the membrane, and electric cells have been built from distilled water and gelatin. National Cash Register Company has a research program on these devices. If it becomes possible to develop a small voltage in a tiny, millionth-of-an-inch capsule filled with water or a water solution, and to use this voltage to affect neighboring capsules in a useful way, a whole new field of technology may be opened up.

Such a technology would be closer in size and structure to the complex technology of living matter than anything man has yet devised. Thus the tiny capsules originally developed for use in business records may some day prove to be another step in the design of computing machines as small and as versatile as a "brain," or chemical factories as silent and as efficient as a tree.

Foods in Capsules

Further uses for capsule powders in the field of foods and drugs have been suggested.

Liquid coffee in capsules would retain all it odor and flavor until it was ready for use. Unstable drugs could be protected by encapsulation. Perfume capsules could be coated on facial tissues, with the scent released when the tissue was rubbed on the skin.

Distilled water may be encapsulated to protect its purity. Air-in-capsules might be used to create tiny air pockets in materials to increase their buoyancy.

Adhesives containing an activator in capsules could not harden until the surfaces to be cemented were pressed together and the capsules broken.

The NCR paper is the only commercial application of capsule powders at present. However, a laboratory demonstration of a computing machine memory has been made and a prototype of a practical working memory is expected to be completed within a year.

The computing machine memory will consist of a revolving drum whose surface is coated with capsule powder containing the light-sensitive metachromic dyes. Marks will be made on the surface of the drum by blue light, read by photoelectric cells, and erased by yellow light.

Prodigious Memories

Since the capsule coatings have a million capsules to the square inch, the number of marks, or "bits" of information, that can be stored in a memory of this kind is potentially enormous.

If each capsule could be used for one bit of information, the entire contents of a book could be recorded on a square foot of paper. Practically, the very large number of capsules means that the number of bits per square inch will be limited only by the resolution of the optical system used to record, read, and erase the marks. There will be no limitation due to grain size, as there is in photographic film. Also, each capsule is unaffected by its neighbors, so the marks will not spread as they do in photographic emulsion or on magnetic tape.

Science News Letter, April 19, 1958

ASTRONAUTICS

Ions to Power Space Ships

➤ INTERPLANETARY rocket ships powered at fantastic speeds by the tiny thrust of streams of electrically charged matter have been shown to be practical by at least one formal Air Force study of proposed ion-powered rockets.

Until now, discussions of future ion-drive rockets have been based mostly on speculation, hope and informal studies.

Detailed results of one formal study made under an Air Force contract were revealed to the national aeronautic meeting of the Society of Automotive Engineers by R. H. Boden, Rocketdyne Division of North American Aviation, Inc. These results show an ion rocket engine "has the capability of producing usable thrust levels and will supplement other rocket engines in applications to space vehicles," Mr. Boden reported.

On April 5, 1957, two Rocketdyne research engineers, Martin I. Willinski and Mrs. Elsie C. Orr, described their proposal for such a space ship to a meeting of the American Rocket Society. At the same time, the Air Force Air Research and Development Command announced the contract to study ion-drive possibilities. (See SNL, April 20, 1957, p. 249.)

An ion-powered rocket would be given thrust by a stream of ions, electrically charged atoms and molecules, ejected at high speed from the rear of the ship.

The thrust, or working force, produced by an ion drive would be very small, but would be sufficient to maintain the rocket at tremendous speeds through space once the ship had been accelerated to a high speed and pushed into the near vacuum of outer space by more conventional rocket engines.

Scientists studying possible ion-drive mechanisms, not only at Rocketdyne but also at other private and Governmental research centers, still are engaged primarily in "basic research" and have not yet reached the "applications" stage.

"The state of the art in the ion rocket engine is in the pre-engineering phases," Mr. Boden said, adding that "three major problem areas exist in the development of the ion rocket engine."

The problems involve the propellants that will be ionized and ejected to provide thrust; the thrust chamber; and the development of the appropriate electrical generator to accelerate the ions.

He reported programs can now be set up for solving these problems.

Mr. Boden revealed the research program is scheduled to continue for another year and is to be expanded to include "a limited experimental program" in addition to theoretical work.

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PHYSIOLOGY

Treat Baby Heart Failure

➤ CONGESTIVE heart failure accounts for between 10% and 20% of all cases of heart disease in infants and children, and the majority of these cases is due to congenital, prenatal, heart disease, a San Francisco physician reports.

Immediate treatment is hampered by the difficulty in properly diagnosing heart failure because the symptoms, in the infant or child, resemble those of infection and are many times wrongly interpreted.

Symptoms which should be watched and which might mean a condition of heart failure are:

1. Rapid respiration—normal respiration at birth is about 40 per minute. It may range up to 100 and still not be identified as an abnormality.
2. Hepatomegaly—the liver is greatly enlarged and may be felt at the navel.
3. Enlarged heart.
4. Rapid heart beat. Any pulse over 120 accompanied by rapid respiration.
5. Gallop, or leaping heartbeat.
6. Abnormal respiratory sounds in the lungs.
7. Peripheral edema. Water rention in the surface skin. This is a late sign of failure in infants and children, and indicates a severe degree of failure, Dr. Saul J. Robinson explains in *California Medicine* (March).
8. Easy fatigability. This sign may be an important clue to detecting congestive failure. Often the mother notices that the infant pauses frequently to rest during feedings.

Dr. Robinson urges that these steps be considered in treating the infants for heart failure:

Treatment for the underlying condition which could mean a combination of failure plus pneumonia, infection or anemia. He strongly urges the use of antibiotics for infection and careful replacement of blood for the anemic, and use of digitalis, according to weight and age of the infant.

A low salt diet will control edema, water retention, a problem encountered in congestive heart failure, he points out. Increased urination should be encouraged through administration of a diuretic, and the supply of oxygen should be increased. Diet should consist primarily of fluid during early stages of treatment, and vitamins should be gradually introduced, he recommends.

Dr. Robinson cautions that cortisone and ACTH may relieve heart failure, but should be used with caution, while actual phlebotomy, or opening the veins, is seldom recommended.

The earlier the diagnosis, the more hope there is for recovery through later surgery after temporary treatment.

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