be the most luminous of all salts under the action of Röntgen rays, especially when in the form of the mineral known as tungsten. He thinks it exhibits the phenomena even in a more marked degree than platino-cyanide of barium. A solution of tungstate of copper in tungstate of calcium, moreover, glows with the same brightness as natural tungsten. A note on the best form of tungstate of calcium for showing fluorescence has also been published by Dr. Ferdinando Giazzi, of Perugia. By a certain process of heating in a coke furnace in the presence of oxygen, the tungstate is reduced to a white saccharoid mass which gives a much more brilliant glow than ordinary tungstate, but the effect can be further intensified by pulverising the mass and repeating the process, the final product which Dr. Giazzi calls the "bisaccharoid" form being, in his opinion, the best substance for shortening the exposure and intensifying the brilliancy of photographs taken with Röntgen rays.

Prof. Giuseppe Martinotti (*Rivista Scientifico-Industriale*) claims to have obtained shadow photographs of metal objects by the use of different kinds of light (including that of bisulphide of carbon), the light from a sulphur flame being found the best. Perhaps the radiations by which these results were obtained may be identical with Le Bon's *lumière noire*. This latter phenomenon deserves to be more fully investigated by physicists than has been done.

At a recent meeting of the *Société Française de Physique*, a discussion took place on a new arrangement of vacuum tube introduced by M. Colardeau, which gives, with short exposures, great clearness of images. The ordinary "focus" tubes are, according to M. Colardeau, open to several objections; amongst others, the thickness of the glass required to stand the external pressure arrests the passage of a large proportion of the rays; the energy of the discharge is not sufficiently concentrated round the kathode, and the distance between the kathode and anti-kathode is too great. The new form of tube is a cylinder of not more than 6 or 7 mm. diameter, containing a concave kathode of 4-5 mm. radius of curvature, which nearly fills the width of the tube. The lamina inclined at 45°, forming the anti-kathode, is only 7-8 mm. distant from the kathode, and just opposite the focus; and the glass of the tube is blown out into a hemispherical knob 1/10 mm. in thickness; the latter offers but little resistance to the passage of the rays generated at the focus. With this disposition stereoscopic radiographs were taken, which stand out in remarkable relief. The tube has stood the test of a discharge from a coil of very large dimensions without the least injury.

Finally, we would call attention to the excellent radiograph of an entire newly-born child taken by Prof. A. Imbert and M. H. Bertin-Sans, of the University of Montpellier, which is reproduced in the *Revue Générale des Sciences* for June 30. In sharpness of outline and general detail it far excels anything previously attempted in this direction.

METALLIC CARBIDES.

UNTIL about three years ago, the only definite compounds of carbon with metals whose existence had been proved with certainty were the acetylides of some of the metals of the alkalis and alkaline earths, and these were only known in an amorphous and impure state. The construction of the electric furnace by M. Moissan in 1893, in which the heating power of the electric arc was directly utilised, by extending the upper limit of working temperatures, added a powerful instrument of research to the laboratory. Among the many new fields of work thus opened up, the preparation of the difficultly reducible metals, such as tungsten, molybdenum, manganese and chromium, was attacked with much success by M. Moissan. These reductions being necessarily effected in the presence of carbon, the formation of definite metallic carbides of great stability soon became apparent, the properties of which proved to be of such interest that their preparation was systematically attempted. Certain metals, such as gold, bismuth, lead, and tin, do not form carbides at the temperature of the electric furnace, neither do they dissolve any carbon. The metals of the platinum group dissolve carbon with facility, but deposit the whole of it on cooling in the form of graphite, the metals being unchanged. Copper, silver and iron take up carbon in quantities that, although small, are sufficient to cause marked changes in the physical properties of the metals; it is noteworthy that no definite crystalline compound could be obtained with iron. On the other hand, fused aluminium takes up carbon readily with formation of the crystalline carbide Al_4C_3, and the oxides of many other metals furnish similar crystalline compounds when heated in the electric furnace with an excess of carbon. The behaviour of these substances with water furnishes the most convenient mode of classification. The carbides of molybdenum, Mo_2C, of tungsten, W_2C, of titanium, TiC, of zirconium, ZrC and ZrC_2, and of chromium, Cr_4C and Cr_3C_2, do not decompose water at the ordinary temperature. Of those reacting with water, the carbides of lithium, Li_2C_2, calcium, CaC_2, strontium, SrC_2, and barium, BaC_2, furnish pure acetylene; of aluminium, Al_4C_3, and of beryllium, Be_2C, pure methane; of manganese, Mn_3C, a mixture of equal volumes of hydrogen and methane; whilst the metals of the cerite group give crystalline carbides of the type RC_2 (CeC_2, LaC_2, YC_2, and ThC_2), all of which react with cold water, forming a complicated gas mixture containing hydrogen, acetylene, ethylene, and methane. But the most complex reaction is that furnished by uranium carbide, U_2C_3, with water. In this case, in addition to a gaseous mixture containing methane, ethylene, and hydrogen, liquid and solid hydrocarbons are produced in abundance, more than 100 grams of liquid hydrocarbons being obtained in one experiment from four kilograms of carbide. Cerium and lanthanum carbides have also furnished small quantities of solid and liquid hydrocarbons.

With the exception of chromium and zirconium, which form Cr_4C, and Cr_3C_2, ZrC_2, and ZrC respectively, only one carbide of each metal appears to exist, the formula of which is usually simple, and not always in accordance with what would be expected from the position of the metal in the periodic system. Thus, whilst the carbides of calcium, strontium, and barium have the formulæ CaC_2, SrC_2, and BaC_2, and yield pure acetylene upon treatment with water, beryllium forms Be_2C, from which pure methane is obtainable (Lebeau). As already mentioned, aluminium forms Al_4C_3 giving pure methane, whilst the higher members of the same group, yttrium and lanthanum, give YC_2 and LaC_2, yield, with water, complicated mixtures of acetylene, hydrogen, ethylene and methane, together with some liquid hydrocarbons. Cerium and zirconium, again, which are closely allied in the periodic system, form carbides having totally different properties, CeC_2 giving acetylene and methane with water, ZrC and ZrC_2 being unattacked under the same conditions.

These discoveries have already been applied technically in two directions—in the commercial production of acetylene from calcium carbide for enriching coal gas or for burning alone, and in the production of the carbides of silicon, CSi (discovered by Acheson), and of titanium CTi, both of which are extremely hard, the latter even cutting diamond. In organic chemistry, also, they afford a direct synthesis of many hydrocarbons, and offer a means of preparing pure methane and acetylene in large quantities. But perhaps their greatest interest lies in their bearing on certain geological problems. Starting with the fact that cast iron on solution in dilute acids gives a mixture of hydrocarbons, Bjasson and Mendelejeff twenty years ago suggested, independently, that the deposits of petroleum may be due to the infiltration of water into molten masses of metallic carbides, and this view was supported by an observation made about the same time by Silvestri, that some lavas of Etna contained petroleum.

In discussing this question in the light of his own observations, described before the Royal Society on June 18, M. Moissan protests against too hasty generalisation in this matter, as petroleums of different origins may exist, there being clear evidence in some cases that bituminous schists have been formed by the decomposition of organic matters. On the other hand, there is the continuous evolution of methane at Bulgonak and in Pennsylvania, which might well be formed by the action of water upon aluminium carbide; the presence of free hydrogen in the submerged volcanic vents at Santorin (Fouqué), and the occurrence of petroleum and carbonaceous products towards the end of a volcanic eruption, the violence of which would be fully accounted for by the supposition of the entry of water upon metallic carbides at a high temperature. There is also the possibility of explaining the occurrence of petroleums of different composition, for whereas a deposit of the carbides of the alkaline earths would yield acetylene, which at the extremely high temperature necessarily produced and in presence of free hydrogen might be expected to yield hydrocarbons of the Russian type, the carbides of aluminium and uranium, at perhaps a lower temperature, might account for petroleums of the American type. The whole work is extremely suggestive to vulcanologists, and will doubtless result in further investigation on the geological side.

G. N. H.