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 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. □

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.

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. □