A LARGE STATIC MACHINE FOR X-RAY WORK.

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There are many forms of apparatus for exciting vacuum tubes to generate X-rays, and doubtless we are soon to have simpler exciters than a large static machine. I planned this one because I felt satisfied that it would answer my purpose in making X-ray examinations in diseases of the chest until a more efficient form of apparatus was devised. I have also a coil which gives a steady light, but is less powerful than this machine

The machine is in a dark room inclosed in a wooden case, supported two inches above the floor on glass blocks. The case is 8 feet long, 7½ feet high, and 3 feet wide.

Fig. 4 shows my method of making X-ray examinations, the curtain which ordinarily hides the static machine from view being drawn aside to show one end of the machine. Over the patient are two cords, one of which controls a brass rod that short-circuits the machine, throwing the Crookes tube out of the circuit, while the other controls the amount of light. The fluorescent screen on which the X-ray picture is formed is seen on the chest of the patient.

Fig. 2 shows the machine with most of the front of the case removed. The house officer on the right of the picture suggests the proportions of the machine. For convenience, the terminal on the right is extended by a brass rod to a brass ball (hung on a wooden rod) near the middle of the machine; this brings the terminals nearer together. The condensers are covered on the outside on the bottom only.

The machine has four revolving clean plate glass circles 6 feet in diameter and ¼ inch thick and four fixed glass circles 6 feet 4 inches in diameter; it is run by a one horse power motor through a countershaft, and it has a speed controller, which is essential, for by its means the number of revolutions per minute of the plates may be varied from 50 to 275.

A small influence machine, with a single revolving plate, not shown in the figure, 2 feet in diameter, fastened to the inside of the case, is used to excite the larger machine. There are two electric heaters inside the case which may be used if necessary to warm the air when it contains a very large percentage of moisture. These are preferred to the use of chloride of calcium.

The revolving glass plates are attached to the shaft

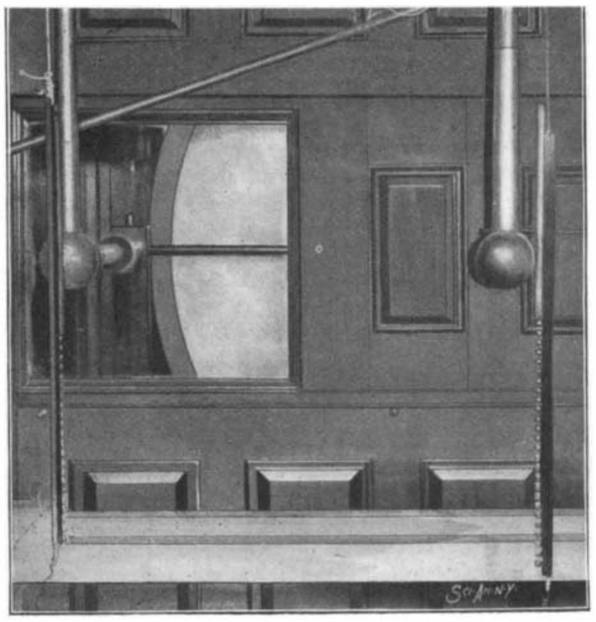

Fig. 1.—DETAILS OF ADJUSTABLE MULTIPLE SPARK-GAP.

by two cast-iron hubs one foot in diameter, each of which is made in three pieces. The center section of each hub is a disk which is loose on the shaft and serves as a separator between the two glass plates; the inner disks, which are contiguous to each other, are fast upon the shaft, while the outer disks are tightened against the glass plates by means of large nuts threaded on the shaft.

Perfect steadiness in the light from the tube is necessary, but when a long spark gap is used the light is unsteady, and this variability makes careful examinations with the fluorescent screen impossible. The long spark gap is also noisy. To overcome the lack of steadiness in the light, I devised what I have called an adjustable multiple spark gap. It consists of hollow brass balls ½ inch in diameter fastened ⅛ of an inch apart along the edge of a ¼ inch strip of vulcanite, Fig. 1, and this strip, with its balls, is free to move up and down through a vertical brass tube, which has a slot ¼ of an inch wide running its whole length; there are two such spark gaps, one on each terminal. When the electricity is turned on, a discharge is seen to go from one small ball to the next. These spark gaps are controlled by the cord seen hanging in the left of the picture, Fig. 4, nearly over the patient's head. By means of this cord, the row of balls and the tubes may be lowered or raised, and thus many or few of the short spark gaps may be brought into the circuit, and, consequently, much or little light be produced. Thus while examining the patient the light may be readily adapted to the needs of the case. This power of regulating the light is of prime importance in examining the heart and lungs. The light may be varied by changing the speed of the machine, but more readily by changing the spark gap, as just described.

The Crookes tube is placed in a closed box in order to prevent its light from brightening the room.

The other cord over the patient is used to raise or lower the brass rod which connects the terminals with the machine, and by this device the Crookes tube is thrown in or out of the circuit and shuts off as soon as the examination is over. The tube should be about three feet away from the patient. A thin screen of aluminum, not shown in the cuts, which should be grounded, should always be placed between the tube and the patient. There need be no fear of any burn, or inconvenience even, from X-ray examinations if simple precautions are taken. In about 3,000 examinations made at the Boston City Hospital I have seen no harmful effects produced.

No account of X-ray apparatus should be given with-

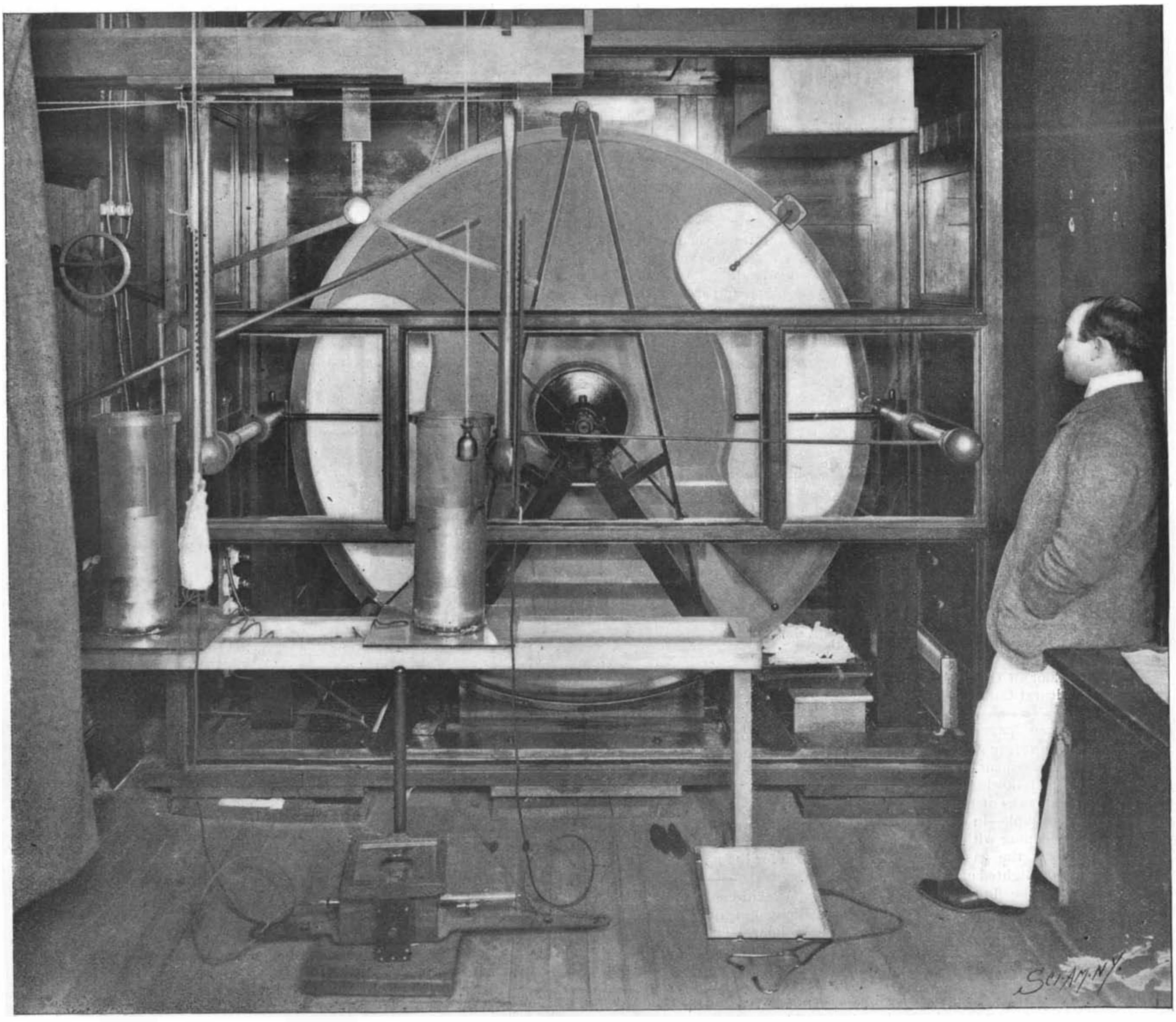

Fig. 2.—MAMMOTH STATIC MACHINE FOR X-RAY WORK.

Diameter of revolving plates, 6 feet; of fixed plates, 6 feet 4 inches.

out referring to the investigations of Dr. William H. Rollins on vacuum tubes. One of the chief obstacles to practical X-ray work has been the inability to control the vacuum in the tube and to lower it when it became too high. This difficulty has been overcome by Dr. Rollins and others.

Three years or more ago, when the X-rays first came into use, it was a question whether pulmonary tuberculosis would give any indications of its presence in any stage. The examination of a few patients soon answered this question in the affirmative, and then the point arose as to how early signs would be obtained by the means of the Roentgen light. Experience has shown that slight abnormality even of the lungs is seen, and that by the aid of the X-rays, together with the usual methods of examination, the diagnosis of pulmonary tuberculosis may be made at an early stage. When we appreciate that in Massachusetts out of ten persons dying between the ages of twenty and thirty-six, six die of consumption, it is evident that this new method of examination will be of value.

There are in the minds of many two misconceptions in regard to the way in which the X-ray assists the physician in pulmonary tuberculosis. The first is that the "germs of consumption" can be seen, and second that they can be killed by the X-rays. We do not see by means of the X-rays the tubercle bacilli; they are microscopic objects which require a lens of very high magnifying power to make them visible, and even then this is only possible after they have been stained with an aniline color. Neither do the rays kill the "germs of consumption," nor, so far as our knowledge goes, have they any action upon them. The advances made by this method of examination are due to the fact that we can in one or both of the following ways. namely, by means of the darkened lung and the shortened excursion of the diaphragm, detect in many cases that the lungs are in an abnormal condition earlier than by other means. To appreciate this point it must be understood in the first place that the lungs in health, being filled with air, allow the X-rays to pass readily and therefore this portion of the chest is bright on the fluorescent screen; but when diseased they become more solid and obstruct the rays, and a shadow of the diseased part is thrown upon the screen. Second, during deep inspiration the diaphragm in health moves up and down through a certain distance; in disease the excursion may be lessened, and this diminished movement is seen upon the screen.

It is of great importance in heart disease to know accurately the size of this organ, and the X-rays give us more exact information on this point than we have hitherto been able to obtain. The heart may be smaller, or, as is more frequently the case, larger than it should be. The enlargement may be the result of inefficient action of the valves or it may be due to quite other causes, but whatever its origin there is nothing more important for the physician to know in many patients than its size, and the X-ray examination, as just stated, enables us to ascertain this more accurately than ever before. When it becomes customary to examine the chest with the X-rays, deaths from heart failure without previous warning will be less common. If the arteries or kidneys are diseased, the size of the heart is affected, and an enlarged heart may therefore suggest these complications. We can not only determine the size of the heart by the rays, but we can also follow its movements in health and disease by these means; and this has not been possible before.

In other diseases of the chest X-ray examinations are of value; for instance, tumors and fluid may be recognized in the chest.

The size and movements of the stomach may be followed under certain conditions, and these examinations may be of service in determining deformities of the pelvis. Many, though not all, stones in the kidneys or bladder can be recognized. We may also distinguish by the rays between gout and rheumatism, and they are also useful to surgeons in cases of fracture, in dislocations, and diseases of bones, and in locating bullets and some other foreign bodies.

To make X-ray examinations, training is needed in two directions; the problems connected with the apparatus must be understood in order to get the best results, and a large medical experience must be at command in order to interpret what is seen on the fluorescent screen and correlate it with evidence obtained in other ways.

One word of warning in regard to X-ray examinations; it should be clearly understood that this new method is only one of many which may be used by medical men to determine from what disease a patient is suffering; but in many cases (especially in diseases of the chest) it is capable of giving valuable evidence, which by itself, or in connection with other signs and symptoms, serves to point out the disease.

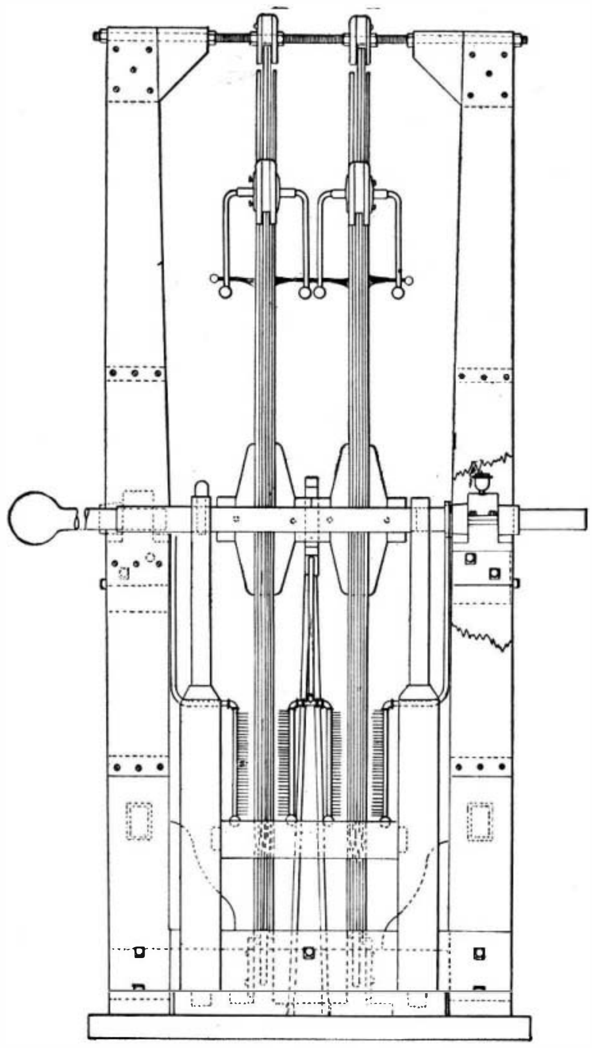

Fig. 3.—END ELEVATION.

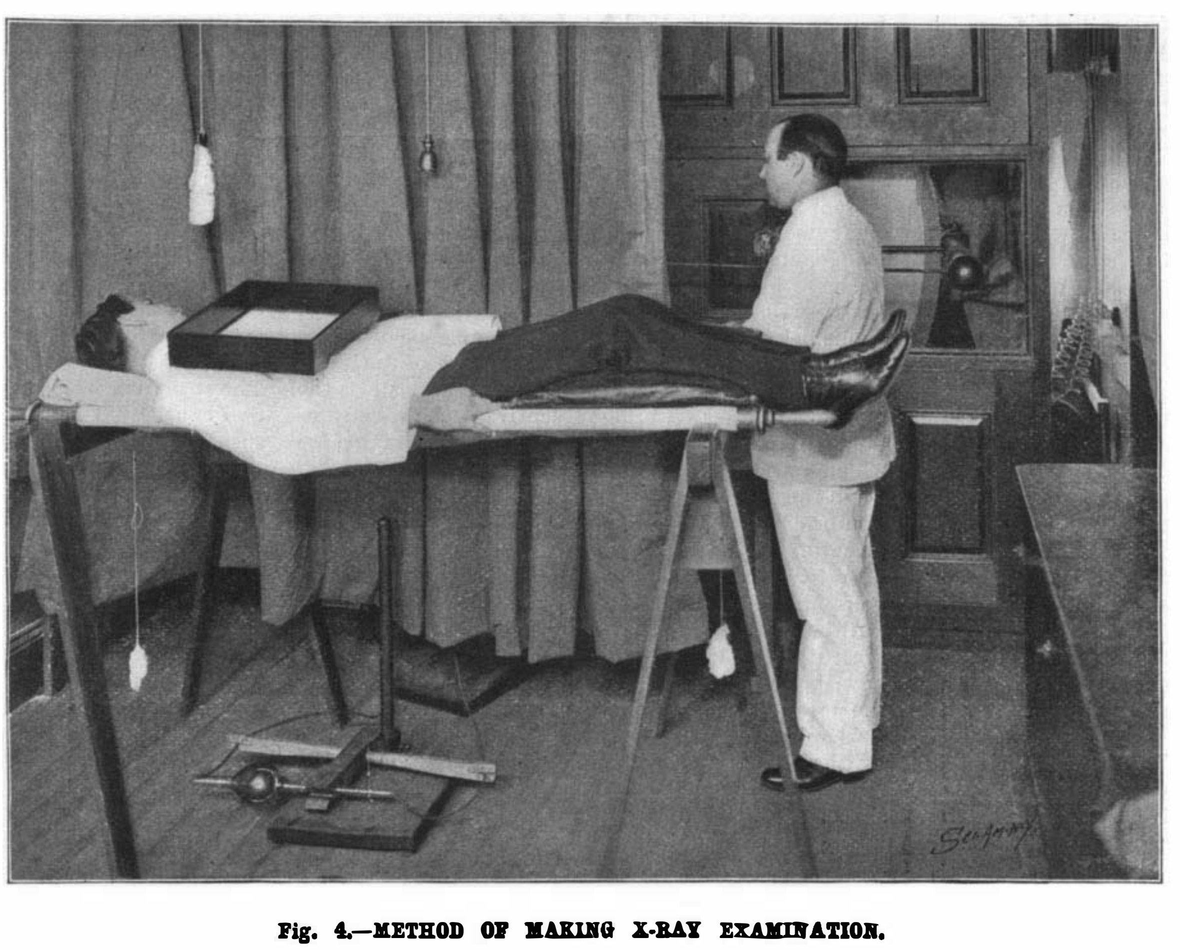

Fig. 4.—METHOD OF MAKING X-RAY EXAMINATION.

The Uganda Railroad.

The British government has just completed 300 miles of the Uganda Railroad. The total length of the route from Mombasa on the Indian Ocean to the northeast coast of Victoria Nyanza is 650 miles; nearly half of the entire road, which is to connect the sea with Uganda, is practically completed. Uganda is one of the most populous and promising parts of Africa, stretching far along the northern and northwestern sides of the second largest fresh water lake in the world. The New York Sun recently gave some interesting particulars regarding this road, from which we glean the following: The railway has been pushed toward the lake, which is the objective point, for the past three years in spite of such serious obstacles as the abnormal rainfall of 1897, which retarded the preparation of the roadbed, and the breaking out of the plague in India. In the first 200 miles the conditions for railroad making were very unfavorable.

There are very few spots where water may be obtained. Last August, when the line was about 200 miles on its way, it had only just emerged from the difficult jungle country. On March 31 of this year the line reached 279 miles, touching the densely populated country southeast of Kenia. It is believed that the railroad will now have an appreciable effect on the export trade. Since August 20 of last year trains have run regularly over most of the route completed at that time; the stations on the way number thirteen. Two trains start every day, one from the coast and the other from the inland terminus; the trains stop for the night. Deducting all the time spent at way stations and in obtaining water, the actual traveling time for the 162 miles is ten and one-quarter hours. This is not very high speed, but is a great improvement over caravan traveling. Only mixed trains carrying freight as well as passengers are now running. The fares for the 162 miles are $20, $10, and $1.70. The latter is for third-class travel and is confined to native and Indian patronage.

Of the financial prospect of the line it is not easy to speak at present, but, unless there are some untoward circumstances, the government will reap much indirect profit from the road. It has been spending $200,000 a year merely for the transport of the material needed by its agents and stations in the lake region. It is estimated that the railroad will reduce this charge to $30,000 a year. The transportation of the steamboat which the government sent to Lake Victoria Nyanza cost $100,000, and it could have been sent by rail for one-fifth of this sum.

Prof. Lanier on the Combustion of Magnesium.

Herr A. Lanier, in the Correspondenz, calls attention to the advantage of reducing the smoke of the flash mixture to a minimum by using an oxidant which itself yields no smoke, nitrate of ammonia being mentioned. Owing, however, to the extremely hygroscopic nature of this substance, some care is required. The salt must be fused to expel moisture; as soon as sufficiently cooled it is finely powdered, and preserved in a well-closed bottle. Various sensitometric determinations were made, and it was found that a mixture of 2 parts of magnesium and 1 of ammonium nitrate gave the same illumination as a mixture of 1 part of magnesium and ¾ part of potassium permanganate. Equal parts of magnesium and ammonium nitrate showed 2·4 times the actinic power of a mixture in which 3 of magnesium and 1 of ammonium nitrate were used. From the point of view of reducing smoke, the use of ammonium nitrate is of very great value, as far less magnesium will serve than when the metal is burned without any addition. Five grains was found to be ample for a fully exposed carte portrait in an ordinary room, and after five exposures the smoke was scarcely noticeable. To ignite the mixture, Herr Lanier places it upon a tuft of pyroxyline or a pad of touch paper (soft paper soaked in a solution of niter and dried). A taper on the end of a light wand may then be used conveniently. He sums up the following as the essential matters in using the magnesium flash with a minimum of smoke: (1) complete dryness of the materials; (2) an extremely fine state of division; (3) complete mixture—each charge being mixed separately with a feather on a sheet of paper; (4) the use of a base of pyroxyline or touch paper.

Victorium.

At the conversazione of the British Royal Society on May 3, information was given by Sir William Crookes of the discovery of what he believed to be a new element. In his work on the fractionation of yttria, he found in a photograph of a spectrum not visible to the eye a group of lines indicating a new element. In honor of the eightieth birthday of the Queen he has proposed to call it victorium. Its atomic weight is probably near 117.