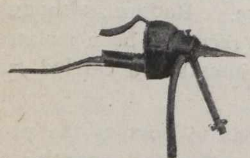
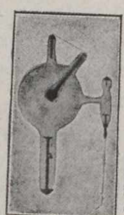
Quartz is found in nature in the crystalline and amorphous conditions, the former variety being known as rock crystal and quartz sand, and the latter is found as opals and other precious stones. On a piece of rock crystal being heated in an open flame it cracks, and when the fragments are melted in the electric furnace a compact amorphous mass is produced which is absolutely insensitive to temperature influences and shows other properties entirely different from rock crystal.

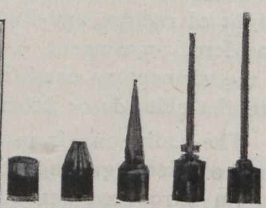
In 1903 Dr. J. Frank Bottomley commenced in a small experimental works erected at Wallsend, near Newcastle-on-Tyne, Scotland, a series of investigations with the object of developing a method suitable for the manufacture of large size silica apparatus. In spite of the many difficulties encountered in this connection, the experiments after three years were sufficiently advanced to commence working on a commercial basis.



KROMAYER LAMP WITH QUARTZ EXTENSION.



A ROENTGEN TUBE.



QUARTZ BLOCKS AND TUBES FOR APPLYING ULTRAVIOLET RAYS, WITH PRESSURE, TO VARIOUS PARTS OF THE BODY.

As it was intended to obtain a relatively cheap product, a raw material less expensive than rock crystal had to be looked for, and a very pure form of silver sand containing over 99½ per cent. of silica was used.

Electric arcs as well as various forms of resistance furnaces were used in connection with these experiments, but the arc method was found not to be practical on account of the difficulty of regulating the temperature, and the risk of the material being contaminated by fragments expelled from the electrodes. Far more satisfactory results were obtained with resistance furnaces using carbon or graphite as resistance material.

Another difficulty is due to the silica volatizing readily at temperatures a little above the melting point. The difficulty of finding a material sufficiently refractory to serve as the containing vessel, while being chemically inactive in regard to silica, was overcome by allowing the sand itself to form its own containing vessel, which method shows the additional advantage of providing an excellent heat insulating material for the lagging of the furnace. As the surface of the silica farthest from the heating resistance is not thoroughly fused, it should be subjected wherever necessary to a subsequent glazing process. As silica, even at very high temperatures, never becomes really fluid, but attains a consistency like that of tar, it cannot be made transparent. However, in this plastic condition the material is capable of being worked into shape either by blowing or by mechanical pressure. It is, for instance, quite possible to draw a length 60 feet or more of ¾-inch tubing. At the works of the Thermal Syndicate, Wallsend, where the Bottomley process is used, fusions of over 70 pounds can be made, and worked into shape, and it is hoped to increase this considerably.

The most valuable feature of these goods is their remarkable insensitiveness to temperature changes, which even allows iron ore platinum to be sealed into quartz crucibles without the latter losing their shape, their transparency to the ultra violet rays, and their insulating properties, which, though decreasing somewhat with rising temperatures, is even at the temperature of electrical furnaces quite sufficient to make the quartz an electric insulator. This feature is the more welcome, as most oxides used in industry will become conductive to electricity at high temperatures. Quartz is therefore an extremely suitable material for making electric radiators. As quartz tubes are fairly pervious to heat rays, they can, in fact, be used also for the transmission of heat. For a similar reason quartz plates are extremely practical as refractory protective mantles, undergoing a relatively immaterial heating even on being radiated upon intensely.

It would be a difficult task to name the discoverer of the ultra violet rays, but should one be inclined to search out the names of the responsible parties, certain it is that the name of Prof. Niels R. Finsen, of Copenhagen, Denmark, would occupy a prominent position on the list; in fact to that gentleman must go the honor of the pioneer work in the treatment of disease by photo-therapeutics. Prof. Finsen proved that the therapeutic properties of light in the treatment of bacterial diseases of the skin, especially lupus vulgaris, or tuberculosis of the skin, was due chiefly to two properties of the light employed, the violet and ultra violet rays; also their power to penetrate the skin and their destructive action on bacteria.

In Finsen's apparatus, the radiation from an arc lamp was filtered through water, (pure water is a conductor of the ultra violet rays) which absorbs most of the ultra red, or "heat," rays, and was concentrated upon the skin by lenses of quartz (which does not, like glass, absorb much of the ultra violet radiation, and which aids in absorbing the ultra red rays). The Finsen lamp, for the use of physicians in private practice, consists of a 20-ampere direct-current arc lamp, a "concentrator" and a "compressor." The apparatus is so mounted on an iron stand that it can be turned in any direction. The concentrator is a wide metal tube, containing a number of quartz lenses, through which a current of cold water flows continuously. The compressor is attached to the end of the concentrator and consists of a short brass cylinder, closed at each end with a plate of quartz and filled with the circulating cold water. The terminal quartz plate is pressed against the diseased portion of the skin, which is cooled by the stream of cold water so thoroughly that a very concentrated beam of light, possessing great heating power, can be employed without danger. A still more important function of the compressor is to drive the blood from the skin and thus to make the skin more permeable by the rays. The treatment is applied for at least 45 minutes at a time. The management of the apparatus is not easy, but the method provides a sure cure for lupus and leaves no visible scars. In Copenhagen a great institution, the Finsen Institute, has been established, which receives from the Danish government an annual subsidy of 25,000 crowns (about

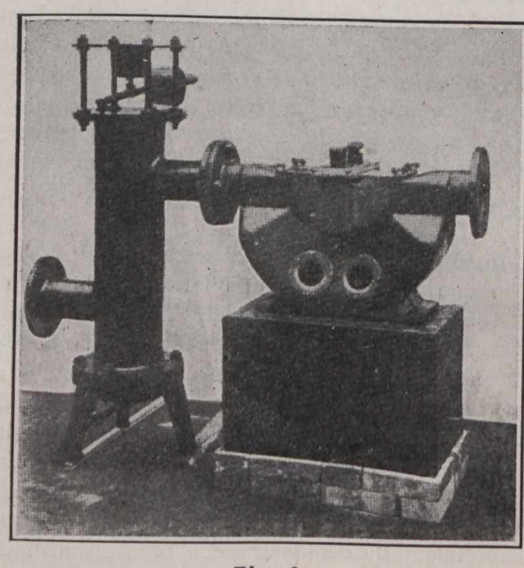


Fig. 2