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CHEMICAL ELEMENTS NOT ELEMENTARY;  
FIND CHLORINE ATOMS HAVE DIFFERENT WEIGHTS

(By Science Service)

Chicago, December 10.— The first successful experiments in splitting up<sup>a</sup> chemical element into two weighable portions which have different properties have been made by Prof. William D. Harkins of the Department of Chemistry of the University of Chicago here. He has just presented his results to meetings of both the National Academy of Sciences and the American Physical Society.

"What we have considered elements are not actually elementary," says Prof. Harkins. "For more than a hundred years it has been considered that all of the atoms of a single element are exactly alike. It is now found that most elements consist of two or more, usually not more than seven different kinds of atoms. Each of the species or kinds of atoms which make up a single element is called an 'isotope', which means that it acts exactly like all of the other species of atoms which constitute the same element."

"Thus lead, considered to be an element, is found to consist of isotopes which act almost exactly like ordinary lead, and are only appreciably different in that their atoms are heavier or lighter than the average weight of an atom of ordinary lead. That lead consists of isotopes whose atoms weigh 206, 208, 210, 212, and 214, was first recognized by an English chemist, Soddy, nearly ten years ago, and this was confirmed by the great American chemist Richards, who made extremely accurate determinations of the atomic weights of some of these isotopes."

### Previous Attempts Failures.

"While it was thus considered that the very heavy elements such as lead and radium are mixtures, attempts to separate such elements into their different isotopes all proved failures."

About 1912 Sir J. J. Thomson found accidentally by using what is known as the positive ray method, that the light element neon, one of the very rare gases in the atmosphere, consists of two kinds of isotopes of atomic weight 20 and 22, but he did not seem to feel himself that this was definitely proved. In 1915 when Professor Harkins first decided to attempt to separate an element into parts, he decided that the best element for this purpose was chlorine, another light element. It happens that this element, a greenish, yellow gas, is now best known by the fact that it was the first poison gas used in warfare by the Germans.

Professor Harkins had developed the rule that any element which consisted of only one kind of atoms would have an atomic weight equal almost exactly to a whole number, and this is now known as the "whole number rule." Chlorine, of all of the light elements, had an atomic weight farthest from a whole number, and this seemed to indicate that it contained large percentages of at least two different isotopes, which are more elementary than the element, so-called. What is called the ordinary or chemical atomic weight is simply the average weight of all of the atoms in an element in terms of hydrogen, which is the lightest of all elements. The atomic weight of



hydrogen was formerly taken as equal exactly to unity, but was later set at a number 1.0078, which is only 0.78% greater than unity. This difference has a remarkable significance, which will be mentioned later.

### War Delayed Success

Experiments were begun in 1916 and would have proved successful much earlier than was actually the case if they had not been interrupted by the war. However, in January 1920 Harkins and Brooker had separated about a third of an ounce of chlorine which has an atomic weight different from that of chlorine, and this separation has since been repeated and confirmed by Harkins and Hayes. This is the first definite separation of an element into parts which has ever been demonstrated.

"Though the elements are almost all mixtures, the percentage composition of the mixture has thus far been found to be the same no matter where the element is found upon the surface of the earth," says Professor Harkins. "To explain this fact the English physicist Aston advances the hypothesis that these elements have been thoroughly mixed in the sea. However, that this cannot be the true explanation is seen when it is considered that the element nickel, consisting of two isotopes of atomic weight 58 and 60, has the same average or chemical atomic weight in the meteorites (58.68) as it has on earth, or the mixture has just the same composition in both, as found by the American chemist Baxter." This indicates either that the material of the earth and that of the meteorites must at one time have been very thoroughly mixed together, or that these are just the proportions in which the atoms were formed when they were built up from hydrogen. Probably, however, both the original proportion in which the atoms were made, and a considerable mixing afterward in the gaseous state, have given the final constancy in the proportions observed. It is not improbable that this constancy of proportions may be found to fail in some cases. The final studying out of this problem is of importance to those interested in the past history of the earth."

### All Atoms Made of Hydrogen

The atoms are compounds of hydrogen. Four atoms of hydrogen first unite to form one atom of helium, which has a mass 0.78% less than the 4 atoms of hydrogen. These atoms of helium in turn unite together, sometimes including some extra hydrogen atoms to form the heavier atoms. The energy developed due to the above mentioned loss of mass when one pound of hydrogen, which costs only a few cents, turns into helium, would be sufficient to heat a large modern residence for more than a hundred years. Six years ago Prof. Harkins pointed this out as a possible future solution of the coal problem.

### NEWS OF THE STARS

#### We Get Nearer the Sun as Winter Comes

By Isabel M. Lewis  
of the U. S. Naval Observatory  
(Science Service)

When winter begins in the northern hemisphere on December 22, at 4:08 a.m., Eastern Standard Time, we will be three million miles nearer to the sun than we were at the beginning of summer last June. The earth reaches perihelion, the point in its orbit nearest the sun, on January 3. It will then be about 91,346,000 miles from the sun. It was in aphelion, the point in its orbit farthest from the sun, on July 4th and its distance from the sun was then about 94,346,000 miles. The mean average distance of the earth from the sun is about 92,897,000 miles so the least and greatest distance differ about 1,500,000 miles from the mean.

As our seasonal changes depend far more upon the constantly changing angle at which the sun's rays strike the surface, caused by the tilt of the earth's axis to the plane of its orbit, than upon comparatively small changes in the distance of the earth from the sun we feel no great effect from this change in distance.



Our winter begins when the sun reaches its greatest distance south of the equator. This time can be computed to the minute and it never varies much over a day from year to year. At that time the sun passes at noon through the zenith of all points in 23 degrees 27 minutes South Latitude, and summer begins in the southern hemisphere at the same instant that winter begins in the northern hemisphere. The sun then starts its northward journey and crosses the equator once more at the beginning of spring.

Since the summer of the southern hemisphere occurs when the earth is nearest the sun and the winter when it is farthest from the sun we would naturally expect to find the summers in the southern hemisphere hotter than our summers and the winters colder than our winters. But the earth is moving most rapidly when it is nearest the sun and most slowly when it is farthest from the sun. As a result the summer of the southern hemisphere is about seven days shorter than our summer and while the heat of the summer is somewhat more intense in the southern hemisphere it is received for a shorter period, As a result there is very little difference in the total amount of heat received during the summer season in the two hemispheres.

The winters of the southern hemisphere are both longer and colder than the winters of the northern hemisphere as they occur when the earth is farthest from the sun and is, at the same time, moving most slowly in its orbit. In about ten thousand years these conditions will be reversed owing to certain slow changes not taking place in the form and position of the earth's orbit. The winters in our hemisphere will then be longer and colder than the winters of the southern hemisphere.

Some geologists go so far as to say that the glacial periods are caused by this alternation in the relative intensity of winter in the two hemispheres. It is certainly true that at the present time the south polar cap extends farther into the temperate zone than the north polar cap.

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#### HELIUM DIRIGIBLE SAILS BETTER, AS WELL AS SAFER, THAN HYDROGEN-FILLED SHIPS

(By Science Service)

Washington, December 20.-- A helium-filled dirigible, in addition to being non-inflammable, is easier to handle in the air. This was discovered in the recent flights over Washington of the C-7, a Navy dirigible built for hydrogen but filled with helium.

This first practical test of helium as a balloon gas on a large scale also demonstrated the superiority of the United States over every other nation in lighter-than-air craft resources. The United States is the only nation that can produce sufficient amounts of helium gas to take care of all of its army and navy needs and have a considerable amount left over for commercial purposes, according to Dr. R. B. Moore, chief chemist of the Bureau of Mines who has directed the work of developing helium gas recovery from the natural gas wells of the country.

Lt. Commander Wood, who piloted the C-7, declared that the helium-filled ship is steadier and moves with greater momentum than any hydrogen-filled airship with which he has had experience.

Paradoxical though it may seem, the helium gas, twice as heavy as hydrogen with 92 % of its lifting power, acts, in an airship, just as a heavy automobile on a road at high speed, in comparison with a light car. Wind currents do not deflect it easily from its path and after it gets under way it travels more smoothly.

In hydrogen-filled ships, it has been necessary, in descending, to let part of the gas escape, after a long trip, to make up for the loss in weight of the fuel which has escaped after being burned in the engine. With the helium ship, its weight is sufficient so that by nosing the ship downward, the propeller will pull it to the ground.

Dirigibles, in flying, pick up static electricity from the atmosphere. With



hydrogen ships there was always danger, in landing, since when the ship touched the ground an electric spark of considerable power resulted. If this spark touched the envelope, fire and an explosion was extremely likely to result. Helium, being absolutely non-inflammable, does away with this danger.

While it is not known how many helium-bearing natural gas deposits there are in Mexico, the wells developed in the United States give off sufficient amounts to take care of all military and naval needs and other possibilities of a considerable commercial development. Dr. Moore asserts that present known sources are sufficient to take care of the urgent needs of the United States for 25 years.

"In a properly designed ship," he said, "the loss of helium is one percent per flying day. In such a ship, the vapors from the gasoline or Diesel engines, which will be used eventually, will be condensed, and thus saved for ballast. It is an interesting fact that the water procured by condensation is almost as heavy as gasoline before it is burned in the engine."

Dr. Moore said that the helium used in the C-7 was shipped from Texas plants in nearly 1,000 cylinders, each containing 200 cubic feet of the gas, compressed.

The tremendous value of helium for use in dirigibles was made apparent during the war. British scientists made endeavors to find a sufficient supply to enable them to use it in their ships. The supply, however, was limited to very small amounts obtained from mineral wells which give off gases containing helium, and from minerals. These sources were woefully insufficient.

In February, 1917, Sir William Ramsay wrote to Dr. Moore concerning work done in the Bureau of Mines. In June of the same year, the War and Navy Departments made funds available for obtaining supplies of helium from sources in the United States. Since that time, great progress has been made.

In the laboratories in the Department of the Interior Building practically all of the research work has been done. The Bureau now has three plants -- two at Fort Worth, Texas, and one at Petrolia, Texas. The latter is the most productive.

At the time the armistice was signed 147,000 cubic feet of helium was on the docks ready for shipment to Europe.

Sir William Ramsay is acknowledged the discoverer of helium in 1894. His discovery was accidental, and was based upon certain findings of Dr. W. F. Hillebrand, of the U. S. Geological Survey, in 1888, connected with a study of gases from certain minerals containing uranium. Its presence on the sun was discovered by astronomers more than 50 years ago.

Up to the time of the war less than 100 cubic feet of the gas had been captured and stored. It was worth about \$1700 per cubic foot.

At the plant in Petrolia, Texas, Dr. Moore says it can be produced for about 7 cents per cubic foot at present. Eventually, he says, it would be possible to produce it at about two or three cents per cubic foot. The capacity of the Petrolia plant is about 40,000 cubic feet of 92 per cent pure helium per day. The government has spent about \$7,000,000 so far in its research work, building plants and producing helium.

For the cost of one modern battleship the Government could build six helium airships, each as large as the ill-fated ZR-2, pay for the work that has been done, and still have some money left over, Dr. Moore says.

The amount of helium obtained from the natural gas wells at Petrolia is 0.93 per cent of the raw gas. The volume of raw gas from these wells is so great, however, that it was wise to build a plant there rather than at a smaller well which gave off a higher per cent of helium. There are a few wells on the continent that give off as much as one and one-half per cent.

The process consists of liquifying all the gas present except the helium. The principal work of perfecting condensers and other machines used in the process has been done in the cryogenic laboratory located in the Department of the Interior building here.

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(Editors: The next article of this series will tell how the climate of the Pacific area affects the people and their activities.)

#### WORLD PROBLEMS OF THE PACIFIC

#### 4. The Population of the Pacific

By W. E. Allen  
of the Scripps Institution for Biological  
Research, University of California

(Science Service)

The great populations of China and Japan, one-fourth of the people on earth, are concentrated in a part of the Pacific area that amounts to only about one-twelfth of the total land surface of the earth.

One-fifth of the land of this earth drains into the Pacific Ocean, which occupies about one-fourth of the earth's surface and is greater than the total of all land area.

The Chinese and Japanese occupy a territory most favorable as to geographical position, climatic features and natural productiveness. The placidity of the Yellow race has done much to keep it within such rigid bounds, but the wide expanse of ocean to the east, the mountain barriers to the west, the mountain, desert and climatic barriers to the north and somewhat similar barriers, combined with opposition from other peoples to the south, has done even more.

For centuries the extremely prolific Yellow men had been-for lack of knowledge or opportunity - content to live from hand to mouth and to die unprotestingly like flies from flood, famine and pestilence. Then came the restless White men who, for reasons of their own, forced upon the Yellow peoples new vistas of lands of ease, comfort and, to the Oriental view, fabulous wealth and opportunity. The Mongolians then became acquainted with the occidental steamship and railroad that would take him to the wonderful new lands.

But before the Yellow man could develop his own means of transportation and arrange his own program of territorial expansion, the White man had firmly established himself in all of the Pacific areas which offered opportunity for exploitation or development. The White man had also found that his own interest, if not his very existence, required that the Yellow man should be kept from indiscriminate wandering and should be encouraged to stay within very definite bounds.

At the same time all peoples of the earth were learning new ways of prolonging life while few of them were learning to restrict propagation. As a consequence the Yellow race is finding endurance increasingly difficult. It is looking anxiously about for means of relief.

The first places toward which their eyes turn are along the borders of the great ocean upon which their home lands lie. Everywhere they see comparative ease and security, if not satiety, of life. Most other countries possess a great deal of fertile land which is either not used at all or not used effectively.

How is the Yellow man received in these lands of promise?

Certain groups of Chinese can thrive in the tropics and they are actually making headway there, in many cases displacing the natives. Australia and New Zealand insist emphatically that their territories are for the White race only although they still have some room and resources to spare. Canada takes the same view as Australia though her territory is not quite so desirable to the Oriental view. The western coast of the United States is the most desirable to both Chinese and Japanese of any land outside of their own in the Pacific region, but it is already occupied by White people who look with jealous eye upon settlers from other races. The uncrowded territories between California and Cape Horn with their less aggressive and influential White inhabitants and their quiescent Red population present some possibilities for occupancy by Yellow peoples. But it is distinctly to the interest of the people of the White race to prevent over population or adverse population in the regions where they themselves have any foothold.

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# LEAGUE OF NATIONS CONSIDERS CO-ORDINATION OF INTELLECTUAL WORK

(By Science Service)

Washington, December 00.- International coordination of intellectual work will be considered at the next assembly of the League of Nations, according to information received here. The official League statement has declared that "the need for the exchange of scientific information and a closer coordination in the field of intellectual activity is greater than before", and a committee of twelve members, both men and women, of the present Council of the International Organization of Intellectual Work, has been asked to consider the project.

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## FINDS METEORITE CHASING A FRUITLESS TASK

(By Science Service)

Washington, December 00.- Do not think that you can tell where a meteorite falls unless you actually see it strike the ground. This is the advice given by Dr. George P. Merrill of the U. S. National Museum who has been following up numerous recent reports of falling meteorites with practically negative results.

Meteorites fall so suddenly, with great speed, and from great heights, so that it is almost always impossible to follow them. Dr. Merrill gives this account of his meteorite chasing:

Some two years ago a meteor passed over Washington and was seen by a large number of people. One man, at the time some 80 miles south of Washington, saw it fall within a half mile of where he was standing. He was certain he could go to the spot and find it. But, the meteor was also seen traveling northward by people in Washington. One party saw it fall on the roof of a neighboring apartment house and collected fragments of it and sent them to the National Museum. They proved to be fragments of the asphaltic roofing material. Another party in Chevy Chase, Md, saw it fall and likewise collected fragments, which proved to be road material. Still another farther north-east saw it strike in the notch of a tree and sent pieces of bottle glass that had evidently come from a furnace along with other clinkers. Noting the direction in which the meteor was travelling, Dr. Merrill wrote to several postmasters in the towns over which it was likely to pass and actually chased it up into northeastern Pennsylvania, a distance of over 300 miles from the point where it was first seen to fall, and it was still going!

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## LARGE INTERNATIONAL SCIENTIFIC MEETING, AT TORONTO, DECEMBER 27-31

(By Science Service)

Toronto, Canada, December 00.- Canadian and American scientists will join in their largest scientific meeting of the year when the American Association for the Advancement of Science, with twenty-two closely related scientific societies, meet here during the Christmas holidays, December 27 to 31.

On the programs of the various sessions, there will be papers by hundreds of scientists telling of their latest work in mathematics, astronomy, physics, chemistry, engineering, geology, geography, zoology, botany, anthropology, psychology, social and economic science, physiology and experimental medicine, education and agriculture. The meetings will be held in the buildings of the University of Toronto.

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DO YOU KNOW THAT -

Industrial smokes and dusts not only injure vegetation directly but often affect the soils of the region.

Odors from the Lake Island garbage plant, formerly operated near New York City, were seriously offensive at a distance of 8 miles. The smells were generally much stronger by night than by day.

Methane in sewage gas is being used experimentally to run the sewage pumping engines in Birmingham, England

The ancient Lake Bonneville, of which the present Great Salt Lake is a small remnant, covered an area of 17,000 square miles and was 1,000 feet deep in places.

DO YOU KNOW THAT -

Toy balloons filled with hydrogen are inflammable and explosive and have been the cause of several accidents to children.

Most of the world's supply of cryolite, an important source of aluminum and also used in making soda and glass, comes from Greenland. The mines are located at Ivigtut, on the southwest coast, exporting 6,000 to 12,000 tons a year, the bulk of which is shipped to Philadelphia.

During the war 15,000 carrier pigeons were trained by the U. S. Signal Corps for service in France, and the pigeons delivered safely more than 95 per cent of the messages entrusted to them.

A few water hyacinths shown at an exposition in New Orleans some years ago led to the introduction of this plant, which soon became a formidable pest in Louisiana and Florida, clogging the rivers and in many cases suspending navigation completely during the summer months. Now an effective means of destroying the plant appears to have been found by spraying the hyacinths with live steam.

DO YOU KNOW THAT -

Writing in 1909, the late Lord Avebury (Sir John Lubbock) illustrated the rapid progress of applied science by the statement that he was "older than any railway company in the world, any gas company, any steamboat company, any telegraph, telephone or electric company."

The terms "benzene" and "benzine", often, but not always pronounced alike, are applied to totally different substances. To add to the confusion, benzene, the foundation of the coal-tar dyes, was originally called benzine, and now often called benzol.

Portland cement was named because, when mixed with water in proper proportions, it sets or hardens into a mass resembling natural stone quarried at Portland, England.

Zinc and copper salts may be efficient in destroying weeds shortly after germination, tests made at Savenac nursery, Haugan, Montana, indicate.



DO YOU KNOW THAT -

Olive, cottonseed and almond oils can be sterilized by a relatively short exposure to ultra-violet light.

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A motion picture film on the subject of the Einstein theory of relativity has been produced in Germany.

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The practical money value of Pasteur's scientific discoveries in saving the grape crop of France was sufficient to cover the entire indemnity paid by France to Germany after the Franco-Prussian War.

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The oldest record of weather observations now extant was kept by William Merle, first at Oxford and afterward at Driby, England, during the years 1337-1344.

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DO YOU KNOW THAT -

Thousands of almanacs have published "Herschel's Weather Table" for predicting the weather from the time of day the moon "charges". This table is sheer nonsense and the astronomers whose name it bears had nothing to do with concocting it.

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More than 100,000 square miles of the United States consists of swamps, bogs or inundated land. Most of this now nearly useless land could be drained and made available for agriculture.

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There are more than 7,000 species of mammals.

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A commercial pilot in England probably holds the world's record for the number of passengers carried. He recently carried his 10,000th, and one small machine has transported 8000 of these passengers.

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DO YOU KNOW THAT -

The Eskimos did not choose their far northern home because they were fond of a cold climate. Not being of a warlike nature, they gradually worked as far north as human beings can exist in order to escape the raids of the more warlike Indian tribes.

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Formerly the bases and sockets of incandescent lamps were made in hundreds of different sizes. At the present time, four sizes of base fit every socket in America, apart from lamps used on automobiles.

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In some parts of the North Atlantic a quart of sea water contains from 3,000 to 13,000 microscopic organisms, collectively known as "plankton."

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The average height of all lands of the globe above sea-level is about 2,400 feet.

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