PHYSICS

Einstein in Simple Terms

The theory of relativity is hard to understand because Einstein's idea is big, not his words. Tribute is paid him this month on his seventieth birthday.

Distinguished scientists are being joined by laymen this year in paying tribute on his seventieth birthday to Albert Einstein, who was born at Ulm, Germany, March 14, 1879. Most of us know that the great mathematician and physicist developed theories which are helping lead the world into an atomic age. But few people dare to pretend they thoroughly understand Einstein. Most of us sometime have appealed to someone to "Explain Einstein's theories in one-syllable words." A quarter-century ago such a plea was answered by the late Dr. Edwin E. Slosson, first director of Science Service.

By the late

Dr. EDWIN E. SLOSSON

Director, Science Service, 1921-29

➤ A FRIEND OF MINE—I don't know him personally, but any man who buys a book of mine is a friend of mine—writes to me: "If you will put Einstein's theory of relativity in words of one syllable perhaps I can understand it."

Now, that is a foolish notion—even though he is a friend of mine. Short words may be easier to pronounce, but not easier to understand. Some of the most difficult words in the language to grasp or define are monosyllables—for instance, mass, force, law, love, God. Chinese is a monosyllable language, but not easy to learn. Einstein's idea is hard to get, not because he uses big words, but because it is a big idea. Einstein does better than put his theory in words of one syllable. He puts it in symbols of one letter. But even those who understand the algebraic language do not find it easy to follow him.

Besides, how can I be expected to discuss Einstein's theory of relativity in words of one syllable when "Einstein" has two syllables, "theory" three and "relativity" five?

But anything to oblige a friend. So here goes:

On a Train

If you were on a train and saw a train on the side track slip by your pane of glass you could not tell which train moved if yours did not jolt. You might think that your train was at rest, and that one moved back, or that both moved, but not at the same rate or the same way. It would be all the same which way you looked at it.

If now you were in a tight box or chest as big as a room that rests on the ground you would feel a down pull, which we call your weight. It is said to be due to a "force." But if the box is off in space where there is no force from the earth to act on it, and the box is pulled up by a rope at the same rate as a mass falls to the earth, you would feel the floor press up on your feet just the same as when you stood on the ground.

You know how it feels when you are in a lift that goes up with a jerk. If, while you were in this box off in space, you should throw a ball up in the air, it would go up a ways then fall down to the floor. So it looks to you, though to a man not in the box it seems that the floor moves so fast that it must catch up with the slow ball.

If you should fire a shot straight from the right side of the box to the left, its path would seem curved down at the end as it would on the earth. So, then, a ray of light, which, too, we say moved straight, would seem to you curved when it passed through the box as though it, like the shot, had been pulled down by some force. But there is no down force in this case for the box is not near the earth. It is due to the fact that the box moves up with more and more speed in the same way as a mass falls to the earth.

Ray of Light

Then we must think that a ray of light near a large mass would not move in a straight line but in a curve. It would act just as if there were a force to pull it in. This has been found to be so. As the light from a star goes past the sun its track is bent to the sun as though the sun pulled the ray, as it does the earth in a curved path. So when the sun is made dark by the moon the stars round about it seem pushed out of place. They do not stand so close as they do on the star map when the sun is not in their midst.

Then, too, the sphere that moves round the sun and is most near to it does not quite close up the ring of its path at the end of a year as it should by the old law. The new law shows why this is so.

A third test of the new law is still to be passed. The light and dark lines that are seen in a beam of light when it is bent out of its course by a wedge of glass should be pushed to the red end of the band if the light comes from large stars like the sun. A long light wave like the red should show more shift than the short waves. This point has not yet been proved for sure. Such a shift has been seen, but does not seem to be of the right size.

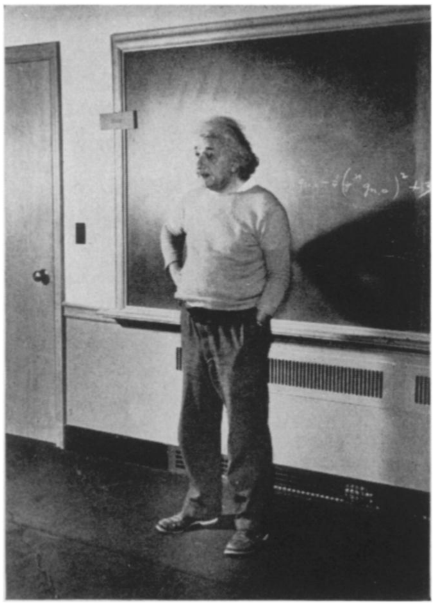
(Note: In the years since Dr. Slosson wrote, the new law was put to this third test and it won out.)

Some strange things must be true if the law holds good. First, we must say that mass and weight are not fixed, but change when the thing moves, though the change is slight save at high speeds. But near the speed of light the change is great. A thing must weigh more when it moves fast. If a rod goes at great speed in the line of its length it will not seem so long as if it were at rest. No mass can be made to move as swift as light.

A clock in a state of rest does not show the same time as a clock that moves at high speed. As it moves fast through space it seems to slow up. A man would not seem to grow old if he could move with the speed of light.

It is a matter of choice if we say that the earth goes round the sun or that the sun goes round the earth. It all lies in the point of view.

If a ring is seen to be one foot through when a rule is laid on it, it will be Pi (3.14159 and so on) times that length round



EINSTEIN IN CLASSROOM—An American citizen, German-born Albert Einstein is now retired after having served as professor of mathematics at the Institute for Advanced Study at Princeton, N. J. The cold formality of his mathematics, however revolutionary, contrasts sharply with the informality of his dress in a classroom picture taken in 1940.

the rim. But if there is a great weight put in the mid point of the ring, then the line round the rim will not be so long as if the space were free. It will be less than Pi times the line that cuts through the ring at its mid point. If a thin steel disk whirls round fast, its rim will seem to shrink like a hot tire on the wheel of a cart.

It seems, then, that the scheme of points and lines that we got from the Greeks, and that is taught in our schools yet, is not quite true when we come to deal with time and space as a whole. Space would be naught if there were no time. Time would be naught if there were no space. The two must join to form a sort of fixed frame or mesh in which all things are set.

At each point, say the point where you stand, four lines cross and lead out straight in the four ways. One line runs up and down, the next runs right and left, the third runs back and forth, and the fourth runs from time past to time to come. To fix a thing we must know its point on the time line as well as its points on the three space lines. To place an act we must know when as well as where it came to pass.

Mass will warp this mesh of space and time. A mass as it moves forms a sort of a crease or ridge. A mass that is at rest in space, of course, moves on the time line. A mass, as it moves from this point to that must take the track that is most long through the mesh of space and time.

Space as a whole may be closed up in the form of a sphere or roll, and in that sense may be said to have no end, though it may not be so large as we used to think. A ray of light that starts out from the sun may not go on straight for all time, but may not round the sphere of space and come back at the end of a long time to the place it set out from at the first.

All this is not, as you may think, just a new and queer way to look at the world. It can be put to proof to see if it is the true view, and has, as I have said, come out well on such tests.

The great thing is that it starts a new lead for man's thoughts.

Science News Letter, March 12, 1949

NUCLEAR PHYSICS

Carbon 14 Measures Age

➤ RADIOACTIVE carbon can be used in measuring the age of anything that has been alive within the past 20,000 to 25,000 years, it has been determined in experiments at the Institute for Nuclear Physics on the University of Chicago campus. The work was done by a three-man research team consisting of Drs. W. F. Libby, E. C. Anderson and J. R. Arnold; they report their findings in SCIENCE (March 4).

There is a very small concentration of radioactive carbon, of atomic weight 14, in the air at all times. It is believed to be formed by the bombardment of nitrogen atoms by cosmic rays at high altitude. This radioactive carbon enters into the composition of organic compounds, and thus of living things, just like ordinary carbon of atomic weight 12. Like all radioactive elements, carbon 14 decays or disintegrates at a fixed rate; of any given quantity, one-half will have disintegrated at the end of approximately 5,720 years. This is known as the half-life of the element.

Working with this knowledge as background, the three researchers first measured the radioactive carbon content of samples of wood from all parts of the world and from altitudes ranging from sea level up to the high plateau of Bolivia. The figures for all samples came out fairly uniform, indicating a practically uniform distribution of natural radioactive carbon in the earth's atmosphere.

They next checked their new time-clock by measuring the radioactive carbon content of two samples of wood from ancient Egyptian tombs whose age was known from other data. The age as indicated by the new method came out very close to the known age. The researchers are continuing the job of "calibrating" their new method, and expect before long to try it on some materials of unknown age.

Science News Letter, March 12, 1949

MEDICINE

Cancer Picture Improving

➤ WITHIN the next five years you can expect to see the cancer picture make a great change for the better. This was the hopeful feeling among authorities at the close of a meeting on cancer, sponsored by the U. S. National Cancer Institute and the American Cancer Society. Here is how some of them saw the situation:

"We now have the tools needed to find out most of the differences between cancer and normal cells." That is Dr. Paul Aebersold, the Atomic Energy Commission's Isotopes Division Chief at Oak Ridge, Tenn., speaking.

The tools are five kinds of microscopes, four of them relatively new, plus radioactive chemicals which can be used to follow the very fast and complex chemistry in both normal and cancer cells. With these tools, the subtle differences between cancerous and normal cells, Dr. Aebersold believes, can be detected. And he thinks that from this and the 10 or 15 new leads now available on the cause and treatment of cancer, "real achievements will be made within five to 10 years."

Within five years we should have far better tests for detecting cancer in its earliest stages when there is most hope for curing it. That is the opinion of Dr. J. R. Heller, Jr., Director of the National Cancer Institute. He bases this opinion on the new, expanding program for training scientists who will be able to devise and evaluate new, simple tests for cancer that can be applied routinely to large numbers of people.

Right now twice as many cancer patients could be cured as actually are cured, Dr. Charles Branch of the American College of Surgeons and Dr. Charles S. Cameron of the American Cancer Society agreed. They stated that 80% of all cancers occur at places in the body where they can be found by the practicing physician with methods now available to him in his office. These are cancers of the breast, womb, skin, mouth and lower bowel.

Within five years the death rate from cancer of the breast may be cut in half. It could be done by a very simple measure which the American Cancer Society intends to push, Dr. Cameron said. The method is simply to teach all women over 35 years old to examine their own breasts once every month. The monthly examinations are believed necessary to detect the cancer in its earliest stage. There are not enough physicians to do the job, but "any woman with any intelligence can learn to do it," Dr. Cameron said.

Second new cancer-detecting measure the Society will push is routine chest X-ray examinations of people in the older age groups. From this conference, Dr. Cameron said, it has been learned that this measure will be practical for early detection of the apparently growing numbers of lung cancers. If found early, these cancers can be removed by surgery.

"It will be impossible ever to prevent cancer, or to devise a test that will show that a given person is going to develop it," Dr. E. V. Cowdry of St. Louis declared.

Scientists know about 250 chemicals that will cause it, in addition to almost all physical agents from heat and the sun's ultraviolet rays to atomic radiations. The remarkable thing, Dr. Cowdry points out, is that most of us escape cancer.

"But," he said, "we can learn to detect cancer earlier after it starts."

Science News Letter, March 12, 1949

When boiling peeled *potatoes,* the more water used the more food value lost.

The *wild rushes* seen in tidewater marshes have several valuable uses, including for woven chair seats.

Speed and size of future *planes* must be compromised with the limitations of available passenger loads, safety and navigational problems, and airport facilities.