the probability curve. The applicability of this curve to the representation of height has been frequently tested, and is found always to hold wherever the conditions upon which the law depends are present; viz., that variations in the phenomenon in question be due to a large number of causes, no one of which has any great effect. Where the law does not hold in the case of a series of heights, the probability is strong that there are some influences in question which cause a considerable variation in the average height. In several parts of France there is a strong indication of the existence of two types, distinguishable by their difference in height. If we draw the curve of height for these portions, this phenomenon is evident. A good example is shown in the department Doubs. The top of the curve for this region is M-shaped, while, in dealing with a case in which the probability case does hold, — that is, when a single type is present, as in La Creuze, — the top of the curve resembles an inverted V. There exist, then, in all the provinces in the north-eastern half of France, two types which can actually be separated from each other. This is shown on the map by the occurrence of pairs of smaller circles; and the ratio of the size of these circles indicates the proportion of the two types in each part. The average height of the tall type is 5 feet 6.6 inches; of the other, 5 feet 4.6 inches. It is certainly a curious fact that these two peoples, who now have every thing in common, — language, mode of life, and all, — who intermarry freely, and probably have no consciousness of their dual origin, should still be unidentified by the constant characteristic of a difference in height.

It is probable that other circumstances than those of race can affect the stature of a people. Chief among these are, 1°, the well-being of the community; and, 2°, pathological conditions. There are countries where the average stature has changed without the introduction of a new racial element. In the low countries (Holland, etc.) this phenomenon is ascribed to the effect of the draining of the marshes, and the general betterment of the people.

The statistics of Saxony, from 1852 to 1854, make possible a comparison between the heights of the liberal and the laboring professions. If we draw the curves representing the number of each class at each height, the curve for the liberal professions shows a superiority of height throughout. They have fewer short persons, and more tall ones. The difference between the two, however (5 feet 5.6 inches and 5 feet 4.25 inches), is smaller than in the case of racial difference.

A case in which pathological influences (such as cretinism) seem to be active is offered in Switzerland. Here there seems to exist a true type of dwarfs whose heights centre about 4 feet. The suggestion that minor influences such as these may also be active in producing the differentiation of height in France, is worthy of consideration.

THE EXTRACTION OF SUGAR FROM SORGHUM AND SUGAR-CANE.

The experiments in the application of diffusion and carbonatation to the extraction and crystallization of sugar from sorghum, which have been in progress under the direction of Dr. H. W. Wiley and his assistants at Ottawa, Kansas, during September and October, have been described by him in Bulletin No. 6 of the chemical division of the department of agriculture. The difficulties met with were largely of a mechanical nature, or resulting from the effects of early frost injuring the quality of the cane which was used for the experiment.

Of the trial on Oct. 8, Dr. Wiley says that during a run of about 21 hours, 70 cells, of about 1400 pounds of cane apiece, or 49 tons, were diffused, giving from 65 cells 96,140 pounds of juice. The exhausted chips contained less than 2 per cent of sugars, and the waste waters about the same amount; so that the extraction may be said to be nearly complete. The cost was about 80 cents per ton, and, with improvements in the mechanical details of the apparatus, labor and fuel can be saved, and the cost reduced to 30 cents. The juice drawn off stood to the cane chips in the ratio of 110 : 100 in the first, and 95.3 : 100 in the second, part of the experiments. The solids it contained varied from an average of 1.024 per cent, corresponding to a specific gravity of 1.0394 at 25° C., in the first half, to 10.55, corresponding to 1.0405 at 25° C., in the second half, of the experiment.

The juice corresponding to 15 tons of cane was defecated by the method of carbonatation, and yielded 4320 pounds of *masse cuite*, containing 77 per cent of solids, or a little more than 14 per cent of the cane worked. This, on being 'swung out,' yielded 1420 pounds, or 30 per cent of sugar well washed and dried, polarizing about 98 per cent, or at the rate of 95 pounds to the ton. The yield of second sugars would, of course, increase the rate of production per ton. Allowing 12 pounds to the gallon for the *masse cuite*, the number of gallons per ton would be 24, which is far in excess of the amount usually produced.

Dr. Wiley's general conclusions are as follows: —

1. By the process of diffusion 98 per cent of the sugar in the cane was extracted, and the yield was

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.