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THE GROWTH HORMONE

By WATSON DAVIS

A GLIMPSE into the future when sexless human beings will be produced and when short people can be made tall by injections of a growth-promoting hormone was given by Professor Herbert M. Evans, of the University of California, in his presidential address to the American Association of Anatomists, meeting in New York City.

Before taking the distinguished anatomical research scientists into such a future as H. G. Wells might describe, Professor Evans, known as the discoverer of the antisterility vitamin E and for his work on hormones, announced the following important discoveries made by himself and his co-workers.

1. The pituitary gland, situated in the exact center of the head, produces in its front portion two distinct kinds of powerful secretions or hormones, one of which is growth-promoting and the other of which is sex-gland stimulating.

2. The growth hormone injected daily into animals from which the pituitary gland has been removed turns them into normal-sized, sleek-coated, active and healthy animals possessing an undeveloped infantile sexual system. This creation of adult creatures without a developed sexual system is a proof of the separation of the growth-promoting hormone from the sex-stimulating hormone, accomplished by very precise chemical process.

3. The growth hormone is strangely converted into the sex-stimulating hormone by means of the chemical substance found in the urine of pregnancy.

4. An overdose of growth hormone produces diabetes in normal animals.

5. The growth hormone not only promotes growth but it is also a necessary stimulus for some other sister glands of the body, notably the adrenal. Dr. Evans's work shows that his growth hormone is needed in some mysterious way by the adrenal cortical tissue before it can manufacture its own hormone that cures Addison's disease and is necessary to normal life. The adrenal cortex hormone was recently purified for clinical application by Dr. W. W. Swingle, at Princeton, and Dr. Frank A. Hartman, at Buffalo. Dr. Evans's work shows that the growth hormone is the secretion of the pituitary which stimulates the adrenal and thyroid.

The growth-promoting hormone has already been applied to at least one human case of dwarfism, although Dr. Evans did not comment on this case in his address. A young girl suffering from arrested development was given injections and her height increased about four inches.

"It is said that the Mikado wished to add to the stature of the Japanese soldiers," said Professor Evans commenting on his work. "This growth-promoting hormone should be able to do it, but even the Mikado could not pay the price that it would cost at present. The cost of producing the growth pituitary hormone is prohibitive. It may take a decade to determine its formula and even longer for the chemist to make it in the form of pretty white crystals with coal tar as the raw material. We are the faint beginners in this work. Perhaps *Science Service* will write the story in 1955."

Unlike Alice-In-Wonderland, once growth is attained, shrinking can not be accomplished. Some feel that growth might be arrested by injuring the pituitary anterior lobe by x-rays or some other method, but this would be a very dangerous procedure.

His production of full normal growth in animals without sex development by means of the growth hormone caused Professor Evans to remark: "Writers like H. G. Wells, Julian Huxley and J. B. S. Haldane might explain that one of the greatest social problems to which man is heir could be solved by transferring this achievement to the human race."

The production of diabetes by an overdose of growth hormone was a big surprise in Dr. Evans's work, although it had been known that animals without pituitary glands were unusually sensitive to insulin, the hormone used to combat diabetes.

At his Berkeley, California, laboratories Dr. Evans had the assistance of the operative skill of Richard Pencharz, the chemical genius of Karl Meyer and the biological analytical work of Miriam Simpson. A decade of work on the growth hormone led up to the present discoveries. Professor Evans gave great credit to other workers in the same field, particularly to Professor P. E. Smith, of Columbia University, who detected precocious sexuality after portions of the pituitary gland had heen implanted in rats deprived of their own pituitary glands.

"Because of its manifold relations," said Professor Evans, "the growth hormone will now surely be conceded to be one of the most important secretions of the body. It has basic physiologic importance quite apart from being essential to growth."

THE CURVATURE OF SPACE

PROFESSOR ALBERT EINSTEIN says that space may be and probably is the sort of uncurved, three-dimensional space that Euclid imagined. Although he in a sense scraps the less familiar and more complicated brands of space-time that he has been using, this does not affect the validity of relativity, which has been at the foundation of much scientific thinking for two decades.

Professor Willem de Sitter, Dutch astronomer, who had built his own shape of universe on Einsteinian foundations, joins with Professor Einstein in espousing space which is on the average Euclidean. These two eminent astrophysicists conceived the new kind of universe when working together recently at Mt. Wilson Observatory and their joint announcement is made in the March issue of the *Proceedings* of the National Academy of Sciences just issued. Professor Einstein is now *en route* to his home in Germany while Professor de Sitter is traveling in South America.

This joint announcement, that is sure to cause a furore in the world of science, means that the universe around us may be not only unbounded but infinite, in-

stead of finite and unbounded as Einstein and his followers have previously believed.

In the Euclidean universe now re-enthroned, light travels in straight lines and goes on and on forever and ever. A ray of light would not traverse the circuit of the universe and come back to where it started as it would in the superseded Einstein and other varieties of space. Curvature of space is on the average banished from the universe.

"We must conclude that at the present time it is possible to represent the facts without assuming a curvature of three-dimensional space," Professors Einstein and de Sitter say in their report.

Two important developments made Einstein and de Sitter change their universes. One of these was the piling up of evidence at Mt. Wilson Observatory at Pasadena, by Dr. Edwin P. Hubble and others that the shift toward the red of spectrum lines in light from far distant nebulae is evidence that the universe is expanding at a terrific rate, as high as 15,000 miles per second and that the farther away the nebula the faster the recession.

The other factor was the demonstration by Dr. Otto Heckmann, privat-dozent in astronomy at the University of Göttingen, Germany, that an expanding universe can have matter throughout it and still be Euclidean. When Einstein built his first universe he did not dream of an expanding space. He thought it static and constant in size and found himself forced to make space curved to fit this idea. This gave his famous finite but unbounded universe which, upon Dr. Heckmann's suggestion, he and de Sitter now revise.

Into the equations of Einstein relativity which have stood the test of time, Professors Einstein and de Sitter, following Heckmann's lead, have inserted both Euclidean space and the recessional velocity of the nebulae indicated by the expanding universe idea and the Mt. Wilson measurements of red-shift in light from the nebulae. They were then able to compute the density of matter in the universe and found that it compares favorably with the ideas that are current as to how matter is spread throughout space on the average.

It is almost impossible to imagine how thinly spread on the average is the matter in the universe. One pound of matter spread throughout a sphere sixteen times the diameter of the earth would give this extremely small density of matter. And as the universe is expanding at a super-terrific rate at extreme distances outward, always getting larger as it were, the density of the matter in the universe must be getting less and less.

Professors Einstein and de Sitter observe, however, that as more astronomical data are gathered it will undoubtedly be possible to determine with more precision the density of matter in the universe. If it should turn out that there is more matter per volume of space, then it will be necessary to return to the original Einstein space even with an expanding universe. If the matter is more sparsely distributed, it will be necessary to learn to live in a space of average negative curvature, such as Lobatschewski, the Russian scientist, dreamed of a century ago. In this strange space an infinite number of lines parallel to a given straight line can be drawn through any point.

The revision of the geometry of the universe by Professors Einstein and de Sitter does not appreciably alter the geometry of the galaxy of stars in which we live. Consequently it leaves unaltered the theoretical predications originally made by Einstein which so triumphantly vindicated his theory. These are: The wriggling of the orbit of the planet Mercury, the red-shift of the spectral lines in the sun and companion of Sirius, and the bending of light rays about the sun which is merely the Euclidean interpretation of a Riemann straight line. A straight line in Riemann curved space is curved when interpreted in Euclidean space. The geometry of an Einstein universe is based on the assumption that light travels in straight lines.

Professor Richard C. Tolman, California Institute of Technology, wires: "The article of Einstein and de Sitter in the *Proceedings* of the National Academy shows, if we assume a uniform distribution of material in the universe and assume the cosmological constant to be zero, that our present knowledge as to the density and velocity of recession of matter can be accounted for, if we ascribe the value zero to the spatial curvature of the universe. Our present observation data are thus shown to be insufficient to distinguish between the three theoretically possible cases of positive, negative or zero curvature, and hence we can not now say whether the universe is closed, hyperbolic or flat. It is possible that sufficient data to throw more light on such questions will be available in the not too distant future. The article deals, of course, with the spatial curvature of the universe as a whole when looked at from a large scale point of view and does not affect our views as to the curvature of space in the neighborhood of individual gravitating bodies."

AGE OF THE EARTH AND OF THE STARS

A NEW clock for measuring long periods of time may prove the rotation of the great galaxy of stars in which the solar system is located, Professor Robert H. Baker, director of the University of Illinois Observatory, suggested in an address during the dedication of the new building housing the great Harvard collection of four hundred thousand astronomical photographs.

The revolution of the Milky Way, which occurs about once in four hundred million years, would supplement the rotation of the earth, which measures the day, and the swing of the earth around the sun, which measures the year.

When the dinosaurs existed, some two hundred million years ago, Professor Harlow Shapley, director of the Harvard College Observatory, said in commenting, the solar system was on the other side of the galaxy.

The age of the earth is not less than eighteen hundred million years, and probably about two thousand million years, as measured by the radioactive clock, according to Professor Arthur Holmes, of Durham College, England. Accurate determinations of the amount of helium in rocks give the geologist information on their age, because helium is given off at a known rate by the disintegration of radioactive uranium and thorium elements in the rocks.

The oldest known rocks exist in North America. Up until a few weeks ago uraninite from the Black Hills, South Dakota, held the record with 1,460 million years of age, but radium-bearing rock from the radium bonanza at Bear Lake in northern Canada has shown nearly the same age, and rock from Manitoba assays an age of eighteen hundred million years. As these rocks were molten when laid down and injected into existing rocks, the rocks around them must be even older.

With increasing age the earth is not getting any feebler in energy, Professor Holmes observed. In fact, in the Tertiary age, which led up to the appearance of man, the earth seems to have been more active than in earlier ages. Professor E. W. Brown, of Yale University, stated that new estimates of the age of the earth have disturbed the astronomer's confidence in the stability of the solar system. Although he feels no concern about the immediate safety of the earth, he can not tell just what it was doing two thousand million years ago when its crust was formed. Professor P. W. Bridgman, of Harvard, warned that it was unsafe to theorize as to what had happened thousands of millions of years in the past and what would happen far in the future because we have only a few hundred years of time on which to base ideas.

The age of the universe suffered an extreme pruning at the hands of Professor Ernst J. Öpik, Esthonian astronomer working at Harvard. Ten years ago the universe was thought to be ten million million years old; now Professor Öpik divides these old estimates by a million or so and makes the universe about the same age as the earth, about three thousand million years.

THE PRODUCTION OF TUNG OIL

THE tree that supplies $12,000,000 worth of tung oil to the United States each year is being taken from its native China to the far southern states of this country. Already about 25,000 acres of land have been planted in trees producing tung oil, Dr. Henry A. Gardner, director of the scientific section of the American Paint and Varnish Manufacturers' Association, told members of the American Chemical Society meeting in New Orleans. He estimates that between 50,000 and 100,000 acres of trees will be needed to supply the quantity of oil that has been imported from China. Tung oil trees have been grown successfully in California, Alabama, Louisiana, Mississippi and Florida. However, California is not considered a favorable state for the commercial growing of the trees because of the lack of low priced land in sections where the soil and climate conditions are suitable. The largest plantings have been made in northern Florida.

Seeds of a tree of the genus Aleurites, which is native to China, produce tung oil. They ripen about October in both China and North America and are crushed in a mill similar to that used to press peanuts for peanut oil. The fruit which contains the seed is about the size and appearance of a small russet apple. The tree is deciduous, shedding its leaves in the fall and covering itself with new foliage in the spring. It will stand light frosts.

The Chinese use tung oil for waterproofing, making native lacquer and ink. In this country, in addition to its applications in the manufacture of varnishes and varnish paints, it is "used in making insulating compounds, as an ingredient in automobile brake linings, in gaskets for steam pipes, in linoleum and table oilcloth, for waterproofing fabrics, paper, cartridge shells, etc., as a binder for wall board and plastic synthetic lumber, or lacquers, primers, pipe coating plastics, synthetic resins, battery jar compounds, airplane tubing fillers, etc."

The first tung oil seeds were brought to this country in 1905 by David Fairchild, plant explorer of the U. S. Department of Agriculture, and planted at the government experiment station at Chico, California. Seedlings were distributed to southern states. Extensive plantings, however, were not made until eight years ago.

ITEMS

ORANGE juice may travel to market frozen solid in blocks, to be thawed into potable palatability by the consumer. But before this is possible more must be known about its chemical makeup and physiological behavior, according to Dr. M. A. Joslyn, of the University of California, who spoke at the meeting of the American Chemical Society. Oxidation appears to be the principal cause of deterioration in frozen orange juice, Dr. Josyln said. It can be almost completely eliminated by de-aeration of the juice and handling under an atmosphere of inert gas, such as nitrogen. The commercial application of this method is feasible and yields a satisfactory product.

THE basic life processes of vegetarians proceed at a slower rate than those of meat-eaters, in Europe as well as in America, according to measurements by Professor G. Wakeham, of the University of Colorado. His results were reported to the American Chemical Society. Professor Wakeham made measurements of the basal metabolism, the body's rate of expending energy when resting, for fifteen strict life-time European vegetarians. He found that their basal metabolic rates were, on the average, nine per cent. below the normal rate. Seven to ten years of vegetarianism, said Professor Wakeham, are required to produce this effect. This was found by examination of vegetarians of from one to fifteen years' standing. Professor Wakeham recently made a similar study of American vegetarians.

THE question of whether a person will be naturally right-handed or left-handed is decided before birth, Miss Stella M. Leche, of the department of anatomy, Tulane University, told members of the American Association of Anatomists. Miss Leche has studied the ridges and surface markings of the palms of 244 left-handed persons and compared them with those of 300 persons chosen at random. These markings on the skin of the palm are known to be different for the right and left hands. Likewise, they show which is the dominant hand, that is whether the person tends to use the right or the left hand for writing, cutting and other similar tasks. Since the nature of the markings on the palms is determined long before birth, Miss Leche concluded that the matter of which hand will be dominant is also decided at this early period in the individual's life.