Presidential Address by Hugh K. Picard

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Introduction. In addressing you to-night I propose to follow the course taken by my predecessors in giving a brief survey of recent metallurgical progress, in so far as such has come within the purview of my particular character on matters affecting our industry. In normal times it would be a simpler task to follow and record such developments, but the War has imposed entirely new conditions which increase the difficulty of a review, such as secrecy (in order to prevent leakage of information to the Enemy), urgency (wherein economics have been thrown to the winds in the materialization of a desired military result), an entire re-grouping of the factors of chemical and metallurgical supply and demand, and, finally, the promise of revolutionary changes in regard to labor.

As to the first of these it is to be hoped that, as the necessity for secrecy no longer exists, many of the great advances in technical and metallurgical science evolved under the stimulus of war may now become known for the early benefit of our national industries.

Further, it is much to be desired that such industries as have sprung up in response to our urgent necessities (other than those concerned with the production of purely war material) will not only be retained by us, but will continue to develop to the advantage of the country and the nation. Certain of these have been re-created in an artificial atmosphere of State support or subsidy; several, with such assistance, having reached a stage of technical efficiency, it appears to be of vital importance that further encouragement should be afforded them for such periods as will secure their permanence or of their requiring a minimum of external support.

Tungsten. A typical example of this is the tungsten industry, about which so much has been made public. Even the non-technical reader is now familiar with the general facts regarding this metal, while a certain amount of information as to its production has also become known through the technical press. It will be sufficient for me to refer to Julius L. F. Vogel and A. F. MacLaren, whose able work resulted in the production of this essential metal—essential not only in war, when its supply was a vital necessity to the country, but also in time of peace. Its importance is well expressed by the American metallurgist, Colin Fink, who says: "It may some day be said that tungsten made democracy possible." Through the efforts of these metallurgists and their associates we are now independent of foreign supplies and, moreover, the quality of the British production is superior to that previously imported from Germany.

Flotation. In regard to recent metallurgical advance during the past few years it will probably be conceded that the practice of flotation has brought about greater progress in metallurgy than any other single invention. At the inception of the froth-flotation process in 1905, oils, such as oleic acid (then deemed to be insoluble), were used. As careful analysis showed the mineral so frothed to be intimately associated with the insoluble oil employed, the impression was gained that this had uniformly coated the particles which had been floated, and that the air bubbles had become attached to such oiled particles. As the amount of oils used was relatively minute, say 2 lb. to the ton of ore, while the aggregate surface of the particles oiled is enormous, calculation showed it to be questionable whether an oil could be distributed qua 'oil' in such extreme tenuity and still retain its original physical properties.

With the discovery, some four years later, that other and wholly-soluble frothing-agents were found equally and sometimes even more effacious, the conception that oil was primarily essential to frothing was necessarily modified, and the process became more widely known as that of 'froth-flotation.' With later discoveries as to the partial solubility of essential oils, of the beneficial effect of certain insoluble oils in 'stabilizing' the froths and of sub-aeration procedure, the elimination of any need for pulp-heating, or in many cases for acidification, together with the use of alkaline circuits, etc., modern flotation has made remarkable advances.

Broadly speaking, the essential conditions for effective flotation appear to be that the material to be floated must be capable of flocculation, while that not to be floated must be brought as nearly as possible to the reverse state. This is achieved by the addition to the ore-pulp of reagents which by adsorption or sorption at the surfaces of the various particles increase such differentiation. Acids, alkalis, and certain alkaline salts act in the direction of wetting the gangue by water more profoundly, producing a deflocculation effect, whereas the adsorption or sorption of a minute amount of an immiscible oil at the mineral surface renders this still less capable of being wetted by water, and thus stabilizes a mineral-coated bubble in water.

The water-soluble portion of an oil, or a water-soluble substance such as cresol, amyl-alcohol, etc., reduces the tension of water, and thus permits the latter to form an extended froth surface for occupation by the less water-wetted floatable mineral. Certain oils may thus pay a dual part in flotation. Variations in ore constitution — both physical and chemical in the nature of the water, in choice or limitation of reagent, and in local conditions generally—are so wide that each one will present a flotation of its own, requiring individual study. Where the factors are so varied flotation must in large degree remain an art, as well as a growing science. This condition, however, governs applied science generally, and metallurgical processes form no exception to the rule.

I understand that contributions to the more scientific aspects of flotation may be expected shortly, which will, no doubt, go far to elucidate the fundamental principles on which the process is based.

Since the outbreak of war flotation methods have been widely, indeed almost universally, adopted. During this period, the greatly extended use of this process in the United States is the most notable feature, and it is hardly too much to say that concentration practice has been revolutionized: in addition to the increased recoveries of mineral due to the ability of this method to deal effectively with slime, its adoption has led to a general simplication of concentration procedure, with a corresponding reduction of working cost.