seen others completely narcotized by doses of morphine, that would only have quieted a cough in most; and so on to the end of the chapter.

We are well aware that book doctoring is held at its proper valuation by the leaders in the medical profession, and that to such, the really skillful, even the slightest peculiarity of temperament is not deemed unworthy of attention; but there are too many, far too many, who put all patients on the same plane, and confine themselves rigidly to one routine of treatment.

No less are idiosyncracies of mind and disposition to be regarded in imparting instruction to the young, or in our everyday dealings with our fellow men. Most mental peculiarities are easily discovered by the practiced student of human nature, and it as much our duty in our attempts to instruct and reform others, to avoid nauseating them mentally as it is that of the physician to avoid over-dosing those he is attempting to heal.

STEAM BOILER INSPECTION AND INSURANCE.

At a meeting of the Directors of the Hartford Steam Boiler Inspection and Insurance Company, held at their office in Hartford, March 31st, the following report of business done in the month of February, was read by the President: "Visits of inspections made, 180; number of boilers examined, 332; external examinations, 261; internal examinations, 84—while, in addition, 18 were tested by hydraulic pressure; number of defects in all discovered, 226; number of dangerous defects, 26; furnaces out of shape, 13; fractures, in all, 21—3 dangerous; burned plates, 20—2 dangerous; blistered plates, 53—2 dangerous; cases of incrustation and scale, 45; cases of external corrosion, 23—3 dangerous; internal corrosion, 3—1 dangerous; internal grooving, 6; water gages out of order, 6; blow-out apparatus out of order, 2—1 dangerous; safety valves overloaded, 22—3 dangerous; pressure gages out of order, 14—8 dangerous; boilers without gages, 1; cases of deficiency of water, 3. In the month's work four boilers have been found in such condition as to be positively dangerous, and beyond repair. These four have been condemned, and are being replaced by new boilers. In one of the cases of internal corrosion, noted above, an internal examination revealed to the inspector plates so badly weakened that upon sounding them with a hammer a hole was broken entirely through. This shows the importance of careful internal examinations. Many cases similar to the above have been found in localities where laws requiring annual inspections to be made are in full force. State and municipal inspection laws require only the hydraulic test to be applied; hence incrustation, scale and internal corrosion are defects which such inspections take no cognizance of.

"We must again revert to the subject of *overloaded safety valves*. Twenty-two have been found; while three were entirely inoperative—from excessive loading and neglect. One spindle was very crooked, and extra weighting was resorted to. In another the valve was corroded fast in its seat, and was raised with great difficulty. In another the fulcrum joint was corroded fast, and in raising the lever the connection was entirely broken out.

"Now, although a manufacturer may think he has a very careful engineer, and that inspection is hardly necessary, he must admit that a man whose business it is to thoroughly examine boilers, internally and externally, will discover defects which another would pass over. While many and serious defects have been discovered by the company's inspectors, no risk has been assumed except where the boilers have been put in good repair. Among the 2,500 boilers under the care of this company, slight damage has occurred to one in the city of Providence, during the month. Our inspector from this office visited the establishment at once, and made careful examination of the ruptured sheet; repairs were immediately made, this company assuming the expense."

DEATH OF JAMES HARPER.

The recent sudden death of James Harper, senior member of the celebrated publishing house of Harper & Brothers, of this city, has taken away from us one of our most honored and respected citizens. His death resulted from injuries received by being thrown from a carriage while taking a drive. His funeral, which took place upon the 30th of March, was largely attended by the most prominent citizens of New York, and was further honored by the closing of the different houses in the book trade throughout the city. He was, in many respects, a remarkable man, and his life was one long example of the beauty of all social and Christian virtues, combined with business and literary judgment, to a highly exceptional degree.

Applications of Steel Castings.

A few days ago we saw a number of specimens of steel castings imported by Philip S. Justice, of this city, which showed a degree of tenacity and ductility seldom found in steel forgings. The castings were of varying thickness, form, and weight, and had been subjected to forging, bending, percussion when cold, hardening, tempering, etc., all the tests that would be used to determine the toughness of the best wrought iron, and some that would be inadmissible with steel forgings. The result was wonderful. Cored castings were brought together under the hammer, and drawn out without showing any evidences of unsoundness. The castings showed no blow holes or evidences of want of homogeneousness, but were in all respects as sound as any forgings. They finished under the file or on the lathe elegantly. It is claimed they can be made as thin as one-sixteenth of an inch with facility. Their solidity may be conceived from the fact that hydraulic cylinders, unlined, of fourteen inches inside diameter, two feet ten inches long, and only two and a half inches thick, stand a test to which one of cast iron eight inches thick, would succumb.

These castings have been used in England for some time, but have only lately been introduced into this country. The applications of this method of working steel are numberless, or at least equal in number and similar in character to those of cast iron, and calculated to supersede wrought iron and steel forgings to a very great extent.

BEET ROOT SUGAR.

No. IV.

Technology.—Part I.

As a complete account of the various modern processes for manufacturing beet root sugar would fill several reasonably sized volumes, it will be impossible for us to exhibit them in all their multitudinous details in the pages of the Scientific American, where they would stand in the way of the publication of a large amount of useful and interesting reading matter of a more varied nature.

For this reason we shall have to confine ourselves to the illustration of the most recent and perfect methods of manufacture only, which we shall strive to do, as concisely as possible, without omitting any item of importance.

We will add, the specifications and detailed estimates for the establishment of a sugar factory, calculated to work an average of 150,000 lbs. of beet root per twenty-four hours, during a campaign of from four to five winter months, and corresponding in the United States to the average product of the cultivation of 500 acres in beets. This important subject has never, to our knowledge, been fully elucidated in any printed work on the making of sugar, and may be found of value to parties intending to start this branch of industry in America.

PRODUCTION OF STEAM.

Beet root sugar works consume a large amount of steam for driving engines which propel root-washers, hydraulic pumps and presses, pulpers, water pumps, centrifugals, etc. Steam also conveys the juice and sirups from one place in the building to another, and is the agent used for evaporating and boiling them.

The quantity of heating surface needed is generally estimated at about 250 square feet for every 10,000 lbs. of roots worked during 24 hours, or the H. P. is supposed to correspond to 50·8 lbs. of water evaporated per hour, or 6 lbs. of water for every square foot of heating surface of the boilers.

Practically, we have found that a well-managed modern sugar factory employing vacuum pans, both for the concentration of the juice and for its final boiling down, and capable of working 150,000 lbs. of beets every 24 hours, necessitates 120-H. P. boilers, and 17·216 feet of heating surface to the H. P.

The pressure of steam through the whole works ought never to exceed three atmospheres, or 45 lbs. to the square inch.

From the above, we derive the information that the steam department of a 500-acre beet root sugar factory and its cost in gold, will be as follows:

1. Three steam boilers of 40-H. P. each, with two internal pipes and one flue, calculated at 17·2 feet of heating surface per H. P., with fire boxes, grates, safety valves, gages, anchors, steam valves, H-pipes, etc., complete. Cost, $3,700.

2. Two steam drums, superposed over the boilers, with fittings complete, serving as reservoirs for the return steam from all parts of the works. Cost, $260.

3. One small 4-H. P. donkey engine, driving two feed pumps, each of which is capable of supplying a 120-H. P. boiler. Cost, $520.

The total valuation of the appliances for the production of steam in a 500-acre factory, is thus seen to reach $4,480.

WASHING AND PULPING OF THE BEETS AND EXTRACTION OF THE JUICE.

As soon as the works are in perfect readiness for a start, which will generally take place during the latter end of the month of September or during the month of October, the steam is "got up" in the boilers to 40 or 45 lbs. pressure, and the beets to be worked are at once, and regularly, carted in.

Each empty wagon or cart employed for the conveyance of the beets from the trenches to the factory is carefully weighed, and its number and weight noted. Every time this wagon reaches the factory with its load of beets, it is re-weighed, and the weight of the wagon being deducted from the total, furnishes at once the amount of beets carried in for consumption. The wagons and their loads are weighed on large platform scales placed on the roadside near the works. In this manner, during the whole campaign, an exact account is kept of every load of beet entering the works, and of every pound of beet consumed.

The quantity and percentage of sugar made is thus controlled, and in case of some fault in the processes of manufacture, it is at once made manifest. Much valuable information is also furnished by these data as regards the relative value of different fields or portions of land, and the amount of beets grown on them; information which may be made available during following seasons.

The beets as they are brought in are placed in piles alongside of the beet root washer. This is a long, cylindrical, slightly inclined revolving drum, constructed of parallel rods of iron, so distanced as to allow the water and small rootlets to pass between them without permitting the passage of large fragments or of small-sized beets.

This drum revolves in an iron tank, furnished below with a manhole door, which allows it to be occasionally cleaned out; this refuse being carted off as manure.

The proper speed for a root washer is from ten to twenty revolutions per minute.

The more water employed in washing the beets the better, but the supply of both roots and water must be as regular as possible.

Care must be taken that at the lower outlet of the root washer, where the beets fall on an incline plane, interstices be left wide enough for the superfluous water to escape before it reaches the pulper, where its presence would cause irremediable damage.

On leaving the root washer, or rather the incline below it, the beets are pitched into the jaws of the pulper, where they are seized between revolving cylinders, armed with spikes or or knife blades, which rapidly reduce them to a fragmentary form. These fragments pass into the pulper proper, which consists of a double revolving drum, driven by belting. It is constructed by *tightly* fitting into two circular iron end plates, alternate series of small saw blades with projecting straight teeth, and carefully-made wooden rulers 0·39 of an inch broad and 0·78 of an inch high. The saw blades are toothed on both edges, so that by reversing them, one side can be employed after the other has been worn off. The teeth are from 0·156 to 0·195 of an inch in length, and measure 0·078 of an inch from tip to tip in the same row. The thickness of the saws is about $\frac{2}{50}$ of an inch.

The steel of which these saws are made is tempered in such a manner as to cause them to be stiff and hard without being easily broken.

Immediately in front of the revolving drum, whose speed must be from 600 to 700 revolutions per minute, is placed a stout, finely-attached blade of steel facing the points of the saw teeth, and adjusted so nicely as to leave no holes or intervals through which any fragments of beet root would find their way.

This precaution alone prevents solid particles of beet from getting into the woolen sacks during the subsequent pressing, an accident which would be sure to be followed by the bursting of the sacks and wasting of pulp over the spots where the lumps are to be found.

A newly-set pulping drum always produces a rough pulp, in which a portion of the vegetable cells remain untouched; a consequence of this fact is that a larger quantity of juice is actually extracted from pulp made by a pulper which has had some usage, and whose teeth have become worn, than from a new one.

The pulp to be of good quality must be thin, and present no rough or angular "grain" when pressed between the fingers. A limit, however, exists to the advantageous divisibility of the beet root, which is reached when the teeth of the pulper are nearly worn away, and the pulp becomes "pasty," and will ooze through the meshes of the wool sacks when pressed, a circumstance attended with very serious consequences.

A small stream of water, regulated by a cock, is allowed to run constantly on the top of the drum, and to mix with the pulp, where it effects a partial maceration. The influx of this water is to be so regulated that the juice which is expressed will indicate 4·5 to 4·8 degrees of Baumé's densimeter.

The pulp is received in front of the pulper in a small reservoir.

At this point the further processes of manufacture may vary according to the system of extraction of juice adopted. Four of these are now practiced in Europe; they are as follows:

1. The use of powerful hydraulic presses.
2. The employment of centrifugal machines.
3. The method of maceration.
4. The diffusion process.

Without entering here into a discussion of the relative merits of these various processes, which, when well conducted, have in all cases produced the same amount of sugar from the same amount of beets, we shall simply state that the second materially increases expenses for the fuel used during evaporation, on account of the large quantity of water which has to be added to the juice, and that the two last processes need an amount of care and skill on the part of the laborers, which is difficult of attainment.

The system of extracting the juice from the pulp by means of hydraulic presses, worked by pumps driven by steam power, is simple, easily managed, and efficient. In order to effect this, the pulp is first put into bags made from the wool which grows on the bellies of sheep. These bags are 33 inches deep by 22 inches broad, and the quantity of pulp put into them is a shovelful, or a quantity which, when slightly flattened, will not exceed the thickness of a finger.

The sacks are piled up one over the other, separated by sheet-iron trays, and are first submitted to a preliminary pressure in a rapidly-working press, which extracts a large quantity of the juice contained in the pulp. They are then transferred to the hydraulic presses, where the remainder of the juice is squeezed out.

When working in the proper manner, the table of beet root sugar presses must ascend in from five to six minutes, and stop for several minutes before beginning to descend. Too rapid rising of a press destroys the sacks. If the pulp has been sufficiently pressed it will look and feel dry, and will not weigh more than 18 per cent of the weight of the beet root which produced it.

The expressed juice, both from the first press and from the hydraulic presses, is run through pipes connected with funnels or "chapels" into an iron reservoir united by means of a valve or cock, with an upright boiler, called a "*montejus*" which we shall describe in our next article.

Specifications and valuations in gold for the washing,