vulgaris), among all these beauties, but the peculiarities and oddities of his manner of living will compensate the observer for the lack of beauty. The reddish-brown mass on his back is a cork-sponge (*Suberites domuncula*), which keeps company with him. If the sponge is detached from the crab, and both are placed in a tank, the spectator will see a most humorous performance, for the crab will endeavor to procure his mantle and will make the most frantic attempts to get it; in fact he will behave about in the same manner that any person would that has been deprived of a very much needed garment. If he finally gets his covering again he places it upon his back, shifts it, tries it, and after many attempts is at last satisfied. The crab disguises himself by means of the sponge, which grows so rapidly that it is ofttimes difficult for the crab to reserve for himself the freedom of movement for his limbs and continually munching jaws. The crab generally locates himself in the neighborhood of other sponges and there waits for his prey, either attacking them in open fierce combat or in his sly and stealthy way, of which it is a great favorite.

The nests of the weaver bird or the stickleback fish are real masterpieces of animal ingenuity, and are deserving of the praise they call forth; but if we remember that the intelligence of vertebrates is far superior to that of the mollusca, we cannot do otherwise than admire the nest building fileshell (*Lima hians*), Fig. 6. The shell is absolutely white, and fringed by numerous orange-colored tentacles, which serve to furnish the food and the breathing water, as also to build the nest.

The peculiar nest, which is built of small pieces of shells and stones, connected by very fine threads that the animal spins, resembles a fortress, from the main entrance of which the tentacles of the shell project in a defiant manner. The *Lima* swims very well, and drags its tentacles along like the tail of a comet.

The finger date shell (*Lithodomus dactylus*), shown in Fig. 7, bores through the hardest rocks slowly but surely. Schleiden relates the following in regard to it: The temple ruins of Serapis are situated near Puzzuoli (in the Bay of Naples), and three of the columns still stand erect. The columns are of the most beautiful Cipollini marble, and the first seventeen feet are perfectly intact and smooth, but the next seventeen feet have been perforated by numerous date shells, and in some of the apertures the shells are still to be found. The remaining forty-five feet of the columns have been very much affected by the atmosphere. All this is very easily explained, if we assume that the ground upon which the temple stands settled so that the columns were immersed in the ocean to the height of thirty-four feet, and were then perforated by the date shells. Later the land rose again, and the columns were once more upon dry land. Odd documents give proof that the temple formerly stood in the ocean, but that the land began to rise in the fifteenth century, for one of the old deeds of those times conveys to the priests of Puzzuoli "all the new land that is rising out of the water." The ground sank about fifty-two feet, rose again, and, according to all appearances, is now sinking. All these movements were so slow and gradual that not a stone has been displaced, and the columns stand as straight as they ever did. The question arises, by what means does the date shell accomplish its gigantic task? Some assumed that it secreted a strong and powerful dissolving liquid, the composition of which we do not know, but closer examination has revealed the fact that the boring is accomplished by means of fine silica needles on the feet of the animal, so that mechanical labor is required.

Fig. 8 represents a sponge—the antler sponge (*Raspailia viminalis*), in view of its peculiar shape.

Fig. 9 represents the well known sea cucumber, or *Cucumaria planei*.

A New Orang-Outang in London.

The somewhat formidable animal whose arrival at Mr. Jamrach's establishment was noticed in a recent impression of the London *Daily News*, from which paper we extract, has been safely housed at the Royal Aquarium, Westminster. In order to secure his comfort, and it may be added that of the public also, a strong cage has been fitted up, the bars of which are stout enough to allay any apprehensions as to the possibility of its restless occupant finding his way out. Writing on the subject of the orang-outang, Mr. Frank Buckland says that, "so far as can be judged he is an adult, or nearly an adult. He has been brought from Malacca in a box three feet high, and as he sits in the box the top of his head almost touches the top of the box." Stretched to his full height he measures about four feet, and seizes the bars at the top of his cage with the greatest ease, swinging to and fro with all the agility of his race. Some idea of his great strength may be gathered from the nervous energy with which he grasps the bar with his fingers, which are about five inches long, and from the muscular development of his arms and shoulders. He peels an orange with great dexterity, and sucks it with evident relish. He is fond of retirement, and when an opportunity offers will envelope himself from head to foot in his blanket, any attempt to remove which arouses a display of passion which would suggest a speedy retreat on the part of the offending person. His anger is expressed in a peculiar manner. He purses up his lips as though about to whistle a tune, and dashes about his cage with restless energy, stopping every now and then to peer through the bars in search of his enemy.

When in good humor his natural ugliness and the fierceness of his eyes are much softened by the intellectual formation of his forehead, which may be said to be beautiful by comparison with the other portions of his frame. This is a point in which naturalists will no doubt be interested. Although somewhat shy, he does not absolutely shun the public gaze, but generally looks straight before him over the heads of the crowd, as though searching for some object familiar to him. Any unusual sound, such as the beating of a drum, attracts his attention at once, and causes him to turn his head round sharply in a listening attitude.

Concluding his remarks upon this singular animal, Dr. Buckland states that "the hair about his head is so arranged that he appears to wear whiskers. He has, moreover, a red dish beard, and under his beard is a very remarkable pouch, the use of which has not as yet been clearly ascertained. As, however, it is capable of dilatation with air, it is, in all probability, directly connected with the organs of voice. It is a wonder to me how ever the natives managed to catch him, whether as an infant or full growth."

A NEW ACID PUMP.

The use of acids in the arts and manufactures is of great importance, and there is scarcely a laboratory or factory which does not use more or less acid, the quantity varying from a single carboy a month in the smaller establishments

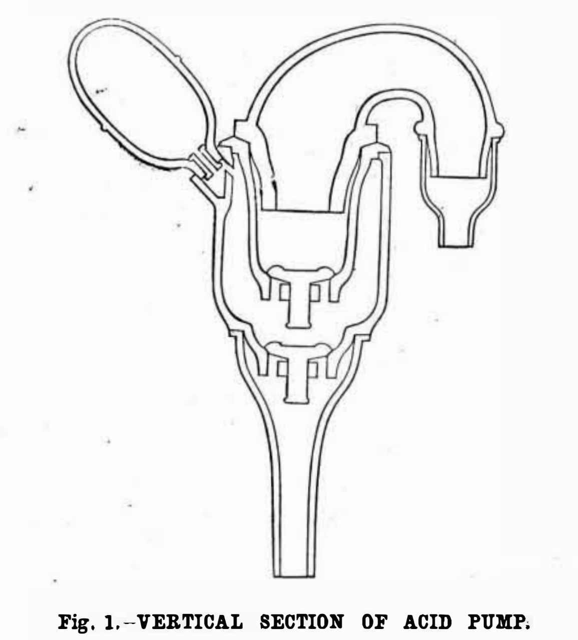


Fig. 1.—VERTICAL SECTION OF ACID PUMP.

to more than one hundred carboys a day in the larger works. The carboy, as is well known, consists of a large glass bottle holding from ten to twelve gallons, packed in hay, in a box with its neck protruding from three to six inches. A carboy of sulphuric acid weighs from 170 to 200 pounds, and is a heavy and cumbersome article to handle; and the problem of getting the acid out of this inconvenient holder without danger to life, clothing, and floors, has been the subject of much study and experiment. Various expedients have been resorted to for removing acid from these unwieldy packages, but they have been regarded as impracticable and unsatisfactory.

The late Francis Nichols, of New London, Conn., devoted his time for about eight years to study and experiment in this direction, and invented a pump which would pump the acid independent of the carboy without injury either to the pump or acid. His last inventions and improvements have recently been patented in this country and in Europe.

The principle on which the pump is constructed may be seen in Fig. 1. The body or working part of the pump con-

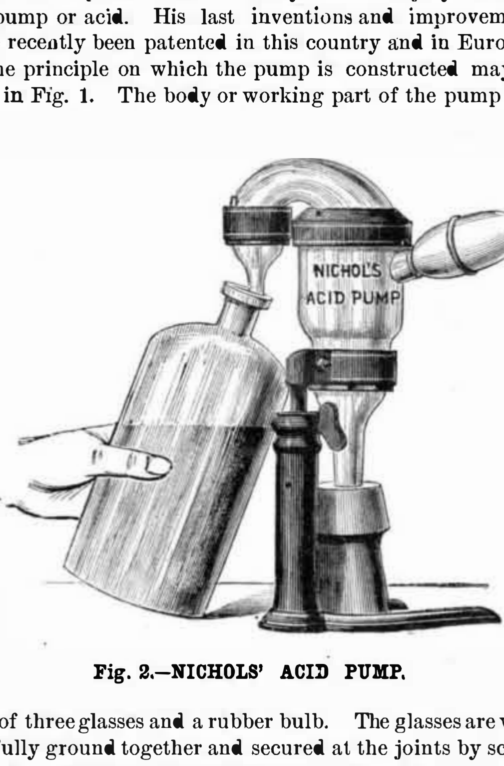


Fig. 2.—NICHOLS' ACID PUMP.

sists of three glasses and a rubber bulb. The glasses are very carefully ground together and secured at the joints by screw couplings, making them perfectly air-tight. The two valves are fitted to their places and carefully ground by machinery constructed especially for the purpose. In use: the rubber bulb is compressed by the hand, which drives the air into the chamber between the glasses, C and B. The lower valve remains tight, and the air escapes through the valve near B. The hand, now removed from the bulb, allows it to expand, and as a vacuum is created in the chamber the upper valve closes and the acid rises through the suction tube into the chamber to fill the vacuum. Another compression of the bulb drives the acid up through the upper valve, and the chamber is again filled with acid; as this operation is repeated the liquid flows from the nozzle of the pump. The relative capacity of the chamber and bulb is so nicely adjusted that the acid never rises high enough in this chamber to enter the bulb. It will be noticed that an air chamber is formed at every joint by a downward projection of the top piece; this prevents the acid from ever reaching any joint so long as the pump stands erect. A discharge tube attached to the nozzle of the pump extends to a point just below the bottom of the carboy, so that continuous pumping for a short time will give a siphonic action which can be instantly arrested at any time by the removal of the bulb from its nipple. A metallic bulb may be substituted for the rubber one, giving greater power. By means of a metallic bulb a large tube may be used on the siphon, which will be capable of emptying a carboy of sulphuric acid in less than three minutes.

By the pump shown in Fig. 2, without the siphon, the quantity delivered can be nicely measured. Its action is rapid and perfect. The glasses are entirely enveloped in a light cast iron covering handsomely ornamented, and the apparatus is light, durable, and perfect in its action. Any quantity of acid can be drawn without the least danger to clothing, person, or floors, and the person using the pump, who may be entirely inexperienced in such matters.

These pumps have been examined and approved by the U. S. Mint, Assay Office, and Torpedo Station; the fire departments of New York, Boston, Lynn, Cambridge, Rochester; and over five hundred manufacturers of the United States. We understand that 1,200 of them are in use. They are now on exhibition at the Fair of the American Institute.

Further information may be obtained by addressing the Acid Pump and Siphon Company, New London, Conn.

The Fire Engineers.

The National Association of Fire Engineers convened in Boston, September 15. At its first session a report was submitted recommending organization on a plan based on the rules of the New York Fire Department. A report favoring the telegraph as the only reliable system for giving alarms was adopted. The second day Chief Hilliard, of Provincetown, in an essay on the firemen of the future, predicted the placing of the fire service on the same level with the army and navy as a means of public protection. The fact that pipes carrying low pressure steam will give rise to fires when in contact with wood, was held by Chief Hopkins to be fairly well established.

The protection of theaters and other places of public gatherings was considered in a report by Chief Engineer Green. He recommended the close and careful official supervision of such buildings during their construction. Theater stages, with their large area of inflammable properties, could and should be entirely separated from the auditorium by brick walls extending to the roof, with a gauze or iron drop. The latter should likewise be used to separate the stage and the auditorium, with ventilators over both, inclosed mainly in double-thick glass, which would answer for ventilation and would shut out cold air. The glass, in case of fire, would be broken by the heat, and the hole thus made would act as a chimney to let out the dense smoke and flame. Chief Nevins, of Brooklyn, favored the placing of such structures directly under the supervision of fire engineers with discretionary powers.

Charles S. Halloway, of Baltimore, made a report on the topic "Spontaneous Combustion," narrating a number of incidents illustrating the frequency of fires from this cause.

The drill of children in the public schools was next considered, Chief Combs, of Worcester, submitting a report in which he urged that more attention be given to this matter by school teachers. He advised the drilling of children, and thought that a drum should be kept in every school building, to be beat on only in case of fire, as a signal for the children to fall into line and march to the ordinary place of egress under the command of their teachers.

Other committees reported the advisability of the passage of State laws requiring buildings in business sections of cities to be fireproof and insuring better protection to people living in tenement houses.

In a valuable paper on the mutual relations of the fire engineer, the architect, and the underwriter, Mr. Edward Atkinson, of Boston, pointed out many common faults in the construction of buildings used for manufacturing and storage purposes. Chief among these are elevators, flues, and other air-connected spaces through which flames spread rapidly from floor to floor. The precautions against fire insisted on by the Boston Manufacturers' Mutual Fire Insurance Company have reduced the losses on mills, factories, and similar properties to one-tenth of one per cent on the amount of risks taken. A good word was said for petroleum, which is popularly supposed to increase the risk of fire. Mr. Atkinson said that the introduction of petroleum oils has been in many ways of benefit to the Mutual Insurance Company. About one-fourth of the factories insured therein are lighted with kerosene oil, but great care is taken to get the safe lamps and safe oil. Factories lighted with the vapors of gasoline are not insured at any rate. But the great value of oils made from petroleum in cotton factories is that they are "absolutely free from liability to spontaneous combustion," and one great source of danger has been removed by their introduction."

Mixing of White with Colored Light.

It was noticed several years ago that when white light was mixed by the method of rotating disks with light of an ultramarine (artificial) hue, the result was not what would naturally have been expected; for, instead of obtaining a lighter or paler tint of violet blue, the color inclined decidedly toward violet, passing, when much white was added, into a pale violet hue. Two attempts have been made to account for this curious fact: Brücke supposes that the light which we call white is really to a considerable extent red, and that the mixture of this reddish white light with the blue causes it to change to violet. Hubert, on the other hand, reaches the conclusion that violet is really only a lighter shade of ultramarine blue. He starts with the assumption that we obtain our idea of blue mixed with white from the sky, which, according to him, is of a greenish-blue color. We then apply, as he thinks, this idea to the case of a blue which is not greenish, namely, to ultramarine blue, and are surprised to find the result different.

Prof. O. N. Rood, of Columbia College, shows, in a paper in the *American Journal of Science and Arts*, that these explanations are hardly correct, since they fail to account for the changes which, according to his experiments, are produced in other colors by an admixture of white. Prof. Rood prepared a set of brilliantly colored circular disks which represented all the principal colors of the spectrum and also purple. These disks were then successively combined in various proportions with a white disk and the effects of rapid rotation noted, a smaller duplicate colored disk uncombined with white being used for comparison. It was thus found that the addition of white produced the following changes: Vermilion became somewhat purplish; orange became more red; yellow, more orange; greenish-yellow was unchanged; yellowish-green became more green; green became more blue-green; cyan blue became less greenish, more bluish; cobalt blue became more of a violet blue; ultramarine (artificial) became more violet; and purple became less red, more violet. Exactly these same effects can be produced by mixing violet with the foregoing colors.

These experiments, says Prof. Rood, seem to explain the singular circumstance that when complementary colors are produced by the aid of polarized light, it is difficult or impossible to obtain a red which is entirely free from a purplish hue, a quantity of white light being always necessarily mingled with the colored light. "In the case of the red, orange, yellow, ultramarine, and purple disks, I succeeded in measuring the amount of violet light which different proportions of the white disk virtually added to the mixture, and found that it is not directly proportional to the amount of white light added, but increased in a slower ratio, which at present has not been accurately determined. For the explanation of the above phenomena, Brücke's suggestion that white light contains a certain amount of unneutralized red light is evidently inapplicable, since the effects are such as would be produced by adding a quantity not of red, but of *violet* light, and for the present I am not disposed to assume that white light contains an excess of violet light. The explanation offered by Hubert does not undertake to account for the changes produced in colors other than ultramarine, and even in this case seems to me arbitrary. Neither have I succeeded in framing any explanation in accordance with the theory of Young and Helmholtz which seems plausible."

Method of Examination for Color Blindness.

The following is the order issued by the Surgeon General of the Navy for the examination of seamen for color blindness:

"Upon the receipt of this order and the colored worsteds to be used as tests, medical officers of ships and stations will make a careful examination of all persons in the navy as to their color sense, the result to be reported to this Bureau according to the accompanying form. Quarterly returns will also be made of the result of the examinations of those who shall be hereafter examined for the service.

"The method to be employed is that of Holmgren, and for this purpose a set of test wools is supplied, which contains three large skeins, 'test colors,' green, purple (pink), and red, and a number of small skeins, the 'confusion colors.'

"The usual mode of examination is by Holmgren's method, which may be briefly described as follows:

"The worsteds are placed in a pile in the center of a piece of white muslin which is spread out on a flat surface in a good daylight. The green test skein is placed aside upon the white cloth, and the person to be examined is directed to select the various shades of the same color from the pile, and place them by the side of the sample. The color blind will make mistakes in the selection of the shades; or a hesitating manner with a disposition to take the wrong shades may show a feeble chromatic sense. The purple test skein is then used. If the test with the green skein has shown the person examined to be color blind, and on the second or purple test he selects only the purple skeins, he is *incompletely* color blind; but if he places with the purple, shades of blue or violet, or both, he is completely *red blind*. If, however, he selects to be placed with the purple, shades of green or gray, he is completely *green blind*.

"The red test skein need not necessarily be used, but it may be employed to confirm the diagnosis already made, for the red blind will select to match the red skein, shades of green or brown which to the normal sense seem *darker* than the red, while the *green blind* will select the shades of green or brown which seem lighter."

The Slow Development of Sugar in Cane.

"Observer" contributes to the New Orleans *Times* the following observations made by him last year, showing the gradual development of sugar in cane:

August 12, wet weather, green joints, no sugar, lower joints polarized 4·8 per cent sugar.

August 19, dry weather, green joints, no sugar, lower joints polarized 8 per cent sugar.

August 21, wet weather, lower joints polarized 8 per cent sugar.

August 28, dry, cool nights, upper joints polarized 4·8 per cent sugar, lower joints polarized 9·6 per cent sugar.

September 10, wet weather, white cane, upper joints polarized 4·8 per cent sugar, white cane lower joints polarized 9·6 per cent sugar.

September 17, dry, bright, cool nights, purple cane, upper joints polarized 6 per cent sugar, lower joints 10·4 per cent sugar.

September 23, dry, sultry, warmer nights, upper joints polarized 8 per cent sugar, lower joints 13·6 per cent sugar.

September 30, dry weather, lower joints polarized 13·6 per cent sugar.

Early December cane of the following description was found, the ground being low and badly drained, and the cane very crooked at the same time: Density, 11·2 per cent (6·2° B.); polarized 8 per cent sugar, which is equal to 71·43 per cent sugar, and 28·57 per cent not sugar.

Juice like this would yield more than half molasses, from whatever percentage extracted out of 100 pounds of cane.

The juice of suckers had a density of 10 per cent (5 56 B.), and polarized 8 per cent, therefore poor in saccharine, but not inferior as to quality. Some planters seem to be made happy by suckers, but the foregoing analysis shows that there may easily be too much of a good thing.

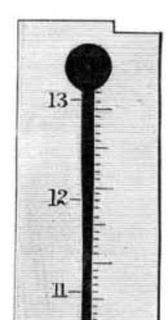
The lower part of good, sound cane showed juice of a density averaging 15 per cent with a polarization of 13·5. This would have been very good if three-eighths of the cane had not been as inferior as the above crooked cane.

From these observations, taken, however, as examples only, it can be seen that cane grown in well drained or easily drying lands, may be as good or even better the 1st of September than cane grown on low marshy soils by December.

STANDARD WIRE GAUGES.

BY M. W. GRISWOLD.

As all civilized nations divide the circle into 360 degrees, and as there can be no variation in any of these, nothing can be more standard than to take one of these angles for a wire gauge, an angle that everybody is familiar with and recognizes as fixed. But with this to begin with, no good would result if we were to select a certain size wire to start with, and then regulate all the other sizes from that (as in the old so-called standard gauges of the present day). This might perhaps do if all makers were to guess alike on their starting size. The metric wire gauge shown in the engraving starts at the center of the circle (or apex of the angle), which having no size is called 0, and to fix upon the points for the other numbers, the metric system is adopted as being a standard measure, and from 0 both sides of the angle are graduated so that one millimeter from the center gives No. 1; from No. 1 two millimeters for No. 2; from No. 2 three millimeters for No. 3; from No. 3 four millimeters for No. 4 (10 mm. from 0), and so on in arithmetical progression with one millimeter as the common difference.



With this gauge there is no guesswork in fixing upon a size, either to start with or to carry out the system indefinitely; and when referred, the exact diameter of any number can be easily calculated without measuring, if one prefers to do so, or does not happen to have a rule at hand.

The metric measure is adopted here, as it is evidently coming into quite general use, Spain having put it into full force throughout her entire possessions on July 15, and Turkey having gone so far as to recognize it.

If the wire consumers were to adopt this metric wire gauge and order from its numbers, the wire drawers would undoubtedly yield to the popular demand.

Mascart's Observations on Atmospheric Electricity.

The apparatus employed by M. Mascart for the measurement of atmospheric electricity is a Thomson's electrometer, in which the deviations of the magnetic needle are mechanically recorded by a pen.

The curves found by means of this apparatus, as described in a recent paper before the French Academy, proved that the potential electricity of the air is generally positive, especially when the sky is clear. On a cloudy day this electricity is diminished, changes rapidly, and is from time to time negative. Rain nearly always produces great deviations. An approaching storm is usually indicated by great negative variations, followed by very extended oscillations, a tendency toward negative electricity being predominant. Rains accompanied by positive electricity are extremely rare, and scarcely ever appear except during storms.

The intensity of the atmospheric electricity, which under ordinary circumstances is always positive, is by far greater and more uniform during the night than during the day. From 9 o'clock P.M. until 3 o'clock A.M., it varies but little: it decreases at sunrise, reaches its minimum against 3 o'clock P.M., rises again rapidly, and attains its maximum at about 9 o'clock P.M. The amplitude of the daily oscillation is much smaller during the winter than during the summer months.

A connection between the electric condition of the air and the temperature seems to exist, but several years may yet pass before this relation can be determined with certainty.

The fact that the maximum intensity occurs at night is contrary to the generally adopted law. According to the observations of Quetelet, in Brussels, two maxima of atmospheric electricity have been held to exist, one in the morning and one in the evening; and also two minima, one during the day, the other during the night. It is of the greatest importance that the observations of M. Mascart have corrected this erroneous assumption, which seems to be based upon imperfect observations.

The direct observation of atmospheric electricity has hitherto been made chiefly during the day hours, and the relative maxima found morning and evening have led to the erroneous assumption that a minimum of electric intensity occurred during the night.

Another very common source of error has also been overlooked, viz., the imperfect insulation of the apparatus. Care should always be taken that the glass supports of the apparatus are not exposed to the changes of the atmosphere. Many wrong observations have probably been caused by neglecting this precaution.

American Public Health Association.

The Executive Committee of the American Public Health Association have announced that the eighth annual meeting of the association will be held in New Orleans, December 7–10. Papers will be presented on abattoirs, epidemics, life insurance in its relation to the public health, the storm water question in city sewerage, the sanitary engineering problems of the Mississippi River, the hygiene of emigrant ships, the prevention of venereal diseases, voluntary sanitary associations, etc. The special questions suggested for discussion at this meeting, in addition to those connected with the papers above referred to, relate to methods of preventing the spread within a town or city—after they have once been introduced—of such contagious or spreading diseases as diphtheria, scarlet fever, yellow fever, measles, small pox, etc., and are as follows: What are the best means of securing prompt and reliable information as to the presence and location of cases of such diseases? What are the best means of securing isolation of the first or of single cases of such diseases, and what are the chief difficulties in securing such isolation? Under what circumstances is it proper to declare such diseases epidemic in a place? Under what circumstances is it proper to recommend the closure of schools on account of the prevalence of such diseases? What precautions should be taken at the termination of each case as to the care and disposal of the dead, the disinfection and cleaning of the room and house, and the period of time at which it is safe to allow the convalescent to return to school or society? Brief, practical papers upon any or all of these points are earnestly requested. Notice of intended papers should be sent to the president, Dr. J. S. Billings, Washington, D. C., or to Dr. E. H. Janes, Secretary, New York.

The Danish Butter Industry.

The Danes have made a marked advance in the butter industry by introducing the following measures:

1. Complete change of the butter season, which commences now on the 1st of November and ends on the 31st of August. In this manner the Scandinavian farmers produce the maximum of butter at the moment when the prices are the highest. While the butter of other countries pours into the London market during the spring and summer, the butter from the North occupies that place during the winter, a season when the scale is the most remunerative.

2. Introduction of Swarz's system into the dairies, *i. e.*, cooling the milk on ice, skimming after twelve hours, mathematical regulation of the churning, working and other manipulations, substitution of long and cylindrical vessels of polished sheet iron instead of little flat bowls of wood, and daily churning.

3. Fabrication of sweet butter, *i. e.*, butter churned immediately after the skimming.

The Racing Record Again Surpassed.

At Chicago, September 18, the celebrated trotter Maud S. surpassed the previously unparalleled record of St. Julien at Hartford (2:11¼) by half a second, making a mile in 2:10¾. On the same day, at Sheepshead Bay, Ferida beat by a quarter of a second the best time on record for a four mile race. The time was 7:23½. For twenty-five years the best time has been Lexington's, at New Orleans, 7:23¾.

Electricity from River Currents.

An inventor of this city proposes to utilize the swift current of rivers by systems of anchored floats carrying current wheels connected with electro-dynamo-machines. The electricity thus generated might be conveyed to factories on the shores and set to work by means of electro-motors; or it might be used for lighting towns, or even for running trains on railways.