SCIENCE NEWS

Science Service, Washington, D. C.

THE MECHANISM OF THE SUN'S HEAT

THE sun is a giant atom-smasher, feeding on atomic energy by transmuting hydrogen into helium, with carbon playing the part of go-between and not consumed. This is the picture that was painted at Washington and Jefferson College by Dr. H. A. Bethe, professor of physics at Cornell University. Dr. Bethe spoke under the auspices of the Society of the Sigma Xi, national fraternity for the promotion of scientific research. He will lecture again at several universities and colleges during the next few days.

The precise mechanism by which the sun maintains its tremendous output of energy, by which we all live, has now been definitely worked out. It is a six-step reaction, Dr. Bethe explained, between the nuclei or central cores of elementary atoms.

In the tremendous heat that prevails inside the sun, 36 million degrees Fahrenheit at the center, chemical reactions do not occur. But when nucleus meets nucleus, something similar takes place. They may knock each other to pieces and the fragments recombine to form new elements. Or a nucleus may swallow another whole, again producing a new element. At each such transmutation, a burst of energy contributes to the sun's radiation.

Already, it is estimated, the sun has existed in this way a billion and a half years. And it would continue to exist another 30 billion years, Dr. Bethe stated, if it kept on at its present rate. But the sun gets hotter as it grows older, eats up its hydrogen faster, and will probably have consumed the last morsels before ten billion years.

Five million years are required to run through the six-step reaction that maintains the sun's heat. To begin with, a carbon nucleus picks up a hydrogen nucleus and is transformed into nitrogen. The latter disintegrates to another form of carbon. This picks up an additional hydrogen nucleus, becoming a different form of nitrogen. The latter picks up a hydrogen nucleus, becoming oxygen. This oxygen disintegrates to still another form of nitrogen, which is finally struck by a hard-hitting hydrogen nucleus and completely smashed. From the fragments, two new elements are formed, helium and the original carbon with which the series started.

Thus, after some five million years, we are back where we started. Carbon has not been consumed, but has merely acted as a go-between or catalyst to keep things going. All the intermediate products have disappeared. During the process four hydrogen nuclei have been consumed, and only helium remains. Thus, hydrogen is the fuel of the solar fires, and helium is the ash.

COLLISION WITH BIRDS A HAZARD IN AIR TRANSPORTATION

COLLISION with birds, particularly large specimens, is one of the most serious hazards to transport planes, sometimes causing destruction of the plane and threatening the life of pilot or passengers, according to the report of Allen L. Morse, chief of the aircraft development section of the Civil Aeronautics Administration, read at the national aeronautic meeting of the Society of Automotive Engineers. Airplane accidents involving bird collision, Mr. Morse said, have amounted to 61 since 1939, two thirds of which occurred at night, more than a third shattering or penetrating the windshield.

Mr. Morse told of one pilot whose plane collided with a flock of five swans at night. One swan penetrated the leading edge of the left wing; the second almost tore off the left vertical stabilizer, jamming the rudders, the third swan struck and dented the engine cowl, and later two swans went through the propeller. A portion of a swan, taken from the wing after landing, weighed 11½ pounds. Wild swans weigh as much as 20 pounds.

Such reports show that impact forces in collisions with birds are enormous. Even small birds, Mr. Morse went on, not only have penetrated the windshield, but in one instance continued through the bulkhead, traveled the length of the cabin, penetrated the rear cabin wall, and lodged finally in the baggage compartment. Fortunately in this case neither passengers nor crew were struck.

For use in tests to devise adequate protection against birds, Mr. Morse called for development of a high-pressure air catapult which could shoot freshly-killed carcasses against a plane windshield, thus simulating actual flight-collision. Freshly-killed birds are necessary, since their bodies offer the same resistance as live birds. Meanwhile windshield combinations of glass and plastics offer some protection. It is to further test these combinations that the high-pressure catapult is needed.

A POWERFUL MAGNETIC FIELD DISCOVERED IN SUNSPOTS THAT BLACKED-OUT RADIO COMMUNICATIONS

THE giant group of sunspots that was visible to the naked eye from February 25 to March 1 had the most powerful magnetic field ever measured at the Mount Wilson Observatory, an investigation at Pasadena has revealed.

On two days the magnetic field attained the value of 5,100 gauss. A strength of 3,000 gauss is about average for most large spots. Although spots have been photographed and studied at Mt. Wilson on every clear day for over a quarter of a century, not one has ever exceeded this value. The spot-group was also remarkable in that it contained magnetic fields of opposite polarity almost in contact, like the north and south poles of a horseshoe magnet, instead of being widely separated as is usually the case.

The spot-group was held responsible for the violent magnetic storm which began about midnight on March 1 and lasted for 24 hours. The magnetic field of the spot itself is not believed to have caused the storm, but rather charged particles projected from the spot at a high velocity toward the earth. Frequently during magnetic storms telegraph and teletype service is disrupted and radio transmission seriously affected.

The spot-group is now out of sight on the side of the sun turned from the earth but should be brought into view again by the solar rotation about March 22.

Such a large outburst of solar activity is of exceptional interest in that it occurred only two years from the next predicted minimum in sunspot frequency. The last minimum of the 11-year cycle was in 1933 and maximum about 1937.

DISEASE-FIGHTING BLOOD SUBSTANCES

FOR the first time in medical history, disease-fighting blood substances known as antibodies have been formed artificially in laboratory flasks. Hitherto these protectors against germs and viruses have been formed only within the bodies of living persons and animals. The new feat of inducing their production in glass vessels was performed in the laboratories of the California Institute of Technology by Professor Linus Pauling, Professor Dan Campbell and Dr. David Pressman.

Up to the present time, the experiments have not been carried far enough to discover whether or not it will be possible to prepare these protective solutions in the laboratory for general clinical use, although exploratory work along these lines is already under way. The immediate value of the research lies in its contribution to a better understanding of the biochemistry of the reactions of blood proteins to the presence of disease-causers that result in the formation of protective antibodies.

According to the theoretical picture conceived by Professors Pauling and Campbell and Dr. Pressman, antibodies are formed by the modification in shape and structure of the large molecules of certain blood proteins, known as serum globulins, which takes place in the presence of disease germs or virus particles. They envision the complex structure of the molecules forming in the presence of the disturbers with certain changes that enable them to seize hold of the offenders and render them harmless. The modifications in molecular form of the globulins enable them to perform such arrests whenever the blood is invaded by germs or virus particles like those that modified their original formation.

In these experiments serum globulins were induced to "unfold" their molecules by heating or treatment with alkali, in the presence of an antigen, or disease-provoking agent. Then the unfolding force was slowly withdrawn, permitting the molecules to re-fold themselves, but with modifications due to the provocative presence of the antigen. It was found that a protein solution subjected to this treatment acquired the various characteristics of a natural blood serum which would be obtained from an animal which had been immunized with the same antigen. The investigators have prepared in this way antibodies against various simple chemical antigens, and also against a complex sugar-like compound from cultures of pneumonia germs.

STATISTICAL METHODS AND HUMAN HEREDITY

STATISTICAL statements of the probability of inheritance of a given trait in human heredity can not predict how a particular individual will turn out, but do have potential value when large numbers are taken into account, is stated by Professor J. B. S. Haldane, of the University of London, in the concluding chapter of a book entitled "New Paths in Genetics" published by Harper.

"It is true," he conceded, "that there is almost always an element of uncertainty in predictions concerning individuals. But when we deal with millions, probability becomes certainty, and conjecture accurate prediction. And when Herr Hitler writes of the evil effects of race crossing it seems worth while to point out that a race is nothing homogeneous, but a collection of very various individuals who have something in common which can only be accurately described in terms of the statistical methods which we are working out. Before we can speak accurately of the evil effects of so complicated a process as a racial cross it would be well to investigate the evil effects of a single gene substitution.

"We geneticists who are working on the accurate description and analysis of human genetics stand between two extremes, the conservatives who do not wish to see scientific method applied to human affairs, and the reactionaries who would apply half-baked science to them in the interests of a particular class or nation. Unlike conservatism and reaction, progress demands clear thinking. If this book can help towards clear thinking on human genetics it will not have failed."

Growth of cities in Europe is credited, in another chapter, with the improvement of human heredity through the wiping out of hereditary defects. When people lived and died in the same small village circle, cousins marrying cousins for generation after generation, defects resulting from recessive genes kept cropping up as a result of this inbreeding. But when people began to migrate and to mix the population, human outbreeding became the rule and many of these once common defective genes eventually became lost.

THE HIGHWAY FROM ALASKA TO THE UNITED STATES

OBJECTION to the Alaska highway route announced by Prime Minister Mackenzie King of Canada has been made by members of both American and Canadian Alaska highway commissions and the Alaskan delegate to Congress, Anthony J. Dimond.

The route they favor is closer to the Pacific coast and is known as "A" route. It is held to be "shorter, easier to build, and of greater strategic value." The selected route announced by Prime Minister King is known as the "C" route and lies some 500 miles east of the Canadian Rockies. It was recommended by the Permanent Joint Board of Defense.

According to Mr. Dimond, the selection of the farther inland route was "a grievous mistake," an opinion concurred in by Donald MacDonald, a member of the Alaska International Highway Commission of the American Government and its acting chairman, Thomas Riggs. Both of these members pointed out that the "A" route has been the choice of this commission and the British Columbia-Yukon-Alaska Commission since 1938 when the two commissions were appointed by President Roosevelt and the Canadian Government, respectively.

Mr. MacDonald, engineer member of the American Commission and a student of the Alaska highway prob-

lem since 1928, told Science Service that the section of the route announced by the Prime Minister between Watson Lake and White Horse, Alaska, creates "extremely difficult" engineering problems. This section is a strip of about 240 miles of frozen tundra. Beneath this is a layer of mush or water which has seeped down through the tundra. To construct a road over this will be virtually impossible.

Mr. MacDonald and Mr. Dimond both stressed that the "A" route, which would connect Prince George, British Columbia, and Fairbanks, Alaska, could connect airfields near the Canadian Pacific coast, thus aiding air reconnaissance as well as possible attack on invading air forces. Pan American Airways Alaska service now flies over this route.

The selected inland route was defended, however, by an Army engineer member of the Permanent Joint Defense Board, who asked that his name be withheld. This spokesman said the inland route was chosen "purely for military reasons, and not for economic or commercial reasons." He pointed out that the inland route connects Canadian airports through Fort Nelson, Watson Lake, White Horse, Boundary and Big Delta to Fairbanks and that military authorities of both United States and Canada are agreed unanimously that the selected route is the proper one under present circumstances.

RESPIRATORY DISEASES

THE current and revolutionary theory that colds, influenza and other respiratory diseases, which cause the most illness in any age group, may be spread through the air, rather than by direct contact with the infected person, is supported by detailed evidence in the *Journal* of the American Medical Association.

Three distinct lines of investigation are reported by Dr. Leon Buchbinder, of the DeLamar Institute of Public Health of the Columbia University College of Physicians and Surgeons. These are the discovery of germs from the throat and mouth, means of identifying individual strains of streptococci bacilli, and development of several effective means to control respiratory infections on the theory that they are air-borne rather than spread by direct contact.

Most interesting perhaps are the means of control. There is suggestive evidence, Dr. Buchbinder reports, that the spread of contagious infections in children's hospitals and in operating rooms can be reduced by ultraviolet light. Somewhat the same results, though less supported by evidence, are obtained with chemical sprays.

Some time ago the contact theory seemed verified by the success of the so-called barrier method of nursing in contagious disease hospitals. However, it did not entirely prevent spread of disease from bed to bed or ward to ward. Current success with ultraviolet light and spraying the air with chemicals seems now to indicate that disease organisms may be carried for some distance through the air without losing their vigor, and may perhaps be halted by the light or spray. There have been several reports that the spread of chickenpox in institutions is slowed by ultraviolet light. The air-borne theory of contagious disease is particularly interesting at present, because of the congregation of soldiers in Army camps. One of the chemical "mists" used to halt air-borne infections is propylene glycol. It has been found that a one part to two million dilution of propylene glycol vapor will completely protect mice against dilutions of influenza virus, usually fatal.

ITEMS

A RISE in tuberculosis in countries where war has caused a food shortage was predicted by Dr. Esmond R. Long, director of the Henry Phipps Institute, Philadelphia, in an address to the fortieth annual meeting of the New York Tuberculosis and Health Association. Dr. Long pointed out that already a rise in tuberculosis death rates has been recorded in the British Isles, attributed by public health authorities to poorer nutrition. He said proper nutrition is an important constitutional factor in resistance to this disease. During the first world war there was a serious rise in tuberculosis in the warring countries. Careful analyses in later years credited a major share of this to malnutrition, particularly to deficiency in protein consumption. Later studies have indicated the importance of vitamin A and vitamin C. These food substances are looked upon as protective. They may spell the difference between ability and inability to resist minor tuberculosis infections.

RESISTANCE to infantile paralysis and other diseases caused by viruses may depend on whether or not the cells of the body are thirsty for water and are well-fed or undernourished, it appears from experiments reported in the *Journal of Experimental Medicine* here by Dr. Douglas H. Sprunt of Duke University School of Medicine. Dr. Sprunt discovered in experiments on rabbits that thirstiness, not just in a dry mouth but in every cell of the body, lessens resistance to vaccinia, the virus used in vaccinating against smallpox. Infantile paralysis often strikes children and young people after athletic contests or similar physical exertion in the summer. Water sweated from the body at such times may have created such a dry, thirsty state throughout the body that the nerve cells which the infantile paralysis virus strikes were unable to resist the virus attack. When there is plenty of water in the tissues of the body, however, the virus tends to be localized at the invasion point and can not grow and spread enough to cause disease. This, at least, appears to be the mechanism in the case of the vaccinia virus and the rabbits. Food also plays a part in resistance to virus infection. Contrary to what might be expected, resistance to the virus is greater when the body is undernourished than when it is well-fed.

THAT pork can be made safe for human consumption, so far as any lurking trichinae are concerned, by proper freezing, has been determined by the U. S. Department of Agriculture. Sections of pork or pork products not more than six inches thick are freed from parasites by exposure to a temperature of five degrees Fahrenheit for twenty days, or ten degrees below zero for ten days, or twenty degrees below zero for six days. Thicker pieces may be made safe by longer freezing. The department warns that in many food locker plants temperatures are not kept low enough to insure a complete kill in stored pork.