numerous experiments is shown in Figure I, and it is given here as an illustration of this phase of the graphite industry.

The ore pulp, rendered fairly dilute, was fed at the point A, and, forming a thin film, ran down the incline B. During the journey the flakes of graphite were presumed to acquire, and maintain, a position parallel to the surface B, and, upon striking the water level C, they were supposed to volplane as it were across the space G to the overflow lip D, where they were discharged to the small screen E, and removed by any suitable means. The gangue particles, being granular, sank in the space G, and were discharged through the valve F. Water level was regulated by the tailings valve.

Theoretically, the principles involved were fairly sound, and in practice some of the flakes did volplane across the clear space, and were duly collected; but, again, some of them didn't, and the proportion that did was very, very much smaller than the proportion that didn't.

About this time a dry process of rolling and screening was receiving a good deal of attention, and its adoption in Canada became almost universal. Here

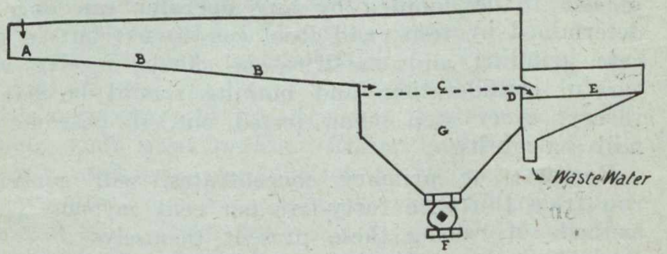

FIG. 1.

again the shape of the flake was taken advantage of, and here again the principles involved were fairly sound—up to a point.

The broad lines of the flow sheets usually adopted were somewhat as follows:—The ore was dried in either kilns or rotary driers, and was ground by the usual dry methods to minus 20 mesh. In this form it was fed to small high speed flour rolls. The theory simply was that, the flake, being flat and tough, would pass through the rolls uninjured, while the gangue being granular, with the exception of any mica present, would be pulverised to dust, and could thus be removed by screening. The rolled material was passed over a forty mesh screen. This yielded a fairly clean flake. The throughs were dusted over an eighty mesh, and then passed to another battery of rolls, after which the material was scalped over sixty mesh, the throughs being again de-dusted, and further treated with rolls and screens.

The principles upon which the process rested have long been recognized. The first graphite mill in Canada used buhr stones and screens for the final treatment of concentrates, and the latest uses rolls and screens for the same purpose; but there is a vast difference between treating a high grade concentrate, and a ten to twelve per cent ore. In the first case the destruction of valuable flake is small, and the wear and tear on rolls and screens is negligible, while in the latter the destruction of flake is enormous, and the cost of wear and tear becomes a most formidable item. In practice it was found that, with the roll and screen method, a large proportion of the graphite was broken up, and therefore passed out with the dust. The large quantities of floating dust in the air of the mills caused trouble with bearings and belts. Recoveries were low, operating efficiencies were low, costs for repairs and renewals were high, and so the process inevitably languished, and eventually died.

While the roll and screen process was dying out, a plant using wet crushing, grinding, classifying, and tabling machinery was designed and built. In this process the very slight difference between the specific gravities of graphite and its gangue caused many troubles; but the plant may be considered the most successful one working on disseminated ores up to the advent of the use of oil flotation on graphite ores.

The flow sheet was roughly as follows: The ore was broken in jaw crushers, and ground in a ball mill and tube mill. The resulting product was then sized in screens and hydraulic classifiers, and passed to a series of tables, which produced concentrates, middlings, and tailings. Middlings were re-ground and re-tabled. Concentrates were filtered, dried and then passed to a finishing plant consisting of rolls and screens.

The recovery of crucible flake was high, and the operating efficiency was high. The plant, consequently, has run fairly continuously for some years, and latterly flotation has been installed. The construction of this plant marked the return of graphite to the more or less beaten paths of milling practice, and during the war several other plants adopted the gravity process. All other plants, however, installed dry gravity tables, and the processes were dry throughout.

Reports of the results of these mills differ; but they all eventually closed down. It is the opinion of the writer that the enormous cost of repairs and renewals was largely responsible for this. High costs, and low operating efficiency appear to be factors accompanying every dry process.

The use of gravity methods for concentration, brought into discussion a point that had, apparently, escaped notice before, or if it had not escaped notice had, at least, not been raised, namely the intimate intercrystallization of graphite and its accompanying rocks. It was found, through careful examination of table middlings that, even at most minute sub-divisions, graphite and gangue were still to be found clinging to one another. This is a most important point in considering the application of the flotation process to graphite ores, and it will be treated in a subsequent portion of this paper.

The use of standard gravity tables, for the concentration of graphite, marks the last phase of the past. The use of the oil flotation process belongs to the present; but before passing from the past to the present it might be remarked that it is singular that the flotation process was never discovered by the early graphite operators. Fine graphite will often float without the aid of oils, and on every tailing pond big blobs of graphitic froth may be seen. It seems remarkable that, to none of the numerous operators came that flash of inspiration that would have bridged the gap between those floating blobs of mineralized froth and a new process.

Frank Elmore saw the imprint of an oily hand marked out by collected copper slime, and from this germ of thought one phase of the flotation process was born. Graphite operators, for years, actually saw the mineral laden bubbles that were, eventually, to