ISOTOPICS

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COVER: Meteorologist, Philip H. Lowry, checking the weather map on a light table. (See Group Profile on pages 4 and 5.)

The Cloud Chamber

This is the third of a series of articles written for the layman, explaining some of the technical programs of the Laboratory and the meaning of the various terms used.

For weeks a large hole yawned from the Rochester Street side of the building at 51 Brookhaven Avenue. Truck-load after truck load of concrete, 24 in all, was poured into the opening to form a foundation 8 feet thick. On this pad will rest one of the most useful instruments of nuclear science, an enormous high pressure cloud chamber weighing many tons which was designed by Dr. Thomas H. Johnson, chairman of our Physics Department, and Dr. Ralph P. Shutt, of the Particle Physics Division. This will be the largest cloud chamber with the highest pressure of any in existence.

A cloud chamber, the invention of Dr. C. T. R. Wilson, an English scientist, is one of the simplest of the tools of nuclear research. In operation it takes advantage of the law of nature that when warm moisture-laden air expands it cools and the water vapor it contains condenses to form a cloud. In just this way warm air from a valley sweeping up the side of a mountain range forms clouds when it cools by expansion under the lower pressure of the higher altitude.

The interesting property of the cloud formed in a cloud chamber, on the other hand, is the fact that the water droplets form upon ions left in the path of a charged particle. (Ions are electrified particles formed when a neutral atom loses or gains one or more electrons.)

In the cloud chamber a mixture of gas and vapor, rendered as dust-free as possible, is compressed by the action of a piston or a diaphragm, just as the mixture of gasoline and air is compressed in the combustion chamber of an automobile. When the pressure in the chamber is instantaneously reduced by the opening of a valve, the cooling action that accompanies the lowering in pressure causes a mist to form. Electrically charged particles, from any source moving through the mixture produce a large number of ions along their tracks, upon which tiny droplets of water condense. At this instant a bright light is flashed and the path of each particle is recorded on a photographic plate.

When the chamber is placed between the poles of a very strong electromagnet, the tracks become curved in an arc. Scientists can learn much about the nature of the particle that caused a particular track from a study of this curvature. For example, a particle of low energy will trace a sharply curved path, while the path of a high energy particle will be nearly straight. Negatively charged particles in a magnetic field follow a course exactly opposite to the paths taken by positively charged particles.

The small cloud chamber on display as a part of the Laboratory's Nuclear Energy Exhibit depends upon particles emitted by a small amount of polonium to produce the paths that are visible to the observer. The big cloud chamber to be installed at 51 Brookhaven Avenue will contain argon or helium gas and until the cosmotron is completed, will depend upon cosmic rays to produce the paths. It was designed to obtain further information about the meson, one of the particles found among these rays of extremely high velocity and penetrating power that continuously bombard the earth. It is thought that they have their origin beyond the earth's atmosphere and may be produced by changes in the form of atoms that are taking place continuously in inter-stellar space.

Dr. Johnson, who has pioneered in the design and use of high-pressure cloud chambers, states that in an ordinary low-pressure chamber operating 12 hours a day the possibility of obtaining demonstrations of the rare cosmic ray phenomena, such as the splitting of mesons into other particles, which happens at the end of their range, would occur only about once a year because the rays are of such high velocity that they pass right through the average chamber. (The meson is one of the newest of the nuclear particles to be identified. Their existence was first suspected by the Japanese scientist, Yukava, and subsequently they were discovered in the cosmic rays by Dr. Carl Anderson, Nobelist from California. Too little is known about mesons, but it is thought that they produce the forces which hold nuclear particles together.)

Brookhaven's new cloud chamber will operate under a pressure of 4500-lbs. per square inch, making it the equivalent of approximately 300 ordinary chambers. The high pressure will slow down the rays so that splitting of more mesons will take place within the chamber. It is expected this may occur almost daily and that in a few months of operation it will furnish information to answer many of the questions regarding cosmic rays which now puzzle the physicists.

The steel yoke which will hold the chamber together under the extremely high internal pressure will weigh about 120,000 pounds and will act as the path for the magnetic field. It will be tied together at its four corners by four huge bolts and nuts, each weighing about 1,000 pounds. Four coils, each weighing three tons, will be energized by the current from four Diesel electric generators to form the magnetic field. The tracks in the chamber will not be observed visually but a pair of stereoscopic cameras will produce a three-dimensional image of the tracks, and the resulting photographs will then be studied by the physicists.

Many important discoveries in nuclear and atomic physics have been made with cloud chambers. Photographs of cloud chamber tracks have revealed the existence and characteristics of various particles that make up an atom. When the Laboratory's high-pressure cloud chamber is in operation in 1949, the physicists expect to obtain further information about mesons and the part that they play in nuclear energy.

REPRODUCTION of a photograph taken in a high-pressure cloud chamber. The heavier line starting near the top is a meson being slowed down by the gas in the chamber. The thin track running to the right from the end of the meson track is an electron of high energy created when the meson disintegrated.

Lorraine B. Kostuk

STAFF PROFILE

Mrs. Lorraine Bowditch Kostuk, secretary to Dr. Thomas H. Johnson, Chairman of the Physics Department, has the honor of being one of the few members of the staff who have been with the Laboratory since its early days. When Lorraine was employed in November, 1946, as secretary to Dr. Norman F. Ramsey, acting chairman of the Physics Department, there were only four other staff members in that department.

Lorraine was born in Center Moriches, N.Y. She graduated from Center Moriches High School and then attended Washington School for Secretaries in New York City. Her first employment was with the National Economy League and she left there to accept a position as secretary to the Director of the Academy of Political Science at Columbia University.

An accomplished violinist, Lorraine was concert master for the Center Moriches High School Orchestra, and after graduation was a member of a double string quartet in Patchogue. In October, 1947, Lorraine married Victor Kostuk, a resident of Eastport.

An ardent swimming fan, Lorraine spends most of her spare time at the seashore, although she also enjoys tennis, sailing and bowling.

Robert A. McCleary

STAFF PROFILE

The responsibility of trying to provide motor transportation for staff members rests lightly on the shoulders of Robert A. McCleary, supervisor of the Motor Pool Section. Several years experience in the same position while he was in the Army accustomed him to the many problems that arise. Now, with nineteen drivers and 159 vehicles under his supervision, Robert capably handles his daily task of allocating cars and drivers to fill the most urgent requirements.

Robert was born in Ayre, England, in 1919. When he was nine months old his family came to America and settled in Chicago. He graduated from High School in 1936 and entered the employ of the Standard Oil Company. He enlisted in the Army in 1940 and within two months was promoted to 1st Sergeant. When war was declared he was sent to the South Pacific and spent two years in Guadalcanal.

In 1944 Robert returned to the United States and was assigned to Camp Upton. In 1945 he was placed in charge of rail and motor transport. On September 26, 1945, when he was discharged from the Army, he was immediately hired as a civilian employee with the same duties. He retained his motor pool responsibilities through the changes that preceded the establishment of the Laboratory on the site.

Robert and his wife, Antoinette, live on Country Club Road in Bellport. He is Secretary of the Bellport Fire Department and Quartermaster of the South Bay Post of the Veterans of Foreign Wars.

STAFF PROFILE

Six years of service in the Marines, most of the time in the South Pacific, should cure anyone of a liking for camping out. William E. Evans, administrative aide to Thomas F. Sheridan, is the exception. His hobby is still camping. He takes advantage of every opportunity to spend a few days in the Ramapo Mountains with two companions who are students of Forestry.

Bill acts as a trouble-shooter for Mr. Sheridan and his duties require him to make frequent calls on the various groups in the Technical Services Division (to the delight of the feminine staff members).

Bill was born in Wilkesbarre, Pa., and graduated from Trinity School in New York City. He entered Columbia University in 1938 and graduated in 1946 with a degree of B.A. after an interlude of four years of active service in the Marine Corps. Enlisting in the Marine Reserves in 1940 he was called to active duty in 1942 and sent to the South Pacific. As lieutenant in an Amphibian Tractor Company he took part in the assault on numerous islands including Guadalcanal.

In 1946, when he was discharged from the Marines he had attained the rank of Captain.

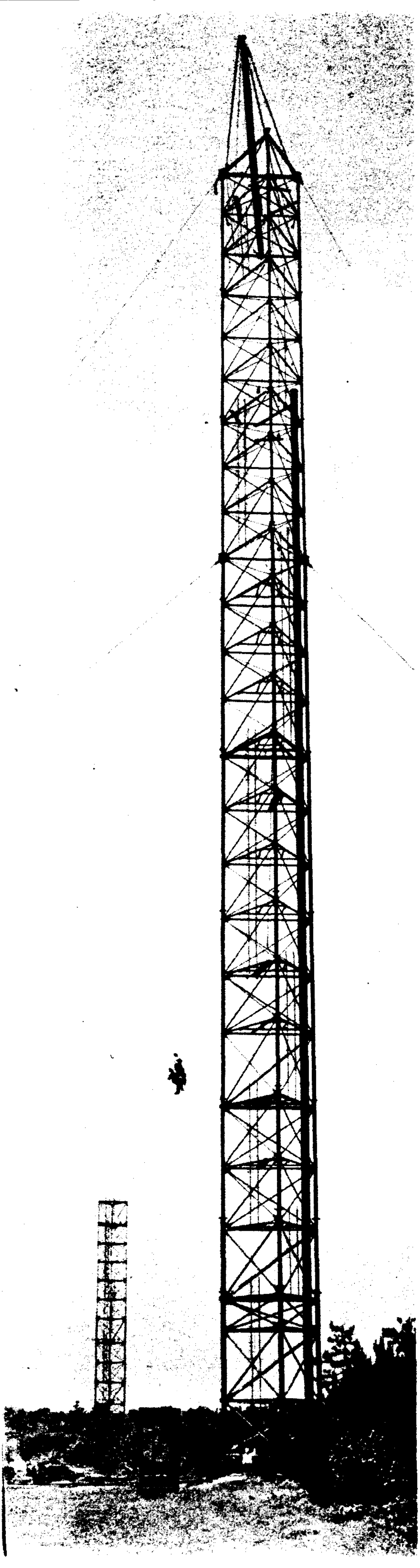
Bill lives in the Laboratory Dormitory and on week-ends travels to his home in New York City, near the Yankee Stadium, or goes on a camping trip. He made all of his camping equipment, including sleeping bags, pack frames and tents.

Bill states that he has no immediate matrimonial intentions but it is probable that the weekly trips are not made only to visit his mother or to sleep under the stars.

In addition to his liking for camping, Bill enjoys most outdoor sports. He is a member of the Men's Dormitory Bowling Team, the Rifle and Pistol Club, and is a frequent visitor to the swimming pool.

William E. Evans

***BOARD OF TRUSTEES** of the Brookhaven Employee's Recreation Association (L. to R.) Jake ten Hove, Architectural Planning; Thomas A. Newham, Fire Department; George L. Davison, Material Control; Budd S. Pollock-President, Electronics; Annette Zingale, Stenographer; Richard L. Vogt, Recreational Supervisor; Kay E. Boysen, Director's Office; Robert Brouwer-Treasurer, Fiscal; Trustees C.G. Yax, AEC, and Bernard Manowitz, Nuclear Reactor, were absent when this photograph was taken.*



Meteorology Group Profile

The reporter for the Hartford (Conn.) "Courant" who wrote, "Everybody talks about the weather but nobody does anything about it" had no idea that anything ever would be done. Since that time rain and snow storms have been artificially brought on, but the main concern of most meteorologists is what the weather is going to do.

The Laboratory Meteorology Group, headed by Norman R. Beers, is interested mainly in micrometeorology; that is, weather on a small scale, which has been facetiously called the study of a "tempest in a teapot." While many meteorologists devote themselves exclusively to the weather of the world and of the continents, the Laboratory group also studies carefully the weather in the area within their chosen "teapot", a circle within about a 12-mile radius of the Laboratory site. When their plan is in full operation they will have a micronet of 10 surface weather stations, 4 on the site and the others located in various spots from the Sound to the shore of the Great South Bay.

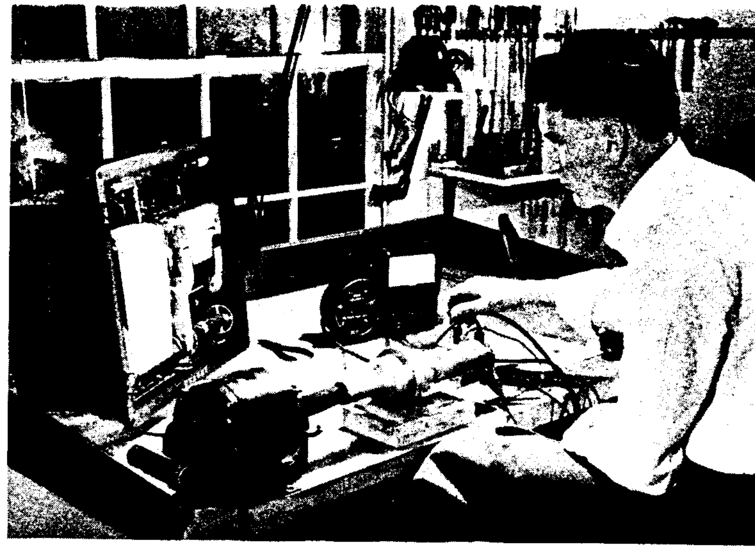
The U.S. Weather Bureau has established a special station here under the direction of Raymond C. Wanta, to cooperate in the Laboratory's research program, to train additional personnel for similar work at other installations, and to carry on research.

In the field east of the Meteorology building on Pascal Place are several small structures and a 75-foot weather pole. Wind vanes, anemometers (wind speed indicators) and electrical temperature gauges jut from the pole at various levels. The wind direction and speed, and the temperature of the air are recorded electrically inside the building, but to measure the rain or snowfall, a technician must examine one of the small can-shaped receptacles on the ground near the weather pole.

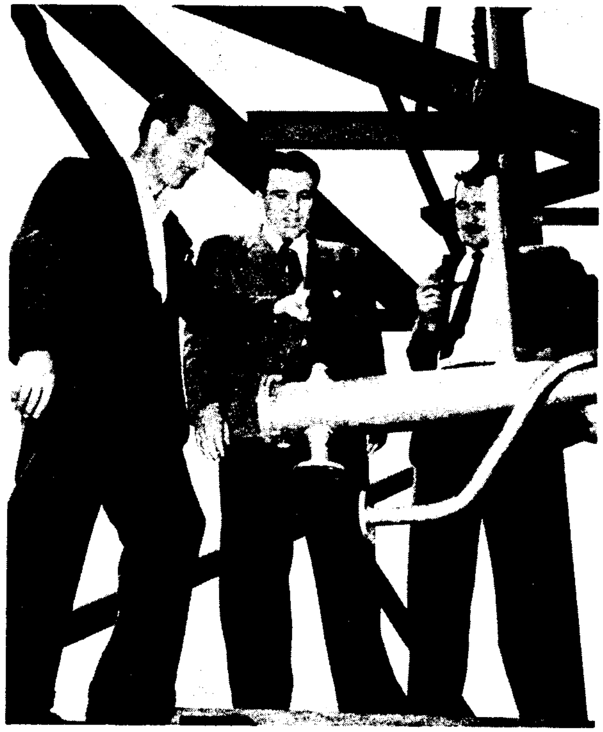
The man who may be seen daily in the field is not idly swinging a keychain as he surveys the surrounding landscape. He is, in the jargon of the weatherman, "slinging a wet bulb thermometer." An ordinary thermometer with the mercury bulb wrapped in a wick saturated with clean water is swung on the end of a short chain. The air passing the bulb and wick cools the mercury by evaporation and the reading taken when the operation has been completed helps the technicians to determine the humidity.

Dry and wet bulb readings are also taken high in the air above the Laboratory by a technician in an airplane that makes two flights a day over the Laboratory in good flying weather. Wind direction and speed in the upper levels are measured by tracing the course of 30" helium-filled balloons which are released twice daily. A technician watches their flight through a theodolite housed in the small building with adjustable sides that stands near the weather pole. (cont.on p.8)

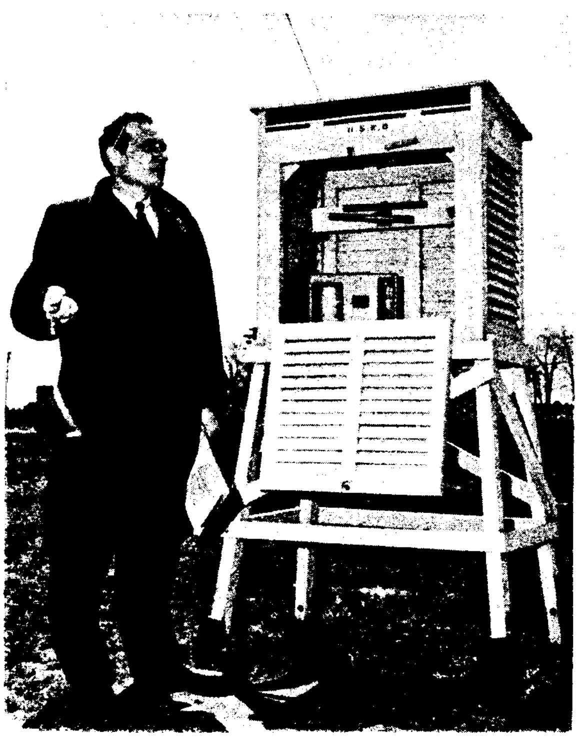
Daniel A. Mazzarella and Herman F. Bohnhorst analyzing and plotting weather reports.



Roger A. Syler testing a wind r corder and indicator.



William G. Matjan, representative of the Design Engineers; Norman R. Beers, head of the Meteorology Group and Raymond Wanta, head of the local U.S. Weather Bureau Station, examining tower mounts for wind and temperature instruments.



Frederick E. Bartlet "slinging a wet bulb thermometer" and studying cloud types.

Frank G. Scott releasing a pil balloon to observe upper air cu rents.

METEOROLOGY GROUP PROFILE (cont., from page 4)

On the second floor of the weather building, technicians plot and draw weather maps. These are the basis for the reports posted daily on the Laboratory bulletin boards. To aid them in their forecasts, reports of weather conditions from points all over the world and from ships at sea are received by teletype.

The steel tower, 420 feet in height, in the field near the new Meteorological building will carry instruments similar to those on the weather pole. In addition, it will support a 20" steel pipe, 350 feet high. From this pipe a white "bil-fog" smoke will be released at frequent intervals. Study of the course taken by the smoke after it leaves the pipe will enable the meteorologists to trace the paths of wind currents in the Laboratory area.

A smaller tower, 160 feet high, in addition to carrying weather instruments will also serve as an anchor for two cables connected at the further end, 900 feet away, to the high tower, at approximately 100 feet above the ground. These cables will carry a trolley from which meteorological instruments will be swung so that readings may be taken at any point between towers.

Meteorologists will visit the top of the high tower at stated intervals to check instruments and make general weather surveys. They will not travel up on a "hook" as the steel workers did, but in a small elevator.

Whether the members of the Meteorology and Weather Bureau crews are taking their twice-daily dry and wet bulb readings high in the air in a plane above the Laboratory, tracing through the theodolite the course of helium-filled balloons, interpreting the clatter of the teletypes which talk of weather from points all over the world and from ships at sea, or painstakingly plotting and drawing their maps, the Laboratory weather man, like the weather itself, observes no holidays, attends to his instruments continuously, and no minute of the night or day finds his work shop closed.

STAFF PROFILE

Karl H. Walther

Making anything out of glass, from an odd-shaped test tube to an oil or mercury diffusion pump, is all in the day's work for Karl H. Walther, technical specialist in charge of the Glass Blowing Shop. Since he started to work for E. Machlett in 1936 he has been steadily engaged in the glass blowing trade and is thoroughly equipped to produce anything in the glass line.

Karl was born in Germany and came to America with his parents in 1929. He graduated from the High School of Commerce in New York City and attended night school at Columbia for two years studying chemistry and psychology.

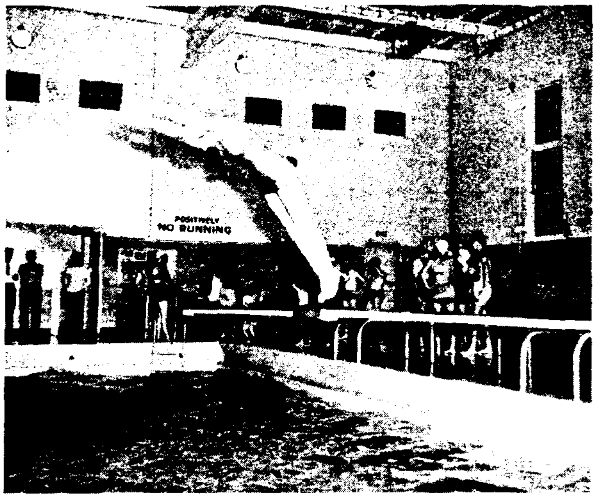
During the war he was employed as a glass blower in the Physics Section of the Manhattan Project. He entered the employ of the Laboratory in May, 1947, and spent his first few months here ordering equipment and organizing the shop which he now heads.

Karl is married and lives in Coram, N.Y. He has two children, Peter, 4, and Carol, 18 months old. His hobby is photography but he says he finds little time for it. Some of his spare time is spent in keeping four year old Peter out of the glass blowing shop in the cellar of his home. Peter may some day take up glass blowing, according to Karl, but at present he is more interested in breaking it.

ISOTOPE SO

Men of atoms all remind us
We may make our world sublime
Or, exploding, leave behind us,
Meteors in space and time.

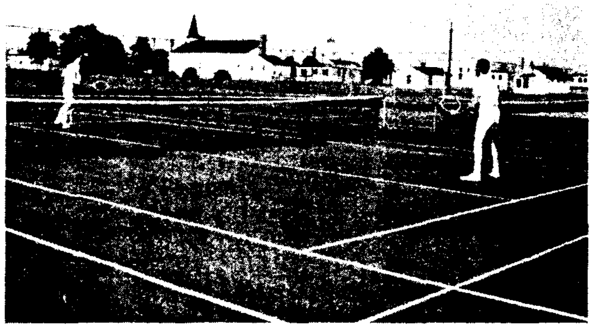
(D.K.Bruner-Sat.Evening Post)



They swam at the Swim-Dance on July 14th. While others watch, Miss Alice M. Gewehr, Mr. Rens Schirmer's secretary, displays perfect form as she leaves the springboard.

They also danced on July 14th. Photograph of a section of the floor shows a few of the dancers merrily tripping the light fantastic.

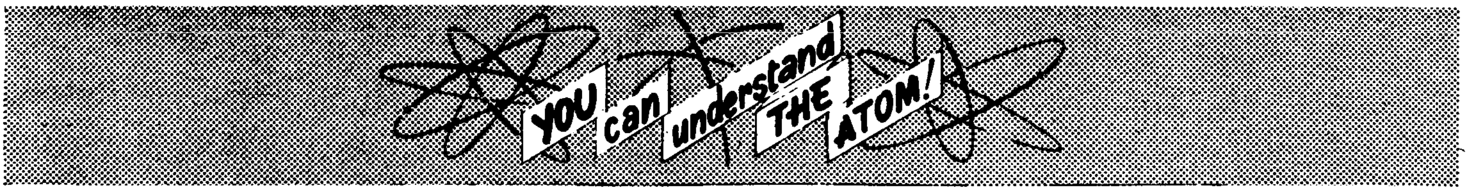
Sport Shots



Action photo of Dr. Karl Drew Hartzell (in far court) as he defeated Dr. Marvin Fox 6-2, 6-4 to win the first BNL tennis championship.

Robert T. McKee, Men's Dormitory team, gets set to take a cut at the ball as Stephen M. Takats, Fire Department team, prepares to catch it. Umpiring--Roy Churbuck, Fire Department. Men's Dormitory won 9 to 8.

Spike" Chamberlain, Photography, who staggered around the course to amass a score of 125, tries to put the "whammy" (1948 for jinx) on Tommy Marrion as he scored 76 to win the June BNL golf tournament.



This is the fourth of a series of articles on atomic energy, written by R.J. Blakely, which were printed on the editorial page of the Des Moines Sunday Register.

The chemical properties of elements are determined by the electrons in their atoms. Elements of different chemical properties in compounds can be separated from each other by chemical means--boiling, solution, etc. Elements which have the same chemical properties cannot be separated from each other by chemical means.

The atomic weights of elements are determined by the weights of the nuclei of their atoms, one part of which is the proton. There were several puzzles to solve concerning the relationships between chemical properties and atomic weights.

One puzzle was that two elements were discovered--ionium and thorium--which have the same chemical properties but different atomic weights. Another puzzle was that three types of lead were discovered with different atomic weights. Both are cases of substances which occupy the same place in the Periodic Table (that is, have the same atomic number), and have the same chemical properties, but have different atomic weights. They are the same OUTSIDE the nuclei but different INSIDE the nuclei of their atoms. They are called ISOTOPES (from the Greek words meaning "same" and "place").

Several methods were worked out to separate isotopes of the same element from each other. All are based on the differences in the masses of the nuclei. Three should be kept in mind.

1. **The centrifuge or whirling method.** When liquids or gases of different weights are whirled together, the heavier tends to go to the outside, just as milk does in a separator.

2. **The magnetic method.** When atoms are ionized--that is, caused to flow in an electric current--and when they pass near a magnet, the lighter particles are deflected more than the heavier, in the same way that fine iron filings are deflected more than coarse iron filings. (Incidentally, electromagnetism is one method used to "weigh" electrons, protons, alpha particles and the nuclei of other atoms.)

3. **The gaseous diffusion method.** When gases of different weights are pumped through tiny holes, the molecules made up of light atoms go through faster than the molecules made up of heavy atoms.

By these and other methods it was discovered that all the elements have between one and eight isotopes. In nature the 92 elements have about 250 isotopes.

The lightest element, hydrogen, whose atomic weight is 1, was discovered to have an isotope with an atomic weight of 2. This discovery was so important that the heavy hydrogen isotope was given a special name, DEUTERIUM, and its nucleus was called a DEUTERON (both from the Greek word for "second"). It was important because heavy hydrogen, having the same chemical properties as ordinary hydrogen, can be used in place of ordinary hydrogen in compounds. It produces what is known as HEAVY WATER, which can be traced through human and animal bodies because of its greater weight. The same can be done with other isotopes, notably heavy oxygen. By such "tracing", much can be found out in physiology and other sciences.

For some time scientists had known that there must be something in the nucleus of the atom to account for the differences between its atomic number and its atomic weight. They also knew that this something had to be electrically neutral, because its presence is not expressed in the electric charge of the nucleus. When it was discovered, through the bombardment of beryllium with alpha rays, it was thought at first to be a ray because it was not deflected by magnetism the way protons and electrons are.

However, it travels too slow for a ray and it packs a punch when it hits a particle. Thus it was known to be a particle. And since it is not deflected by magnetism it was known to be neutral electrically. Therefore it was called the NEUTRON.

The only apparent difference between a proton and a neutron is that the proton is charged by one unit of positive electricity. Is the neutron a proton which has captured an electron (which is one unit of negative electricity) and has become neutralized? Or is a proton a neutron which has captured a unit of positive electricity?

A unit of positive electricity the same mass as the electron was discovered. It is named the POSITRON.

The neutron was discovered in 1932. Its discovery completed what we now know about the structure of the nuclei of atoms. The nucleus of an atom is made up of the proton and the neutron. The number of protons in a nucleus determines the number of electrons around the nucleus and it also determines the atomic number of the atom. The number of protons plus the number of neutrons determine the atomic weight of the atom. Two atoms which have the same number of protons but different numbers of neutrons are isotopes of the same element.

From here the story has to do with the splitting of the nuclei of certain atoms to release the unbelievable amount of energy which they contain.