matronly dress. The hues of the males were, on the contrary, more brilliant than previously. Their general color became much lighter, and in the older individuals the lower jaw projected anteriorly, forming a sort of knob. The distension of the abdomen of the female by the eggs, caused the section of her body to assume an oval shape, while that of the male resembled the outline of the eye of a broad-axe. Fierce battles took place between the males the conqueror celebrating his victory by feasting upon the body of the vanquished ; the females swam uneasily about the ponds, trying the bottom with their fins, seeking for gravel in which to deposit their eggs. The bottoms of the ponds being formed of clay and large stones, they were obliged to pass into the races for that purpose. These had previously been prepared by covering their bottoms with fine gravel, and placing across them obstructions, forming a series of dams and eddies.

"On October 30th, fishes were perceived in the race, busily engaged in forming a nest for the reception of their eggs, by removing the fine gravel from a circle of about a foot in diameter. Across the lower end of the raceway, a net was quietly placed, and the gate at the racehead closed, by which the flow of water was stopped. To avoid being left high and dry, the fishes were obliged to pass down stream, and were thus captured in the net, the fishes being placed for the nonce in a large tin kettle. About a quart of pure spring water was placed in the impregnating pan ; a male was then taken and held in the manner depicted in the engraving, the left hand grasping the neck below the gills, and the right the body just behind the gills. By gentle pressure with the fore and middle fingers of the left hand, a quantity of the milt was expressed, the amount being further increased by gentle friction toward the tail. This was continued until the water became opalescent or pearly in its appearance. A female was then taken and treated in the same manner, eggs, instead of milt, being extruded. The eggs and milt were allowed to remain in contact for about fifteen minutes, at the expiration of which time they were carefully washed.

"It has been ascertained by experiment, that fifteen grains of the milty fluid of the male is sufficient to impregnate ten thousand eggs ; but in practice a much greater quantity is used. The bottom of the impregnated pan, as shown in the same drawing, having a depression calculated to hold one thousand eggs, the quantity obtained could be readily estimated. The eggs average one sixth of an inch in diameter, and weigh one grain each.

"After being thus secured, the eggs were taken to the hatching house, which had been made ready for their reception in the following manner : The hatching-trough had been filled to the depth of two inches with fine gravel carefully boiled, to destroy the eggs of any insects which might have been present ; over this a gentle stream of water from the spring, filtered through four screens of fine flannel, was conducted. Upon the gravel the eggs were placed, the greatest care being taken to avoid any sudden jar, as the recently impregnated egg requires the most gentle handling, lest its suddenly acquired life be as suddenly extinguished. After resting in their new location for a few moments, they were evenly spread over the bottoms of the troughs by means of a fine feather. During the entire process the eggs had not for an instant been exposed to the atmosphere

"This process of impregnating and depositing in the hatching house was repeated semi-daily until January 12, 1868, during which period about seventy-five thousand eggs were taken. Experience shows that from a trout of one pound about one thousand eggs is the average yield ; but owing to causes entirely beyond the control of the proprietor, only twenty thousand hatched. The dead eggs were removed daily, being readily distinguished by turning snow white ; those still retaining their vitality resembled small pearls, being translucent and slightly clouded. The first young appeared December 10th, forty days after the impregnation of the eggs.

"When first hatched, the young presented the grotesque appearance shown in the smaller figure of the cut of the trout. The ungainly abdominal appendage, technically termed the 'yolk sack,' is, however, gradually adsorbed into the body of the young fish, the entire process requiring six weeks for its completion.

"During this period the young trout requires no food, being nourished entirely by the contents of the 'yolk sack ;' but immediately after its absorption it is necessary that they should be regularly and carefully fed. Various substances, all of an animal nature, have been tried, but after various experiments, Dr. Slack has found the muscular fiber composing the hearts of beef cattle to be the most suitable. This is prepared by being chopped into minute fragments, which are passed through a fine wire sieve. When the fishes have attained the length of one and a half inches, the eggs of other fish are employed as food. When placed in the first pond, they will be fed entirely, for some time, upon maggots, the larvæ of the common blue-bottle fly. The appearance of these disgusting, though to the pisciculturalist useful little animals, are regarded as fixing the period at which the transfer from the hatching house to the pond should take place."

Troutdale, as we have stated, is easy of access from the city of New York, and a visit to the ponds would amply repay any one interested in the art or science of pisciculture.

It is a part of the business of the fish farmers to furnish in season impregnated trout eggs, either for the stocking of ponds or of scientific observation and research. They can be carefully packed, and forwarded by express to any point, with full directions, or under the care of a competent person. By means of a small apparatus invented by Dr. Slack, which can be placed in an office or library, the fishes can be hatched without the necessity for a hatching house. This apparatus is not unlike the aquarium in common use in our parlors, and requires very little more attention, though the work of "manufacturing trout" at home would furnish far more interesting employment than a mere aquarium, and at the same time be not less pleasant to look upon'.'

The *Evening Post* says, on the subject of fish culture, that, "In nearly all our rivers the supply of fish is growing less. The stake nets in the Hudson, stretching for hundreds of rods into the channel do not take more in a day than were formerly taken in nets a quarter or a fifth of their size. In the Susquehanna, Potomac, James, and Deleware, where drift nets are used, the supply of fish is in like manner decreasing. No more fish can now be taken in a net a hundred rods long than formerly in one of five rods. The same reports come from the South ; and, unless the fisheries are suspended, or the supply of fish increased by artificial means, there will soon be no more shad in the market.

"The commissioners recently appointed by the Albany legislature. Messrs. Seth Green and Robert B. Roosevelt, have entered upon their duties—the establishment of suitable hatching boxes along the upper waters of our rivers—with much interest and in a manner that promises the most gratifying results. Although appointed for New York only, they have lately visited several southern states, to endeavor to interest the fisherman of the southern rivers in pisciculture, and to induce them to adopt the system of artificial breeding that has proved so successful in Connecticut. Their object in thus extending their observations and labors is to make fish culture general. It has been discovered that shad do not invariably return to the rivers in which they are spawned, and in order that an even supply may be obtained it is necessary that the propagation should proceed simultaneously on all parts of the coast. The James river was the furthest point south visited by the commissioners. There they succeeded in interesting the fisherman and establishing hatching boxes on a small scale. On the Potomac it is expected that their suggestions will be generally adopted.

"The Susquehanna and Deleware are to be visited, if they have not been already, and after introducing the system extensively in our rivers, the commissioners will proceed east in July or August. By this means it is expected that the next year's supply of shad will be largely increased, while that of the following season will be still greater."

HERRING'S CENTER VENT WATER WHEEL.

Perhaps one of the main faults of turbines in general use is the expenditure of a considerable amount of the force of the water against an immovable platform, tending to retard the course of the stream ; and another is the diversion of the current toward the center, where comparatively little force can be exerted, and the want of an exit of sufficient capacity to release the water after it has done its work, or expended its force. The intention of the inventor of the form of wheel shown in the accompanying engravings is to obviate these objections and utilize in a more perfect manner the force of the water.

Fig. 1

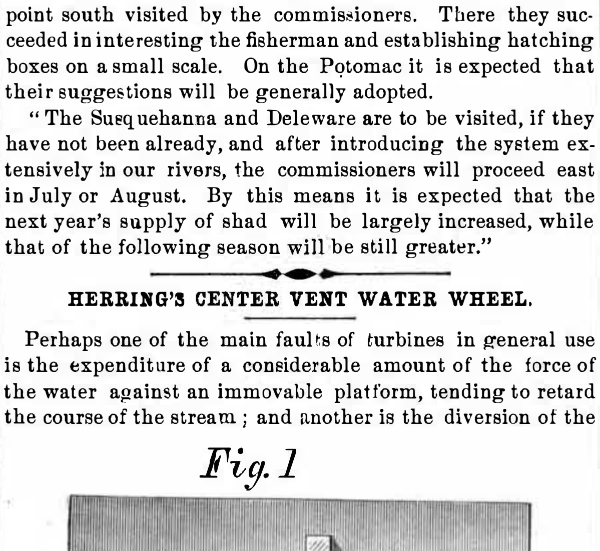

Fig. 2

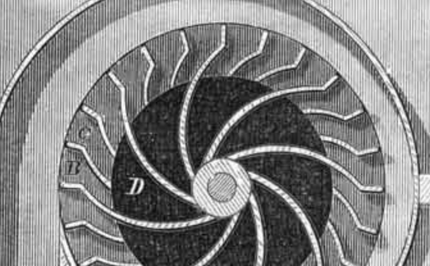

Fig. 1 is a plan view, as seen from its top, showing the scroll, A, the alternate long and short buckets, B and C, and the center vent, D. Fig. 2 is a perspective view of the wheel, showing the long buckets, extending from the periphery of the wheel to the center, and the short buckets, reaching from the periphery to the inner edge of the lower rim. The buckets, both long and short, are radial at their outer ends, where the water impinges upon them. The bottom of the scroll, A, has a circular opening that receives the lower rim of the wheel, and the water acts first against the radial parts of the buckets, and then re-acts against the curved portions, passing out through the opening at the center of the lower rim, which forms a portion of the bottom to sustain the water.

The wheel may be set to turn either to the right or left, as occasion may require, operating equally well in either direction. The advantage of alternate long and short buckets is, that the water has a strong action against them near the periphery, while a free escape is allowed for the water after its force is expended.

The device was patented Oct. 29, 1867, by George W. Herring, and all communications relating thereto should be addressed to him, Joseph Taney, or Thomas N. Egery, all of Bangor, Me.

FELL'S RAILWAY OVER MONT CENIS.

In our editorial letter published on page 259 of the last volume, we referred to the near completion of Fell's overmountain railway. Since that time the cars have been put on, and from last accounts regular trips were being made. Some of the worst bits of the line, the steepest gradients, the sharpest curves, the most appalling glimpses down precipices and into rugged ravines, where the train, if overthrown into them, would most assuredly be smashed to splinters, occur within the first few miles after leaving Susa. But the newcomer on the line contemplates these without emotion. No unpleasant sensation of peril distracts his attention from the engineering skill and resource displayed in the construction of the line, or prevents his enjoying the beauties of the mountain scenery. He feels like one drawn along a difficult road, but from whose mind every timorous sensation is banished, by seeing how completely the skillful driver has his steam horses in hand, directs them at will, curbs them with a finger. And, indeed, it is this curb power which constitutes one of the greatest marvels of the Fell system. When going twelve miles an hour down gradients of one in twelve, the brakes are applied, the perpendicular wheels cease to turn, the horizontal wheels clip the central rail with hundred-vise power, and within some thirty yards the train is brought to a complete standstill, without the slightest shock or concussion. It would be possible to employ such power as would bring the train up short, and produce all the effects of a railway accident. When one stands upon the line and contemplates the steepness of the slope down which one has just slid easily without strain or inconvenience, he to some extent realizes the prodigious force applied to restrain the momentum of the string of ponderous carriages launched upon that declivity. It is the triumph of mechanical power wielded by a few brakemen's hands, that turn, without apparent effort, the bars in connection with the various wheels. The control is perfect, and measurable to a nicety. In fact, on the descent of the mountain there is nothing to warn a traveler, who should not look of a window, that he is on a railway of a very unusual construction. The motion is steady and easy ; there is no jarring of any kind, and one soon ceases to notice the sloping position of the train.

Not less surprising than the steepness of the ascents and descents, is the abruptness of many of the curves, some of them forty-four yards radius. It is probably by these that nervous persons will be more unpleasantly impressed than by the up-and-down-hill work, until a little practice removes the unfounded apprehension. As before mentioned, some of the worst bits of the road are in the first four miles after leaving Susa. Some of the curves are so sharp that one can hardly understand how the carriages, which are about fourteen feet long, outside measurement, contrive to grind round them. But round they do go, with perfect ease, just when one might fancy they were about to fly off, like a steel bar escaping from a curved groove, and, as they turn, the wheels and rails together give out a shrill metallic sound, which one at first may mistake for a whisper of the railway whistle. Just below the now abandoned but still formidable looking fortress of Esseillon, which all who have passed the Cenis will remember, frowning toward France a little below Lanslebourg, is one of the most remarkable of these curves, horseshoe shaped and forming three fourths of a circle. The places where the line runs very close to the edge of deep precipices are few in number. What has been said already of the power which the engine driver and brakeman have at their command by means of the horizontal wheels, will have convinced all that, with common care, there exists no danger, no possibility of the train getting off the rails. This conviction is soon arrived at by any person traveling on the line, and who, however small his scientific knowledge, takes the trouble to examine the principle and construction of the railway and carriages. Another danger, more than once suggested as scarcely to be avoided, disappears upon actual observation. I refer to the risk of a crumbling of the edge of the mountain road. Aided a little by imagination, this looks very plausible upon paper. For the greater part of the distance, but not throughout, the railway gives the wall to the horse and pedestrian traffic, and takes the outside edge. This does not mean, however, that it is constantly on the brink of precipices ; and, where it is so, every precaution has been taken. The masonry that already existed as a support to the coach road, has been examined, strengthened, and extended. Large masses of fresh wall, often many feet thick, have been constructed in various places. It is so obviously the interest as well as the duty of the company to make assurance doubly sure in this respect, that it is absurd to suppose every precaution has not been resorted to.

Danger from avalanches has been guarded against by covered ways, some in masonry—where stones and pieces of rocks are apt to fall—and others of iron roofing. The adoption of this plan has enabled the constructors of the line to make use of a considerable part of the old road over the mountain, a gradual ascent which was abandoned for a zigzag line, on account of the danger to passengers from avalanches and falling stones. Exclusive of several short tunnels, the road is covered in for a distance of altogether nearly six miles, in several places on each side of the summit of the mountain. The chimneys of the experimental engines were considerably lower than those of the French engines employed for the

© 1868 SCIENTIFIC AMERICAN, INC