

energy we should be forced to give up the principle of the conservation of mass, since the masses of two helium nuclei at rest add up to a sum definitely less than the masses of the original nuclei of the lithium and the hydrogen; but it turns out that the mass of that kinetic energy is of just the right amount to annul the discrepancy and make perfect the balances of the masses before and after the collision.

There are other such cases and all prove that Einstein's theorem of the equivalence of mass and energy is valid, and valid even for those nuclear phenomena for which we have no certainty that the ordinary laws of electricity are true.

Dr. Einstein therefore wished to

make a derivation of his famous theorem not depending in any way upon those laws as did some of the earlier derivations. His present proof has this feature. Nothing is postulated except some of the fundamental assumptions which were made about moving particles in the earliest theories of Lorentz and Einstein.

To be precise, he imagines two particles colliding, and he shows from these assumptions that if their mass changes at the collision their energy must suffer a counter-balancing change.

Physicists will welcome this new demonstration of a principle which has suddenly assumed so great an importance in their field.

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are not seen but which go right through things with great energy. Tests show, too, that energy may turn to mass. Thus some of the new bits of mass just found in the last two years may be made when hard rays that are not seen but come from the sky hit things in tests. Jeans says that when bits of mass join far out in space they may cause the known hard rays.

Einstein told how to prove on paper in a way not too hard how mass is bound up with energy. That is why men went to hear him.

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PHYSICS

Einstein Believes in Orderly Certain World

PROF. Albert Einstein believes in an orderly world in which you can predict with certainty what is going to happen, despite the fact that his theories have seemed to undermine such ideas.

He holds the door open to an infinite universe, although his relativity has been associated with a finite universe.

And he "feels absolutely sure, nearly sure, that it will not be possible to convert matter into energy for practical purposes," although his famous equations of 1905 prove conclusively that matter and energy are interchangeable.

Trying to get energy from the atom is not practical because you have to use so much energy to do it. It is similar, Prof. Einstein said, in an interview at Pittsburgh, "to shooting birds in the dark in a country where there are only a few birds."

Uncertainty now seems to rule in the physical world, but Prof. Einstein believes that eventually a new kind of certainty will hold sway. Prof. W. Heisenberg has shown, Prof. Einstein recalled, that it is impossible to observe a situation without influencing it in a way unknown to us. This makes it impossible to know that initial state and so also the final state of a situation.

It is impossible to verify finally the law of causality. This has caused most scientists to believe in a universe ruled by the statistics of probability, but Prof. Einstein has a feeling that the final form of our physical law will be deterministic. This nobody can know.

Prof. Einstein says how we view the world is a matter of taste. Science is not yet sure whether the universe is finite or whether it goes on in space forever. Prof. Einstein explained that the "curvature of space may be positive,

PHYSICS

Here is Einstein's Theory In Words of One Syllable

About ten years ago, Dr. Edwin E. Slosson, late director of Science Service, wrote upon request what he termed "The Einstein Primer," explaining the theory of relativity in words of one syllable. The following article offers in one-syllable words the background of Einstein's recent talk on "A Simple Proof of the Equivalence of Mass and Energy." Only three words in this article contain more than one syllable: Einstein, energy, and electricity or electric.

By **ROBERT D. POTTER**

IT can be said that the weight of a thing is its mass times the pull of the earth on it. Thus its weight is fixed by the place where it rests on earth. But mass, too, is shown by tests to change with speed. There are, then, two kinds of mass; a rest mass and a speed mass.

How much mass may change with speed is shown in tests where a charge of electricity is made to go just a bit less than the speed of light. Then its mass may be twice as much as when at rest.

Think of it this way. A shell comes from a gun. As it speeds in the air it drags some of the air with it. The whole mass that moves in the air is part shell and part dragged air. The sum of the shell mass and the air mass it drags goes up as the speed of the shell.

Einstein shows that a group of things that has a mass of sum M has energy E , which is the same as M times the

square of the speed of light. This fact is true both when the mass is at rest or when it moves. Thus a watch wound up weighs more than one not wound. And a fly wheel that moves weighs more than one at rest.

Only hard tests show this gain of mass; for the gain must be cut by the square of the speed of light which is very large. A big ship that moves at sea gains in weight just about 1,000,000 part of an ounce by its speed.

Sir James Jeans says that all the energy a man puts in, in a life time of work, weighs just one 60,000th part of an ounce. Thus it can be seen why it would be of such use to get the energy out of just one ounce of gold, or air and such things. It would be worth as much as six times ten, times ten, times ten, times ten of men.

When one gram of the most light kind of gas is made to change to the kind of gas which lifts air ships there is a loss of .008 grams of mass. While the loss of mass is small, the gain in energy is great. W. F. G. Swann says the energy is as much as that which would heat rain in a tank ten feet deep and eight times ten feet wide from ice to steam.

One way to get this energy out would be to break up small bits of mass. Man can do this now when he makes bits of mass with electric charge on them hit hard on bits that are not the same. Such hits may cause rays that

negative or zero." If it is negative or zero the universe is infinite.

The two-hundred inch telescope now being built in California will see

a larger sample of the universe, Prof. Einstein anticipated, and thus may allow a better answer to this question.

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MEDICINE

Seek Cancer Control Through Study of Cell Growth

First Step is to Stop Cell Increase; Next to Find What Makes Cells Mature In Normal Fashion

TEACHING cancer cells to forsake their fast-growing youth and become mature is the ambition of Dr. Frederick S. Hammett of Philadelphia's Lankenau Hospital Research Institute. He reported his latest steps in cancer research to the American Association for the Advancement of Science.

A first important step has been taken through the discovery that a sulfur-containing chemical, called sulfhydryl, is essential both for normal growth and for the riotous growth of "flaming youth" that is one characteristic of cancer cells.

Discover another chemical that will inhibit this wild growth, and Dr. Hammett believes that the first step toward cancer control will have been taken. And sulfoxides, derived from sulfhydryl, might accomplish this if they could be put into the cancer tissues so as to do their work.

This is all very well in theory, but practically, Dr. Hammett pointed out, it is another matter.

A Research Problem

The preparation of sulfoxides is a research problem in itself. Fortunately, Dr. Gerrit Toennies of the Lankenau Institute is solving this. But the sulfoxides used must be able to reach the cancer tissue without getting destroyed themselves by the life processes of the cells which would tend to break them up into ineffective chemical groups. There is also the probability that any such chemical group that could check the growth of cancer cells might also check other cell growth which is essential to health, such as blood cell formation. Finally, even if malignant growth could eventually be slowed by means of this sort, the effect might be only temporary.

Enormous though the difficulties are,

Dr. Hammett and associates refuse to be discouraged.

"To allow oneself to be sidetracked because of the apparent impossibility of solution of the problem set is to admit that scientific progress is impossible," Dr. Hammett declared with the unbeatable spirit of the true scientist.

Determiners of Maturity

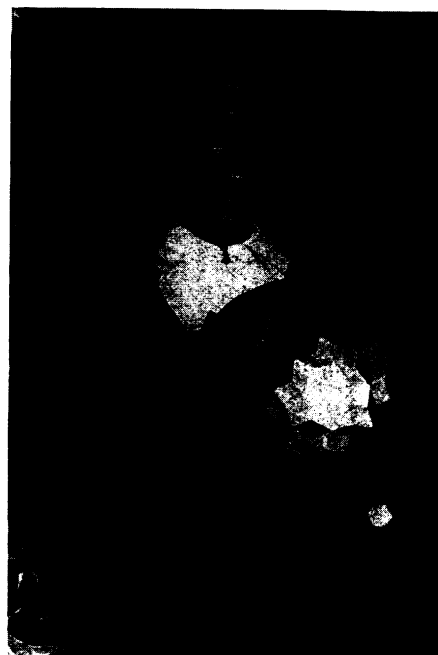
He has, in fact, another string to his bow. That is to discover the naturally occurring chemical factors which determine cell maturity. Since scientists have found the naturally occurring chemical factor, sulfhydryl, that is of major importance in growth of cells by multiplication, he hopes that he and other scientists will be able to discover what chemical group it is that makes them mature, that is, organize and get ready to take over grown-up functions and activities.

Dr. Hammett and associates have been working at this phase of the problem for three years, and while they have attained some results, the work is being continued and he believes it will be many more years before success is achieved. If they can find the chemical agent responsible for cell maturity, and can develop the practical aspects of the sulfoxides that neutralize sulfhydryl's quality of increasing cell numbers, they will be able not only to stop cancerous growth but to do away with its malignancy.

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Early men and women learned to grow food plants before they learned to make durable pottery, judging by discoveries in Palestine.

Investigation of the low vitality displayed by children in an English school showed that, for one thing, 62 per cent. of them got insufficient sleep.



HYPER-CUBE

At the exhibit of the American Association for the Advancement of Science, scientists saw this model with 24 dimensions devised by Paul S. Donchian who has discovered a method of projecting symmetrically into 3-dimensional space the hyper-cube series to any number of dimensions, preserving a standard unit edge. This photograph and that on pages 3 and 13 were snapped by the staff photographer of the Pittsburgh Press.

PHYSIOLOGY

Nervous System Likened To Radio Broadcast

THE brain and nervous system should be compared, not to the telephone and switchboard, but to the radio broadcasting system with each nerve a receiving set tuned to pick up its own individual messages, Prof. Paul Weiss, of the University of Chicago, told scientists attending the meeting of the American Association for the Advancement of Science.

The muscles are the operators that tune in their nervous receiving sets to pick up the correct messages, Prof. Weiss said. He bases this conclusion on experiments conducted since 1921 in the transplantation of extra, or supernumerary, limbs and supernumerary muscles on such lowly creatures as salamanders.

Live animals with such transplanted limbs were demonstrated before the meeting. When an extra limb, or series of them even, are transplanted next to the normal limb of the animal, these extra limbs behave like extra sets of