ISOTOPICS

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ISOTOPICS

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COVER: Marshall Bull, Photography and Graphic Arts making a copy of a photograph in the process of preparing a lantern slide. (See Group Profile on pages 6 and 7.)

ELECTRONICS

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

In gathering information about electronics this writer prepared a series of questions defining what the layman would like to know about the subject. The answers furnished by Dr. J.B.H. Kuper, chairman of the Department of Instrumentation and Health Physics, were so clear that we are publishing them with a minimum of editing.

Q. What is, or are, electronics?

A. A great many men who are considered to be leaders in the field of electronics have attempted to write definitions for the word but so far none of these definitions have been found acceptable to any reasonable fraction of the other experts. Although this state of affairs caused uneasiness at first, it was soon realized that there are advantages to being able to define one's field to suit one's self as occasion arises.

The field of instrumentation, which may perhaps be broken down into electronic and mechanical, is not so difficult to define. It is a phase of applied physics--physics applied to the problem of sharpening and extending the scientist's senses. For example, with a microscope, or electron microscope, a scientist can observe objects thousands of times too small to be seen with the naked eye. With various types of servo-mechanisms and recording systems he can amass volumes of statistical data which would otherwise impose a prohibitive load on his time, and with devices such as scaling circuits he can count events occurring at rates too high for him to hear.

Once science progresses past the earliest "string and sealing wax" phases the need for instrumentation of various types seems to grow steadily. Instrumentation, and particularly the electronic phases of it, has always loomed large in nuclear research. In the earliest days radioactive substances were studied indirectly by means of the light they were able to elicit from various fluorescent materials, but it soon became apparent that the electrical effects, particularly ionization of gases, furnished the best means of measuring nuclear phenomena. Ever since, the equipment of the nuclear scientist has been growing more complicated as his experiments become more refined.

Q. Is there such a thing as an electronician and is electronics electrical engineering?

A. Besides not having a definition of their field, those who work in electronics often find it awkward that there is no term such as "electronician" by which they can handily refer to themselves. As a result, we are either called electronic specialists, electronic experts, or something else, depending on how well we made out in our last problem.There is no standard way by which an individual becomes an electronics expert. The budding electronics expert may have behaved quite normally during his school years, although he probably displayed some tendency to take alarm clocks apart and to put the family radio out of commission. In college he may have majored in physics or in electrical engineering, but a degree in either of these fields is not a guarantee he will turn out that way. The only serious sympton is a morbid interest in radios. It commonly turns out that the living room is strewn with parts in the frantic effort to get the thing working on the eve of the World Series.

But even if we cannot give a decent definition of our field and don't know what to call ourselves,we at least know what we are doing. We are set up to supply many of the instruments used by the rest of the Laboratory for their measurements, particularly in determining the activity of a sample containing unstable nuclei. Some of these instruments are quite new, but the earliest form of Geiger counter made its appearance forty years ago. That device, now known as a proportional counter, is widely used, although it is merely one of a large family of devices used for detecting radiation.

Q. How is electronics associated with nuclear energy research?

A. It is the business of the Electronics Division to assist the rest of the Laboratory in securing the one of the various types of apparatus best suited to the job at hand. In a surprisingly large number of cases it turns out that none of the ordinary devices will be satisfactory for a particular problem, and then it is up to us to develop a new equipment with the special features required.

Although our work on radiation detection equipment finds the widest application in the rest of the Laboratory, it by no means accounts for all of our efforts. We have consulted with scientists from other divisions on many other types of instrumentation problems. Sometimes we are able to suggest a commercially available instrument to accomplish the desired end, or occasionally to suggest a modification of the proposed experiment itself in order to permit the use of a more readily available instrument.

However, in a large proportion of the cases it becomes necessary to design and build a special instrument, or to modify an existing one. Problems in this class include such widely different devices as a photoelectric densitometer to measure the concentration of smoke in the air, or control circuits for stabilizing the current in the large electromagnets of a mass spectrograph. The work we have done in equipping the background monitoring stations falls largely into this class, since we have had to design afresh, or extensively modify, all the equipment in those stations in order to achieve a goal of unattended operation for periods of a week at a time. Although we have made good progress, there are still a great many problems in this connection which are as yet unsolved.

When it becomes necessary for the Electronics Division to construct special equipment, we call on our extensively-equipped staff shop for any machine work needed, and the electronics construction is done by our group of technicians. Our Glass Blowing Shop makes special Geiger tubes for use when they are not too busy constructing laboratory glassware for other parts of the Laboratory.

(Continued on page 3)

STAFF PROFILE

Geraldine Bishop Davison

If Mrs. Geraldine Bishop Davison, laboratory technician in the Biology Department, answered the telephone simply by saying "Hello", rather than identifying herself, it is probable that there would be repercussions, as her mother, Mrs. Geraldine A. Bishop, is the Laboratory's chief telephone operator.

Geraldine was born in Patchogue and graduated from the Patchogue High School. She was a member of the high school dramatic and glee clubs and was crowned "Football Queen" at the annual football dance in 1943, the team's undefeated year. She was also advertising manager of the school newspaper.

After leaving high school Gerry attended Plattsburg State Teachers College and Adelphi School of Nursing, majoring in Biology in both institutions.

Gerry was a secretary in the Signal Corps office and was employed for a time in the Photography Department at Camp Upton. She decided that she would like to see the West Coast so she spent six months in California. In August, 1947, she was employed by the Biology Department as a laboratory technician and is doing research work on trillium plants. Incidentally, Gerry has taken flying lessons and has received her permit to fly.

George "Curt" Davison, assistant to Mr. Richard Vogt, recreation supervisor, finally persuaded Gerry that two could live more happily than one, though not more cheaply, and they were married in June, 1948.

Gerry is a member of the Archery Club and is on the Script Committee for "Life and Half-Life". She likes art, music, dancing and all outdoor activities.

STAFF PROFILE

Fred L. Crozier

Members of the Laboratory Police Force are on the alert 24 hours a day. Probably part of the reason for their wideawakeness during the early morning hours is the fact that Chief Fred L. Crozier is an amateur radio fan and sits up till all hours trying to reach radio "hams" in all parts of the world. He pops up at the Laboratory any time from midnight until dawn.

Chief Crozier was born in New York City and spent a good many years as investigator for the Pinkerton National Detective Agency. His work with this agency took him into all corners of the United States. Prior to his employment with the Laboratory, Chief Crozier was employed as Inspector of Police Protection for the Manhattan District and he came to Upton in September, 1946, to organize the Police Department in preparation for the Laboratory's occupancy of the site. There were 18 men on the force at the time Chief Crozier took over, and this was built up to a complement of 40 men before AUI assumed responsibility for the site in March, 1947.

Chief Crozier is married and lives in East Patchogue. When questioned about hobbies he stated that amateur radio and "puttering" around the house constituted most of his leisure hour activities.

STAFF PROFILE

If it ever becomes necessary to write pay checks in foreign languages, Fiscal is equipped to handle the situation, as Olga C. Vario, Administrative Aide, speaks, reads and writes French, Italian, Spanish and German.

Olga attended James Monroe High School in New York City and graduated from Hunter College, the youngest member of her class, with a degree of B.A. She is now a candidate for a Master's degree. For several years she taught languages in high school and finally was employed in the Fiscal Department of the Manhattan District.

Entering the employ of the Laboratory as an Administrative Assistant, Olga was soon made an Administrative Aide. She is responsible for supervising the preparation of the payrolls.

Olga was taught to play the piano by her father, who is a professional musician. Her mother, sister and brother are all musicians. In addition to music, Olga is interested in arts and craft.

Olga C. Vario

ELECTRONICS - (Continued from page 1)

A small group attends to the pumping and filling of Geiger tubes and ionization chambers. Repair and calibration work on portable equipment is handled in a separate building at 16 Pennsylvania Street.

Wherever practicable, we try to avoid making large quantities of a particular equipment. Rather than operate a small production line, we prefer to design a prototype and make good drawings of it and then farm the production job out to a subcontractor. This procedure has been used with considerable success in equipping the area monitoring stations.

In addition to all the above, which may be considered broadly as service work for all parts of the Laboratory, the Electronics Division has its own research problems. These are concerned with improving the performance of ordinary Geiger counters and more particularly with studies of extremely fast counters. Where the ordinary counters are restricted to speeds of the order of a few thousand counts a second, we are trying to get satisfactory performance at rates of several million a second. These high counting speeds will be required in connection with the high energy particle accelerators such as the Cosmotron, which will put out a very intense beam in a pulse of short duration. In order to accumulate significant data without taking an extreme length of time, it will be necessary to count at very high rates during the pulse.

Great strides have been made toward solving this problem at Brookhaven and other laboratories in applying the so-called scintillation counters. When a nuclear particle or a gamma ray of sufficient energy is absorbed in certain crystals, the latter emit very weak flashes of light of extremely short duration. If these tiny flashes are picked up with a photocell and the resulting currents are amplified millions of times, the combination can be used as a counter. It is perhaps interesting to note that this most modern development of counting technique is simply an improvement on the direct visual scintillation method introduced by Crookes about 1912, an improvement made possible by an electronic device--the photomultiplier tube. Although ordinarily photocells cannot begin to compete in sensitivity with the naked eye, when it comes to observing flashes of very short duration the photomultiplier tube wins out. As a result, the problems of counting at very high rates and of measuring time differences between events as small as a hundred millionth of a second are now on their way to a solution. And as the research program of the Laboratory develops we expect to continue to help other scientists to acquire more and better data with less expenditure of time and effort.

SCENE IN THE REPRODUCTION ROOM. *In the foreground Harry H. Maile is preparing photostats. Robert P. Brown (center) is inspecting photo offset copy. Andrew F. Brems (left rear) and Joseph F. Whittaker are operating printing presses.*

ARTISTS PREPARING SKETCHES *in Illustration Room. Left to right, Henry Wright, George Cox and Margery Morse.*

ROBERT J. WALTON *(left) boarding an aeroplane to take aerial photographs of the Pile buildings.*

Photography and Graphic Arts

GROUP PROFILE

The aeroplane that dips and turns above the Laboratory site almost every day, occasionally carries a camera man from the Photography and Graphic Arts Group.

Leaning over the side of the open cockpit grasping the handles of a big aerial camera to photograph the Pile buildings is merely one of the many strange assignments handled by the members of this Group every day.

No request surprises them. It may be for photographs of objects invisible to the human eye, of electronic devices, the filtering equipment under the swimming pool, or a lineman on a pole. Again it may be for printing reports that vary from 5 to 90 pages, for photostating documents and book pages or for the production of art works of all types from a block-letter heading to a sketch of the Cosmotron. Preparing lantern slides is another of their many duties.

In one six-month period the Group produced about 500 lantern slides, 2,000 photo negatives, 7,000 photo prints, 10,000 photostat pages and over half a million offset pages; and in one month, they processed more than a mile of motion picture film.

Anyone who has seen the striking photographic enlargements and colored sketches on the walls of the Staff Lounge, or who has noticed the technically excellent and artistically conceived illustrations in various Brookhaven publications, can readily appreciate that the work of such a group is a distinct asset in the presentation of a scientific program.

FLORENCE E. BATVINIS and ALF CHRIST-OFFERSEN examining a negative taken from the files. These files contain more than 3,500 negatives.

JOHN F. GARFIELD, leader of the Photography and Graphic Arts Group, photographing an electronic device.

PAUL A. SIMACK preparing an over-sized photograph with an enlarging camera.

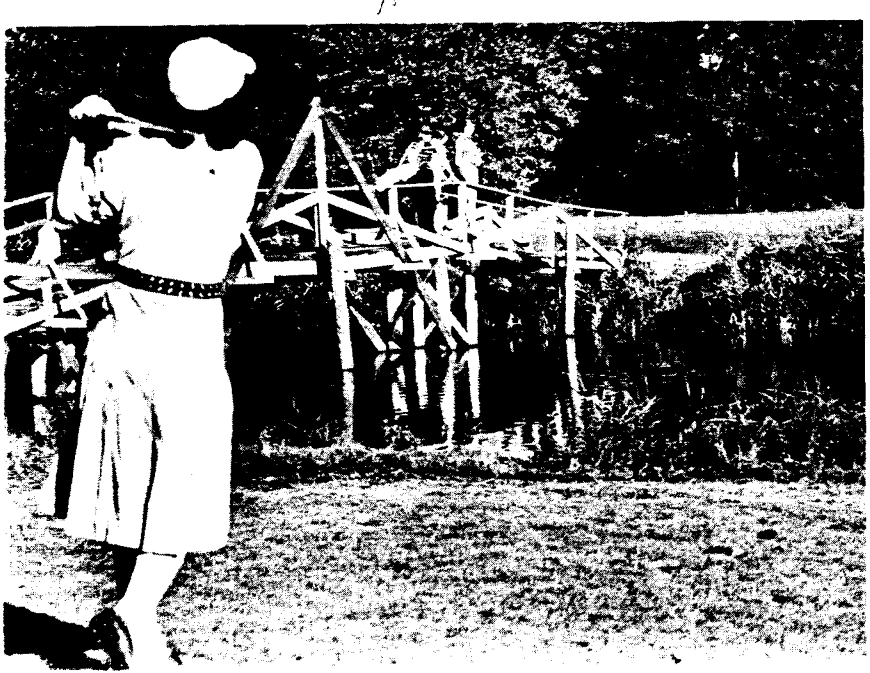
ADAM R. LASKY drying motion picture film.

ROBERT F. SMITH operating a photo-micrographic camera. This camera photographs objects invisible to the human eye.

MALCOLM A. HERBERT focusing a plate-making camera.

LEAGUE LEADERS - *Materials Control Softball Team, winners of first place in the 1948 League Schedule. Front Row, left to right: Frederick Van Dervoort, Anthony Meo, William Johnson, George Davison, William Rench, Edward Nielson. Second Row, left to right: William McCluskey, Kenneth Swezey, Steve Palermo, Benjamin Guidone, Ralph Giannotti, Phillip L. Borzi. Third Row, standing, left to right: Charles Dominy, Joseph C. Hermus, Stanley Pollack, Donald Aviano, George Preston, Kenneth J. Hughes.*

LOUIS L. DARLING (left), winner of the Chip and Putt Contest in the September Golf Tournament, being congratulated by Thomas A. Marrion, chairman of the Golf Committee.



FRANCES G. DEVINE, playing the water hole at the Bellport Country Club during the September BNL Golf Tournament.

*1948 **SOFTBALL CHAMPIONS** - Fire Department Softball Team, winners of the 1948 BNL softball championship. Front Row, left to right: Orville Meyer, Frederick Peters, Thomas A. Newham, James R. Newham, William Wisnofski. Back Row, left to right: Fred Schramm, Alfred Texeira, Chief Joseph C. Crawley, Chief Walter F. Schmelz (Night Chief), Myrton J. Kinney, ~~Frederick J. Strier.~~ Team members absent when photograph was made: Stephen M. Takats, George J. Kramer, Herbert W. Zenker and Arthur F. Rooney.*

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Walton
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__ACTION SCENE__ from final game of 1948 softball championship, won by the Fire Department. At bat, Michael A. Chiuchiolo, Motor Pool-Police; catching, Stephen M. Takats, Fire Department; umpire, Roland G. Churbuck, Fire Department.

__DANCERS__ in the Gymnasium at the BERA first annual mid-summer dance held Thursday night, August 5.

Walton
8-12-8

STAFF PROFILE

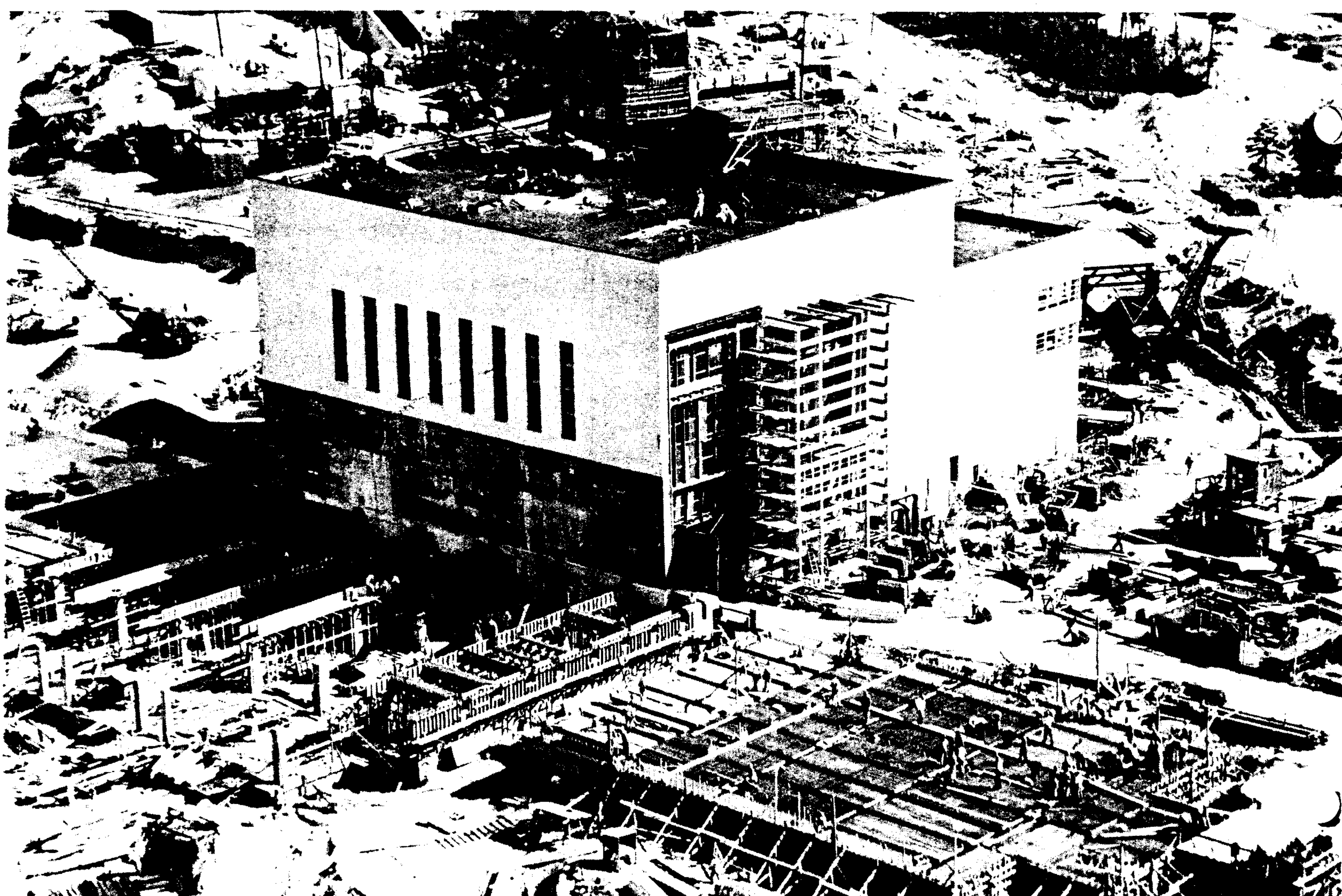
Maurice V. L. Leonardi

A period of employment covering eight years without a day of sick leave is unusual. Maurice Leonardi, stationery engineer in the Heating Department has such a record. His only absence from his work during 8 years was to recover from a brain concussion caused when an absent-minded engineer moved a troop train under which Maurice was working.

Maurice was born in Virginia of Portugese and American parentage. After leaving school he served in the Auxiliary Service and in the United States Navy. From 1925 to 1934, he had what he terms a "sweet" job, working with the Loft Candy Company. After 1934 he decided that he preferred country to city life and built a house for his family in West Yaphank. In 1940 he started to work here, part of his duties during the war being to set up kitchen equipment in troop cars. He served, incidentally, under Donald E. Mallory, head of the Buildings and Ground Division of the AM Department, who at that time was a Major.

Maurice is married and has a son and a daughter and two grandchildren, a boy and a girl, who afford him a great deal of pleasure. He and his wife still live in West Yaphank about 9 miles from the Laboratory site.

Maurice states that the Cannon stoves shown in his photograph are for emergency use only, as most of the Laboratory buildings have modern heating equipment.



PILE PROGRESS - Aerial view of Pile buildings taken on September 28, 1948, showing progress being made in construction of laboratory wings.

DR. SPARROW'S EUROPEAN TRIP

Dr. Arnold H. Sparrow (Biology) recently returned from attending and speaking at the Eighth International Genetics Congress in Stockholm, Sweden. About five hundred geneticists from all parts of the world gathered to hear some two hundred papers. Two of the main topics discussed at the Conference were the "Induction of Mutations" and "Radiation Effects." (Mutation--Variation--Offspring differing from the parents in some marked characteristic) Dr. Sparrow's paper was on "Artificially Induced Mutations--Some Factors Affecting the Sensitivity of Chromosomes to X-ray Breakage and Subsequent Recombination."

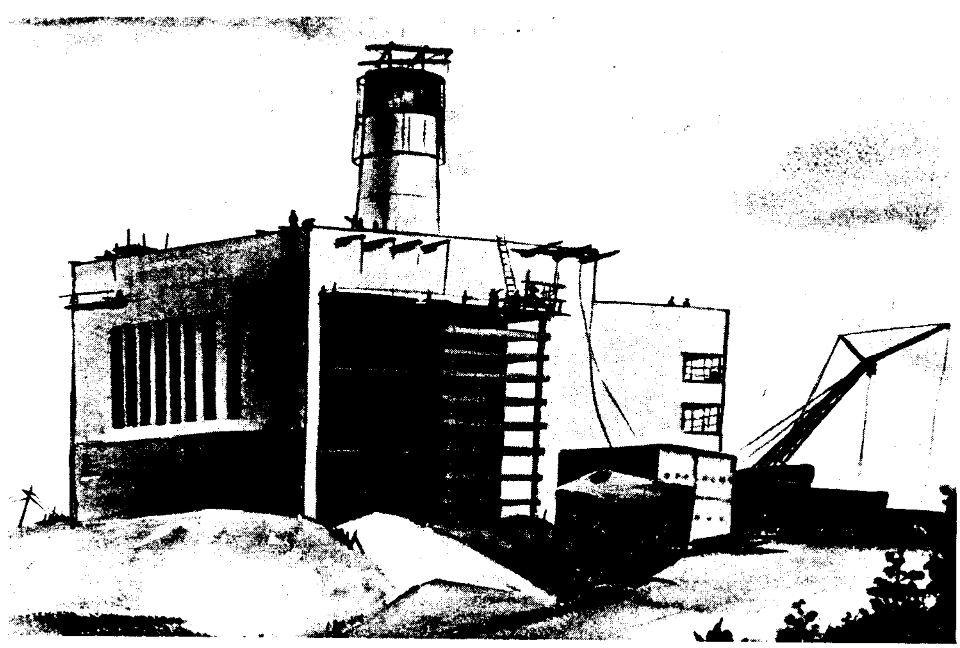
A visit to Stockholm's Institute of Cell Research left Dr. Sparrow and fellow geneticists breathless at the excellence of architectural design and at the modern equipment in use by Swedish scientists. At the University of Uppsala (created in 1477) members of the Congress observed plant breeding experiments. New and better varieties of plants resulting from these experiments will probably soon be in use. The plant experts in Sweden are using "Radiation Induced Mutations" in their breeding program. To date, many harmful and a few beneficial effects have been found. It is hoped that new and better varieties of certain cultivated crops may result from using the new beneficial mutations.

In Copenhagen, he visited the Carlesberg Laboratories which specializes in micro-chemical methods (the analysis of minute quantities of biological material). Here may be measured the respiratory action of the amoeba. Measuring one one-hundredth of an inch in size, the amoeba is one of the simplest known forms of complete animal life, and is also the chief cause of dysentery. Similar micro-chemical work is being done at Brookhaven, except that we are not yet equipped to conduct experiments on such minute quantities.

While in Paris, he visited the University of Paris, and the Institutes of Radium, Biology and Physical Chemistry. At England's Harwell Atomic Site, already in full operation, Dr. Sparrow received an interesting preview of future Brookhaven operations. Visits were also made to the Physics Department of King's College and Chester Beatty Research Institute.

At Strangeways Laboratories and at the Department of Radiotherapeutics in Cambridge, England, Dr. Sparrow was introduced to an excellent technique employed in studying the effects of radiation on cells grown in tissue cultures. The experiment is continually under the microscope which has apparatus so arranged that the entire growth is recorded on film. The Botany Department of Cambridge University provided the opportunity of seeing experiments in effects of radiation on plant and animal chromosomes. Hammersmith, Royal Cancer and Mt. Vernon Hospitals, which he also visited, conduct experiments for the development of improved methods in radiotherapy and cancer diagnosis.

Dr. Sparrow returned to Brookhaven feeling that scientists in Europe are making remarkable progress considering the dislocation caused by World War II.



REPRODUCTION of a water color painting of the Pile Building, by Robert M. Chace of the Housing Group.

YOU CAN UNDERSTAND THE ATOM

This is the fifth 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.

Even after the structure of the atom was completed in theory several important questions remained.

One had to do with radioactivity. Why do some materials spontaneously continue to emit rays and particles?

Another question was, since all protons are positive and likes repel, why do protons not fly apart from each other when packed together in the nucleus? It was observed that (except for ordinary hydrogen) the number of neutrons in the nucleus of an atom is always at least equal to and usually greater than the number of protons.

A third question was raised by the fact that the mass of each atom (except ordinary hydrogen) is less than the total mass of the protons and the neutrons which compose it. In other words, the whole is less than the sum of its parts. The difference is slight but real. How can this be? To understand it, two great scientific princioles have to be put together.

The first principle is the conversation of matter which we have already mentioned: Matter can be neither created nor destroyed but only altered in form. The second is the same concerning energy: Energy can be neither created nor destroyed but only altered in form.

Since some mass in the nucleus of the atom disappears and since mass cannot be destroyed, it must be converted to energy. Einstein had suggested as early as 1905 that mass and energy are two forms of the same thing. He reasoned that just as energy can be converted to various forms, such as heat and electricity, and just as matter can be converted to various forms, such as solids, liquids and gases, so can mass and energy be converted to each other. In other words, Energy equals Mass.

This formula needs translation because mass and energy are not in the same units. For example, to translate pounds into ounces, one must multiply by 16. Einstein showed that to translate mass into energy mass has to be multiplied by the square of the speed of light, which he called "c". So the formula is e equals m times c squared. Energy is expressed in ergs and mass is expressed in grams and the speed of light is expressed in centimeters per second. Since the speed of light is about 186,000 miles, or 30 billion centimeters per second, one can see that a very little mass converted would yield a great deal of energy. A mass of one gram (1-28th of an ounce) times the square of 30 billion equals an incredible amount of energy in ergs--9 with twenty zeros after it!

When a rock is balanced on top of a hill it is in an unstable state. A little energy to topple it over releases a good deal of energy as the rock rolls down the hill. When the rock reaches the valley it has less potential energy and is in a more stable state. The same is true of some chemical compounds.

And the same is true about the nuclei of some atoms. Protons and neutrons which are free are in an unstable state. When they go together into a nucleus they are in a more stable state, but they lose a slight amount of mass. This mass is converted to energy, some of which binds the protons and neutrons together in the nucleus, some of which is released. The difference between the mass of the free protons and neutrons before joining and the mass of the nucleus which they form is called the "packing loss". The energy which holds the protons and neutrons together is called the **BINDING ENERGY.**

The more energy it takes to move a rock back up a hill, the more stable is the position of the rock in the valley. The greater the energy holding the protons and the neutrons together in a nucleus, the more stable the atom is. Tests of the binding energy of the different atoms, in other words, of their stability, revealed differences between them and a regularity among these differences. The binding energy of number 1 in the Periodic Table (hydrogen) is zero, because its nucleus is composed of only one proton and no neutron. And the binding energy of number 92 in the Periodic Table (uranium) is over 70. However the progression is not straight from zero to more than seventy. It is from zero at number 1 sharply up to over 80 at number 26 (iron) and then gradually down to about 70 at number 92.

This is vastly important. It means that both the elements lighter than iron and the elements heavier than iron are less stable than iron. Being less stable than iron they require less energy to bind their nuclei together. Beginning at both ends of the Periodic Table and working toward iron, if it were possible to convert the lighter atoms into heavier atoms and the heavier atoms into lighter atoms by rearranging their protons and neutrons, the atoms which would be formed would be more stable, more mass would be converted to energy to pack them together, and more energy would be released. In other words, energy would be released in the process from relatively unstable to relatively stable nuclei in the same way that energy is released when a rock on a hill comes down from a relstively unstable to a relatively stable state.