gular slit in front of this slit, would strike the paper ribbon. Now, if the rays were intercepted by interposing either the hand or a lead plate, the small paper rectangle would be darkened, and its outline lose in distinctness. As soon as the screen was removed, both the brilliancy and distinctness would reappear, thus proving that the light diffused by the paper ribbon was increased by the action of N-rays.

Now, the diffusion of light is a complex phenomenon where regular reflection plays the part of an elementary fact. The author therefore thought of investigating whether the reflection of light is also modified under the action of N-rays. For this purpose a polished knitting needle of steel was placed vertically in the position previously occupied by the paper ribbon. In a box completely closed but for a vertical slit at the height of an Auer lamp (shut by a screen of transparent paper), a flame was placed so as to illuminate the slit. By placing the eye at the slit, the image of the latter formed by reflection on the steel cylinder was distinctly seen, while the reflecting surface was struck by N-rays, the action of the ray seeming to strengthen the image. Similar results were obtained when the needle was replaced either by a plane bronze mirror or a polished quartz surface. All these effects of N-rays require an appreciable time both to be produced and to disappear. On the other hand, no action of N-rays on refracted light could be observed, though various experiments in this direction were undertaken under many different conditions.

As the capacity of seeing small variations in candle power varies for different persons, these phenomena are nearly at the limit of perceptibility to some persons, who only after a certain practice will be able to observe them regularly and safely, whereas others will at once and without the least difficulty note the strengthening effect of N-rays on the candle power of a small illuminant. Now, as the author has recently observed the same phenomena with considerably increased intensity when replacing the Auer burner by a Nernst lamp, these phenomena may now be produced with such intensity as to be visible to anybody.

INDUCED RADIO-ACTIVITY AND ALUMINIUM.

BY DR. M. METZENBAUM.

It has been stated that if a sealed tube containing radium of high activity be suspended in a normal salt solution, and solutions containing various drugs, these solutions become radio-active and are capable of affecting photographic plates. It has further been intimated that if radium has a therapeutic value, then these solutions, which have been rendered radio-active, might likewise have a therapeutic action; and that since solutions can be taken internally, the possibilities of these radio-active solutions might be of considerable value. In view of these statements, I conducted a very large series of experiments, from which the following negative results have been obtained:

Two tubes of radium of 1,000,000 activity, each containing 5 milligrammes, and two other tubes of lesser activity, each containing 50 milligrammes, were placed in a normal salt solution and remained there for ten days. This solution was placed in test tubes of very thin glass and in the small vials in which hypodermic tablets are contained. These were then strapped with adhesive plaster to the film side of photographic plates. Some of the plates had first been covered with black paper. The tubes were thus maintained from a period of twenty-four hours up to twenty-one days, and in no case was there the faintest sign that the photographic plates had been affected.

It has been known for a long time that aluminium offers very little resistance to the rays of radium and radio-active substances. I therefore took many boxes made of very thin aluminium, filled these with so-called radio-active solutions, and placed them on photographic plates covered with black paper. But in no instance, even after ten days, was any image obtained.

Then aluminium boxes were filled with these solutions and placed on the bare photographic plates, and after forty to forty-eight hours a very definite outline of the boxes was obtained. Stimulated by this last observation, which I then considered a correct one, as indicating a result due to the so-called radio-active solutions, I practically completed a series of ninety-six experiments, from which I made the following inferences, which would be very gratifying if true, but as I will soon show, are incorrect:

First.—A normal salt solution becomes radio-active, as proven by the outline of an aluminium box containing this solution, when this box is placed on a bare photographic plate for forty to forty-eight hours.

Second.—A saturated salt solution becomes more radio-active than a normal salt solution.

Third.—As the amount of salt in the solution is increased, so is the induced radio-activity.

Fourth.—A tube of 10 milligrammes of 1,000,000 activity does not induce a greater amount of radio-activity into a salt solution, than does a tube of 20 milligrammes of 7,000 activity, or a tube of 15 grains of 40 activity. From this it seemed as though a salt solution could be rendered radio-active to a certain degree only.

Fifth.—The radio-activity seemed to be just as great after a tube of radium was suspended in a salt solution for ten hours, as it was after the tube of radium had been kept in the salt solution continuously for three weeks.

Sixth.—That a tube of radium could be placed in some salt, and if this salt were made into solution, it would retain its radio-activity.

Seventh.—That this radio-activity is not lost after several weeks.

If all of these inferences had not been overthrown, and if these radio-active solutions had any therapeutic action, then surely these results would have been of great value, for it would be possible to transport these solutions, or to render substances radio-active, and to apply them. A tube of radium costing a few dollars would accomplish the same result as a tube costing $250.

When these aluminium boxes were placed on the photographic plate, they produced only an outline of their rim. This I explained by the fact that they were slightly concave, and affected the plate only at the points of contact. It was also noticed, no matter what solutions the boxes contained, that there was always about the same amount of print for the same length of time. I had also noticed that distilled water, when submitted to the tubes of radium, produced the same amount of print. This caused me some doubt; for I believed it to be the solids in the solution which became radio-active. Then aluminium boxes filled with these salt solutions and empty ones were placed on the reverse side of the photographic plates. They did not affect the plates after a period of ten days.

During the entire series no aluminium box had been used more than once, for I soon observed, if a box had contained any of these solutions or any radio-active substance, no matter how much I cleaned it or boiled it, the box still affected the photographic plate, while the steel keys, which had been covered with the various uranium salts, and thorium, if they were cleaned thoroughly, would not affect the photographic plate. These boxes were always kept in a place where I considered them out of the influence of all radio-active substances.

These observations forced me to seek for an error. This action of metallic aluminium on the photographic plates I concluded must be sought for in the boxes themselves. Several empty boxes were placed on bare photographic plates, and after forty-eight hours they gave as good prints as if they had been filled with the solutions. I thought that somehow they might have been rendered radio-active. Some new boxes were then obtained and placed on bare photographic plates. After forty-eight hours these also affected the plate, as well as many other new boxes.

The next questions which presented themselves were:

First.—Is the particular product of aluminium, from which these boxes are made, radio-active?

Second.—Is all aluminium radio-active?

Third.—Is the action of aluminium on photographic plates due to radio-activity, or some other cause?

Fourth.—If this action of aluminium on photographic plates is not due to radio-activity, to what, then, is it due?

Fifth.—What action will aluminium salts have on photographic plates?

Summary: Many aluminium articles were placed on bare photographic plates, and in every instance they produced their own image in forty-eight to ninety-six hours.

The same aluminium articles, when placed on photographic plates covered with black paper, did not produce an effect on the plate in ten days. The same aluminium articles, when placed on the reverse side of the photographic plate, or when separated from the film by a plate of glass, did not affect the plate in ten days.

The summary of the experiments of placing aluminium salts, of which there are many, on bare photographic plates, is that in no instance was the plate at all affected after ten days.

The inferences to be drawn are:

First.—When metallic aluminium is placed on the bare photographic plate in the dark, it will produce its own image.

Second.—That aluminium will not affect the photographic plate, when separated from the film of the plate by black paper, glass, or when placed on the reverse side of the plates. Therefore, aluminium is not radio-active.

The action of metallic aluminium on photographic plates is probably either a chemical action or an electrical action between the metal and the albuminate of silver of the plate. This observation, that metallic aluminium when placed on a bare photographic plate produces its own image, has heretofore not been pointed out. Tubes of radium were placed in various powders, as bismuth subnitrate, for several days; then these powders were placed directly on the film of the plate, and in no instance, even after ten days, did they show the slightest effect on the plate.

These conclusions give positive proof that by suspending tubes of radium of varying strength, for long periods, in various solutions and various powders, neither the solutions nor the powders are capable of affecting photographic plates. Nor was it possible to show the supposed induced radio-activity by means of an electroscope.

SCIENCE NOTES.

M. Chevalier, the eminent French explorer, has recently returned from prolonged travel in Central Africa. He has secured a valuable collection of interesting documents and photographs of the country and its people. Furthermore, he carried on his travels a phonograph, upon which he has secured records of the languages of the various natives in the region which he explored, made by the natives themselves. These records will be reproduced by Mr. Chevalier in the course of his lectures describing his travels, experiences, and discoveries.

A French inventor, M. Heit, has devised a new type of compass, which is automatic in its action. By means of this contrivance, the direction of the compass is automatically registered minute by minute, so that by consulting the chart which is thus produced the ships' officers can ascertain the exact route traversed at any time of the passage. In the Heit apparatus the compass card, instead of having at its center an agate resting on a fixed steel point, is fixed on a steel pivot which rests on a fixed agate. The latter is immersed in a drop of mercury, which serves to conduct the current of electricity that renders the registering of the movements of the compass possible. To perform this function, a small silver index, kept in constant electrical communication with the pivot by a fine and flexible wire, is attached to the card. Normally this index does not touch the fixed basin surrounding the card, but by means of the electrical current the circuit is rapidly closed and opened, with the result that the angle of the boat with the meridian is registered. For this purpose the basin is divided into a certain number of sections, isolated from each other and corresponding in each case to a special circuit, the registration being made on a sheet of paper by means of a spark produced by a small induction coil. The apparatus also registers the speed of the boat by recording the revolutions of the screws, at each stroke of the piston a current being closed and a signal sent to the receiver.

Mr. Percival Lowell, director of the Lowell Observatory, speaking of what constitutes satisfactory or unsatisfactory vision of the celestial bodies, says, in substance: Studies directed to that end have resulted in a knowledge of the conditions which constitute good or bad seeing. . . . The basis of the matter lies in the well-known fact that systems of waves traverse the air, several of these systems being present at once at various levels above the earth's surface. The waves composing any given system are constant in size and differ for the different currents all the way from a fraction of an inch to several feet in length. If the distributing wave be less from crest to crest than the diameter of the object glass, the image is confused by unequal refraction from the different phases of the wave; if the wave be longer than this, a bodily oscillation of the whole image results. The first is fatal to good definition, the second makes accurate micrometric measurement difficult. It is easy to make these waves visible by taking out the eyepiece and putting one's eye in the focus of the instrument when the tube is pointed at a bright light. It is further possible to measure their effect by carefully noting the character of the spurious disk and diffraction rings made by a star, and the extent of the swing of the image in the field of view. By combining the amount of confusion with the degree of bodily motion of the resulting image the definition at any time and place can be accurately and absolutely recorded. The perfection of the optical image of a star testifies to the lack of damaging currents with reference to the object glass used. It records all the waves below a certain wave length. Similarly, the amount of bodily motion registers all those above that length.

The biggest carving knife ever manufactured may be seen at the World's Fair. This monster blade is 30 feet in length and has an edge as sharp as a razor. It is made out of the finest steel, and the handle is a masterpiece of the cutler's art, elaborately carved and beautifully polished. It would take a veritable giant to wield a knife like this. The blade is altogether of American manufacture, and it is expected to show for the first time that American cutlery has now reached a point of perfection where it fears no rivalry. The giant carving knife cost several thousand dollars, and special machinery had to be made before its construction could begin. No such knife was ever before manufactured.