

## PHYSICS

## 8-D Atomic "Space"

► SCIENTISTS ARE really visualizing a sort of 8-dimensional world in order to have enough "space" in which the sub-atomic particles can perform the most fundamental acts in the universe.

To understand and explain the actions of sub-nuclear particles, some two dozen of them probably, it is necessary to take mental flight into realms that are difficult to imagine concretely. Actually, the scientists do not talk about dimensions but "degrees of freedom."

Dr. Freeman J. Dyson, professor of physics at the Institute for Advanced Study, Princeton, N. J., explained this sub-atomic situation in a National Academy of Sciences lecture.

His explanation of what is called "product space" as postulated by the Princeton mathematical physicist, Dr. A. Pais, runs something like this:

If a line is multiplied by a line, through every point of a line we imagine a new line and these determine a plane.

If a line is multiplied by a circle, so that each point on the line becomes a point on a circle as well, the result is a cylinder.

If a circle is multiplied by a circle, each point on the first circle becomes also a point on the surface of a new circle at right

angles to the first. The resulting figure is a ring-shaped, doughnut-like solid, which the geometers call a torus.

Passing from these two- and three-dimensional figures to the world in which we live, we can imagine that we can extend this kind of development of figures into some other kind of space which we will consider to be at right angles to the space we live in.

In this new space, every point in space as we see it would be replaced by a tiny sphere. The important properties of such a sphere are the fact that a point on its surface can shift around from one side of the sphere to the other, and that, while doing so, that point could have its own bodily rotation, or spin.

However, physicists are still not satisfied with this new kind of space, because it does not give them enough degrees of freedom to account for the many kinds of sub-nuclear particles. Our world is not three-dimensional only, but is a space-time continuum.

In the new world just imagined, an additional dimension, corresponding to the fourth dimension time gives us, would offer enough dimensions for the particles.

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simple electric shock which in most cases stops the fibrillation.

By having an electrocardiogram running during the operation, the surgeon can even tell in advance from changes in this record of heart activity that fibrillation is coming. In such a case, he can stop the flow of ice water and within a few beats the heart is back to normal. The same situation holds during the warming up process.

The reason why this fibrillation may come during hypothermia is that the colder a person gets, the less oxygen dissociates out into his tissues, even if he has an ample supply in his blood. Then the heart muscle as well as other body tissues do not get enough oxygen. The difference between hibernating animals and humans under hypothermia is that the hibernating animal can still dissociate oxygen from the hemoglobin in the blood to the body tissues.

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## SURGERY

## Ice Water for Surgery

► RUNNING ICE water or ice cold salt water into the chest cavity brings the temperature down low enough for operations on the heart without otherwise refrigerating the patient.

This simple new method for achieving hypothermia, or very low temperatures, was announced at the meeting of the American Surgical Association in Cleveland by Drs. Brian Blades and Howard C. Pierpont of George Washington University School of Medicine, Washington.

It has already been used successfully on a 25-year-old man who had an aneurysm, or sac, ballooning out from the arch of his

aorta. In order to repair this defect, the aorta, which carries all the blood from the heart to the rest of the body, had to be clamped shut for 20 minutes.

Previous experiments with dogs had showed that this running ice water method of chilling would bring the animals' temperature down to 78.8 degrees Fahrenheit in an average time of 45 minutes, and sometimes in half an hour.

The warming process after the operation is done by circulating tepid water or salt water, at about 113 degrees Fahrenheit, through the chest cavity. This takes about 30 minutes on the average.

The method is quicker, simpler and safer, the George Washington surgeons believe, than methods involving immersing the patient in cold water, packing him in ice, using refrigerating chambers and blankets, or putting a chilled tube between the femoral artery and vein in the leg.

The great danger in hypothermia, or refrigeration, procedures is that the heart may go into ventricular fibrillation. When this happens the heart muscle fibers are twitching irregularly instead of in a strong, synchronized beat. If the fibrillation is not stopped fast, the patient will die.

With the running ice water method, the surgeon can tell at once if fibrillation has started. Then he can immediately give

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