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THE EVOLUTION OF THE STARS

THINGS are not always what they seem and stars with all the earmarks of old age may really be in their youth, astronomically speaking, according to the latest views of Dr. Henry Norris Russell, professor of astronomy at Princeton University. Dr. Russell's ideas on stellar evolution have been widely accepted among astronomers, but one difficulty that has puzzled them has been the fact that stars of nearly every possible type may occur in the same cluster. These different types are supposed to represent various stages in the normal evolutionary sequence, but it has also been thought that all the stars in the same cluster were formed at approximately the same time.

According to the latest improvements of his theory, however, Dr. Russell supposed that all the stars proceed through the same general course of evolution, but some are handicapped. The most massive ones start at the beginning, but those of less mass may start at the middle of the scale, without having passed through the earlier stages, while those of least mass start near the end. As a result, if a large number of stars is formed at about the same time, the ones of small mass will be almost immediately in the same condition that their more massive brethren will only reach after many billions of years. The astronomer, examining their light with his spectroscope, will find them of different types and may think them to be of different ages.

The source of energy of the stars, at one time thought to be due to a gradual contraction of their bodies, may be supplemented by actual conversion of their matter into energy, as proposed by Professor Eddington, of Cambridge University, England. Dr. Russell suggests that a star may at first contract, and then after it has reached a certain point, cease contracting and use up its actual substance by conversion to energy.

ULTRA-VIOLET RADIATION

THE ultra-violet radiation of the sun, invisible rays of too short wave-length to be seen, but which are responsible for tanning people's skins and which also affect photographic films, is increasing with the rise in the number of sun spots. This is the conclusion of Dr. Edison Pettit, astronomer at the Mt. Wilson Observatory, in a paper read before the Rochester meeting of the American Astronomical Society.

Dr. Pettit's studies have been concerned with the ultra-violet waves about one seventy-five thousandth of an inch long, just a little shorter than the deepest violet rays visible to the eye, which are about one sixty-five thousandth of an inch in length. As glass absorbs the ultra-violet rays, it has been necessary to use quartz lenses, and the amount of radiation is measured by means of a thermocouple, a device which gives a minute current when light, either visible or invisible, falls on it, the exact current being measured by means of a delicate galvanometer.

The method used has been to compare the ultra-violet radiation which passes through the quartz lenses and a thin film of silver, with green light passed through similar lenses, a green celluloid filter and a thin layer of gold, a series of measurements being made, first of the ultra-violet and then of the visible green light. The whole apparatus is attached to one of the observatory's telescopes, so that it can follow the sun in its motion across the sky.

When he first began his investigations in June, 1924, Dr. Pettit found that the amount of ultra-violet light from the sun was about two thirds that of the green, but as the atmosphere absorbs more of the ultra-violet than it does of the green he had to calculate what it would be if he could examine the sun's light before it passed through any of the air around the earth. In this way it was found that the sun gave off about 39 per cent. more of the ultra-violet than of the green, but in November, 1925, the ultra-violet radiation, when corrected for atmospheric absorption, was over one and a half times as great as the green, and it is still getting stronger. This means that the proportionate amount of the rays which tan the skin has increased 83 per cent. in the last year and a half. This, Dr. Pettit said, is in harmony with the increase in the number of sunspots, of which an unusually large number have been seen on the sun's face within the last few months.

THE INTELLIGENCE OF WHITE RATS

FIVE hundred white rats are being given intelligence tests to determine learning ability with respect to age in the Stanford University laboratories of psychology. The study is being financed by a grant from the Carnegie Corporation of New York of $12,000 to be extended over a period of three years. After the first year higher animals, such as the cat, will be studied.

The problem in the case of animals, according to Professor Calvin P. Stone, who is conducting the experiments, is to test the ability to learn at successive stages of development. With rats, ages of 20, 30, 50, 100 and 200 days are used. Intermediate ages may be used later in further expansion of the work. Both the learning of new habits and the breaking of old ones are to be tested.

Two types of tests are being conducted by Professor Stone at present, the problem box and the maze. The problem box is a square box of wire screening from which a door leads to another box containing food. The door can be opened only by stepping upon a small platform projecting from the side of the box.

When the rat depresses this platform with his feet an electric current releases the door leading to the food. A rat is given this test once daily for 20 days and the time required for him to depress the platform is noted. Then a period of 50 days is allowed to elapse before the test is repeated to determine his retention of the habit formed. About 100 rats of each age are being tested.

The maze is one of the oldest devices used to test intelligence and learning ability. It consists of a laby-

rinthine passage containing many blind alleys, but only one direct path to the end, where food rewards the successful rat. A hungry animal is placed at the starting point and allowed to find his way to the exit. The number of false moves taken and the time required measure learning ability by this trial and error method. In addition to the 500 white rats now being used in these experiments, a breeding colony of about 100 animals is maintained.

A rough estimate of the relative rate of physical development in the rat and in man would be about 30 to 1. A rat one month old is equal in physical development to a child two and one half years old. Results now at hand would seem to indicate that the ratio of mental development is probably more nearly 50 to 1, according to Professor Stone.

Professor Stone began his present work June 1 and with one assistant worked seven hours daily during the summer. At present two research assistants are devoting four hours a day to the work.

NON-FILTERABLE BACTERIA

ELUSIVE, ultra-microscopic forms of life, minute as those which cause smallpox, scarlet fever, sleeping sickness and other diseases in human beings, are responsible for many of the diseases of animals, which cause an inestimable loss each year to farmers of every country.

Dr. Hubert Bunyea, avian pathologist of the U. S. Department of Agriculture, reported to the Washington branch of the Society of American Bacteriologists on the work that has been done in the control and eradication of these diseases in the United States and other countries. Rabies, foot-and-mouth disease, hog cholera, fowl pest, and bird pox, he said, are outstanding examples.

While the economic losses due to rabies are not as great as some, it is a very prevalent disease. All mammals, including man, are susceptible to it. It exists among the predatory animals of the Northwest, and this adds to its economic as well as its public health aspect.

The disease has been deprived of much of its horror by the discovery of Pasteur that animals and people could be rendered immune by repeated treatment with weakened doses of the virus. But the process is complicated and costly, and efforts to simplify it and make it practical for every-day use as a preventive in the case of domestic animals, have not yet been entirely satisfactory, Dr. Bunyea said.

Another germ too small for the microscope to disclose with ordinary light rays is the one that causes the foot-and-mouth disease and which has recently been made the subject of intensive investigation. This disease infects cloven-footed animals and is very contagious. The U. S. Bureau of Animal Industry has a commission investigating this subject in Europe. The bureau opposes the importation of any foreign viruses to this country, even for scientific study, in fear of their spreading and prefers to study them where the diseases occur.

Hog cholera, which once nearly annihilated the swine industry in many parts of the country, is also due to a virus of the extremely small kind. The actual organism is still unknown, although a serum with protective power has been in use for years. The organism not only passes through filters that retain ordinary bacteria, but it can not be grown in test tubes in the laboratory.

Fowl pest is also caused by ultra-microscopic bacteria. It existed in the United States last year, and is believed to have been spread from a sample of virus brought into the United States for study at one of the large eastern universities. Prompt measures eradicated the disease.

The organisms of fowl pest are very resistant under certain conditions and can survive for at least seven months in artificially stored blood. Fowls are more susceptible to their own special diseases than mammals and man are to theirs. Their semi-wild nature prevents their easy isolation and individual treatment, while their habit of flocking allows infection to spread rapidly.

The ultra-microscope, which uses X-rays instead of ordinary light, and can see what the ordinary microscope fails to reveal, has already been employed in the study of the minute forms of life that cause various animal diseases. So far the results have been only partially successful, but research of this sort has only just been begun, and the possibilities are unlimited.

ITEMS

No climate or race of people is exempt from cancer, and half a million die each year of the disease, says Dr. G. Fichera, in an article in the *Prensa Medica*. Europe alone accounts for 300,000 cases, and North America for 95,000. England's cancer mortality is placed at 45,000 a year, that of France at 24,000, Italy 27,000 and Argentina 5,700.

ECONOMIC losses running into many millions of dollars are caused in the United States each year by heart disease, according to Dr. J. G. Carr. "About one half of the patients with chronic heart disease are of an age at which their earning capacity should be at its highest and when family responsibilities are likely to be heaviest. This disease causes partial disability for years or total disability for over a year and a half." One third of the families represented in one of the dispensaries were dependent upon charity, and figures obtained by Dr. Carr from two institutions showed that the economic loss, both public and private, for only a small part of the heart disease patients, mounted up into the hundred thousands.

RETURN to food conditions much more primitive than those at present in vogue will be necessary if the ravages of dental diseases are to be checked. This is the lesson derived by Dr. T. D. Campbell, of Adelaide University, from an exhaustive examination of teeth and jaws of Australian aborigines which he finds are strikingly large, well-formed and healthy. "There is in every respect," Dr. Campbell says, "a very marked difference between the well-formed Australian dentition, and the ill-formed, disease-stricken masticatory outfit with which modern civilized peoples are burdened." The marked immunity from dental disease among the aboriginal children and grown-ups, he attributed to the coarse, tough food which formed their diet and the crude methods of preparation and cooking. Even children's teeth he found were well worn from chewing tough substances at an early age.