MATHEMATICS

Prof. Tullio Levi-Civita— Extends Relativity Theory

MORE precise in defining the fundamental law of the universe than even Einstein's general theory of relativity, Prof. Tullio Levi-Civita, mathematical physicist from the University of Rome, announced to Harvard's Tercentenary Celebration new relativistic formulae that apply to two bodies instead of just one as is the case with those of Einstein.

Previous verifications of the general theory of relativity dealt only with gravitational fields due to a single body, Prof. Levi-Civita explained. In the classic case of the advance of the perihelion of the planet Mercury, Einstein considered the field as due to the sun alone, an approximation which is legitimate owing to the smallness of the ratio of the mass of the planet to that of the sun.

But Prof. Levi-Civita now considers the corresponding problem for two bodies of comparable mass as for instance two suns or stars whirling around each other.

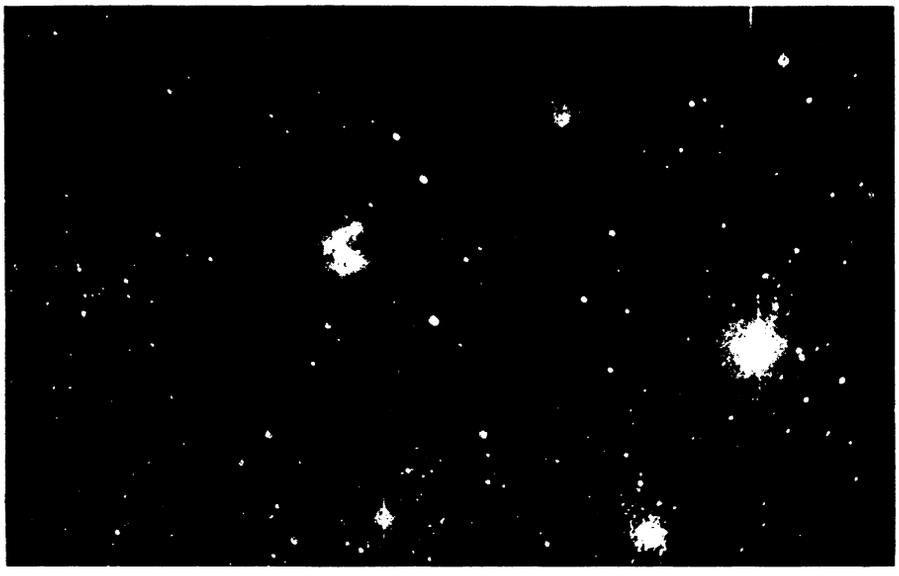
His equations show that it is possible to visualize the force exerted as consisting of two parts, one an attraction that acts the way Newton assumed and the other an Einsteinian perturbation. These two together produce an advance of perihelion.

This is not so surprising, he declared, but it is strange that the center of gravity of the motion wobbles slightly instead of being at rest or moving uniformly in a straight line.

Einstein's sensational prediction of the advance of Mercury's perihelion which brought his general theory of relativity into prominence was tested by direct observation. The revision of the Einstein theory that Prof. Levi-Civita suggested cannot be tested upon the planet Mercury with quite so much ease, but Prof. Levi-Civita does expect that astronomers will test it by observations upon double stars which are gigantic systems of twin suns seen as one spot of light in telescopes but capable of being disentangled by their spectra or "rainbows" of light.

Prof. Levi-Civita's solution of the relativistic problem of several bodies will probably be the focus of mathematical and astronomical work for several years to come. The expounder of this new relativistic view is no novice in mathematical physics. He has been a leader in hydrodynamics, theoretical dynamics and pure geometry. His contribution to the theory of absolute differential calculus is credited with helping to lay the foundation for the general theory of gravitational relativity of Einstein. Now, at the age of 63, he is older than Einstein.

Science News Letter, September 12, 1936



THE BLUE NEBULAE

Ordinary photographic methods bring out the blue nebulae at center and right, but do not indicate the importance of the giant red nebula at the lower center of the photograph. Compare this photograph with that on the facing page.

MATHEMATICS

Prof. Ronald Aylmer Fisher— Poses Mathematics Problem

LIKE mathematical problems? Here is one which was given to the learned American Mathematical Society meeting in connection with the Tercentenary celebration of Harvard University by the noted British mathematician, Ronald Aylmer Fisher, professor of eugenics at the University of London.

"The agricultural land of a predynastic Egyptian village is of unequal fertility. Given the height to which the Nile will rise, the fertility of every portion of it is known with exactitude, but the height of the flood affects different parts of the territory unequally. It is required to divide the area, between the several households of the village, so that the yields of the lots assigned to each shall be in predetermined proportions, whatever may be the height to which the river rises."

If mathematicians can solve this problem, said Dr. Fisher, one of the primary problems of what is called mathematically "uncertain inference" will be solved.

Dr. Fisher's invited paper dealt with the history and role of uncertain inference in mathematics. The field is one in which mathematical reason is applied to uncertainties, yet applied with logical rigor.

The problem is one which is being increasingly met in science where it is necessary to take observation data with all their imperfections, their paucity in number and imperfect precision, and yet draw inference from them which the observations warrant.

Lack of this method of uncertain inference, the British mathematician pointed out, is the basis for the old phrase "anything can be proved by statistics."

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PHYSICS

Dr. W. F. G. Swann— Discusses Cosmic Rays

ALL physicists agree that some of the cosmic radiation which strikes the earth's atmosphere from outer space must be electrically charged particles flying at high speeds. But, in the opinion of a number of investigators, those bullets of energy called photons must also play a part.

Speaking at the Harvard Tercentenary Celebration, Dr. W. F. G. Swann of the Bartol Foundation of the Franklin In-

stitute presented mathematical arguments to the effect that photons are really not at all necessary as primary components. Charged particles suffice to explain everything if only one makes certain assumptions as to the way these particles behave. And Dr. Swann has found, by means of mathematics, just how particles must behave in order that the whole body of cosmic ray facts may be clarified on the particle basis alone.

Little is known of the habits of these fast-flying bits of electricity. Some of the characteristics which Dr. Swann has ascribed to them have been observed in the experiments of other scientists. Other traits with which he has endowed them are entirely original suggestions and have not, as yet, been brought to the test of independent experimental check.

Some of the things which must be true of the electrified particles if they are to constitute the whole cosmic ray story are the following:

1. There must be two kinds of particles.

2. As they pass through matter, both kinds must lose energy at a rate which increases as the energy of the original particle increases.

3. Both kinds of primary particles must produce other high speed particles (called secondaries) by collision with atoms in the air; but the facility with which they do this is different in the two kinds.

Crux of Theory

The crux of this theory is the way in which the secondary cosmic rays are treated. The existence of secondaries is a well-known fact. But heretofore they have constituted a sort of "mess" which obscured the real cosmic ray facts. According to Dr. Swann's view, however, they are practically the only thing anyone observes, and, more than that, they can serve to lead the experimenter back to those real facts which lie behind the scene.

Puzzling to physicists has been the scarcity of very high energy particles when cosmic rays were being watched in the Wilson cloud chamber. For it was known from experiments dealing with the effect of the earth's magnetic field that much of the incoming radiation must have energy greater than ten billion volts.

This paradox disappears in Dr. Swann's theory. Compared with the large number of lower energy secondaries, the high speed primaries are very rare indeed. They may be likened to an "unseen hand" which guides the behavior of the secondaries, and it is through the study of these locally generated particles that the true nature of the ones from outer space can be decided.

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PHYSIOLOGY

Dr. James Bertram Collip—Pituitary Governs Behavior

THE SMALL pituitary gland located in the head has more to do with man's behavior than any of the other glands, Dr. James Bertram Collip, professor of biochemistry at McGill University, told scientists at the Harvard Tercentenary celebration.

All of the glands have an important influence on behavior, but the pituitary, because of the way it affects each of the other glands and various other organs of the body, has the greatest effect. Dr. Collip explained how the glands and nervous system work together in man and higher animals. The glands themselves are influenced by the nervous system, but the chemicals they produce, known as hormones, may in turn affect the nervous system.

Scientific knowledge of the glands shows how widespread their influence on behavior is, but it does not justify some of the "fantastic" claims that have been made. Dr. Collip warned his hearers against overlooking basic principles in interpreting behavior on glandular grounds.

As an example of the way in which the pituitary gland affects behavior, Dr. Collip cited the case of a wolf-hound puppy studied in his laboratory. Soon after removal of this animal's pituitary gland, it was noted that the puppy, although belonging to a naturally aggressive stock, became extremely timid and stupid in his behavior, which was entirely different from that of a normal wolf-hound puppy. A few days after treatment with anterior pituitary extract, the animal's behavior changed markedly again, so that he became much more like the normal puppy of his breed. The change was so apparent that a worker in the laboratory, unaware that treatment had been started, commented on the unusual activity of the puppy and asked if anything had been done which might account for it.

Even more dramatic was the case Dr. Collip cited to show how more than one set of glands may similarly affect body mechanisms and behavior. This was the case of a man who had diabetes and was having insulin treatment. In this condition it sometimes happens that too much insulin has been given, or not enough carbohydrate food is eaten. The patient then suffers from too little sugar in his blood, has convulsions and will become unconscious unless given some sugar or other carbohydrate at once.

The patient Dr. Collip described was walking down the street one day when he felt such an attack coming on and realized that he had forgotten to provide himself with a chocolate bar for the emergency. He went at once to a drug store and tried to explain to the druggist what he wanted. But by that time his gait was unsteady and his speech incoherent. The druggist thought he was a drunken man and threw him into the street. The patient became enraged at this treatment, promptly recovered, and was able to proceed to another drug store where he made known his wants, obtained what he needed and continued on his way.

In this case, Dr. Collip explained, another set of glands, the adrenals, became activated by anger and released enough of their hormone, adrenalin, to cause an increase of the patient's blood sugar sufficient to restore his equilibrium and powers of speech. The insulin-producing islets of Langerhans in the pancreas are the glands primarily concerned with control of the body's use of sugar, but the case of this patient shows how the adrenal glands also may affect sugar utilization and also behavior.

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PSYCHOLOGY

Prof. Charles Gustav Jung—Hunger Most Important

NOT sex alone, but five groups of instinctive factors were listed as the primary motivating forces of the mental behavior of man by Prof. Charles Gustav Jung, of the Technische Hochschule, Zurich, father of "Analytical Psychology," speaking before the scientists gathered at the Harvard Tercentenary Conference.

The instincts, with their compelling power over human behavior, are originally physiological phenomena, Prof. Jung holds, but they may become "psychified" by becoming important as determiners of mental behavior. First among these is hunger.

"No matter how unequivocal the physical state of irritation called hunger may be, the psychic consequences resulting from it can be manifold," Prof. Jung said. Hunger, he explained, can appear as denatured, or even as meta-