

SCIENCE NEWS

*Science Service, Washington, D. C.***"GHOSTS" OF THE UNIVERSE***(Copyright, 1940, by Science Service)*

TINY images of all the stars beyond one of extremely high density are "ghosts of the universe." They may be produced as the star bends light rays going past in a manner comparable to the way that a camera lens bends light rays from a scene and focuses them to form a picture on the film.

Speaking at Pasadena before the American Physical Society, Dr. Fritz Zwicky, of the California Institute of Technology, said that such images would afford a check of his theory of the ultimate fate of the gigantic star explosions called supernovae. When one occurs, a previously inconspicuous star suddenly rises to equal a hundred million suns in brilliance.

After such an explosion, which occurs on the average only once in several centuries in any one galaxy, such as our own Milky Way system, according to the theory, the end result is a collapsed neutron star. This would represent the lowest states of energy that matter could possess without actually turning into radiation.

Because they would be so exceedingly dense, far surpassing even the "white dwarf" stars in which a cubic inch of matter might weigh millions of pounds, they could not be seen. The force of gravity would be so great that any light they might emit would not be able to get away.

That there is an effect of gravity on light was one of the predictions of the theory of relativity of Professor Einstein. It has been confirmed by observations of the sun, where the effect is so slight that very delicate measurements are required to detect it.

With the neutron stars so dense, light from a distant star of the normal kind passing near one would be bent through a large angle, as if through a prism. Where the light rays that have passed all parts of the edge of the neutron star meet, an image would be formed, so that the star would really act as a gravitational lens. The image would be seen, if at all, floating in space, between us and the neutron star. Images of other stars would also be formed, so, within a small ring, there would appear "a miniature edition of all the unobscured luminous objects in the universe." Dr. Zwicky said that if the neutron star is close enough, and in the right position, this image might be observed, suggesting that astronomers search for such images. Even if the details could not be seen, an analysis of the light might reveal its character, for the spectrum would be a combination of the spectra of many different kinds of stars. "If the neutron star theory of supernovae is correct the number of collapsed stellar remnants of supernovae in our galaxy would exceed one million, and several collapsed neutron stars may be expected within a sphere of ten light years."

Less than ten visible stars are now known to be within this distance.

THE SUPERNOVAE*(Copyright, 1940, by Science Service)*

THE smallest pieces of atoms known to science may be responsible for the biggest star explosions—the "super-

novae"—stars which suddenly flash out from relative obscurity to equal 100,000,000 suns. This theory is proposed by Dr. George Gamow, professor of mathematical physics at George Washington University, who worked out its details with the aid of a Brazilian scientist, Dr. Mario Schenberg. Neutrinos, they believe, are the cause. These are emitted from the nuclei of atoms, together with electrons, in one form of disintegration which happens with radium and similar elements. They carry away about two thirds of the energy released from the nucleus when this happens. Because they are so small and have no electrical charge, they have been most elusive.

Inside a star which has started to contract, the temperature would reach several hundred million degrees. Under these conditions processes that can never happen under earthly conditions would easily take place. An electron might hit the nucleus of an iron atom, converting it into a form of another element, manganese. This element, known as Mn-56, has been made artificially in the laboratory. In the process a neutrino would be given off. But the core of the Mn-56 atom would, in a few hours, turn back to iron, with the liberation of an electron, and another neutrino. Then another stray electron would change the iron back to manganese, again with a neutrino released.

Dr. Gamow says that there are dozens of analogous processes which would work the same way. As these worked to and fro, he says, neutrinos would be produced all the time. He said that "the neutrinos would penetrate without any difficulty through the body of the star and escape unobserved, carrying away the energy. The process provides for the unlimited cooling in the center of the star, and prevents the central temperature and pressure from rising above a certain value. It is thus clear that, when this process starts, the star must rapidly collapse under its own weight. The outer layers of the star, heated by the compression, will lead to a large increase of the observed luminosity, which will be registered by astronomers as a nova, or supernova, explosion. However, the radiant energy (light, etc.) emitted during such explosion will be but a small fraction of the total energy liberated in the collapse, since most of the energy escapes unobserved, carried away by the neutrinos."

Dr. Gamow pointed out that this agrees closely with astronomical data. These indicate that the energy detected by telescopic observations is much smaller than might be expected from such a collapse. He also explains the difference between ordinary novae, or "new stars," which get to be about 10,000 times as bright as the sun, and the brightest of the supernovae, which are ten thousand times brighter than the novae. It is due, he believes, to the fact that the stars have different masses. He finds that a mass 40 per cent. larger than the sun is a critical value. Above this figure the collapse is much more violent—result is a supernova. These great stellar explosions occur in our Milky Way system about once in three centuries. The last explosion of that type in our galaxy was that observed by Tycho Brahe in A.D. 1572. The previous one was observed by the Chinese in 1054.

The Star of Bethlehem was evidently also a supernova of about 4 B.C.—JAMES STOKLEY.

URANIUM

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THE first determinations of the amounts of various elements produced by transmutation of uranium 235 in the breaking-up process by which it is hoped to produce atomic power have been made recently by Drs. A. V. Grosse, E. Fermi and H. L. Anderson, of the department of physics of Columbia University. Their results are announced in a report to the *Journal* of the American Chemical Society.

When the form, or isotope, of uranium known as U 235 is hit by a neutron, a tiny atom fragment, it breaks up into two pieces, which are different elements. Dr. Grosse and his associates find that the results of this division, or fission, fall into two groups, one of heavy elements, the other lighter ones. In the first is iodine, xenon, caesium, lanthanum and cerium; in the latter molybdenum. They have computed the proportions of each that will result from the fission of 100 U 235 atoms. On the average, the yield would be a little more than 50 of the heavy group elements, and about 6 of the lighter.

However, it is pointed out that the equation they have made to show the results "is as yet incomplete, for the fission of 100 atoms of U 235 will produce 100 atoms of the heavy group and simultaneously 100 atoms of the light element group (in addition to neutrons and energy). This indicates that the discovery of additional fission fragments is to be expected."

CUNNINGHAM'S COMET

HYDROGEN gas, never before recognized in a comet, has been discovered in Cunningham's comet, now visible in the western evening sky. This discovery, which radically changes the ideas of astronomers about the nature of comets, was announced by the Harvard College Observatory, where the comet was discovered in September. Up to the present carbon, oxygen, nitrogen and sodium have been the principal elements recognized in comets by analyses of their light. Except for the sodium, these have always been in compounds, such as carbon monoxide.

Studying one spectrum plate of the new comet, Leland E. Cunningham, discover of the comet, and his colleague, Dr. Fletcher G. Watson, have found dark bands that seem to show that a comet consists mostly of hydrogen.

Similar dark bands have been found in comet spectrum photographs before, though they have never been interpreted as due to hydrogen in the comet itself. It is planned to re-examine these old plates as soon as possible. With further exposure that may be made of the new comet, these may confirm the presence of hydrogen.

If it proves correct; the new discovery will be important in the interpretation of future comets. Any new clue to their birth will contribute to understanding better one of the major unsolved puzzles of astronomy, the origin and evolution of the solar system.

THE ELECTRON MICROSCOPE

NEW facts about the diphtheria bacillus, which that germ has hitherto kept secret from prying microscopes,

have been discovered by Dr. Harry E. Morton, of the University of Pennsylvania School of Medicine, and Dr. Thomas F. Anderson, of the research laboratories of the Radio Corporation of America.

The electron microscope, which uses particles of electricity instead of light and magnetic fields instead of lenses allowing investigators to examine objects one fiftieth the size of anything heretofore visible, enabled Drs. Morton and Anderson to record the location of chemical reactions within the tiny diphtheria germ. They reported to the Society of American Bacteriologists that crystals of tellurium metal are formed from tellurite salts within the diphtheria bacillus.

The fact that the diphtheria bacillus and other microorganisms could reduce tellurite salts to black tellurium metal has been known since 1900, but in the case of the diphtheria bacillus it was not known where the formation of the metal occurred.

Crystals of tellurium are not only contained within many of the diphtheria cells, the electron microscope pictures showed, but in some cases the crystals perforate the cells and extend into the surrounding space.

"Occasionally," Dr. Morton said, "when the crystal projects through the cell the outline of the cell extends along the edge of the crystal a short distance suggesting that the cell 'membrane' was perforated from the inside outward. The tellurite crystals disappear upon treatment with appropriate chemicals."

SCIENCE IN 1940

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(Continued from December 27, 1940)

ENGINEERING AND TECHNOLOGY

The Pennsylvania turnpike, a 160-mile road without crossroads, was opened between Harrisburg and Pittsburgh.

The biggest steam turbine made since 1930, capable of 80,000 kilowatts, was completed.

New values of the viscosity of steam at high pressures and temperatures were made available.

The largest conveyor belt system carried 1,100 tons of gravel, sand and crushed rock per hour 9.6 miles to Shasta Dam.

A suspension bridge near Tacoma, Wash., was opened, becoming the third largest in the world, but a few months later it collapsed in a gale.

AERONAUTICS

A SUCCESSFUL helicopter made in the United States and an autogiro capable of vertical takeoff were demonstrated. A new interceptor fighter plane, capable of ascent at a speed of more than a vertical mile a minute, was demonstrated.

The Allison engine, America's principal contribution to the art of liquid cooled aircraft engines, was perfected to the point of going into quantity production in the General Motors Indianapolis plant.

Military airplanes attained speeds exceeding 400 m.p.h. Air-cooled airplane engines developing more than 2,000 horsepower were developed.

The world's largest land passenger airplanes, with a

daytime passenger capacity of 42 passengers, weighing 25 tons and powered with four engines, went into production.

Air transport planes began to carry passengers in pressurized cabins above the weather.

The keel was laid for the world's largest flying boat, for the U. S. Navy.

Federal control of aviation was changed with the abolition of the Civil Aeronautics Authority and the creation of the Civil Aeronautics Board and the Civil Aeronautics Administration.

Military air service in the United States was aided when an air officer was made deputy chief of staff and a lieutenant-general was placed in charge of the G. H. Q. Air Force.

New aviation fuels that increase safety by reducing greatly the fire hazard, were developed.

An elaborate government program to train civilians as pilots was started.

Air service from the United States to New Zealand and Australia was inaugurated.

New air routes into China kept that nation in touch with the outside world despite invasion.

An airplane was for the first time certified by the government as being stall-proof and spin-proof.

A program to build large numbers of airplanes for U. S. defense was started.

New laboratories for aviation research were begun by the National Advisory Committee for Aeronautics at Moffett Field, Calif., and at Cleveland, Ohio.

MEDICAL SCIENCES

DEVELOPMENT of a new measles vaccine and its success in clinical trials on a small group of children was announced. New evidence of the importance of thiamin, or vitamin B₁, not only for preventing disease and minor degrees of ill health, but for increasing the alertness and capacity for physical work in persons of ordinary good health was obtained from diet studies on human subjects.

Lack of riboflavin, one of the B vitamins, in the diet was discovered to cause keratitis and cure of the condition by riboflavin was announced.

Synthesis of pantothenic acid, one of the B vitamins, and its identification as an adrenal gland-protecting factor for rats, and its usefulness in human nutrition were announced.

A new vaccine from influenza and distemper viruses was found to give ferrets solid immunity against several strains of influenza and was tried on humans during an epidemic in Puerto Rico but without definite conclusions.

A second virus cause of influenza, to be known as Influenza B virus, was discovered and found to cause epidemics in alternating cycles with Influenza A virus.

Sulfathiazole was announced as an improved remedy for pneumonia and as a valuable remedy for staphylococcal infections and as a possible cure for bubonic plague.

Evidence of regression of cancer achieved by treatment of patients with fast neutron rays from the cyclotron was reported.

Neutrons slowed down by boron proved five times as effective as fast neutrons in destroying cancer tissue in

test-tube experiments and cured transplanted cancer in mice.

"Air bends" or aeroembolism, occurring in rapid ascents to high altitudes, can be prevented by oxygen inhalation treatment before taking off.

Signs of heart damage due to oxygen lack were discovered in flyers at altitudes as low as 5,000 feet.

A "pocket-size" emergency oxygen inhalation apparatus for parachute descents from high altitudes was devised.

Five groups of eye defects significant in certain types of work and new tests for detecting them were announced together with a theory of job selection on an eye-sight basis.

A serum for treating Rocky Mountain spotted fever was developed.

Two kidney extracts were reported to give relief from high blood pressure.

Isolation from soil bacilli of chemicals capable of destroying a large range of pathogenic micro-organisms and promising results with the use of one of them, gram-acidin, in treatment of chronic bovine mastitis, were announced.

Successful vein grafting or splicing was accomplished with the aid of the anti-blood clotting chemical heparin.

Sulfanilylguanidine was announced as a promising remedy for bacillary dysentery and other intestinal infections.

Test-tube transformation, for the first time, of living mammalian cells into cells of apparently radically different type which may be cancer cells was achieved by methylcholanthrene treatment in search for the secret of the change of normal cells into cancer cells and suggested that a change in the cell membrane may be crucial to the transformation of normal to cancer cells under chemical treatment.

Cancer-causing substances, it was announced, have been extracted from the presumably healthy livers of cancer patients and, apparently for the first time, from human breast cancers.

A new route by which cancer cells and disease germs can spread through the body, by-passing the heart and lungs, and thus in the case of cancer giving a false sense of security in prognosis based on lung involvement, was discovered in the valveless vertebral veins.

Discovery that glutamic acid occurs naturally in both right-handed and left-handed forms refuted the idea that appearance of the left-handed form in the body was an indication of cancer.

Antibodies that can inactivate influenza virus were discovered in human nasal secretions and seen as a possible protection along with a change seen during influenza in the cells of respiratory mucous membrane of ferrets.

Cirrhosis of the liver in rabbits was produced by a diet lacking in a substance found in yeast and thought to be choline.

Evidence showing that the liver is of fundamental importance in the formation of prothrombin and in the metabolism of vitamin K was reported.

Aluminum treatment of silicosis in human patients was begun with early encouraging results.