Sand and Slime.—Finding that fine material interfered with rapid and even leaching of the tank contents, the two were separated and the clean sand leached by itself, a much more satisfactory method. The finer material, at first discarded, was later found to contain a good proportion of the valuable metal, often the most of it, and the problem of its treatment arose. It could not be leached, as it was too fine and packed so tightly in the tank as to be practically impermeable, and the only way in which it could be satisfactorily extracted was to keep it in suspension in cyanide solution while the dissolving progressed, and to separate the two after the extraction of the valuable metal was complete. The fine material, by common consent, has been called slime; and while the exact definition of the word has been the subject of much controversy, it is generally taken to mean the extremely fine clayey or colloid portion of the ore which may not be successfully leached. Its treatment bothered operators for many years, and in the devising of an applicable method, the agitation system, now highly perfected, was born.

El Oro Methods.—At the mill of the El Oro Mining & Railway Co., at El Oro, Mexico, one of the early plants in America to attempt the separate treatment of slime, the material was agitated in shallow, rectangular tanks by means of compressed air introduced through a hose moved from point to point by an operator. The system made use of the mechanical efficiency of the air in keeping the solids in suspension, and also the oxygen in the air to supply that necessary in the completion of the chemical reaction. This method was troublesome and expensive, requiring too much labor to be economical, and was soon replaced by round tanks in which the agitation was mechanically done, using a central vertical shaft provided at the bottom with arms for keeping the solids in suspension, and air was added either through fixed pipes in the tank or into the suction of a centrifugal pump used to assist agitation. A later development made use of a hollow vertical shaft through which air was introduced, passing thence through hollow agitating arms and escaping through a series of small holes, thus combining mechanical and air agitation at the same time. These methods gave good results; but the notion of "killing two birds with one stone" had not been forgotten, and agitation by means of compressed air alone was studied until the tank known as the "Brown" or "Pachuca" was developed and became almost universally used.

The "Pachuca" or "Brown" tank is a tall cylinder of steel plate having a cone-shaped bottom and is fitted with a tube vertically placed in the centre. This tube acts as an air lift, raising the mixture of solid and solution and discharging it near the top of the tank, thus maintaining a constant circulation and giving no opportunity for the solids to settle. The tank is very tall in comparison to its diameter, made so in order to minimize the chance of settling; and to further this object, the cone bottom is made so steep that solids can hardly remain on it. The usual dimensions of the standard tank of this kind are about 15 feet in diameter and 45 feet deep, although in some cases the proportions are varied. The central tube reaches from near the bottom of the tank, where compressed air is admitted, to within a few inches of the top. This latter point is the subject of many variations, some operators maintaining that the necessary conditions are complied with when the tube reaches only half way up the tank. It will be seen that this is an air lift working under practically ideal conditions as to submergence, and power requirements are not large. In a standard tank, which will hold about 100 tons of dry slime at the usual dilution, the operation is stated to require about 100 cubic feet of free air per minute, compressed to 25 to 50 pounds per square inch. The higher pressures are required to start operations after the tank has been without agitation for some time, and the lower ones to maintain agitation after it has been started.

The Trent System.—Having thus devised a method of treatment which accomplished a straight air-agitation treatment, operators continued to experiment with means of improving it and reducing its cost. The height of the "Pachuca" tank, as it is usually called in the United States, militated against its economy, as it is generally believed now that it requires more power than should be necessary for the performance of its duties. Many other systems have been invented and put into use, most of which use compressed air as motive. One known as the Trent system operates by the use of a centrifugal pump in a tank of large area, having a flat bottom, and comparatively low. Such tanks may be 20 to 30 feet in diameter and 10 to 15 feet deep. The pump is fed from a point near the surface of the tank and forces the pulp through an appropriate gland in the tank bottom into a system of arms, made of pipe, placed so that they may revolve near the bottom of the tank. The arms are fitted into a grit-proof bearing, and the pulp exits are all curved in one direction, the force of the discharging pulp causing them to revolve in the tank after the fashion of an automatic lawn sprinkler. To supply oxygen to this system, air is introduced into the pump column from a compressor; or this may be done by arranging a sniffle valve in the suction, although this is likely to reduce the efficiency of the pump.

The Dorr Agitator.—Probably the latest claimant for honor as an agitator is that known as the Dorr, which uses a flat-bottomed tank like that in the Trent system. The mechanism is like that used with the well-known Dorr thickener—a central shaft carrying two arms, inclined upward at an angle from the centre. Upon the bottom of these arms are a series of inclined blades, which act as rakes, drawing the settled material toward the centre of the tank. Upon reaching the centre, the slime comes under the influence of an air lift, which circulates it much as it is done in the Pachuca tank. The discharge of this air lift may be free, as in the Pachuca tank, or through a distributing canal fastened to the central shaft; in the latter case the discharged slime is distributed over the entire surface of the tank. Here again the air is made to serve two purposes. The particular advantage claimed for this tank is that it requires very little power, the mechanically moved arms revolving very slowly and requiring only from ¼ to ½ a horse power, while the air lift has no great height and small quantities of air under low pressures may be used. Tanks with flat bottoms and great area, compared with their height, are preferred on account of their low installation cost and also the influence upon the first cost of the milling plant. When tall tanks are used, costly excavations are required in addition to the heavy installation expense of the tanks themselves.

It is, of course, not to be thought that the devices mentioned cover the entire field of slime agitation, as many other ideas have been put into practice; but they do represent the most successful types and indicate the essential fact that air can be made to perform two distinct functions at the same time.

Other Uses of Compressed Air in Cyanide Plants.—In addition to the uses named, compressed air performs