fully double that obtained in the ordinary way. 2. The difficulties to be overcome in the application of diffusion are wholly mechanical. 3. The process of carbonatation for the purification of the juice is the only method which will give a limpid juice with a minimum of waste, and maximum of purity. 4. By a proper combination of diffusion and carbonatation, the experiments have demonstrated that fully 95 per cent of the sugars in the cane can be placed on the market either as dry sugar or molasses.

PROGRESS IN METALLURGY.

ONE of the serious metallurgical problems of today is the recovery of the by-products from the manufacture of coke by the destructive distillation of bituminous coal. In this country coke for metallurgical purposes is prepared almost exclusively either in open heaps or in 'beehive' ovens, — hemispherical fire-brick chambers into which sufficient air is admitted to burn the distillates, and thus to produce the heat required for the distillation itself. Not only are the distillates, which contain ammonia and tar, of great value to the color-maker, thus wasted, but, as they burn in actual contact with the coking mass, much (often twenty-five per cent) of the coke itself is incidentally burned. Both these evils are completely avoided by coking in retort ovens, heated externally by the combustion of the distillates, but after they have deposited their tar and ammonia in surface condensers. The first volume of the Journal of the Iron and steel institute, for 1885, contains an important group of papers and discussions on this subject, whose net result is to place the advocates of retort coking in a much stronger position.

The iron blast-furnace is the chief consumer of coke; and though in continental European blast-furnaces (and in British foundery cupolas as well) retort coke is as efficient as beehive coke, and though the calorific powers of the two fuels are almost identical, yet in British and American blast-furnaces the efficiency of retort coke has hitherto proved so low as to largely offset the advantages of the retort, — its greater yield of coke and its recovery of by-products. Hence the retort has gained but a slight foothold in these countries, though used on the continent very extensively and successfully with coals of widely varying compositions and properties. We may solve the retort problem either by adapting our retorts to the requirements of our coal, or by adapting our blast-furnaces to the requirements of retort coke.

Mr. J. Lowthian Bell shows by conclusive experiments that the low efficiency of British retort coke is due to its ready solubility in the carbonic acid which it encounters on entering the blast-furnace; and this, in turn, appears to be mainly due to the comparatively low temperature of retort coking. It would seem practicable, however, to raise this temperature approximately to that of the beehive; and Mr. H. Simon and Mr. Watson Smith describe the adaptation of the Siemens regenerative system to the retort for this purpose, and the improvement in the quality of the tar which it has effected. The problem of adapting the retort to the coal seems thus in a fair way to solution, while that of adapting the blast-furnace to retort coke appears to be in an equally promising condition, if we may judge from comparative tests which Samuelson describes, conducted on a gigantic scale in his blast-furnaces, themselves highly efficient, in which British retort coke shows an efficiency equal to that of the best beehive coke. This one success outweighs in importance fifty previous failures.

A very important contribution to the world's supply of tar and ammonia is promised from another source. A large and constantly increasing proportion of our metallurgical furnaces are heated by gas produced by the simultaneous distillation and partial combustion of bituminous coal and similar substances. In the apparatus employed the hydrocarbons, etc., arising from distillation, incidentally become diluted with such enormous volumes of nitrogen and carbonic oxide from the partial combustion of the coal, that the condensation of their tar and ammonia would require apparatus of a size and cost which are simply prohibitory; and, unable to separate these valuable substances, we burn them in enormous quantities. But Mr. John Head describes an egg of Columbus which promises to enable us to isolate the distillates for condensation and the manufacture of illuminating-gas.

A knowledge of the relations between the chemical composition and the physical properties of iron, which would enable us to infer the latter from the former, would be invaluable: unfortunately investigation has thus far only plunged these relations into hopeless confusion. To elucidate the subject, Dr. Hermann Wedding has carried out extensive and ingenious microscopic studies of the structure of iron. We have not space to analyze the results which he here presents, further than to give as a sample his announcement that malleable iron, produced by any fusion process, consists of two distinct components: 1°, minute porphyritically distributed crystalline particles; and, 2°, a homogeneous matrix in which they are distributed.