THE "PHOTOGRAPHOPHONE."

BY ERNST RUHMER.

The SCIENTIFIC AMERICAN has from time to time presented to its readers different methods of recording and reproducing both musical sounds and human speech. Of these methods, perhaps the most generally known is that employed by Mr. Edison, in which a stylus attached to a diaphragm engraves upon a rapidly revolving wax cylinder the sound impulses thrown against the diaphragm. Still another system has been devised by the Danish engineer Valdemar Poulsen, who records sounds magnetically by passing a steel ribbon between electromagnets energized with an intensity depending upon the strength of the current which has been telephonically set up in the circuit. In a third, and perhaps a more sensitive method than either of the two mentioned, photography is employed as the recording means.

Under favorable conditions the variations in the intensity of oscillation of a "speaking" arc light* are so appreciable that it is possible to record them upon a moving sensitive film. Upon this possibility the construction of my "photographophone" depends.

The photographophone, as shown in Fig. 1, consists primarily of a light-tight wooden casing in which photographic-film reels are mounted, the film as it is unwound from one reel being received by the other, as in the cinematograph and similar chronophotographic machines. The reel is driven by a small electric motor through the medium of a belt and pulley. Traveling at a uniform rate varying from 2 to 3 meters per second, the film passes the focus of a lens in front of which the source of light, which may be a speaking arc and which is caused to undulate in accordance with the sound waves, is placed at a suitable distance. The film after having been subjected to the action of the undulating light is developed in the ordinary way and fixed. If the record be very long, special developing apparatus is necessary, resembling that employed in the development of cinematograph pictures.

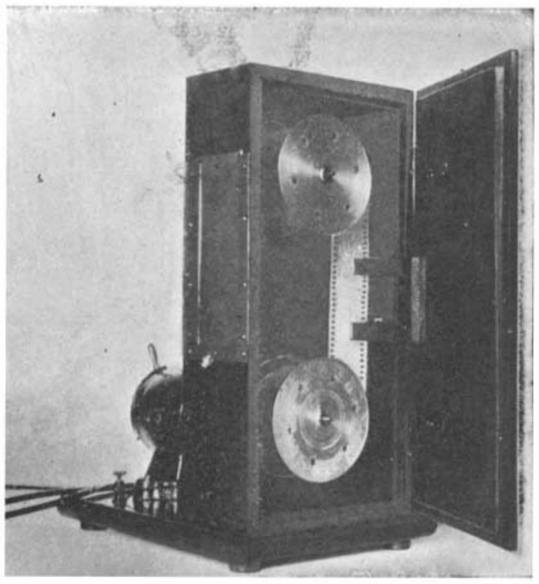

Fig. 1.—THE FILM-CASING OPEN.

The variations of light may be distinctly seen on the film. Fig. 4 shows a film which has been acted upon by the light, and then developed and fixed. In reproducing the recorded sound, an ordinary stereopticon is used in place of the original undulating source of light, the film traveling with the velocity equal to that with which the record is made. Behind the film an exceedingly sensitive selenium cell is removably mounted and connected with two telephone receivers in the circuit of a small dry battery (Fig. 2). The variable transparency of the film will cause the selenium cell to be illuminated with a light which flickers in accordance with the undulations of the recording arc. It is a well-known phenomenon that selenium conducts electricity with an intensity that varies as the light by which it is illuminated. The ever-varying light thrown upon the sensitive cell of the "photographophone" causes the current in the circuit to vary therewith, these variations of current being transformed at the telephone receivers into acoustic waves, corresponding with the sound undulations originally photographed upon the film.

By this method sounds are reproduced with astonishing distinctness. The loudness can be varied by increasing the candle power of the light employed in the stereopticon. Indeed, it is possible so to magnify the sound that a record can be reproduced with a clearness equal to that of telephone transmission. It is immaterial whether a positive be made from the film or whether the original negative be used. Apart from the extreme sensitiveness of this photographic method of recording sound, the invention is of considerable practical utility in so far as any number of positive copies can be made from the original negative. The film may be so long that the speech or song to be recorded may be almost interminable. Moreover, the films are so compact that even a very long record can be stored in an exceedingly small space.

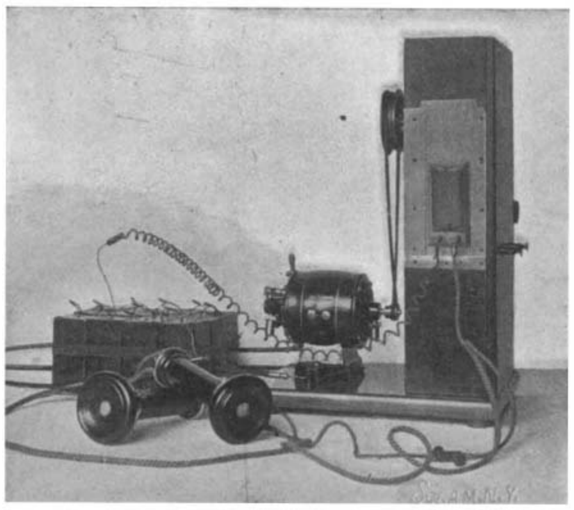

Fig. 2.—THE RECEIVER.

By using an undulating incandescent lamp in place of the speaking arc light in an improved instrument which I have constructed, I succeeded recently in attaining very good results with a film speed of 20 centimeters per second. It is my intention to employ the photographophone in connection with the cinematograph and to ascertain whether it be possible to record the movements of bodies and of sounds (such as music) upon the same film. By means of the many auxiliary apparatus which have been devised in late years for the purpose of magnifying sound, it is to be hoped that the photographic sound-record may be successfully reproduced in a large auditorium.

Berlin, April, 1901.

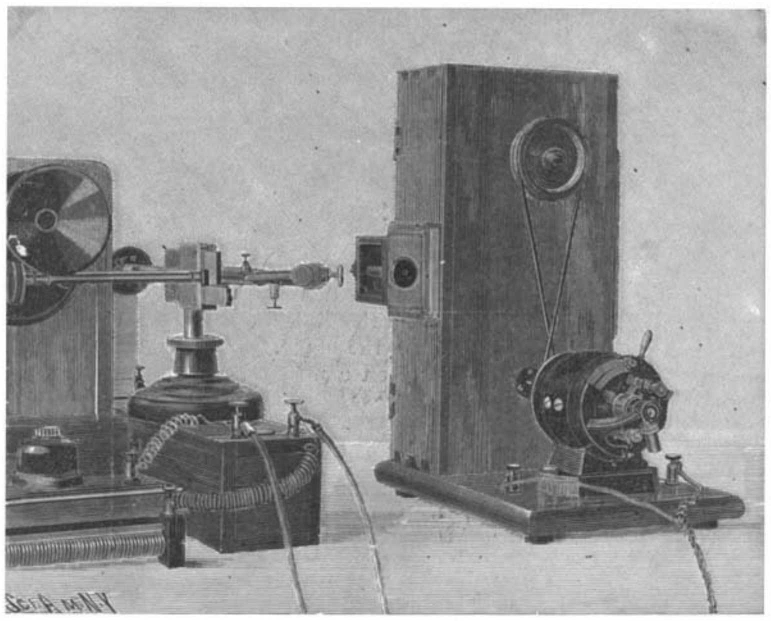

Fig. 3.—THE "PHOTOGRAPHOPHONE."

* SCIENTIFIC AMERICAN for June 8, 1901, page 358.

A New Method of Preparing the Hydrates of the Peroxide of Sodium and Their Properties.

M. George F. Jaubert has lately made a series of experiments with the peroxide of sodium, and finds that the hydrates of this body may be easily prepared and may be used to produce hydroxyl in different degrees of concentration; this method will no doubt be of value in different chemical operations. In an account given to the Academie des Sciences, M. Jaubert describes his experiments as follows: It is well known that the peroxide of sodium, under the action of a small quantity of water, decomposes violently with disengagement of oxygen and leaves a residue of caustic soda. This reaction is accompanied with considerable heat, and the temperature may rise above the boiling point. The following equation shows that 18 parts of water suffice to decompose 78 parts of the peroxide:

$$Na_2O_2 + H_2O = 2NaOH + O.$$

The experimenter has found that quite another reaction takes place if the peroxide is simply exposed to the action of dry air, free from carbon dioxide. In this case the quantity of water absorbed by the peroxide may greatly exceed the theoretical amount necessary for its decomposition. While 25 parts of water poured drop by drop upon 100 parts of peroxide seem to bring about an almost total decomposition, it is found that by using water vapor at the ordinary temperature the same quantity of peroxide may be made to absorb up to 200 or 225 parts of water, and this without decomposition—that is, without giving off oxygen. The experiment was carried out by placing the peroxide in a closed vessel provided with a pressure gage; the chamber contained also a vessel of water, whose vapor was constantly absorbed by the peroxide. At the end of 24 hours the pressure had not changed, but the weight of the peroxide had increased from 100 to 136; it had been transformed into a pure white and friable mass, resembling snow. It was then left for a number of days and its increase in weight per day was as follows: 100 (original), 136, 163, 223, 256, 275; at the end of 5 days more it weighed as much as 325. As the hydration may be stopped at any time, it is possible to obtain by this process, and in large quantities, the hydrates already known, $Na_2O_2 + 2H_2O$ and $Na_2O_2 + 8H_2O$, as well as a series of intermediate and unknown hydrates. M. Jaubert has studied especially the hydrate $Na_2O_2 + 8H_2O$, which he has prepared in great quantities. It appears as a snowy white mass, in contrast to the yellow color of the peroxide. It dissolves easily in water without giving off oxygen, but is less soluble in ice-cold water, and in this way may be precipitated. It is thus obtained in pearly scales resembling boric acid, and analysis gives the above formula. The hydrate of the peroxide of sodium dissolves in water with a great lowering of temperature; in concentrated acids it dissolves without appreciable change of temperature and gives solutions of hydroxyl of remarkable stability. This property makes it of great value in the preparation of hydroxyl. The hydrate is quite stable when cold, and has been kept for more than six months without appreciable change, but at 30 deg. to 40 deg. C. it partially decomposes and gives off oxygen; at 80 deg. to 100 deg. its decomposition is total. This body, which may be easily prepared in the laboratory, permits of obtaining solutions of hydroxyl chemically pure and in all degrees of concentration up to 85 per cent.

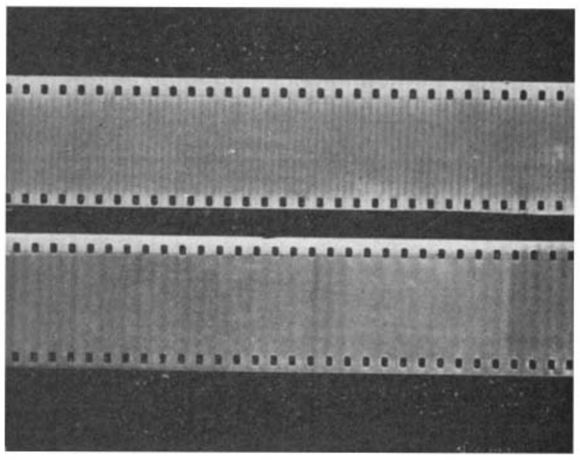

Fig. 4.—A PHOTOGRAPHIC SOUND-RECORD.

A Natural Zoo in Uganda.

Sir Harry Johnstone, the English special commissioner for Uganda, has recently returned to London after an absence of two years. He is going to propose to the English government that a stretch of country lying between Eldoma Ravine Station and the slopes of Mount Elgon, which contains the most extraordinary quantity of game that he has ever seen in tropical Africa, should be preserved as a national park or game preserve, similar to our Yellowstone. This district is entirely depopulated, the result of the terrible internecine wars of several years ago. It is now filled with all kinds of game indigenous to Central Africa, and the animals have been left unmolested for so long that they are quite as tame as if they had been kept in captivity.

His caravan passed through vast herds of elephants and rhinoceri, while zebras and antelopes would even approach them within a distance of ten yards. Lions were also frequently encountered. It was in this district that the commissioner discovered the new specimen of giraffe, the male of which had five bosses or horn cores. The fourth and fifth horns protruded from the head just behind the ears at the base of the skull. Sir Harry Johnstone also met the extraordinary race of apelike men, first discovered by Mr. Grogan and Mr. Sharpe, on the borders of the Congo Forest. He secured several photographs and measurements to confirm his meeting with this simian race. These people, however, must not be confounded with the Congo dwarfs, who are quite a distinct race, since whereas the latter measure about four feet in height, the former are of normal stature.