

## Evidence for transfer of leukemia immunity

Leukemia, cancer of the white blood cells, causes about 400,000 deaths a year. Leukemia in many animals is caused by a virus, and scientists suspect that human leukemia is also caused by a virus. Three researchers reported last week at the annual meeting of the Federation of American Societies for Experimental Biology in Atlantic City that mother rats inoculated with a virus found in leukemic cells can transmit immunity to their offspring.

Harry L. Joachim, Steven Keller and Martin Gimovsky of Lenox Hill Hospital and Columbia University's College of Physicians and Surgeons have, in the laboratory, been growing tissue cultures of leukemic cells that contain a virus. This virus, when injected into rats, produces leukemia "entirely similar to that in humans," they say. They had observed that infant rats were very susceptible to the virus, while adult rats seemed naturally resistant. The problem was to protect the infants during the few weeks when they were susceptible.

The researchers injected a number

of adult female rats with the virus and then mated them to normal male rats. The newborn rats from those pairs, as well as rats born to uninjected mothers, were then injected with a lethal dose of the virus. All rats born of non-immunized mothers died; none of those whose mothers had been injected showed any sign of disease. These results, say the researchers, indicate that "the immunized mothers are able to transmit to their offspring the resistance to the disease which they have acquired." They theorized that the immunity could have been transmitted from mother to offspring by two possible routes: circulation through the placenta (the structure by which the embryo is attached to the wall of the uterus) during intrauterine development, or through the milk during nursing.

Either way, says Joachim, the immunity must be of a humoral type, in which antibodies circulate in the body fluids. In the other type of immunity, cellular immunity, the antibodies are anchored to certain cells in the body. These cells cannot pass through the placenta; humoral antibodies can.

To pin down the transmission

route, the pathologists repeated the previous experiment, except that after the newborn rats were injected with the virus, some, of those born to immunized mothers were placed for nursing with non-immunized mothers, and some born to non-immunized mothers were given to immunized mothers. Leukemia developed in 35 percent of the rats born to immunized mothers and nursed by non-immunized mothers, and in 11 percent of rats born to non-immunized mothers and nursed by immunized mothers. None of the rats born and nursed by immunized mothers developed leukemia; those born and nursed by non-immunized mothers developed the disease.

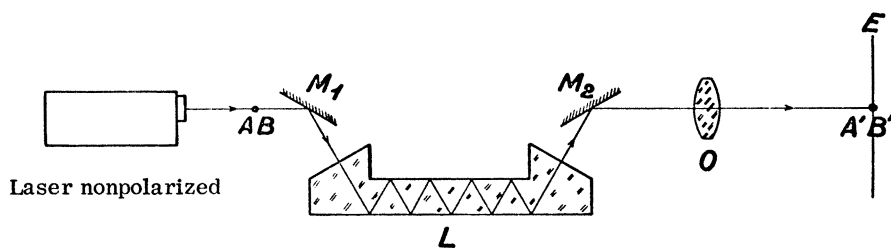
The team concludes that immunity to leukemia can be transmitted to offspring through both placental circulation and milk, but that the milk route is more efficient. "It is quite possible that cancer in humans is also induced at a very early age when the resistance to carcinogenic agents is minimal due to immunologic immaturity. Protection during this critical period could then conceivably be achieved by immunization of mothers with specific or non-specific vaccines."

## Photons: An experiment that may show mass

One of the basic principles of modern physics is the so-called wave-particle duality. Material particles, protons, neutrons, electrons, etc., are in some ways also waves; waves, such as light, are also particles. Experiment has repeatedly shown that the principle, difficult as it may be to accept or understand, is quite true. Appreciation of the wave-matter duality settled a three-century-old dispute over whether light was a train of waves or a stream of particles by saying it was both.

The man who 50 years ago first wrote down the idea of matter-wave duality, Louis de Broglie, and another French physicist, Jean Pierre Vigier of the Institut Henri Poincaré in Paris, now suggest that certain experiments on the reflection of laser light give indirect evidence that the photon or light particle has a small rest mass. If true, this contradicts the developed theory of optics and electricity and magnetism, which assumes that the photon rest mass is exactly zero.

The experiments, conducted by A. Mazer, C. Imbert and S. Huard, dealt with total internal reflection of laser light at the boundary between a dielectric material and vacuum. It is a well-known optical principle that a light beam proceeding through a medium



C. Imbert

*Imbert's arrangement to study total internal reflection of laser light.*

with relatively high refractive index (the dielectric in this case) and striking the boundary with a medium of lower refractive index (the vacuum) will be totally reflected if it strikes the boundary at an angle less than a certain critical value. What happens in detail is that the oncoming beam actually exits from the dielectric medium into the vacuum, loops around and reenters the dielectric. The difference between the points of exit and reentry causes a lateral displacement in images made with the light, and it was the relation of these lateral displacements to the linear polarization of components of the laser beam that the experiment of Imbert and collaborators was studying.

The results came out in contradiction to predictions based on both classical and quantum physics. In the April 10 *PHYSICAL REVIEW LETTERS* de Broglie and Vigier suggest that they can be interpreted as due to relations between

the polarization of the electric fields in the light wave and the spins of photons associated with the wave, provided one assumes that the photons have a finite mass. The amount, they figure, should be equal to or less than  $10^{-48}$  grams.

A number of physicists have done experiments to look for a photon mass without so far finding evidence of any (*SN*: 7/17/71, p. 46). They carry on the search not because such a tiny mass would have any practical effect in electrical or optical technology, but for the philosophical, intellectual and esthetic character of physical theory. If photons have rest mass (and then by implication neutrinos do too), all particles and their associated wave fields are on the same footing. One no longer has to worry about the infinities and indeterminate results produced by doing arithmetic with zeroes. Also, de Broglie and Vigier point out, a small photon rest mass would make Einstein's fa-

mous formula,  $E = mc^2$ , truly universal. One of the consequences of this relation between matter and energy is that one kind of particle can be constructed out of other kinds of particle, properly selected. But zero-mass particles have to be excepted, since, having no mass, they cannot be made out of particles that do. If photons have mass (and neutrinos also), de Broglie and Vigier suggest that photons could be constructed as neutrino-antineutrino combinations.

The two theorists suggest that the experiment of Imbert and collaborators might be modified by introducing thin layers of materials with other diffractive indices so as to give more evidence of the working of photon mass if there is one. It remains to be seen whether experimenters will take them up on it. □

## Electrical stimulation therapy in humans

The potential for control of the brain by electrical stimulation has been vividly demonstrated in animals. The treatment is as powerful in humans but has been less often publicized, probably because of the serious emotional and ethical issues involved. These issues will move from theoretical to practical concern as research on humans gains momentum.

At Tulane University's School of Medicine in New Orleans Robert G. Heath has developed a method of employing electrical brain stimulation for the development of new behaviors in human beings. Charles E. Moan, also of Tulane, described to the meeting of the Southeastern Psychological Association in Atlanta last week how this electrical brain stimulation succeeded in one patient. Pleasurable responses were elicited in a 24-year-old male homosexual by electrical stimulation of electrodes implanted in the septal area of the patient's brain. The pleasure relaxed the patient and allowed therapists to expose him to heterosexual stimuli and situations he had previously feared and rejected.

Prior to treatment the patient showed signs of paranoid psychosis with suicidal tendencies. His homosexual experiences began at age 12 and he had never experienced heterosexual relations. Prostitution, alcohol and drugs had become a way of life. He was in a depressed state and showed signs of temporal lobe epilepsy. He failed to respond to any form of psychiatric treatment before the stimulation therapy.

The subtle brain stimulation resulted in the patient's experiencing and displaying improved mood, self-confidence, generalized muscle relaxation, euphoria, elation, inter-personal warmth, tension

release and sexual arousal. Added Moan, "It was during subjectively pleasurable states such as these that he became sexually motivated and masturbated upon viewing a heterosexual stag film." The therapists administered the pleasurable electrical stimulation to the patient at appropriate times during the therapy and it was used as a form of positive reinforcement in an over-all

## How sodium helps calcium into the bloodstream

Ions from various elements are essential to the body's life-giving processes. They are believed to act as electron transfers as cells break down ATP, or energy molecules, into energy. Ions move in and out of the body's some 180 billion cells with the ease of a Houdini. Yet exactly how the different kinds of ions enter and escape, especially against gradients—where there are more ions outside the cell than inside, or where the membrane is electrically charged—is one of the more intriguing questions facing cell physiologists.

The movement of calcium ions in and out of the cells of the intestine is particularly challenging, both because calcium is a vital mineral from foodstuffs and because intestinal tissue is unique. The cells of the intestine are positioned in such a way that the functions of the borders of the cell are differentiated. One border, the brush border, is adjacent to the cavity of the intestine, through which food passes. The other border, the basal membrane, is in contact with the bloodstream, or the body.

Calcium from food in the diet readily moves from the intestinal cavity into intestinal cells for digestion, probably by simple diffusion. The reason is that calcium often reaches exceedingly high concentrations in the intestinal cavity and both electrical and chemical gradients are favorable for passage of calcium into the intestinal cell.

But passage of calcium out of the cell into the bloodstream, for use by the body, is a problem. Here calcium must cross a gradient unfavorable to its movement. The concentration of calcium in the bloodstream is probably a thousand times higher than the concentration of calcium in the intestinal cell. There is also an electrical-chemical gradient resisting calcium's exit. So to move against this powerful resistance, calcium ions need energy, which they probably obtain from ATP molecules or some other energy source. Movement of calcium out of the intestinal cell into the bloodstream has also been suspected of requiring sodium. Now Stanley J. Birge Jr., Helen R. Gilbert and Louis V. Avioli of the Jewish Hospital of St. Louis present evidence in the April 14 *SCIENCE* underscoring such sodium dependency. □

therapy. When allowed self-control of the device, the patient stimulated himself electrically 1,300 times in a three-hour period.

The electrodes have been removed from the patient's brain, and, according to Moan, a one-year followup shows that he has solved many of his personal problems and is leading an actively and exclusively heterosexual life. □

Before they undertook their research, they knew that a chemical inhibitor of sodium ion reabsorption into the kidney cell, ethacrynic acid, also inhibits calcium ion reabsorption into the kidney cell. This suggested a relationship between transport of both kinds of ions. So they decided to see whether such inhibitors might help delineate the role of sodium in getting intestinal cell calcium into the bloodstream.

They found that ethacrynic acid inhibited net water transport and therefore sodium transport, as well as calcium transport, out of the intestine into the bloodstream. The chemical ouabain, however, inhibited sodium transport but not calcium transport. But by fractionating out intestinal cells, they went on to identify a phosphatase enzyme located in the basal membrane of the intestinal cell and implicated in calcium transport. Its activity was also inhibited by ethacrynic acid but not by ouabain. Because this enzyme is known to depend on sodium as well as on calcium, the St. Louis investigators concluded that the enzyme probably mediates the exit of calcium into the bloodstream, and to do so, it must first be activated by sodium.

In sum, sodium probably has a role in getting calcium out of intestinal cells into the bloodstream. The role is most likely the activation of an enzyme or enzyme system that catalyzes the exit of calcium. □

## Protested award

Last year Saul J. Krugman of New York University Medical Center reported success in producing active immunization against serum hepatitis (SN: 3/27/71, p. 211). This week in Atlantic City the American College of Physicians gave Krugman the James Bruce Memorial Award for his work. But not everyone applauded. A group of doctors, nurses and medical students staged a demonstration that brought the ceremony to an early close. They protested the fact that Krugman had exposed children to hepatitis. They claim he forced the parents to allow their institutionalized children to be used as guinea pigs. He denies there was any coercion. □