STRANGE POWER OF RADIUM

MOST CONCENTRATED FORM OF ENERGY KNOWN.

A Lecture by Sir William Ramsay Telling What Is Known of Radium and Its Emanations—Three Kinds of Rays —Curative Properties of Radium.

LONDON, Feb. 16.—Speaking at the Authors' Club last Monday night on the subject of radio-activity Sir William Ramsay summed up nearly everything known about radium and its emanations.

Starting with a definition of the terms concentration and energy, he traced briefly the discovery of radium by Mme. Curie and the methods of its extraction from uranium ores. Then after a description of the cathode rays and the discoveries of M. Becquerel, he pointed out how all material human progress really consists in the first place in the concentration of energy, and in the second place in raising what was termed the economical coefficient.

Becquerel found that there were three different kinds of rays given out from radium. First there are rays which can be easily kept in a glass tube, which are known as Alpha rays. Then come a second kind, called Beta rays, which can pass through glass, and which turn out to be the same as the cathode rays of Lenard. The third kind, or Gamma rays, are very penetrating and appear to have some analogy to light, except that unlike light they can pass through nontransparent substances.

These rays can pass through about six inches of lead, and possess the power of discharging an electroscope. Lead, in fact, is moderately transparent to the Gamma rays. It was not quite clear whether the word ray was quite applicable to these rays or emanations, as there was a doubt as to whether they were really given off or were simply undulations or waves in the ether.

He should say that the Alpha and Beta rays were something like minute particles shot out from the radium, whereas the Gamma rays corresponded more to waves in the medium which surrounds us and which is termed ether. As regards the Alpha rays, Prof. Rutherford was the first to point out that these were due to a gas, but a similar observation was made by a German, Dr. Schmidt, in connection with thorium, another element discovered by the speaker to be capable of discharging the electroscope when placed near it.

The fact remained that radium was continually giving out gas. That was why the Alpha rays could get out of a vessel containing radium. The Beta rays were also particles—smaller than the Alpha rays, and travelling at an enormous velocity. The Gamma rays were not particles at all, but waves or undulations in the ether. These latter rays were still being investigated.

It was possible in some degree by means of calculation to measure the mass of the particles of the Alpha and Beta rays. Suppose a cannon to be pointed horizontally and loaded with a certain known charge of powder and a shot, if the cannon was fired the shot would not go in a straight line, but would describe a parabola, and the distance to which the shot would travel would depend upon its mass, upon the explosive force of the powder, and upon the attraction of the earth in dealing with the Alpha particle, and find out how much it was deviated from a straight line by the attraction of the electric field, and ascertain the rate at which it was propelled, they could calculate how heavy it was, and what its mass was.

Prof. Rutherford and Sir J. J. Thomson made such an experiment, and found that while the Alpha particles—that is, the gas which escapes from radium—have a very considerable mass, something about twice that of an atom of hydrogen, the mass of the Beta particle was exceedingly small, and was only equal to about one-thousandth of the mass of a hydrogen atom.

The Beta rays were being investigated and it had been found that they play an important part in the composition of matter. If matter was not made up of Beta particles revolving round each other like the planets of the solar system these particles were revolving around something or other or, according to Sir J. J. Thomson, like small suns or planets revolving around each other. Returning to the Alpha particles Sir William proceeded to say that when radium emitted these particles it lost energy. It was always losing energy and it could not be stopped from doing that. It was true it went on very slowly and it was an interesting question how long it would take to emit all the Alpha particles which it contained. The first question was: What were these Alpha particles? The second was: Into what did radium change after emitting these particles? The third question was: How long did it take to undergo these changes?

The first change appeared to be into this gas—the so-called Alpha rays. Quite two-thirds of the energy of the radium was transferred to the gas which it gave off. This raised the question of the transmutation of an element.

It was long believed to be possible to change one element into another. He was not going to throw cold water on the ancient alchemists, because it was possible by the addition of small quantities of certain substances to change altogether the appearance of certain metals; for instance, by the addition of a small quantity of arsenic you could change copper into a white, brittle substance altogether unlike the malleable copper which was there before, and by the addition of a very small quantity of yeast you could change a large quantity of sugar into alcohol. These were changes of an alchemistic nature and radium went on continually doing what the alchemists of old tried to do when they attempted to change various elements into gold or silver. Radium went on changing and you could not stop it.

Prof. Rutherford gave the name of emanations to the rays given off by radium because he did not recognize them as gases, but it really was ordinary gas, or rather quite an extraordinary gas. It came off radium at a regular rate, and that brought him to the question, How long would radium last? His answer was, forever.

The amount of gas was always proportionate to the amount of radium present. Suppose he took a slice of bread and cut it in two, taking a minute to do it, and then he cut the half in two again, and so went on continually cutting each piece in half, how long would it take him to cut that bread entirely up? He could never do it. He would be always halving to infinity, and the operation would take him an eternity to perform. That was the case with radium. The amount of gas produced was always proportionate to the amount of radium there and it was always being produced.

When would radium be half gone? They had just measured it in his laboratory, and it would take 1,750 years, so that if any one invested in radium he would retain at least half his capital at the end of 1,750 years.

The Austrian Government some time ago entrusted him with about half a gramme, or one fifty-fifth of an ounce, of radium for private use. It did not belong to him, but its value was about £8,000. Less than a year ago Dr. Gray and himself performed the experiment of isolating the Alpha emanation of radium, and they enclosed it in a fine glass tube—much finer than the finest thermometer tube that ever was made. They compressed it and liquefied it.

When liquefied it shone with a purplish light, though it was quite transparent, like water. It shone with a light of its own. When reduced to a temperature of minus sixty centigrade it solidified, and then it glowed with an extremely brilliant light like a miniature arclight. The quantity they had was extremely small, but they ascertained its boiling point, its melting point and its specific gravity, and all this was done with a smaller quantity than the point of the finest needle. Of course they used a microscope.

This substance was the most concentrated form of energy known. It was a substance which went on changing into other things, to which various names were given. These substances were named radium A, radium B, radium C, and so on up to radium F. Some of them had a very short existence, lasting only half an hour or three-quarters of an hour, and he had never seen them. He had seen radium D—a substance which would be gone in about forty years. That gave one time to look at it. It was a substance rather dull looking, like lead, and that was nearly all he could tell them about it. There were other substances, probably like the polonium discovered by Mme. Curie.

During these emanations radium gave a great deal of energy, generally manifested as light, but as a matter of fact radium kept itself hot. There was a great deal of heat generated. It could be calculated; and it was found that it gave off about 3,500,000 times as much heat as would be given off by the oxyhydrogen blowpipe, which gave a temperature of over 2,000 degrees Centigrade. There they had, surely, the greatest concentration of energy ever known. He doubted if ever they would ever get anything greater.

What did this energy do? It sent out the Alpha rays at a velocity of about 40,000 miles a second, and these particles naturally carried a great deal of energy. The Beta rays, although only about one-thousandth the size, also carried great energy, owing to their enormous velocity, which was still higher than the Alpha rays.

There were plenty of things they could do with this energy. They could decompose water and metallic substances, and in these decompositions they found elements produced which they did not imagine to exist in the substances so treated. For instance, in decomposing ordinary copper sulphate they were surprised to discover lithium in what remained and no trace of the copper salt. He had repeated this experiment five times. The experiments were still going on.

The phenomena which he had described were hardly capable of explanation. He had nothing to do with it. He could only describe it as an act of God. An act of God had been described by an eminent lawyer, who was a Scotsman, as an act which no sensible man would believe God would have performed.

Dealing with the therapeutic properties of radium, Sir William remarked that it had been said that radium cured cancer. He did not believe it to be by any means certain. It was exceedingly doubtful, though it had never been rightly tried, and all one could say was that there were things which had been favorable to that suggestion. In this week's *Lancet* there was an account by Sir Lauder Brinton of a case of cancer which was at least ameliorated and life prolonged by radium emanations. The Radium Institute was making inquiries of that kind with large quantities of radium and under efficient control. He thought they might postpone their decision as regarded the cure of cancer, but there was no necessity to postpone it with regard to the cure of rodent ulcer. It was a certain cure for that.

THE SPORTSMAN'S SHOW.

Annual Exhibition to Open in the Garden on Wednesday.

The big amphitheatre in Madison Square Garden will make one of its lightning changes. The Motor Boat Show closed last night and the exhibitors will hustle their boats, motors and other things out of the Garden and back to the shops and a gang of workmen will start in to transform the big place into a scene in the woods for the annual Sportsman's Show. It will be the sixteenth annual exhibition and the managers promise that it will be better than ever. It has always been a popular exhibition here and it is expected that lovers of the woods and of out door life as tired of the winter and take this opportunity of getting next to wood life with the guides and other attractions at the show.

There are to be more than 150 guides from the many hunting and fishing resorts. These are coming from the Adirondacks, from Maine, from New Brunswick, Nova Scotia, Canada, Virginia and other places and these guides will be busy with their stories all the time they are here.

One exhibit will be a complete collection of heads, horns and trophies from the interior of South Africa. The collection, which consists of sixty separate exhibits, has been loaned to Manager Dressel by A. B. [illegible], the famous South African traveller, who makes his headquarters in Abyssinia. The collection is the most complete of its kind ever sent out of Africa and includes a duplicate of every animal shot by ex-President Roosevelt during his recent trip. Not only will the Roosevelt duplicates be shown but also many rare specimens the former President was unable to secure. The collection is the result of a two years shooting expedition through the wildest parts of Africa and many of the specimens which will be placed on exhibition have never before been shown in this country. The collection has been secured by a New York museum, permission having been obtained to have the complete outfit at the Sportsman's Show in transit from South Africa to New York. The collection will be in charge of Mr. [illegible] partner, who has been entrusted with the delivery of it.

In addition there will be an Indian exhibit showing the customs and habits of several of the tribes in their natural state.

The collection of wild birds and game fowls will be the most complete ever brought together in this country. At the Madison avenue end of the Garden will be located a big pool, which will comprise every well known species, while mammoth cages in different parts of the main floor will be filled with game birds from Africa, Australia and other distant countries. Among the collection will be a number of bleeding heart pigeons, which will be exhibited for the first time in this country. Rare species of pheasants, crane and other rare birds will be housed during the show.

The basketball tournament will be divided into two sections—junior and senior. The former will play in the afternoon and the latter in the evening. The former will be composed of the Y. M. C. A. branches of the West Side, Washington Heights, Greenpoint, Bedford and Williamsburg, while the senior competition will bring together Washington Heights, Williamsburg and Greenpoint Y. M. C. A., Pierce A. C. and John Hall Memorial. As the tournament does not come under the Amateur Athletic Union championship it is expected that the results will not indicate the probable winner of the championship. There is considerable rivalry between the Y. M. C. A. branches and the teams are very evenly matched. The tournament will be conducted on the round robin system.

The model yachts of the Brooklyn Yacht Club, which consist of fifty boats used in competition on Prospect Park lake last summer, are to be shown. A space 150 feet long has been set aside for this exhibit.

An extra attraction at the show will be in the concert hall. James A. Cruikshank will give entertainments there typifying the great outdoors in this country of New England. Mr. Cruikshank has more than a thousand illustrations which he will show on a screen. The attraction is under the auspices of the Boston and Maine, Maine Central and New Haven railroads.

Indians and Virginia to Meet at Football.

It has been learned that the Carlisle Indians will play football in Washington next fall against the team of the University of Virginia, which will not meet Georgetown. The loss of this game to Georgetown with Virginia has hit the Washingtonians hard. The trouble arose because the Georgetown faculty has decided [illegible] for the time being, and the Virginia folks didn't want to take the chances of not getting a big game at all. Unless football is put back on a figure at Georgetown next fall it is likely it will be out. It is likely that the Indians and Virginia will meet on November 8. George Washington and Georgetown which will not give up their playing fields if they have games scheduled themselves.

EATING IS ONE-HALF HABIT

PROF. CHITTENDEN'S TESTS AND HIS CONCLUSIONS.

Experiments With College Professors, Soldiers and Athletes Showed That They Thrived on Much Less Food Than They Were Accustomed to Eat.

In connection with the discussion of the price of food and as substitutes for meat some observations made by Prof. Russell H. Chittenden of Yale University are of interest.

The field of dietetics has not yet ceased to be a ground for controversy, and its history so far has been a disproving to-day of what was taken up yesterday. Prof. Chittenden happens to be the present authority, although the publication of the results of his experiments five years ago was the cause of a great upheaval.

"It is self-evident that the smallest amount of food that will serve to keep the body in a state of high efficiency is physiologically the most economical and hence the best adapted to the needs of the organism," says Prof. Chittenden in his book "Physiological Economy of Nutrition."

To find this smallest amount of food required by three distinctly different types of individuals he undertook a series of experiments continuing over several months. The results of these experiments he gives in his book.

In the first group were five men, of different ages, professors and instructors in Yale University, representing the mental rather than physical worker. In the second group was a detail of volunteers from the Hospital Corps of the United States Army, representing the moderate worker, men of different nationalities, ages and temperaments. The third group was composed of eight young men, Yale students, trained athletes, some of them with exceptional athletic records.

The professor in describing the experiments which he conducted with himself as a member of the first group says: "I weighed 65 kilos, was nearly 47 years of age, and accustomed to eating daily an amount of food approximately equal to the so-called dietary standards. Realizing that the habits of a lifetime should not be too suddenly changed, a gradual reduction was made in the amount of proteid food taken each day, resulting in a month or so in the complete abolition of breakfast except for a small cup of coffee. A light lunch was taken at 1:30 P. M., followed by a heavier dinner at 6:30. The total intake was diminished as well as the proteid constituents.

"There was no change to a vegetable diet, but there was and still is a distinct tendency toward the exclusion of meat in some measure, the appetite not calling for this form of food in the same degree as formerly. At first the lessening of the daily amount brought a slight discomfort, but it soon passed away and an improved physical condition was perceptible. A rheumatic trouble in the knee joint which had persisted for a year and a half entirely disappeared; sick headache, bilious attacks and other minor troubles also ceased their regular visits; a keener appetite and more acute sense of taste was developed and a greater liking for simple foods. In seven months I weighed fifty-eight kilos instead of sixty-five.

"During the ensuing summer the same simple diet was persisted in—a small cup of coffee for breakfast, a fairly substantial dinner at midday and a light supper at night. Two months were spent in Maine at an inland fishing resort, and by rowing a boat frequently six to ten miles in a forenoon, sometimes against head winds and without breakfast, and with less resultant fatigue and muscular soreness than in the old days, I disproved the mistaken idea that it is impossible or unwise to do physical work on an empty stomach.

"Returning to New Haven, I found that my body weight was practically the same as before the summer vacation. During the first months of the experiment eight kilos were lost under the gradual change of diet; then the weight apparently remained stationary, from which it might fairly be assumed that the body had finally adjusted itself to the new conditions."

From his experiments with the professional men Prof. Chittenden decides that certain general conclusions seem to be justified by the results obtained.

"A healthy man," he says, "whose occupation is such as not to involve excessive muscular work, but whose activity is mainly mental rather than physical, though by no means excluding the latter, can live on a much smaller amount of proteid food than is usually considered essential for life without loss of mental or physical strength and vigor.

"This means that the ordinary professional man who leads an active and even strenuous life, with the burden of care and responsibility, need not clog his system and inhibit his power for work by the ingestion of any such quantities of proteid food as the ordinary dietetic standards call for."

After giving this blow to the popular conception that the hard working professional man should feed his brain Prof. Chittenden goes on to prove his point by giving the resultant figures of the experiments carried on with himself and four of his colleagues as subjects.

"We are certainly warranted," he says, "in the assertion that the professional man can safely practise a physiological economy in the use of proteid food equal to a saving of one-half to two-thirds the amount called for by existing dietary standards, and this without increasing the amount of non-nitrogenous food consumed. Indeed the latter class of foods can likewise be diminished in amount without detriment to health or strength when there is no call for great physical exertion."

The experiment with the second group included twenty men—of whom fourteen were privates, volunteers for the experiment, and non-commissioned officers, cook, cook's helper, &c., representing as great a variety of types as possible and different nationalities and temperaments. The detachment lived for six months at New Haven under military discipline and constant surveillance. A gradual sifting reduced the number to thirteen.

"Here," says Dr. Chittenden, "we had a group of men quite different in type from the preceding group; men accustomed to living a vigorous life under varying conditions and who naturally had a great liking for the pleasures of eating.

"During the first two weeks the ordinary army rations were given to the men; later a gradual change was made, accompanied by a reduction in the amount of proteid food with some reduction likewise in the total full value of the food. At no time were the men placed on a cereal diet or on a truly vegetable diet.

"The object in view was simply to study the possibilities of a general physiological economy in diet with special reference to the minimal proteid requirement of the healthy man. To be sure, in doing this, meats, owing to their high content of proteid, were very much reduced in amount, and on many days no meat at all was given, but the main change was from a heavy meat diet, rich in proteid, to a lighter diet comparatively poor in proteid with an increasing predominance of vegetable and cereal foods.

"That there is no need of a daily diet containing 118 grams of proteid food seems fairly indicated. The members of the soldier detachment lived without discomfort for a period of five months on amounts of proteid food not more than one-half that called for by the ordinary standard dietaries, and this without increasing the amount of non-nitrogenous food.

"Body weight, nitrogen equilibrium, physical strength and vigor, ability to respond to sensory stimulation, the composition and general condition of the blood all remained unimpaired under a diet with a fuel value of less than 2,800 calories a day.

"Further, the practice of such economy led to marked improvement in the working of the neuro-muscular machinery; the men were less conscious of fatigue than formerly and could do more work without fatigue.

"And it is a remarkable and suggestive fact that when a person has once practised physiological economy in his diet sufficiently long for it to have become in a measure a habit he has no desire to return to a fuller dietary rich in proteid matter; both body and mind are fully satisfied with the smaller amounts of food."

Here is a sample day's bill of fare for the soldiers:

BREAKFAST.

Boiled Indian meal, 150 grams; milk, 125 grams; sugar, 30 grams; coffee, 1 cup; baked potato, 100 grams; butter, 10 grams.

DINNER.

Clam chowder with onions, potatoes and tomatoes, 200 grams; bread, 75 grams; mashed potatoes, 100 grams; coffee, 1 cup.

SUPPER.

Apple fritters, 200 grams; jam, 75 grams; tea, 1 cup; gingerbread, 30 grams.

In regard to his experiments with the third group Prof. Chittenden says: "Men in training for athletic events deem it necessary to consume large amounts of proteid food. Custom and long experience sanction a high proteid diet composed largely of meat or of other foodstuffs rich in nitrogen for the development of that vigor and strength that go to make the accomplished athlete; but the daily use of such quantities of proteid food as usually enter into the diet of the average athlete is very questionable."

The subjects were the best athletes in all lines that Yale could produce. In regard to the experimentation Prof. Chittenden says:

"It is quite evident from a study of the results obtained in the foregoing experiments that young, vigorous men of the type under observation, trained in athletics, accustomed to the doing of vigorous muscular work, can satisfy all the true physiological needs of their bodies and maintain their physical strength and vigor as well as their capacity for mental work with an amount of proteid food equal to one-half or one-third that ordinarily consumed by men of this stamp. It is clear that physiological economy in nutrition is as safe for men in athletics as for men not accustomed to vigorous exercise.

"The athlete, as well as the less active man physically, or the professional man, can meet all his ordinary requirements with an intake of proteid food far below the quantities generally consumed, and this without increasing in any measure the amount of non-nitrogenous food."