he immediately turns the water from the plain nozzle to the ball nozzle, and a surprising effect is produced. The entire room is filled with spray, and it is impressively shown how small would be the chances for fire in such a room. The nozzles are made double as shown in Fig. 3, to permit of throwing either a solid or spray jet, the passage of the water to either one or the other of the branches of the nozzle being controlled by the threeway valve. The lawn sprinkler is either mounted on a stand or a short spike as shown in Fig. 5.

The explanation of the phenomenon of the ball nozzle is as follows: The water issuing at the sides of the ball produces a zone of vacuum, where the water is tangent to the ball, on the principle of the ejector. Air pressure upon the outer surface of the ball tends to force it into this vacuum zone, and as the area of the ball covered by the vacuum is many times larger than the aperture through which the water escapes to the cup of the nozzle, the total air pressure on the ball is greater than any water pressure that would be likely to be exerted upon the ball; but as the air pressure is limited to a little less than fifteen pounds per square inch, we can conceive that there might be a water pressure which could no longer be opposed by the air pressure, and as a consequence the ball would be blown out of the cup.

To prove that a vacuum is formed at the zone where the water is tangent to the ball, we have caused a ball to be perforated, as shown in Figs. 1 and 2, and have proved that a vacuum exists at the zone of tangency, by connecting a tube with the perforation, and holding a candle at the mouth of the tube, as shown in Fig. 1. The drawing of the candle flame into the tube shows that air is rushing in to supply the vacuum produced by the escaping water.

In Fig. 2 the parts are placed in similar relation to each other, but the ball nozzle is submerged. In this case the outrush of the water produces a vacuum as before and the air rushing in to satisfy the vacuum escapes in bubbles through the water. When the tube is closed by the finger, thus preventing the air from passing to the nozzle, the bubbles cease.* These explanations and experiments indicate the nature of the phenomenon of the ball nozzle.

The American Ball Nozzle Company will make an attractive exhibition at the Atlanta Exposition, and will furnish the fire protection and several of the fountains.

The Wood of Most Uses.

Theoretically speaking, says Timber, of London, Eng., the oak is the wood which can be put to the greatest variety of uses, but, as a matter of fact, the pine is most used, on account of its abundance. The timber of the oak, which combines in itself the essential elements of strength and durability, hardness and elasticity in a degree which no other tree can boast, has been used as a material for shipbuilding since the time of King Alfred. It is also employed in architecture, cabinetmaking, corving, mill work, coopering, and a thousand and one other ways, while the bark is of great value as furnishing tan and yielding a bitter extract in continual demand for medicinal purposes.

The timber of the pine is also used in house and ship carpentry. Common turpentine is extracted from it, and much tar, pitch, resin and lampblack. Splinters of the resinous roots serve the Highlanders instead of candles. Fishermen make ropes of the inner bark which the Kamchatdales and Laplanders steep in water and utilize for making a coarse kind of bread. The oil obtained from the shoots of the dwarf pine is a kind of universal medicine among the peasants of Hungary, while the soft grained silver fir is in much requisition for the sounding boards of musical instruments, and the Germans employ it almost exclusively in their vast toy factories. In the manufacture of lucifer matches, and, above all, paper pulp, thousands and tens of thousands of acres of pine forests are cut down every year, and the timber, constituting the chief material of English and American builders, is more used than all other kinds of wood put together.

Ruwenzori.

Mr Scott Elliott has been investigating the botany of Ruwenzori, the giant mountain of Central Africa. Up to 7,000 feet he found grass and cultivation; then begins the forest, which up to 8,600 feet consists of deciduous trees, sometimes with thick undergrowth, sometimes quite open, with a profusion of ferns, mosses, and creepers. From 8,600 to 9,600 feet bamboos grow, and the predominant feature is the wetness of everything. Only very watery plants grow among the roots. Above 9,600 feet tree heather takes the place of bamboo, and seems to extend to the snow, which Mr. Elliott could not reach, and even beyond. In one attempt to reach the summit he found what seems to him the Alpine lady's mantle. On the mountain birds and animals are extremely scarce. He saw a sun bird, green yellow, and crimson, above 10,000 feet, and also saw a robin and a goldfinch.

* For an account of interesting experiments with the ball nozzle the reader is referred to SUPPLEMENTS 37, 47 and 51.

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For the Week Ending July 13, 1895.

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THE NEW YORK STATE FISH HATCHERY, COLD SPRING HARBOR.

A very commodious and cheerful looking building is that occupied by the New York Fish Commission at Cold Spring Harbor, Long Island. It stands at the level of the Sound, overshadowed on the west by forest covered hills. Between the highway and the building are the fish ponds, bordered with grass and separated from each other by flower beds and trees. The ground was given in perpetual lease by Mr. John D. Jones, the generous benefactor of the Biological School located here. This large frame building, erected in 1887, takes the place of the little brick one near by, where the work was at first carried on. Of the seven hatcheries in New York, this is the only one so near the coast that it is equally well adapted to raising both fresh and salt water fish. Another advantage is that during the summer months, when the fish need least attention, lobster hatching can be carried on.

The eggs are obtained from lobster men along the Long Island and Connecticut shores, who take them from the "swimmerets," where the female carries them for a year. They are brought in water to the hatchery and placed in tall glass jars; into the bottom of these a stream of salt water passes constantly, keeping the eggs in rapid motion; by means of a siphon, the water is carried out of the jar into a rectangular aquarium; with it go some eggs, and all the baby lobsters, as they burst their shells, straighten out and begin to swim upward.

Of these eggs, 6,900 weigh a liquid ounce, and from 125,000 to 130,000 are placed in each jar at a time; generally, within five days, all are hatched. When they have passed over into the aquarium, there is plenty of room for the struggle which begins with the first hour of the lobster's life. As we watch the rapid movements of the pinkish-white little things, just out of the shell, from a quarter to half an inch long, we see some are carrying or eating eggs. Here is one devouring one of his fellows, a trifle weaker than himself; there two are struggling for the body of a third; all are darting about as if for dear life.

At Wood's Holl, the experiment of putting just 100 little lobsters into a vessel together was tried; at the end of 30 days, only one remained—the fittest had survived.

Other kinds of food have been given to them, but the very young lobsters thrive best upon each other; but for this reason it is unprofitable to keep them long in the aquarium where we have watched them. When they are not more than three days old, they are carried in water to the reefs along the Sound, where they can hide among the rocks and grow in comparative safety, feeding upon each other and what other animal food comes in their way.

Lobster hatching is all that is carried on during the summer, but during the winter and spring tomcods and smelts are hatched by precisely the same method, and are turned into the Sound while not much thicker than a thread. It is interesting to learn that the quantity of both these fish and the lobsters caught along this shore has greatly increased since the hatchery has been in operation. Whereas, at first, the spawn was all brought from a distance, now it is obtained right here in the harbor. This seems easily credible when we are told that during the past season 32,000,000 tomcod and 41,000,000 smelts were hatched.

The greater part of the ground floor of the hatchery is taken up by the 16 troughs, 24 feet long and about 15 inches wide, in which the trout and salmon are hatched. The supply of water is pumped from a spring-fed pond into a reservoir above the hatchery and flows in a constant stream through these troughs from the first of November, when trout hatching begins, until spring.

The piles of black objects on shelves against the walls are the trays upon which the spawn is placed. They are simply narrow wooden frames strung with very fine wires, so arranged that they hold the eggs; but the fish, as they escape from the shell, can slip between them into the water. When the hatchery is in full operation, these trays, each holding 10,000 eggs, are placed five deep all along the troughs.

The process of preparing the eggs for hatching is done artificially. The spawn is taken from the females in the ponds when the experienced hand knows that they are about ready to deposit it; at the same time the "milt" is taken from the males. The two are quickly and carefully mixed in a pail and in this way fully 90 per cent of the eggs are fertilized.

The spawn is then ready to be spread on the trays already described. Then begins the constant and painstaking work of the foreman and his three assistants. They are kept busy removing empty shells, dead eggs and the sediment which collects continually. This cleaning has to be done by the movement of a feather, so easily may the spawn be injured.

The shades at the windows have to be regulated by the sun, for strong light athwart a line of troughs may quickly drive the tiny fish so close together that they are smothered and may even kill the eggs upon which it falls. Sometimes a streak of dead eggs in

six troughs shows the path of a single chance ray of sunshine.

Last year the first eggs hatched in fifty-four days after they were placed on the trays. Some of our readers may not know that for the first forty-five days of a trout's life, he lives upon the yolk of his own egg. He is then about one and a quarter inches long. When these little fish are fifty days old, and therefore must be provided with more food than the water in which they have been hatched can supply, they are turned out into the ponds.

These ponds are shallow wooden boxes set in the ground. Through them the same kind of water as that in which they were born is always passing. The three varieties raised, the speckled brook trout, the brown or European trout and the beautiful rainbow trout, of California, are all put into ponds together, sorted by sizes only.

In large stone-walled ponds are the ancestors of these baby fish, separated according to their ages, the only safety for any being in their exclusion from those larger and stronger than themselves. Last year 1,050,000 trout were raised. We do not know what proportion of these are still here, but there are many thousands much larger, ranging to six years in age. An inventory of the stock has not been taken this season.

Besides these quantities of trout, there is a company of salmon with rich blue fins in a pond of their own, and a small number of Japanese gold fish, which are white, with brilliant red blotches on the back, some German "goldenide" and one great carp live harmoniously together in their own domain.

The most interesting time to visit these ponds is at five o'clock in the afternoon, when the fish receive their daily meal of sixty pounds of beef's liver. It is ground by machinery, that for the "fingerlings" being made very fine. As it is thrown to them, the larger fish leap from the water, and all seize it so quickly that by the time the water is clear and quiet again, it has disappeared. Very often there is a deathly struggle for some doubly coveted morsel.

Many experiments with foods have been tried; mussels, horseflesh, clams, etc., have all been tested, but so far, nothing has been found upon which all thrive, little and big alike, except liver.

The youngest take it for their first regularly administered meal, if not so voraciously, yet with just as good results, as their great-great-grandparents in the big ponds.

The transportation cans are worth looking at. They are of tin, cased in wood, and have large perforations in the covers. Each will hold 8 gallons of water and 5,000 little fish, for it is in these that they are sent to any part of the State where they are wanted. Traveling with them is no easy task. An expert may manage to care for ten cans as far as Albany, for instance, but he has no time to watch the express agent in whose car he travels. Every 20 minutes he must force air into each can, by means of a special apparatus; he must test the water very often, with the thermometer, and in the course of the journey he will have to pound up and put into the cans the 500 lb. of ice he carries as a part of his equipment, for trout need to live in water at only 55° Fah. Thus begins for the trout a freer but usually a shorter life in the pond or stream, where he is sure to fall a victim to one of his own kind or to a sportsman.

It will be interesting to see how long the Fish Commission under its revised administration, with paid officials from the president down, will do its work so economically that the State can afford to furnish the luxury of trout fishing. A. D.

The Church Census.

The census report, covering the statistics of churches, which has just come from the press, contains some interesting facts. It is an elaborate work of more than 800 pages, with colored maps showing the extent of the various organized religious bodies in the various States.

There are 143 distinct denominations in the United States, besides independent churches and miscellaneous congregations. The total communicants of all denominations is 20.612,806, who belong to 165,177 organizations or congregations.

These congregations have 142,521 edifices, which have sittings for 43,564,863 persons.

The value of all church property, used exclusively for purposes of worship, is $679,630,139. There are 111,036 regular ministers, not including lay preachers.

There are five bodies which have more than 1.000,000 communicants, and ten more than 500,000. The leading denominations have communicants in round numbers as follows: Roman Catholic, 6,250,000; Methodist, 4,600,000; Baptist, 3,725,000; Presbyterian, 1,280,332; Lutheran, 1.230,000; Protestant Episcopal, 540,000.

Prof. D. C. Eaton.

Prof. Daniel Cady Eaton, professor of botany at Yale, died at his home in New Haven, after an illness of seven or eight months.

The Future of the Great Arid West.

Mr. Eugene V. Smalley, editor of the Northwest Magazine, and perhaps one of the best informed writers on the resources and development of the great West and Northwest, contributes an interesting article on this subject to the Forum for June.

About one-third of our national area, he says, including Alaska, is too arid for cultivation, except where water can be put upon the soil by artificial means, and General Sherman's danger line, the hundredth meridian, defines pretty closely the western limit of safe farming by rainfall. The western boundary of the arid region is marked by the Sierra Nevada mountains in California and Oregon and the Cascade range in Washington. The only exception worth mentioning to the generally arid condition of this area is a crescent-shaped section including the eastern part of Washington and lapping over a little into Idaho and Oregon. The proximity of mountain ranges causes this country to receive local rains from the Pacific winds that have not been wholly robbed of their moisture. A large part of Southern California west of the Sierras is a desert, except where narrow strips of valleys have been artificially irrigated and turned into orange groves and vineyards.

The eastern boundary of this vast arid space, though approximately marked by the hundredth meridian, as before stated, cannot be accurately defined, as no mountain wall exists to cut off the rain-bearing winds. The country is a great plain from beyond the Canadian frontier to the Gulf of Mexico, and the rainfall steadily decreases as one goes west. A belt of debatable ground where successful agricultural operations are carried on year after year, called the sub-arid belt, extends through the Dakotas, Nebraska, Kansas, Oklahoma, Indian Territory and Texas, with a width varying from one to two hundred miles. All through this belt years of drought follow seasons of exceptional rainfall, and the population fluctuates accordingly. The country is only fit for a judicious combination of stock raising and grain growing on a moderate scale. One finds on every side abandoned farms and half deserted towns. Some of the Kansas counties lying in this region have been practically populated and depopulated two or three times.

The records of meteorological observations, made with unbroken regularity at the Western military posts, in some cases for a period of forty years, show temporary variations of climate, but permanent stability.

The vast domain of unquestioned aridity may be divided into four sections: the great grass plains, the mountain ranges, the enormous desert area occupying most of the country between the Rockies and the Sierras, and, finally, the valleys, where lie the only possibilities of future development in the arid region outside the mining districts. The meaning of the word "valley" is here restricted to the bottoms lying along the streams and the bench lands immediately contiguous, and does not include all the territory drained by the rivers and their tributaries. An idea of the proportion of the reclaimable and irreclaimable lands may be had by running a single furrow through a twenty acre field and letting the furrow represent the valleys that may, at greater or less expense, be watered by canals. The rest of the field will then show the relative area of the intervening table lands that must forever remain in their present condition.

The grass plains are the homes of flocks and herds, but support few towns and no cities; the mountains produce more wealth than all the farms between the hundredth meridian and the Pacific coast, but the population is shifting in character and will never develop the highest civilization, and the third division is just as absolutely a desert as Sahara. Only a thread of valley here and there can possibly be reclaimed. Desert tracts extend from Mexico nearly up to the British boundary and embrace nearly all of Arizona, New Mexico, Utah and Nevada, much of Wyoming, Colorado, Texas, California and Oregon, and the basin of the Columbia in the interior of Washington.

During the past few years the reclamation of the arid lands has been a subject of national interest, but all that legislation has done thus far is to prove that corporate enterprise must be depended upon for the future of irrigation, rather than appropriations from Congress or schemes financiered on the credit of the States. There can be no large additional settlements in the arid states without the building of costly canals, and Eastern or foreign capitalists must supply the money for such undertakings. Irrigation in the fruit districts of Southern California and in the interior of Washington has built up flourishing communities. Similar conditions will gradually prevail, as other valleys in the now arid States and Territories are reclaimed in the same way. A dense population will be attracted by the great productivity of such lands and the certainty of regular and large crops. Continuous villages will spring up from end to end of the canals, electric railways will carry the farmers' produce to the nearest railroad stations for shipment, and a high grade of rural civilization will develop.

Between these cultivated regions there will always remain a wild phase of far Western life on the broad stretches of irreclaimable lands. The realm of romance, courage and rude physical life will not disappear, but the sedentary dweller in the rich and populous valleys will be brought into close contact with the cowboy, the hunter and the miner.

Cycle Notes.

If there ever was a doubt as to the utility of the bicycle, in business or as a means of physical development, or of rational enjoyment, that doubt is dispelled, and even the most conservative is forced to acknowledge that the bicycle is as much of an institution as anything that has appeared in this century. Its conquests are not confined to any country, its use is not limited to any age, and both sexes are equally captivated by it.

The question that now confronts us is, whether it has reached perfection or whether it is capable of further improvement. We think a critical examination by an expert mechanician will result in finding many chances for improvement; perhaps not in its action, for in that respect it seems nearly all that can be desired, but no one can deny that the possibility of the failure of the tire or chain when the cyclist is twenty-five miles from home, without any means of transportation other than those nature furnishes him, is most serious, and calls for improvements, which have been attempted, but without complete success. A bicycle with a never-failing tire and gearing that is equal to all demands upon it is greatly needed.

We have folding cycles, tandems, and twin cycles, we have also the quadricycle, and many adaptations of the bicycle to special uses, such as military operations, mail carrying, ambulances, etc. We have seen a sedan chair on the bicycle principle, and it would seem that this idea might be followed out with profit.

A bicycle with pedals swinging very near the ground would be easily mounted, and would diminish danger in case of an upset. A cycle with smaller wheels and shorter and, consequently, more rigid frame might be a desideratum for business purposes. A tricycle with small wheels might be constructed so as to be convertible at will into a bicycle. Something has been done in this line, but we believe no practical results have been reached. This form of machine would be popular only with a class of timid riders, or of learners, but it would probably have its uses.

Another form of bicycle in which the saddle is dispensed with and the rider occupies a standing position is a possible modification, which might be useful.

It is not intended to convey the idea that inventors have not considered some of these subjects; but the fact that these ideas have not materialized indicates the necessity of greater energy in the bicycle business.

One of the most notable results of the phenomenal popularity of cycling is the marked effect of the bicycle industry on allied trades—and even upon trades that would seem, at first glance, to be wholly outside of any such influence. The nucleus of one of the large bicycle works in this country was a sewing machine factory, where wheels were made in one corner of the shop on a very small scale. Soon the making of sewing machines became secondary in importance, and was finally abandoned altogether for the more profitable bicycle business. This was only the beginning. Since the use of the wheel has become almost universal, many radical changes have been wrought. For instance, a large watch factory has gone extensively into the manufacture of cyclometers and is having difficulty to keep up with its orders. Another manufactory devoted to the making of knitting needles is now working night and day turning out nothing but bicycle spokes. The manufacture of pneumatic tires has become a separate branch of the rubber business, and several former hose factories have devoted their energies to it exclusively. Tire making, in turn, has led to the production of a naphtha free from paraffin or other oily matter for use in rubber cement. The careful workmanship required for bicycle making has had a marked effect upon the standard of the average artisan, and even upon machine shop practice at large. A case in point is that of a factory where all the lathes and other running machinery, including the shafts, have been fitted with the most approved style of ball bearings. The expense was, of course, great, but the owner finds that the efficiency of his works has been increased 25 per cent.

A spiral bicycle track is in course of construction in an old panorama building in Paris. This track is to be three stories high, the grade will be three-quarters of an inch to the yard, and the length 1,625 feet.

A Pompeian Bathroom.

The richest and most complete bath yet found in the ruins of Pompeii has recently been discovered. It is a large building, with sculptured basins, heating apparatus, lead pipes, and bronze faucets. The walls and floor are tiled. Everything is in an almost perfect state of preservation, owing to the roof having remained intact when the city was buried in the year 79.