ance furnace and the slag was of very high temperature, much above that of the bath. By this means it was possible to obtain highly fluid slags sufficiently basic in character.

Too much data is lacking to make it possible to present a practical estimate on the future economic aspect of the process.

NEWS ITEMS.

A new copper alloy which has the hardness of steel and has great tensile strength has been invented by a French metallurgist. Eleven pounds chromium are melted for one hour with eleven pounds aluminum, and then 242 pounds copper are added. The entire charge is kept at fusing temperature during one-half hour. Then 55 pounds nickel are added and the mixture is heated another hour, upon which 44 pounds zinc are added.

The proportions of copper and chromium can be varied according to the use to which alloy is to be put, but the order in which the metals are brought to melting temperature, as also the addition of aluminum, must not be changed. The breaking load with this alloy is said to be 40 tons per square centimetre.—La Fonderie Moderne.

The Canadian Venezuelan Ore Co. has recently acquired an area of about 6,000 square miles of Hematite ore beds at the mouth of the Orinoco River, this site being situated about 2,000 miles from Philadelphia. It seems that this Canadian company beat out a German syndicate in acquiring this ore bed. The shipping facilities are said to be good, and it is expected that the second year's operations will be in the neighborhood of 1,000,000 tons. The following is a furnished sample analysis:—Fe, 57.5; Mn, 0.49; S, 0.062; P, 0.078; TiO_2, 0.078; SiO_2, 12.4; CaO, 0.22. Among those prominently connected with this development are Sir Max Aitken, F. P. Jones, and H. S. Holt.

THE STRENGTH OF SHEET PILING.

In an appendix to the report of the Committee on Wooden Bridges and Trestles of the American Railway Engineering and Maintenance of Way Association, the strength of sheet piling is discussed.

The magnitude of the stresses in sheet piling, due to bending, depends upon the kind of material retained by it. Sheet piling is generally held in place by a wale at the top, one at or near the bottom of the excavated trench or area, and sometimes by one or more at intermediate points.

In deriving the following formulas all weights are expressed in pounds per cubic foot, all distances in feet, and all bending moments in pound-feet. A vertical strip of piling 1 ft. wide is considered for the sake of convenience.

1. Pressure Due to Water. Let the upper wale be assumed at the water surface and the lower wale at the bottom of the excavation, or at a distance D below the surface of the water, both wales being properly braced. By the methods of mechanics the greatest bending moment occurs at a distance 0.577 D below the surface, if the piling be treated as a simple beam. This point is farther from the middle of the unsupported length than in any other case where one or more additional wales are employed. The eccentricity may, however, be regarded as offset by the partial continuity of the lower end which penetrates the soil, and thus the greatest bending moment may conveniently be taken at the middle of the unsupported depth. The value of the greatest bending moment is 3.91 D^3, the weight of a cubic foot of water being taken as 62.5 pounds. If an additional wale be located at a height C above the bottom one, the greatest bending moment between them is 3.91 ($2C^2D—C^3$). In case both the top and intermediate wales be omitted the bending moment at the bottom is 10.42 D^3. If the fluid material retained by the sheet piling is heavier than water the pressures and bending moments are proportionately increased.

2. Pressure Due to Dry Sand. According to Coulomb's theory the horizontal pressure expressed in pounds per square foot for material which assumes a slope of 1.5 to 1 is W H $\tan^2 (45°—½ R)$, in which W is the weight per cubic foot of the material, H the depth at which the pressure occurs, and R the angle of repose expressed in degrees. This indicates that the pressure varies directly with the depth as in hydrostatic pressure, but that the unit weight of the material is W $\tan^2 (45°—½ R)$ instead of W. In the material under consideration it is observed that the trench may be excavated a foot or more below the bottom of sheeting without causing any flow, and hence it may be assumed that the pressure is zero at the bottom as well as at the top.

It has also been observed that the center of pressure against sheet piling is not at one-third of the depth from the bottom, but more nearly two-thirds of the depth (see Earth Pressure and Bracing, by J. C. Meem, in Trans. Am. Soc. C.E., Vol. 60, and the accompanying extended discussion). It seems, therefore, that the angle of repose for any given material is not constant but varies in some manner, although not directly as the depth. In conformity with these facts R may be taken equal to $90° (H/D)^{0.6}$. The exponent 0.6 is based on the result of observations.

For material having an angle of repose of 33° 40', which corresponds to a slope of 1.5 to 1, Coulomb's formula gives a horizontal pressure equal to 0.12 W D^2, and the overturning moment about the base of 0.04 W D^2, which is claimed by Sir Benjamin Baker to be double the true value. From the results of Trautwine's experiments on overturning moment, due to dry sand, it is computed to be 0.019 W D^3. By plotting the horizontal pressures derived from the values W H $\tan^2 [45°—45° (H/D)^{0.6}]$ for different depths, the total pressure for dry sand is found to be 0.029 W D^2, and the centre of pressure is approximately two-thirds of the depth of the excavation from the base, making the overturning moment 0.019 W D^3, as before.

For sheet piling resisting the pressure of dry sand when held in position by wales at the top and bottom of the excavation, the greatest bending moment occurs at a distance 0.43 D from the top and equals 0.0045 W D^3. When an intermediate wale is placed at a height C above that at the bottom, the bending moment becomes 0.0045 W C^2 D.

3. Pressure Due to Wet Slipping Material. There remains to be considered the wet slipping material which exerts a much greater pressure than dry sand but a smaller pressure than water. Such material produces a considerable pressure at the bottom of the excavation. To meet this condition it may be assumed that the depth at which the horizontal pressure becomes zero is 2 D instead of D. When this change is made in the previous value for horizontal pressure the results agree closely with those of observation. The total pressure above the bottom of the excavation is 0.08 W D^2 and the center of pressure is at ½ D. The overturning moment about the base is then 0.04 W D^3.

The greatest bending moment on sheet piling supported at the top and bottom only and retaining wet slipping material is 0.013 W D^3 and occurs at half depth. When an intermediate support is placed at a distance C above the bottom the bending movement is 0.013 W C^2 D.