crease in brain sugars during the first ten minutes of a pigeon's training. The increase is probably due to the animal's general state of alertness; it is not permanent. Dr. Bogoch, however, found that some sugar proteins do show permanent elevation with learning. Months after their training, pigeons maintain this increased glycoprotein content, and the amount of the increase is related to how well the animals have learned. The better the learner, the more residue in its brain.

Dr. Bogoch views the sugar proteins as "switches" on nerve cells influencing the action of neurons. If they can be synthetically duplicated, he suggests, it may be possible to build many more switches into one brain.

Dr. Heinz Von Foerster, professor of electrical engineering at the University of Illinois, explains how protein molecules on the neuron may alter in response to experience.

He describes the molecules as tiny computer parts, reacting to electrical charges. They are continuously changing in molecular structure from stable to excited energy states and back again. An electric charge comes along—the result of experience—and kicks the molecule into an excited state. Its structure changes, for example, from a stable tetrahedron to a less stable square, allowing the molecule to react chemically and form bonds. In the process, it changes a neuron.

"The whole neuron is a different fellow," says Dr. Von Foerster. "Next time its function will be different."

Without chemical bonding, the molecules will return rapidly to their most stable state. Dr. Von Foerster has calculated that the time required for these flips matches that of neural transmission—0.1 to 0.001 second.

As an alternative to storage, Dr. Von Foerster offers what he calls "cognitive tiles." A tile is the smallest neural unit capable of computing meaning from experience.

From conversations with neurophysiologists, he believes a tile can be as small as a single neuron—in other words, one nerve cell may be capable of sensing meaning. At other times, two neurons, four neurons or an entire network would make up the tiles which are laid out in mosaic patterns.

From recent evidence, it appears that many of these relationships between neurons are already programmed at the level of sense organs. Experience does not always come into the brain as unrelated stimuli; the retina itself seems able to compute relationships.

Dr. Von Foerster rejects the idea that all experience is stored somewhere in the brain. "If people stored all the nonsense they have ever seen, they could never retrieve anything," he says.

WHERE NEXT?

A Soviet Month In Space

Satellite	Launch	Decay (to 5/7)	Period (min.)	Inclination (degrees)	Apogee (mi.)	Perigee (mi.)	Purpose
Cosmos 210	4/3	4/11	90.2	81.3	232	123	recon.
Luna 14	4/7		selenocentric orbit				moon data
Cosmos 211	4/9		102.1	81.3	958	123	scientific
Cosmos 212	4/14	4/19	88.3	51.6	124	112	docking
Cosmos 213	4/15	4/20	89.1	51.6	157	115	docking
Cosmos 214	4/18	4/26	90.2	81.3	237	123	recon.
Cosmos 215	4/18		91.4	48.4	321	132	scientific
Cosmos 216	4/20	4/28	89.2	51.0	166	123	recon.
Molniya 1H	4/21		720.8	64.0	24861	254	communications
Cosmos 217	4/24	4/24	87.6	62.2	113	93	maneuvering
Cosmos 218	4/25	4/25	orbit too brief for data				FOBS test
Cosmos 219	4/26		104.7	48.4	1083	140	scientific

The only Soviet manned space flight in the last three years, that of Soyuz 1 on April 23, 1967, ended in the death of Cosmonaut Vladimir Komarov. Since then a vigorous program of unmanned tests of spacecraft and equipment has made U.S. space officials expect something big to happen.

The something big could be just about anything. Guesses have ranged from a manned earth-orbital test of the Soyuz moon craft, to a manned space station carrying as many as a dozen men, to a robot spaceship that would automatically dig up and bring back to earth a sample of the moon, to a manned circumlunar flight.

One thing that has stirred the space-watchers recently has been the most active space month in Russia's history. During April, the Soviets made more launches—12—than there had ever been in a single month before by any country. The U.S. had put as many or more satellites into orbit during one month four times in the past, but each time one of the U.S. launches included a military flight in which eight satellites were orbited at once.

Three of the satellites in Russia's high-flying April were of particular interest to Westerners looking for signs of coming manned missions. Cosmos 212 and 213 docked, coasted and undocked in orbit automatically (SN: 5/4, p. 430), which could indicate preliminary success in developing a maneuvering capability for use in rescuing astronauts from orbit, a technique on which the U.S. is still debating. Another probe, identified only as another Cosmos number, carried out maneuvers on its own a few days later, swooping down to only 93 miles above the earth. This is some seven miles lower than the orbit of any United States manned flight.

There have also been reports that Soviet space researchers are developing a new super-booster, though they are not unexpected around NASA budget time.

There were indications late in the month that Soviet tracking ships had been sent to their posts at sea, which in the past has often been a good indicator that a major shot was coming. Almost two weeks later, however, there have been no further signs of an immediate launch, although some observers believe that past Russian statements could indicate a circumlunar flight this month.

INTERFERON

Opening another route

Most of the work to date on the antiviral agent interferon has sought either to find a way to produce enough of the protein for injection, or to find some agent that will induce the body's own interferon production.

Now it appears that a third approach must be investigated—the injection of foreign cells that have already begun to make interferon.

For almost a decade, interferon has hung like the grapes of Tantalus, always slightly out of reach. It was identified in 1957 by Dr. Alisk Isaacs, as the substance responsible for one viral infection's interference with the development of a later arriving virus. Interferon at first was hailed as a potential answer for just about every virus disease known.

Interferon is a chemical produced by cells under attack by a virus which blocks replication of the virus. It is a cell's first line of defense against viruses.

Dr. Lowell A. Glasgow of the University of Rochester School of Medicine in Rochester, N.Y., says his group has induced interferon production in the white blood cells of mice, then transfused these cells into other mice.

The transfusion of these interferon factories, Dr. Glasgow says, provides

the host with continual high levels of interferon at very small risk. Dr. Glasgow discussed his work with interferon at last week's meeting of the American Society for Microbiology in Detroit.

It was hoped originally that some agent could be found to cause the body to begin interferon production in the absence of infection. In this way an incoming virus would be met by already high levels of interferon and would be unable to gain a foothold.

Many inducers have been found; all have one harmful side effect or another. Recent work, however, has shown that the essential ingredient of an inducer is double-stranded ribonucleic acid (RNA) or a similar double-stranded molecule. This is found in the core of most viruses, surrounded by protein.

Dr. Maurice Hilleman's research group at the Merck Institute for Therapeutic Research, West Point, Pa., has determined that the two essentials for an interferon inducer are double-stranded-ness and the lack of the viral protein coat (SN: 8/19/67, p. 173).

Dr. A. K. Field, one of Dr. Hilleman's co-workers, described some of the group's further work at the ASM meeting. Under test is a two-stranded complex of synthetic polynucleotides structurally very similar to viral RNA and having a low incidence of side effects.

Even if all three avenues to the therapeutic use of the interferon mechanism pan out, however, all will not be roses. It is becoming apparent that, as with most of the body's defenses, the mechanism is not effective across the board.

No animal, Dr. Glasgow says, has been known to maintain a high level of interferon over a long period of time. Chronic viral infections are either chronic because the viruses are poor interferon inducers, or they are chronic because they are resistant to interferon; the host may just give up trying to block the virus. Not enough of interferon's action is yet known for anyone to make an intelligent choice between the two. Maybe both are true. Several viruses producing chronic infection have been found to be both poor inducers and very resistant.

A more basic problem still is how interferon blocks replication of those viruses against which it is effective. Dr. Philip Marcus and co-workers at the Albert Einstein College of Medicine in New York, report that interferon works through an intermediary called translation inhibitory protein (TIP).

Work reported in Detroit supports the idea that minute amounts of interferon attach to a cell's wall and somehow stimulate cellular production of TIP. This in turn appears to block the synthesis of new virus particles. ◇

INTERNATIONAL SCIENCE FAIR

Young talent on display

A rich array of young scientific talent is on display this week at the 19th International Science Fair. Opening May 15 in Detroit, the fair has drawn 428 students—winners of 231 participating fairs—a new record.

The United States sends finalists from 47 states and the District of Columbia. Nine foreign nations, including one new participant, Ecuador, sends winners of their national fairs.

The students come with the backing of news media, scientists, educators and industry to show scientific work of striking sophistication and to be judged by a panel of scientists.

Entries from foreign nations—Japan, Germany, Sweden, Switzerland, Venezuela, Canada, El Salvador, Ecuador and the Philippines—actually account for only a handful of participants at the International. More than 400 are winners of U.S. regional fairs.

Scientific range and imaginative peaks are characteristic of the fair. From Japan, for instance, comes a study of cloud movement with surface wind direction, based on six years of observation, and from Germany, a project on behavioral genetics in the dragonfly.

An Indiana student offers a means of transmitting sound by light because he believes people need a new communication mode. Extra-heavy gravity makes plants sprout faster and increases lipid deposits in mice, according to a Kentucky project.

By far the most important source of ideas for this year's projects were scientific journals and magazines. Also important, but less so, were adult scientists whom the students met through special university or industrial programs and through summer institutes.

These two sources together seem to be roughly three times as important as textbooks, high school teachers and classroom activity combined.

But schools come off better in sparking original interest. An elementary school teacher or class was often instrumental in first directing the student's interest toward science.

The students' reports seem to support results of creativity studies (see page 479). From an early start—sparked by school, outside activity or innate curiosity—creative young people increasingly turn to sources outside the classroom. Both their information and creative expression run in extracurricular channels.

HEART IMPLANTS

A spate; a conference

Between April 28 and May 7, surgeons transplanted hearts in Paris, London, Palo Alto, Calif., and three times in Houston, Tex. They brought the world total to a dozen. Another transplant is planned in Cape Town, South Africa, where Dr. Christiaan Barnard expects to transplant at least three more.

As the eleventh human heart transplant was reported, a conference on transplant techniques was being held last week at the National Academy of Sciences in Washington.

Foremost of the future problems as foreseen by the surgeons: Where can enough hearts be found; how can rejections of the new organ by the body be anticipated early enough to be stopped; how are the expensive operations (with costs up to $1,900 a day while a patient remains under intensive care) going to be paid for when they go beyond the experimental stage?

Dr. Keith Reemtsma, one of the pioneers in transplanting animal organs to man (SN: 1/18/64), who is now in the department of surgery at the University of Utah in Salt Lake City, sees this still as a feasible route to take.

"When I first crossed species in 1963-64, immunosuppressive drugs were not used as much as they are now," Dr. Reemtsma said. "The antilymphocyte serum, also called antilymphocyte globulin (ALG) should prolong survival, so there is hope of using nonhuman donors for future transplants."

Dr. M. C. Botha, a colleague of Dr. Barnard, who as a pathologist took part in the two transplants done by the team at Groote Schuur Hospital, said that although the heart transplant is a reality, important problems remain.

"We need better-matched tissue, better-matched grafts and the ability to detect when both short-term and long-term rejection is taking place," he says.

The difficulty of preserving and storing hearts, even when they are available in matching tissues, was stressed by Dr. Richard R. Lower, long-time researcher in heart transplants at the Medical College of Virginia in Richmond. About 30 minutes is the longest time a heart has been kept viable.

It is estimated that before the experimental period of heart transplants is past, there will have been at least 100.

Babies with congenital heart abnormalities are likely candidates rather than more persons who are physically debilitated. The fact that Dr. Philip Blaiberg has remained well since receiving a new heart Jan. 2 in Dr. Barnard's second try is regarded as due to his general health as well as to the doctor's skill.