—is a function of temperature, wind and humidity. Fluctuations in the acoustic refractive index are calculated to be about 1,000 times stronger than for radio waves. The returned sound waves could be used to provide continuous information on the mean profile of wind speed and direction, as well as humidity.

Dr. Little says the acoustic echo-sounding technique could measure these factors to heights of at least 1,500 meters. It could also be used to derive three-dimensional profiles of mechanical turbulence and temperature differences near ground level. Dr. Little suggests that electromagnetic propagation research would also benefit, since a clearer picture of the atmospheric structure responsible for fluctuations in microwave and optical propagation would be available.

DATA ACQUISITION

Monitoring by telephone

A new weather data acquisition system using automatic public telephone networks was so promising in its test operation during the past year in Sweden that the system will be installed at seven stations this summer.

Prof. Magnus Aronsson of the Swedish Meteorological and Hydrological Institute in Stockholm reports that, after a one-year test period for the eight stations, the question of introducing the system at all synoptic stations will be considered. The telephone number of the station is automatically dialed every hour, or other predetermined time, by a computer.

Automatic equipment, without any manual assistance, reads and transmits the information from sensors connected to the telephone terminal. The information transmitted includes temperature, barometric pressure, humidity, wind direction and wind velocity.

The computer is programmed to initiate the connection with a station twice if necessary. The system can be adapted in the future for transmission of other weather factors, such as liquid precipitation, visibility and cloud cover.

The advantages of the system compared to more conventional weather data collecting systems are increased speed of acquisition, decreased error frequency and reduction of costs for transmitting information.

MEASUREMENT

Pollution levels unknown

The lack of reference data by which climatological changes can be measured is a "major tragedy," Dr. Werner A. Baum, president of the University of Rhode Island, says.

While man faces the "distinct possibility of choking to death" as the result of pollution, meteorologists know "next to nothing about such a simple question as the day-to-day or year-to-year variations in the carbon dioxide content of the atmosphere," he says.

To help determine the best locations for various types of industries, vast amounts of data about climate and weather are becoming increasingly more necessary, Dr. Baum asserts. Scientists from many disciplines will have to work together to study the biological, social and economic consequences of alternate courses of action.

As an example, Dr. Baum notes that properly used forecasts of ocean waves and temperatures by a technologically advanced fishing fleet could change the fisherman from a hunter to a farmer. Other industries that could operate more effectively by taking full advantage of weather forecasts to make decisions include transportation, agriculture and electrical utilities.

UPPER AIR OBSERVATIONS

High altitude information and instruments

A change in the way observations of the upper atmosphere are made may result from taking advantage of such precise navigation systems as Loran C and Omega to locate sounding balloons.

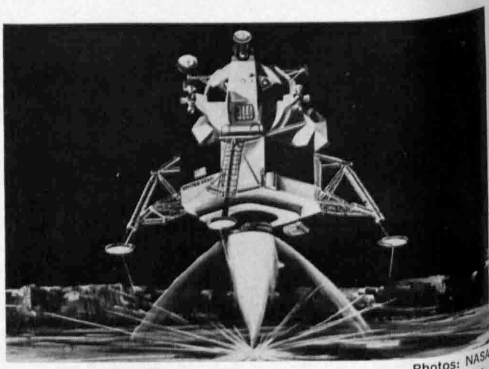
Measurements based on such a navigation system will be more precise and economical than by conventional radio interrogation, says Dr. Robert M. White, administrator of the Environmental Science Services Administration.

Observing techniques and instrument systems must be designed to meet the needs of scientists in many fields as well as weather forecasters, he stresses.

Moonward by jungle gym

Apollo's flimsy, awkward lunar module is getting into the act at last

by Jonathan Eberhart



Photos: NASA

Dangling probes will signal lunar contact as LM lands.

Louis Henri Sullivan's 1896 observation (inspired by tall office buildings) that "form ever follows function" was never better illustrated than by the ungainly looking lunar module that must carry two Apollo astronauts to and from the surface of the moon. Beautiful only to the eye of an engineer or a pop junkyard sculptor, the LM looks like a psychedelic jungle gym covered with tinfoil.

The reason is that the LM is all business: The most specialized manned spacecraft ever built. The other man-carrying part of Apollo—the command module—follows its Mercury and Gemini predecessors in being designed to take its crew from earth, through the atmosphere into space, and back again. The lunar module is the first of its kind, a new generation of spacecraft too weak to lift itself from the earth, too vulnerable to fly through an atmosphere without burning up. So specialized is the strange vehicle that it is even designed in two sections—one to land on the moon and the other to take off again.

The LM is the baby of the Apollo program, having been conceived a year after the rest of the spacecraft and even further behind the giant Saturn 5 booster that will provide the initial push on the moon journey. Only one LM has ever flown (SN: 2/3, p. 114), on the unmanned Apollo 5 mission 13 months ago, and that mission was far from perfect. But the problem on that flight, a computer that shut down an engine after only four seconds instead of a planned 39, forced a radical change of the entire flight plan. It gave the vehicle such an exhaustive workout that officials decided that, if it could handle such a job, it was ready to carry men.

That is the mission of Apollo 9, aimed at a launch this week from Cape Kennedy's pad 39A. The first men ever to fly the LM, Astronauts James McDivitt and Russell Schweickart, will put it through its paces (SN: 1/4, p. 8) knowing that it is incapable of returning them safely to earth if anything goes wrong. Only the command module can do that. The risk, National Aeronautics and Space Administration manned flight chief Dr. George Mueller estimates, is about two and a half times as great as that during Apollo 7, which carried men, but no LM, in earth orbit.

When astronauts finally do take off for the moon in Apollo 11, now aimed for July 15, one man, Michael Collins, will remain in orbit around the moon while the other two, Neil Armstrong and Edwin Aldrin, head down to the surface, using the lunar module's descent engine. After gathering samples and taking photographs and measurements, they will reenter the LM. Using the spent descent stage as a launch pad, they will fire the vehicle's second main propulsion system—the ascent engine—to boost only the ascent stage back up to orbit. There they will transfer to the command module to return home.

The LM was not originally planned as the bizarre, spidery giant it is today. When President John F. Kennedy first made the moon a national goal in 1960, space planners envisioned an open platform, weighing perhaps 4,000 or 5,000 pounds and carrying two men in space suits. When it was realized that a considerably larger, enclosed craft would be necessary, the design changed to such concepts as a simple domed cylinder.

When the first contracts were awarded to the Grumman Aircraft Engineering Corp. in Bethpage, Long Island, N.Y., late in 1962, the command and service modules were already well underway. The service module contains the command module's main propulsion engine and most of its consumables: propellants, oxygen, water and the like. The space agency wanted its lunar module to weigh in at about 22,000 pounds.

Eleven tons seemed adequate. But the safety requirement of double, triple and even quadruple redundant systems, together with increasingly elaborate guidance equipment and other needs, made weight into a problem.

It is still plaguing Grumman engineers, who had to work frantically to save every fraction of an ounce before January's delivery of LM-5, the one that must land and take off from the moon.

By the end of 1964, additions to the lunar module had become so great that NASA upped the permissible weight to 32,000 pounds. Even then, the engineers found their bird still three tons too heavy. They turned for help to a plan first used to trim down another overweight Grumman bird, the Navy F-111B fighter. This was SWIP, Super Weight Improvement Program, in which everything down to the nuts and bolts was lightened by milling, trimming and redesigning. Any reducing idea was considered that could be accomplished for less than $50,000 a pound.

And then, tradegy. "We were just starting to look smart," says a Grumman official, "when along came the fire." The launch pad inferno that killed three astronauts on Jan. 27, 1967, prompted fireproofing changes such as new materials and additional bulkheads which pushed the LM back up to 33,000 pounds. In desperation the engineers, who had already removed or lightened almost everything they could think of, instituted SWIP-II.

Lunar modules 1, 2 and 3 were too far along in assembly for SWIPping (LM 3 is that of Apollo 9, but overweight is only a problem for the landing and take off from the moon); LM 4 was able to make SWIP-I, but its electronics, micrometeroid shields and thermal insulation are still too heavy. Apollo 11's lunar module is the first one to get the full treatment.

Weight has not been the only difficulty afflicting the LM, however. The rendezvous radar, designed to help the

Seat-of-the-pants flying is out for the LM crew, who must stand the whole time.

command and lunar modules find each other for docking, turned out to be so sensitive at first that it was picking up stray signals from other electronics. This was the main reason the first manned LM flight was postponed from Apollo 8 to Apollo 9.

Erratic behavior of the ascent engine's fuel injector, one of the few major components with no backup safety system, gave engineers months of headaches, finally resulting in an engine from one company, Bell Aerosystems, being provided with an injector from another, Rocketdyne, somewhat like buying a Ford with a Chevrolet carburetor.

Windows were also a major weight problem. The LM was to have had a large, high-visibility bubble canopy, like that of a helicopter. To save weight, the cabin was redesigned with two small, triangular windows, but this meant that for good visibility during landing the astronauts would have to stand up. As a result the LM has no seats at all, the crew flies standing up. The men are held down by an elaborate harness-and-pulley system. On the moon they will sleep sitting up on the floor.

One long-term difficulty has been stress corrosion, tiny cracks formed in the vehicle's high-strength aluminum alloys due to localized stress such as that produced by a rivet. Though no failures have been traced to stress corrosion, Grumman has shortened its heat treatment of some parts, and NASA technicians were adding reinforcements and replacing rivets with bolts on Apollo 9's LM right up until it was stacked on its booster at Cape Kennedy in December. "We have the medication," says a Grumman official, "though the sickness will probably never go away."

Since the LM is designed to perform only in the airlessness of space and in the greatly reduced gravitational field of the moon, it has been impossible to test it completely on earth. However, despite its problems, it has performed well enough in the space agency's vacuum simulation chambers to convince its handlers that it will do its job well. "My confidence level has gone up a lot," says Apollo 9 commander James McDivitt.

The lunar module is incredibly complex—it has more than a million separate parts, three times as many as the largest jetliner now in service.

By earth standards it is also flimsy. Its cabin walls, including heat and micrometeoroid shields, are only hundredths of an inch thick. A mild kick would go right throught it.

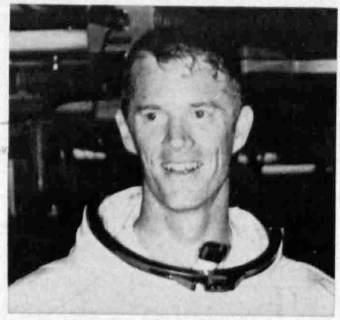
It did have to be designed, however, so that ordinary, mortal pilots could fly it, and as a result its control panels and instruments bear many resemblances to modern aircraft. "Its control response is like a high performance jet," says Grumman consulting pilot Richard Brent, one of a team of pilots who have helped with the vehicle's design from a flier's view.

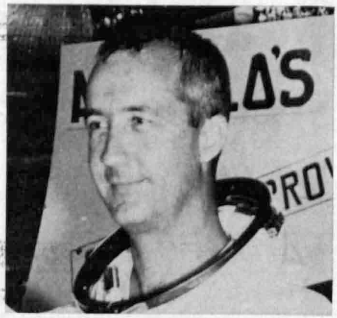
The LM pilot's main controls are two sticks: A pistol grip in his right hand to change the vehicle's orientation without changing its speed or direction, and a T-handle in his left to do just the opposite. The left-hand stick also doubles as the throttle for the LM descent engine, the only variable-thrust engine in the entire Apollo.

The Lunar Landing Training Vehicle, designed to familiarize astronauts with the trickiest part of the job—gliding across the moon at low altitude just before touching down—crashed last December on its last test before astronauts were to have tried it, and the accident is still being investigated. But chief Grumman consulting pilot Scott MacLeod maintains that such training, while valuable, is not vital to the moon landing. Even so, both of the Apollo 11 LM moon-landing crewmen have flown the research craft that was the predecessor of the LLTV.

"The LM," says a NASA official, "finally looks like a good bird." ◇

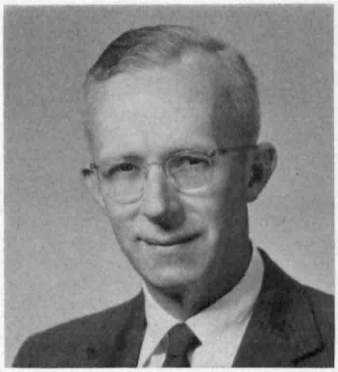
First men to fly the lunar module are (from top) Apollo 9 LM pilot Russell Schweickart and spacecraft commander James McDivitt, veteran of Gemini 4. Landing it on the moon will be Gemini 12 pilot Edwin Aldrin and Gemini 8's Neil Armstrong.





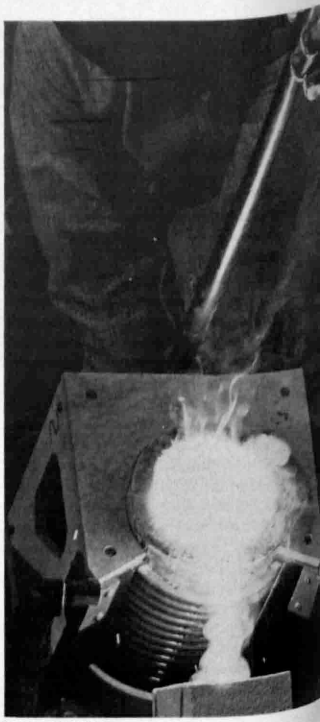
Prof. John Elliot, MIT

Coil of levitation melting device.



Pennsylvania State University

Dr. Mueller: chemistry of one atom.

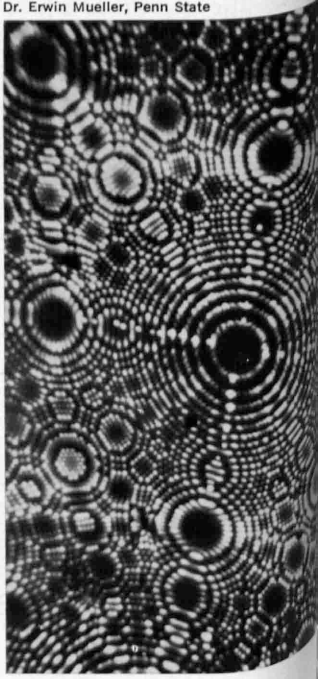


Armco Steel Corp.

Sample steel ingot being poured.

Atomic structure of a metal crystal.

Dr. Erwin Mueller, Penn State



METALLURGY

Searching for steel's research

Times are good for the U.S. steel industry. But then there's the matter of research.

by Edward Gross

Steel men, with the complacency of men who must be doing something right, tend to be impatient of critics who say they are not keeping up with the times. The steel industry is fat. It has just had one of its best years. Success should be its own reward.

But critics there are. They take off from the encroachment of new materials on areas formerly the domain of steel, from swelling competition from abroad and from the fact that the industry's rate of productivity growth has been slower than that of the rest of United States industry. And almost invariably they end with the slow pace of research supported by steel, a pace that may well be at the root of other problems.

The amount steel spends on basic research is "entirely inadequate," says Dr. Cyrus Klingsberg, executive secretary of the committee on mineral science and technology of the National Academy of Sciences.

"The Japanese are beating the hell out of us in steel research in general," he declares. The results show up, he contends, in the fact that Japanese steel is as good or better, and at lower cost.

A prevalent view is that the Japanese and Europeans, because of their emphasis on research, are making the major new technological developments in steel and will threaten U.S. industry.

Steel company officials admit their biggest headache is from foreign competition, especially that from Japan. About 18 million tons came from overseas in 1968, and the figure for this year, despite industry efforts to get Congress to enact restrictive legislation, is expected to range from 18 million to 20 million tons. But they don't agree that research, or its lack, is a cause.

Dr. Karl Fetters, vice president of research and development for Youngstown Sheet and Tube Company, blames the Japanese invasion on the low cost of their steel, a result of low wages. It isn't the only reason, he says in chorus with other steel spokesmen, but it is focal.

Prof. Richard S. Thorn of the economics department of the University of Pittsburgh criticizes the argument's almost exclusive emphasis on cheap labor.

The low productivity, says Prof. Thorn, results from the fact that the steel industry has done little to help itself through research. He cites aluminum, concrete and glass as industries which spend more on research than does the steel industry, whose research

expenditures are below those of nearly all other industries—60 cents of every $100 of sales, compared with five or six times that much for some competing industries.

Steelmakers, at least the big ones, are doing some research, if not all their critics say they should.

U.S. Steel has the nation's only privately owned million-volt electron microscope, to study the granular structure of steel. Steel grains, or crystals, are made up of atoms arranged to form cube-shaped units that join to form a lattice network. Since grain size, shape and orientation influence mechanical properties, understanding their role could help alleviate the problem of high-temperature creep—the slow deformation of a metal subjected to a load.

And U.S. Steel has the only existing atom probe field ion microscope, except for one built by its inventor, Prof. Erwin Müeller of Pennsylvania State University. It goes a step beyond an earlier Müeller invention, the lattice-probing field ion microscope, to perform chemical analyses on single atoms drawn from the mix of metallic and nonmetallic atoms that compose and strengthen steel. Republic Steel Corp. also has a major effort underway to draw stronger alloys from lattice-structure research.

Through their studies, Republic investigators hope to understand the mechanisms involved in dislocations, displacements that distort without breaking the crystal lattices, producing creep, or stretch.

The steel industry also supports, or at least has an interest in, such non-industry projects as the Battelle Memorial Institute's efforts to use a computer to study the phenomenon of brittleness.

Battelle researchers start with the fact that the brittleness of a metal—that is its reaction to stress—is determined by its arrangement of atoms. Since atomic arrangement, in turn, depends on the forces between atoms, knowing these atomic interactions, metallurgists could predict how a block of metal will behave. With the aid of a computer, Battelle scientists are applying force laws to large atomic arrays to make these projections. The end result could be a way to predict properties, such as brittleness, of an alloy without first making the alloy and then testing it.

An important effect of this work is that it will apply not only to steel but to other metals as well. Conversely, the research done on other metals often contributes to the basic understanding of steel. In a sense, then, a researcher in aluminum can simultaneously be doing basic research in steel.

An example of the close relationship between steel and other metals is illustrated by Prof. John Elliot's studies at the Massachusetts Institute of Technology on the fundamental chemistry of metals in molten solutions.

Steel contains alloying metals. On solidification they form compounds with nonmetallic elements, such as carbon, oxygen and nitrogen, which upon cooling influence the properties of steel. But a problem in studying the reactions of the alloying chemical elements is that they become contaminated by the container holding the metal during cooling. By employing a magnetic field to support the liquid steel droplets in space, a process called levitation melting, contamination by a container is avoided. Once it has cooled, the metal can be studied. With the information obtained, Prof. Elliot has been able to get some understanding of the distribution of reaction products throughout the steel.

Overall, the problem appears to be that the United States steel industry is forced to pick and choose carefully among the kinds of research on which it will spend its money.

The kind of research being done, going even beyond the behavior of atoms to research into the relationship between electronic structure and the property of metals, permits steelmakers to modify their product, but not to revolutionize their industry. This is the step steel critics insist must come.

Something like 90 percent of the Japanese steel industry, points out Youngstown's Dr. Fetters, was built after World War II with U.S. money.

From within the framework of a more aged plant complex, he argues that the U.S. industry cannot justify spending any substantial amount of money on research because of the limited return it will produce. "The amount spent in achieving a figure of five percent greater accuracy in the free energy of a chemical reaction will not help us significantly in running a blast furance," he declares.

And for the industry to scrap the investment it has in its steel furnaces and other production equipment, and really go modern, is out of the question.

The industry is just now completing conversion from the old-style furnaces to the basic-oxygen process, a technique developed in Europe in the 1930's (SN: 10/7/67, p. 346). And the adoption—or even serious consideration—of the latest advances, such as spray steelmaking developed in Britain and continuous casting that has had success in the Soviet Union (SN: 11/9, p. 482), will apparently continue to take second place to buy-American and import restriction campaigns as mainstays of the effort to stem the inroads of foreign steel and keep domestic steelmakers fat. ◇

LETTER FROM TOKYO

Computers and the gap

Japan's five-year plan is plugging the cybernetics gap; software is a problem

by Stuart Griffin

Of all the technologies that contribute to the technology gap, the computer stands as the most symbolic. First developed to serve the needs of nuclear weapons design, high-speed computers remain an area in which United States technological dominance is most clear and prominent.

Against this background, Japanese officials are showing considerable satisfaction over their five-year plan to develop a large nationwide computer system. The nucleus of the plan is the Electrotechnical Laboratory, which heads a cooperative organization consisting of Government institutes, universities and industry.

The plan is due to be completed during fiscal year 1971, which in Japan begins April 1.

Japanese computer technology has made a good start on the electronics side, particularly in transistorized computers, which have been on the domestic market since early in the 1960's. But a major technological gap has been in the electro-mechanical engineering of devices to read information in and out of the computer efficiently. Many input-output devices are now being produced under technical tie-up with American computer producers.

Another area where the Japanese computer effort is weak is in software: the design of programs and computer languages. The software development requires much more effort, manpower and expense than building the actual machines, and shortages of experienced software technicians have compelled prime local computer makers to seek U.S. cooperation on a continuing basis in recent years.

The reason Government support is being particularly directed to the computer industry is because Japan has no really large defense or space programs which could be expected to further computer technology as a side-effect.

Support, in fact, dates back to 1957, with the passing of the Electronic Industry Promotion Act, the establishment of the Electronic Industry Council and the founding of the Japan Electronic Industry Development Association. The Government also aided in establishing the Japan Electronic Computer Co., a private organization that buys computers from makers and leases them to users.

With the help of Government promotion and aid, the Japanese computer industry claims to be second only to the U.S. in the number of computers installed. But 40 percent of them are imported, and in the large sizes, the figure goes up to 65 percent.

The five-year plan now drawing to a close has been aimed at developing a multipurpose system: a computer with a large memory that can handle large batches of input data, as conventional computers do, as well as operate in the on-line mode, in which data are fed in continually from outside sensors. Time-sharing, the simultaneous use of a single computer by a number of users at separate input consoles, is also included in the master plan. These are all approaching fruition.

Besides these general goals, progress is being made on various specialized projects: an optical character reader both for letters and numbers and for Japanse ideographs, an artificial voice output device, a graphic display device and a character display system for some 250 ideographs including Chinese characters and Japanese syllabary.

Hardware for these unique peripheral devices has been tested in 1968, with further testing scheduled this year. Software will be on hand by late 1969 or early 1970.

In electronic and memory development, the plan has developed high-speed thin-film wire memories, with a central memory of 4,000 words (50 bits per word), and a cycle time of 200 nanoseconds (billionths of a second). The computer itself will have a memory of about 128,000 words.

In logic circuits, the Electrotechnical Laboratory is working with new ultra-small integrated circuits to develop high-speed response in small space. An integrated gate circuit—the main component of a computer's thinking apparatus—has been developed with a delay time per gate of about two nanoseconds, and work is moving on large-scale integrated logic circuits with about the same delay time.

There has been a problem in arranging consistent funding for the more advanced engineering in the project—some Government circles doubt the ability of Japanese engineers to develop the large-scale system. But money has been found.

Although there has been some internecine bickering among the various Government agencies and industries involved in the program, computer scientists are satisfied with the rate of progress to date, and predict completion of the program on schedule.

But they concede that the development of competent software cabability will take a long time.

books OF THE WEEK

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LUNAR ATLAS—Dinsmore Alter, Ed., new preface by Harold C. Urey—Dover, 1968, 343 p., 154 plates, illus., paper, $5. Republication of the first (1964) edition prepared by the Space Sciences Laboratory of the Space Division of North American Aviation.

MAXIMUM FEASIBLE MISUNDERSTANDING: Community Action in the War on Poverty —Daniel P. Moynihan—Free Press, 1969, 218 p., $5.95. An assessment and analysis of the practical experiences with local community action programs of the war on poverty, trying to translate academic theory into action through local politics.

MINERALS AND MAN—Cornelius S. Hurlbut, Jr.—Random House, 1968, 304 p., photographs, mostly in color, drawings, $15. Generously illustrated, the book presents expert information on the nature, origin and properties of the world's 150 principal minerals together with stories of how they have been used throughout the ages.

THE MOTH BOOK: A Popular Guide to a Knowledge of the Moths of North America—by W. J. Holland, annotations and new foreword by A. E. Brower—Dover, 1968, 479 p., 48 color plates, 263 drawings, paper, $5. A definitive reference work for amateur moth collectors for more than 60 years, this corrected reprint enables readers to use the latest checklists.

MOVING THE EARTH FOR A SONG—M. Wilson Gaillard—John Knox Press, 1969, 112 p., photographs, $4. Tells about one man's conservational efforts in trying to save the habitat of migrating birds.

A NATURALISTIC VIEW OF MAN: The Importance of Early Training in Learning, Living and the Organization of Society—George Crile, Jr., M.D.—World Pub. Co., 1969, 177 p., $4.95. The author, a surgeon and amateur naturalist, develops the theme that there is a critical time in the life of each cell, organ, animal and society, at which the organism in question is particularly ready for adaptive change.

NOBLE-GAS CHEMISTRY—John H. Holloway —Methuen (Barnes & Noble), 1968, 213 p., diagrams, $6.75. Intended to serve as a review of the known chemistry of noble gases, from description of their discovery, species observed spectroscopically and with clathrates, to recent advances in the chemistry of xenon, krypton and radon.

104 HAM RADIO PROJECTS FOR NOVICE & TECHNICIAN—Bert Simon—Tab Bks., 1968, 190 p., diagrams, $6.95; paper, $3.95. Assortment of circuits for useful devices.

1001 QUESTIONS ANSWERED ABOUT NATURAL LAND DISASTERS — Barbara Tufty — Dodd, 1969, 350 p., photographs, drawings, $7.50. World-wide in its range the book answers basic questions about phenomena causing disasters, and specific questions about earthquakes, volcanoes, tsunamis, avalanches, landslides, floods, droughts, fires and animal plagues. A rich source of accurate information.

THE ORIGIN OF SPECIES BY MEANS OF NATURAL SELECTION or The Preservation of Favoured Races in the Struggle for Life— Charles Darwin, ed. with introd. by J. W. Burrow—Penguin Bks., 1968, 477 p., paper, $1.25. Reprint (1859) of one of the most influential scientific books written for the general public.

PERSONAL SPACE: The Behavioral Basis of Design — Robert Sommer — Prentice-Hall, 1969, 177 p., diagrams, $4.95. Discusses investigations of human space requirement and the effects of physical setting upon attitudes and behavior in classrooms, public places, college dormitories and hospitals.

PERSPECTIVES OF MODERN PHYSICS—Arthur Beiser—McGraw-Hill, 1969, 611 p., illus., $12.50. Gives an account of the origin of some of the basic properties of atoms, molecules, solids and nuclei. Intended to be useful both as an introduction to the ideas for students majoring in physics or chemistry, and as a terminal survey for biology or engineering students.

PETROCHEMICALS: The New World of Synthetics — Ray T. Wendland — Doubleday, 1969, 299 p., diagrams, $5.95. Authoritative survey of the petrochemical industry, the properties of petrochemicals, the fluidized cracking operation, and a detailed examination of the specific reactions of ethylene, propylene, butylenes and isobutane.

THE PHYSICAL FOUNDATIONS OF GENERAL RELATIVITY—D. W. Sciama—Doubleday, 1969, 104 p., illus., $4.50; paper, $1.25. Explains step by step the physical theory of Einstein's General Theory of Relativity, from Newtonian dynamics, through the principle of equivalence, red shift, and field equations to the curvature of space-time.

PLANT BREEDING—William J. C. Lawrence—St. Martins Press, 1969, 62 p., 6 plates, diagrams, paper, $1.50. In new series sponsored by the Institute of Biology and the Royal Society, this booklet is designed to present at the advanced undergraduate level the genetic principles on which the subject of scientific plant breeding is based.

PLANT DIVERSITY — Robert M. Harris — Brown, Wm. C., 1969, 96 p., photographs, paper, $1.95. Designed as an introduction to biological principles and to transmit the excitement of an evolving science to the liberal arts student.

PLASTICS IN THE MODERN WORLD— E. G. Couzens and V. E. Yarsley—Penguin Bks., 1969, 386 p., photographs, diagrams, paper, $1.65. Completely revised edition of Plastics in the Service of Man (1956), gives comprehensive account of the physical behavior and chemistry of plastics, their manufacture and manipulation, and the latest applications in industry and home.

THE POCKET ENCYCLOPAEDIA OF PLANT GALLS IN COLOUR—Arnold Darlington—Philosophical Lib., 1968, 191 p., photographs and illus. in color by M. J. D. Hirons, $7.50. British field guide, summarizes characteristics of the more commonly found plant galls, outlines the mode of life of principal gall-causing agents, and suggests student projects in field and laboratory.

PREVENTING FAILURE IN THE PRIMARY GRADES — Siegfried Engelmann — Science Research Associates, 1969, 396 p., illus., $7.95; paper, $4.95. Tasks outlined in the reading and arithmetic sections are designed for children who have not mastered the basic skills, whatever their age or grade level.

PRINCIPLES OF ORGANOMETALLIC CHEMISTRY—G. E. Coates and others—Methuen (Barnes & Noble), 1968, 259 p., diagrams, paper, $6. Provides the undergraduate student with a concise and clear picture of the organic chemistry of both the main-group and transition metals.

A PSYCHOLOGICAL APPROACH TO ABNORMAL BEHAVIOR — Leonard P. Ullmann and Leonard Krasner—Prentice-Hall, 1969, 687 p., diagrams, $9.95. This book develops the central idea that the behaviors traditionally called abnormal are no different, either quantitatively or qualitatively, in their development and maintenance from other learned behaviors. The book traces the conceptual, research and therapeutic implications of not labeling such behavior as an indication of "mental illness."

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