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(Editors: Prof. Shapley, formerly of the Mount Wilson Observatory, now at the Harvard College Observatory, has attracted world-wide attention by his theories of the constitution of the stellar universe. In the following address he calls attention to a mysterious gas, called nebulium, which is seen in the nebulae before they condense into stars, but which is unknown on earth. But some day it may be found here as was helium which was discovered by astronomers in the sun long before it was found by chemists on earth.)

UNKNOWN GAS, NEBULIUM, MAY BE A
FORMATIVE MATERIAL OF STARS AND PLANETS

(By Science Service)

"When scientists solve the elusive mystery of nebulium, the peculiar gas which is the most common element of remote nebulae, but unknown on earth or in sun and stars, will they discover such important and remarkable facts for science and industry as they did when they solved that other big chemical mystery of the stars --- the nature of the gas helium? " Prof. Shapley, of the Harvard College Observatory, asked in an address at the recent meeting of the American Electrochemical Society at Lake Placid, N. Y.

Does nebulium exist on the earth, still concealed from the chemist by its rarity or peculiar properties, much as helium long remained unidentified, though it occurs frequently in rocks and to a small extent in the very air we breathe? This was another question he suggested.

The diffuse nebulae are distant gaseous masses that the astronomers believe are the fore-runners of stars and planets. Their light is due mostly to hydrogen, nitrogen, helium, and the mysterious nebulium. Hydrogen is the most important constituent of water and most liquids; nitrogen makes up four-fifths of the earth's atmosphere and is all-important in the structures of plants and animals; helium is now believed to be fundamental in the making of the metals. Probably nebulium, the fourth important gas in the diffuse nebulae, is or has been of similar significance in the universe, Prof. Shapley said. What may the full knowledge of its nature have in store for us? Is it perhaps one of the known gases, shining in the nebulae under conditions not present in the sun or stars or in our earthly laboratories? Its identification may be one of the epoch-making steps in the chemistry of the stars.

Helium was first found fifty years ago by astronomers while analyzing the light of the sun and stars. It was named in honor of the sun, for which the Greek name is Helios. Its radiations corresponded to those of no chemical substance then known. When, finally, helium was discovered on the earth, it proved to be one of the most important chemical elements. Not only has its value been demonstrated as a non-burning, non-exploding gas for the filling of balloons, but knowledge of helium has greatly increased our knowledge of radium and of the other radioactive elements. When radioactive elements break down, helium is one of the results. In fact, the high-speed ejected atoms of helium constitute the powerful heat-producing rays of radium.

Helium has become of still more importance to the scientist through the discovery that the great majority of all the chemical elements in the stars, in the earth's crust, and in living organisms - such substances as carbon, oxygen, sand, sulphur, copper, and iron - were apparently built out of helium atoms at some time during the past history of the universe.

According to Prof. Shapley, electrical and chemical laboratories of unexcelled power exist in the interiors of stars, where the temperature runs to millions of degrees, and the radiation is nearly all like X-Rays. Even near the surface of the sun the temperature is much higher than that of our electric furnaces, and the most refractory chemical compounds are broken down by the enormous heat and radiation. For some common elements like sodium, potassium, and calcium, the atoms themselves are partially torn to pieces in the solar laboratory.

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WAR TRACTOR DEMONSTRATION
SUGGESTS PEACE USES

(By Science Service)

While the drab-painted iron war horses were darting over the rough ranges of the Aberdeen Proving Ground, Md. where the Ordnance Department of the army was recently showing off its tanks, gun tractors and artillery motor carriages, many there visioned peace time burdens being carried across rough undeveloped country or plowed fields, instead of guns being transported across artillery ranges.

Witnessing the demonstration were mechanical and automotive engineers who have been making the tractor as effective and indispensable in peace as in war.

The heavy self-propelled motor gun carriage is now in storage, useful for demonstrations only. The war is over. But there are roads to be built and virgin land in undeveloped countries that can be conquered by the cross-country, self-track-laying locomotives.

Instead of the caterpillar motor mount for a 8 inch gun that can climb 45 degree slopes and navigate water-filled shell holes at 30 miles per hour, peace requires water-proof, mountain climbing, tractor trucks that can ford streams and ride over mud holes.

The picturesque mounted courier and scout of past years has been replaced by a rapidly moving one-man tank, able to go over nearly anything. Will we see the farmer of a large acreage mount his individual tractor as though it were a horse?

A great gun caterpillar carriage was seemingly being towed by a loosely hanging cable attached to its puffing tractor, but inspection showed that the front tractor generated electricity and fed it along a flexible and extensible cable to the silent and safe motors of the gun mount. Will we have portable power houses supplying electrically driven farm machinery similar to this development of the war?

The tractor was a healthy youth working in all parts of the world before the war. Strife developed it into a horse-eradicating giant, ready to do the work of the world.

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ALASKA IS FULL OF MOSQUITOES
BUT IT HAS NO HOUSE FLIES

(By Science Service)

Washington, October -- Alaska has millions of mosquitoes, but not one house fly. This is the information that is brought back from that territory by Dr. J. M. Aldrich of the U. S. National Museum who made an insect survey there this summer.

Hordes of mosquitoes during the Alaskan summer in places as far north as Seward and Fairbanks provide continual entertainment for the inhabitants, who, however, do not have to contend with the ravages of the domestic fly.

"When the ladies of Alaska wish to wear thin and filmy silk stockings they have to place a protective layer of paper underneath as an armor-plate against the mosquitoes" is one story that he has to tell. Laborers wear mosquito nets and heavy gloves.

Smudges are a national institution there. They are everywhere. In the interior the Alaskan summer is sufficiently warm for swimming. But this sport must be accompanied by a ceremony. The boys construct a hut of branches on the bank of the stream, protect it from mosquitoes by a smudge, and enter and exit from the water with a mosquito-defying dash.

Alaskan mosquitoes do not act as carriers of malaria and yellow fever as do those of the United States and tropics, but they are very vicious. They literally fill the air. In one sweep of an insect collecting net about his head, Dr. Aldrich was able to capture 110 mosquitoes by actual count.

The absence of house flies in Alaska has raised the question as to whether there is a northern limit to the house fly. Heretofore it has been assumed that the domestic fly accompanies man wherever life is possible, but Dr. Aldrich's observation has thrown a new light on the subject. The absence of horses and their manure in large quantities may be a minor reason for the absence of the house fly, but climate seems to be the principal one. Even in the southern end of Alaska's panhandle at Ketchikan there are salmon factories, houses and stores, all unscreened, and with absolutely no traces of the common fly. A few of the rarer flies that are found in the United States also live in Alaska, but in insignificant numbers.

Insects from the interior of Alaska were collected by Dr. Aldrich for the first time. The valley of the Tanana River, a tributary of the Yukon, is very much like the northern part of Minnesota and the region around Lake Superior so far as insects are concerned he has found. Dr. Aldrich's trip extended from Seward to Fairbanks, along the route of the partially completed government railway.

NEWS OF THE STARS

The World's Heaviest Gun on the Moon.

By Isabel M. Lewis

of the U. S. Naval Observatory.

(Science Service)

Suppose that the world's heaviest gun, the 16 inch, 50 caliber coast defense weapon that has just been fired at Aberdeen Proving Grounds by the Ordnance Department for the first time, were on the moon. Details such as these might appear in a lunar newspaper:

Placed on the moon's surface the reduced gravitational attraction of the moon for objects at its surface would give the gun a weight of about 28 tons instead of 170 tons and its carriage a weight of 112 tons instead of 670 tons. Instead of using a 2400 lb. shell and 850 lbs. of smokeless powder, the muzzle velocity of 2700 ft. per sec. could be attained by means of 142 moon lbs. of powder acting upon a 400 moon lb. projectile. The earthly range of forty thousand yards or nearly twenty-three miles would be increased to about one hundred and thirty-five miles on the moon if we consider the effect of reduced gravitational attraction alone but it would, in fact, be far greater than this owing to the greatly reduced effect of atmospheric resistance as well. Just how much greater its range would be on the moon it is not possible to say since the density of the moon's atmosphere is unknown.

If this same projectile were sent over the moon's path at its earthly rate it would require about 53 days to cover the distance that the moon now covers in 27.3 days with its orbital velocity of 3350 ft. per sec.

If a projectile could attain an initial velocity of about 8000 ft. per sec. on the moon it would overcome the gravitational attraction of the moon and pass off into space never to return. In fact we might picture the hypothetical lunar inhabitants experimenting with such a projectile with the intent to bombard our own planet, inasmuch as we have similar designs on the moon. Fired with an initial velocity of 6000 ft. or a little over a mile a second a projectile would leave the moon but would become its satellite revolving in a circular orbit close to its surface.

The initial velocity needed to send a projectile beyond the control of the earth's attraction is very nearly seven miles per sec. and a velocity of five miles per sec. would be required to convert it into a satellite of the earth.

But right here on earth, the army's big gun is sending forth projectiles that travel faster than a point on the equator does in revolving about the earth's axis.

If a shot from this gun were freed from the effects of gravitational attraction and atmospheric resistance so that its initial velocity of 2700 ft. per sec. could be maintained it could make the circuit of the earth at the equator in a little more than half the time that is required for a point to be carried around by the rotation of the earth. A point on the equator covers a distance of twenty-five thousand miles in twenty-four hours and therefore moves at the rate of about 1500 ft. per sec. A shot from this gun would cover the same distance in 13 hrs., 40 min. at the rate of 2700 ft. per sec.

UNITED STATES STILL LEADS IN RADIUM PRODUCTION

(By Science Service)

Washington, October -- Despite reports from London telling of a radium corner executed by British interests when they acquired the product of Czechoslovakian pitchblende mines, America is still and will probably continue to be the leading producer of radium of the world, and it has the largest known reserves of radium bearing minerals.

The importance of the pitchblende mines of Bohemia (Czechoslovakia) has been greatly exaggerated in the public mind, according to Frank L. Hess, specialist in the rarer metals, U. S. Geological Survey. Their total production up to the end of 1920 was only 20,962 grams, while during the year 1920 alone nine radium plants in this country isolated and placed in tubes for medical and scientific use 32,539 grams (1.15 ounces) of radium worth about \$2,253,000, and during the same year ore carrying 43.4 grams (about 1.5 ounces) of radium was mined.

British interests expect 50 to 60 grams of radium from their holdings in about 15 years, but America at the 1920 rate of production would accomplish this in two years.

"Since 1911 when the first uranium minerals were mined in this country for radium, ore carrying 186.5 grams (6.6 ounces) has been mined," explained Mr. Hess. In all about 135 grams of this quantity were extracted, but probably one-quarter of the total American output was dissipated on watch faces, signs, and other self-illuminated objects, principally during the war. Europe probably almost exhausted the radium supplies by such uses during the war.

The whole stock of radium in the world today is not more than 100 grams (3.5 ounces), worth \$10,000,000 to \$12,000,000, or 17 to 20 tons in gold coin.

"In spite of optimistic estimates by some, recent investigations seem to show that our probable radium supplies though the largest in the world are so small that they should be carefully conserved and that no radium should be used for illumination," Mr. Hess says.

THE VACUUM TUBE IN INDUSTRY

By Charles E. Oakes
(Science Service)

The most revolutionary development in the electrical industry during the past decade has been the hot-cathode vacuum tube and the end of the applications of this device is not yet in sight. We are all familiar with the present state of development of wireless telegraphy, the radio telephone, transcontinental telegraphy, and the vacuum bulb rectifier, which many of us use in our garage for charging the battery. All of these are relatively recent developments of an interesting, and what was thought at the time, an unimportant phenomenon recognized by Edison when he invented the incandescent lamp. These inventions are now in daily use but the vacuum tube has had only a limited use in the power and lighting field of the electrical industry. Recent adaptation of the vacuum tube has made possible the use of this device in this branch of the electrical industry.

All metals, when heated, give off infinitesimal particles, called electrons, in the same way that water evaporates when heated. Some metals, such as tungsten, have a rate of emission much greater than others, in the same way that ether evaporates faster than water. This phenomenon has been used in the development of the vacuum tube which now has such a diversified use in the electrical industry.

The vacuum tube is an instrument through which the skill of man has harnessed the electrons. From a hot wire in an exhausted vessel or tube they can be evaporated and then deflected or guided and controlled by such forces as heat and magnetism according to the will of the manipulator. They obey the slightest force instantly. Their application to the wireless telephone is an example. In this case the transmission of intelligence is by the use of high frequency waves such as are used in wireless telegraphy. Sound vibrations are of the order of a few hundred per second, whereas wireless oscillations are of a few million per second, and cannot be heard. If a telephone is arranged in the ordinary way the sound waves are transmitted into electric energy. Thousands of oscillations of the wireless wave occur during the time that a sound wave lasts. If the wireless wave is allowed to act on a multitude of electrons in a vacuum tube the intensity of the wireless waves can be controlled by every tone, sibilant, and ripple in the human voice by having the voice current in the telephone circuit control the number of electrons emitted. The radiation into the ether is thus graduated in intensity in the same manner and when it is received by a distant station and the

waves conducted to another vacuum tube containing a hot wire giving off electrons, they will respond to all the modulations of the incoming oscillation and when employed in connection with a telephone receiver will reproduce the tones of the distant voice.

The wireless field is only one field of usefulness of these amiable particles. The field is constantly broadening. They have not entered the field of the transmission and distribution of power. The vacuum tube rectifier used in the garage is an example. The latest application of control of these infinitesimal particles is by the use of a magnetic field formed simply by winding a coil around the vacuum tube and sending a variable electric current through it.

The magnetic field is essentially the electrical engineers' tool. It is expected that the applications of this new device will multiply. Even now it is foreseen that it will replace the large, electric machines used in arc lighting, and the electrolytic lighting arrester used in the large generating stations. Instead of the large rotating electrical machines now used in substations to transform the high voltage alternating current into direct current used on our railways and industries, these stationary devices will do the job more cheaply and easily. Even their use in the home within a few years is probable.

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TWO-THIRDS OF WORLD'S WATER POWER DEVELOPED IN LAST TEN YEARS

(By Science Service)

Two-thirds of the water power now utilized in the world has been developed during the last ten years, Prof. A. H. Gibson of Manchester, England, pointed out at the recent meeting of the British Association for the Advancement of Science.

"The urgent demand for energy to supply the abnormal requirements of the war period, combined with a world shortage of fuel, was responsible for the unprecedented rate of development in most countries with available water-power resources," he declared. "Development was particularly marked in the countries normally dependent on imported fuel." This development was made possible by vast strides of technical development in electric generation and transmission that have taken place recently.

Since 1915 France has put into commission some 850,000 water horse-power, and the country now has 1,600,000 h.p. under control as compared with 750,000 before the war. In Italy schemes totalling about 300,000 h.p. are under way and it is estimated that the total output will shortly amount to 2,000,000 h.p. Japan, which only very recently began to investigate her water powers has since 1916 developed over 1,000,000 h.p., or almost 20 per cent. of her available resources.

In Canada and the United States many large schemes have recently been brought into service, and some extremely large installations are now in course of construction or being projected. In Canada the total development, some 23 million horse power, in 1918 was almost three times as great as in 1910. In the United States the development had increased from something under two million h.p. in 1901 to 5.3 millions in 1908 and to nearly 10.0 millions in 1920.

Water power development results in the conservation of coal and petroleum and will allow their use in the manufacture of iron, steel, cement, and other products that utilize the peculiar chemical properties of these carbon fuels.

Prof. Gibson also pointed out that the use of water power conserves man-power. Each of the 40,000 horse-power units now being installed at Niagara Falls will require for operation only two men per shift. It was estimated that to produce the same power from a series of small factory steam plants, over 800 men would be required, while if the additional labor involved in trucking, wear and tear of roads, railroad tracks and rolling stock were taken into account, the number of men needed would be considerably increased.

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(Editors: These are short paragraphs that can be used as a daily feature, or that will prove useful as fillers.)

DO YOU KNOW THAT -

An international commission keeps records of the advance and retreat of important glaciers in all parts of the world.

Nuts buried by squirrels are a most important means of extending the valuable black walnut groves of this country.

Minnows from the state of Georgia have been introduced into Spain for use in destroying the larvae of the malaria mosquito.

Underground temperature increases with depth at different rates in different parts of the world, ranging all the way from 1 degree Fahrenheit in 20 feet to 1 degree in 170 feet. The average for the world is 1 degree in between 50 and 60 feet.

DO YOU KNOW THAT -

Infanticide is so common in some parts of the New Hebrides and the Solomon Islands that in many families all children are killed and substitutes are purchased at will.

In Bolivia 17 per cent of the towns are more than 13,000 feet above sea level.

The summer resort business is a great industry that is likely to suffer if the pollution of streams and lakes in the northern states does not cease.

The care for a predicted population of 150,000,000 by 1950, it is estimated that 243,000,000 acres of improved farm land must be added to the agricultural resources of the country.

DO YOU KNOW THAT -

The bluest ocean water is found in the Sargasso Sea, where there are very few minute organisms to modify the natural color of the water.

The bull-roarer, used by the aborigines of Australia in religious ceremonies, is a slat of wood attached to a thong. It gives out a loud groaning or "boeing" noise when whirled, and this is alleged to be the voice of a spirit.

A committee of British botanists and horticulturists is preparing to publish a list of all the important pictures of plants of all species that have appeared in scientific literature. It will contain at least 225,000 entries.

Mosquitoes two million years old have been found in the Eocene rocks of Wyoming and Colorado.

DO YOU KNOW THAT -

The redness of the Red Sea is due to masses of certain seaweed.

Two-thirds of all the coal mined in the United States is used for generating power.

A collection of birds stuffed by Theodore Roosevelt, while a student at Harvard, is now owned by the University of Indiana.

Several German astronomical and geophysical institutions asked the Allied Controlling Commission to allow them to use military range finders for scientific purposes, but the treaty of peace conditions required that they be destroyed.

DO YOU KNOW THAT -

More than 99 per cent. of the population of rural Brazil over six years of age is infected with hookworm.

In the Faroe Islands women still use a rude spinning-wheel introduced from Scotland in 1671.

Islands constitute barely seven per cent of the total land area of the earth.

The consumption of water by railroads in this country has increased until it is now about 900,000,000,000 gallons annually, and on many systems a separate organization to operate the water supply is required.

DO YOU KNOW THAT -

Honeycombs made of aluminum, lightly coated with beeswax, have been successfully used by New Zealand apiarists.

Junks blown out to sea from China or Japan have frequently been carried by the Japan Current and the prevailing westerly winds across to the American coast.

The coracle, or skin boat, used by the ancient Britons, framed of wicker-work and covered with hides, still survives on the rivers of Wales and western Ireland, where the fishermen consider it the safest craft for stormy weather.

A remarkable example of the use of sculpture to illustrate scientific facts is the frieze on the exterior of the New Institute of Human Palaeontology, in Paris, carved by Constant Roux. It depicts scenes from the life of primitive humanity; some of the subjects being reconstructions of prehistoric periods while others represent contemporary life among uncivilized people.
