large school that they were concentrated into a ball of living fish not ten feet across. The seal swam around them with great velocity, preventing their escape, occasionally dashing into them with wide-open mouth.

The California barracuda is always found in schools, filling the water for acres. The Gulf of Mexico species is a solitary fish. In the Pacific the yellow-tail schools often cover the water for acres, then breaking up into pairs or trios. So with the horse mackerel; thousands frequently being found schooling.

Among the mammals the collection of vast numbers is best illustrated by the American bison, which was, and which now, owing to the most outrageous vandalism ever perpetrated in a civilized land, is almost extinct. The bison fairly covered miles of country, presenting a marvelous sight.

The most extraordinary collection of animals to be seen in America are the fur seals which gather at the Pribylov Islands in spring, at the breeding season, later going to sea, and south in February and March, as far as the Santa Barbara Islands, several having been observed at Santa Catalina during the present year, a sea migration of many hundred miles being taken each year.

A very similar movement is seen among the penguins of the South Pacific islands. At times what is supposed to be millions of birds are found on the islands; later they disappear completely, making an ocean trip to some unknown land or sea for unknown purposes and reasons.

This herding or collecting of large numbers is not so common among reptiles, though in certain localities, as illustrated by the accompanying photograph, snakes congregate in large numbers. In Montana a singular cleft in the rocks has been famous for years for the snakes of all kinds which seem to have chosen it as a home. It is of unknown depth, and so snake-infested that no one has had the temerity to probe its interior. Yet every fall quantities of snakes from long distances away have been seen proceeding in this direction, finally entering the hole in the ground, recognizing the place and location as a favorite one for winter hibernation. At the time of these gatherings the place presents a sight that might have been the inspiration of Dante in some of his weird conceptions, the rocks being literally covered with snakes.

More remarkable still for its myriads of snakes is the region about Klamath Falls, Oregon. The writer is indebted to Mr. Castle, the postmaster of the town, for the photograph, which he states does not do justice to the actual condition of affairs, showing, as it does, but a small section of the snake-infested region. The town stands upon the bank or near a little river which for some reason has an attraction for these snakes or is peculiarly adapted to their requirements. Possibly birds which prey upon the snakes are for some reason scarce at this point, and the reptiles have had no interruption for years. Be this as it may, whatever may be the cause, the land along the river front is without exaggeration fairly alive with snakes that are heaped one upon the other, in groups, singly, in rows, lines and masses. One might well believe that the forms shown in the accompanying illustration were cunningly arranged to convey the idea of numbers; but they were photographed as they were found, and Mr. Castle informed the writer that by selecting a place later in the season many more could be shown.

The snakes hibernate here through the winter in holes and crevices adjoining the river bank, and in obedience to the warm sun of spring crawl out and bask in its rays; covering the ground with their sluggish forms and presenting a scene so remarkable in its entirety that it might well be considered the result of a distorted imagination. The snakes, fortunately, are perfectly harmless, and make little or no demonstration when approached, paying no attention to the photographer.

An Invention Wanted to Utilize Fog.

Mr. Herbert Earlscliffe, of Santa Barbara, Cal., has communicated to the Weather Bureau, through the Chamber of Commerce of Los Angeles, a suggestion relative to fog that should call forth all the inventive genius of America. Mr. Earlscliffe says:

"In California there are vast areas of valuable land where the water supply is insufficient. Nature has endeavored to correct this by sending in heavy fogs laden with moisture, and it only remains for the ingenuity of man to utilize this. These fogs generally come in from the ocean at night during the dry summer months, when most needed, but are dissipated early in the morning by the sun. Here is ample moisture brought to our very doors if we could but discover some simple and practical method of condensing or precipitating it on a large scale."

It certainly is tantalizing to think of this immense quantity of moisture present and visible but unavailable. Neither science nor art, at present, can suggest any feasible method of causing this fog to descend in refreshing drops of rain. On the other hand, the green vegetation at the summits of many mountains has often been observed to be due essentially to cloud or fog and not to rain; it may, therefore, be hoped that along the coast of California some device will soon be introduced that shall catch the fog particles as they float along and force them to trickle down in gentle streams of water so as to moisten the earth. We do not propose to condense or precipitate the atmospheric moisture in the ordinary sense of those words, but simply to catch it as the leaves of the trees do. We recall the so called drip from every rock and twig on the summit of Table Mountain at Cape Town, and especially on the summit of Green Mountain in the island of Ascension, and the dampness of the rocks on Pike's Peak, and we cannot doubt but that in many spots throughout the globe vegetation is kept alive by the small amount of moisture that is caught on the leaves, and dripping thence to the ground is soaked up by the roots of the plant. In fact, there are several plants whose leaves and branches are so arranged as to facilitate drip and the collection of moisture by this process. What is needed by the agriculturist on the California coast is some simple mechanical arrangement by which the quantity of fog particles shall be intercepted as they flow past any given plant, and shall be forced to drip or glide downward into the ground at the root of the plant. Any fan-shaped arrangement of sticks or slats that increases the area exposed to the fog should apparently increase the quantity of moisture carried down to the roots. Mechanical devices, the explosion of dynamite, refrigerating apparatus, and other analogous devices are likely to be too expensive in comparison with the return they make.—Monthly Weather Review.

Some German Acetylene Statistics.

Two of the German acetylene journals have become interested in the statistical side of that industry, and have collected and published considerable data upon the subject. One of these journals, Das Acetylen (February 25), sent out 52 blanks and received 37 answers, from which, with collateral information, the following figures were derived.

In 1898, in the German acetylene apparatus shops, there was sold:

Generators	6,451
Burner capacity of each generator	1 to 300
Total burner capacity	112,355
Candle power of burners in Hefner candles	10 to 60
Candle power of burners in Hefner candles, total	3,182,100
Average burner capacity of generator	17
Average candle power of burner in Hefner candles	28

The demand was greatest for apparatus having a capacity of 15 to 30 burners.

Upon the basis that the generation of one Hefner candle (0·888 English candle) requires 0·0265 cubic feet of acetylene, the above capacity of 3,182,100 candles would require the consumption of 84,325 cubic feet of acetylene. If one pound of carbide generates 4·8 cubic feet of gas, there was therefore required a supply of 17,567 pounds of carbide per hour, or, on a basis of a yield of 4·46 cubic feet per pound, an hourly consumption of 19,000 pounds of carbide. Counting 1,900 burning hours per year, the yearly demand for carbide was respectively 16,688 and 18,050 short tons. Taking the price of carbide at 4 cents per pound, or $80 per ton, we see that the sales must have aggregated, for 16,688 tons consumption, about $1,335,040; this sum doubles itself when we consider that but about half the German and Swiss production of carbide is used in these countries, and therefore that at least $2,770,000 worth of carbide was turned out during 1898.

Generators having a capacity of 25 burners are most in demand, and most of this size are sold. The average price being $125, and 6,451 of these being sold, would bring the total up to $806,375. Calculating that one burner costs 25 cents, the 112,355 burners going with these generators will cost $28,089. The carbide works and acetylene apparatus manufacturers in Germany therefore did a business in 1898 amounting to $3,604,464.

The nine largest acetylene firms in Germany have a capital of $1,122,500; and the smaller firms, having a capital under $25,000 each, will agregate $153,750, making a grand total of $1,276,250. There are 1,020 men employed in the shops.

The practice seems to be to make the distribution pipes not so strong as ordinary city gas pipes above 1·5 inches diameter, and to have them with but one-third the cross-sectional area for the same service. The valves and fixtures are made of brass, red castings (75 to 80 per cent copper), white metal and iron; practice has shown that the fear formerly existing as to the formation of explosive acetylides of copper has no foundation.

For generator construction, with few exceptions, leaded iron is used, the plates being from 0·63 to 0·016 inch in thickness (Nos. 10 to 12); in one case, a pressure generator, the walls were from 0·23 to 0·58 inch thick. One firm reported the following weight of plate used: 15 flame generators, 0 039 inch; 30 flame, 0·058 inch; 100 flame, 0·078 inch; 150 flame, 0·117 inch; above this, 0·156 to 0·175 inch. Another firm does not go below 0·058 inch plates even for three to six flame generators. All firms offer the forked burner, some entirely of steatite, and others with steatite heads only, and either angular or of horseshoe shape. In answer to the query as to how many feet of pipe had been laid, seven firms answered that they had put in 533,000 feet of from ¼ to 8 inch pipe.

THE EFFICIENCY OF THE BICYCLE.*

The object of this paper is to call attention to a few interesting points in connection with the efficiency of the bicycle.

In the present investigation no attempt has been made to treat the bicycle under road conditions, but simply as a machine; and the efficiency tests therefore have been conducted along the same lines and with practically the same apparatus as that used by Mr. Mack, and described in his paper before the American Society of Mechanical Engineers.

The apparatus, as shown by the photograph, consists of a 10-inch I beam, 15 feet long, planed smooth on top, mounted at a convenient height and carefully leveled.

At one end of the beam is fixed a pulley, over which runs a piece of indicator cord carrying a scale pan and attached by wires to the rear axle of the wheel. Suspended from the seat post is a frame made of ordinary inch pipe and carrying a shelf 3 feet long. This shelf is placed a sufficient distance below the beam to insure the perfect balance of the wheel when a load of 150 pounds (representing the weight of the average rider) is placed upon it.

The bicycle is now used as a hoisting machine, known weights placed in the scale pan at the rear of the machine being raised by placing other weights in the pan attached to the pedal. These latter weights, which drive the wheel forward through a short distance, are taken from the shelf, thus keeping the total load on the wheel constant. As weights are transferred to the pedal pan the balance of the wheel is maintained by adjusting the remaining weights on the shelf.

As the effective radius of the crank varies very slightly for a distance of some ten degrees on each side of the horizontal, it may be assumed as practically constant during this portion of a rotation.

The apparatus thus represents a rider, weighing 150 pounds, sitting upright and gradually throwing his weight from the seat to the pedal, in order to propel the machine.

The total efficiency of the wheel is now determined by ascertaining the energy expended in one revolution of the pedal and the corresponding work done in lifting the weight drawn over the pulley at the rear. The difference between the two must be due to the friction of the intervening parts of the machine.

If B equals the circumference described by the center of the pedal pin and P equals weight on the pedal, then $B\,P$ equals the energy in inch-pounds expended in one rotation of the pedal pin.

If R equals ratio of large to small sprocket and A equals circumference of tire, then $R\,A$ equals distance passed through by the machine for one revolution of the pedal pin.

Letting M equal the resistance overcome, which would equal the weight placed on the pan at the rear of the machine, divided by the efficiency of the pulley, then $M\,R\,A$ would equal the actual work accomplished.

The efficiency would be determined by the fraction

$$\frac{M\,R\,A}{B\,P}$$

Fig. 1 shows the results obtained from two wheels of the same make and grade, these particular curves being chosen as they give practically the same maximum efficiencies.

The full line is the efficiency curve of the chainless wheel, and the broken line of the corresponding chain wheel.

Fig. 2 shows some very interesting facts. The upper or full line curve shows the results obtained from a special racing wheel gotten out for the use of a man riding for the company. It was understood that the bearings were specially ground, and everything done to make the wheel represent the best possible conditions. It was very light in construction, and carried 1⅜-inch tires. The wheel had been ridden only a few hundred miles, and before being tested was specially cleaned and oiled.

In a test of a $50 and a $75 wheel, both from the same factory, and in the best possible condition, the $75 wheel showed a higher efficiency by about 7 to 10 per cent.

A wheel of high grade taken direct from the factory in which the sprocket wheels and chain were apparently rough in finish, gave a very irregular efficiency, which was far from satisfactory. After having the wheel ridden a few hundred miles it was again placed upon the testing machine, and showed from 5 to 10 per cent higher efficiency.

Another test was made on a wheel representing the best practice in bicycle construction and method of protecting bearings, after it had been exposed for some time to the rain. The wheel was frequently left lying out in the rain for hours, and received no care. The curve showed a remarkable efficiency, and, while the average was far lower than that of the corresponding wheel in good condition, yet it would indicate that the

* By Robert H. Fernald, M.E., Member Civil Engineers' Club of Cleveland. Read before the club, February 14, 1899.

bearings had been but little affected by such usage. The chain, while slightly rusted, was entirely free from mud and dirt, which undoubtedly accounts in part for the remarkable showing.

Besides the tests on general efficiency, a few special tests have been made. Among the results of greatest interest are those obtained from the sprocket tests.

All the combinations obtainable with eight, nine, and ten-tooth rear sprockets and from twenty to twenty-five teeth, inclusive, on the front sprocket were tested.

Fig. 3 shows the results obtained from a combination of a twenty-tooth front with the eight, nine and ten rear. The dotted curve represents the efficiency resulting with an eight-tooth rear. The broken line represents that obtained with the nine-tooth rear, and the full line the corresponding efficiency for the ten-tooth rear.

The average of the preceding combinations shows that while a slight irregularity seems to exist for the smaller loads, the effect for the higher pressures is very apparent, and shows for the average maximum values that the nine-tooth rear has an efficiency equal to 98·7 per cent of that of the ten-tooth, and the eight-tooth an efficiency of 98·6 per cent of that of the nine-tooth. The eight-tooth would then show an efficiency of 97·5 per cent of that of the ten-tooth.

It has been often asserted that the tire is the most important factor affecting the efficiency of a wheel, and that the amount of inflation would hide all other possible chances for variation in efficiency. While no attempt has been made in these tests to go into this question in detail, yet just at the close of the other experiments a few interesting results were obtained along this line (see Fig. 4).

It is the present intention to make tests with wheels running at different speeds, and also when the wheels are forced to run over different obstructions made to represent road conditions as nearly as possible, the power required to drive the wheel being determined by a dynamometer.

It is also probable that a pedal dynamometer will be constructed to register the actual force exerted on the pedal by the rider when the wheel is in regular road service. There are many other points of interest, among which are the duration of cone and ball bearings, the effect of vibration of the frame and the efficiency of different makes and grades of tires under increase of speed.

These different points will be investigated as time permits, and a series of results obtained which will be far more complete than those presented in this paper.

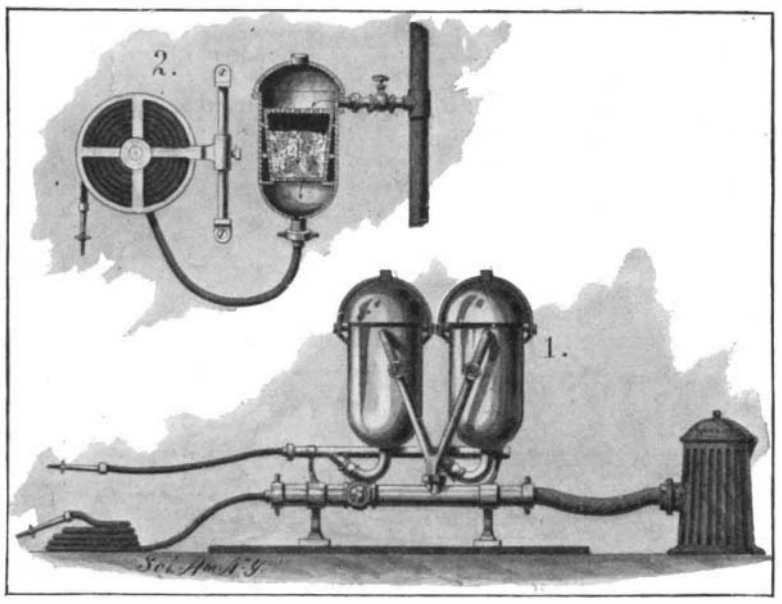
Taxation of Copyrights.

An attempt of the Comptroller of the State of New York to tax copyrights has been defeated. A tax for the year 1897 was imposed by the State Comptroller upon the A. J. Johnson Company, publishers of "Johnson's Universal Cyclopedia," and in proceedings to determine the validity of the assessment, the main objection to it was that the company's property was nearly all invested in copyrights, and that these were not taxable. The Court of Appeals, in opinions by Judges Vann and Gray, has unanimously reversed the decision of the Third Appellate Division, which affirmed the determination of the Comptroller. The court holds that copyrights are not taxable as property, but stand upon the same basis as patent rights, and are exempt from taxation.

The very important previous decision of the court in the case of the Edison Illuminating Company, in which the taxation of patent rights was interdicted, was referred to in the SCIENTIFIC AMERICAN of October 29, 1898.

AN IMPROVEMENT IN CHEMICAL FIRE-EXTINGUISHERS.

In the accompanying engraving, an apparatus for extinguishing fires is illustrated, which is connected with a water supply and is provided with receptacles containing chemicals which, when dissolved in water, produce a fire-extinguishing solution.



A NEW CHEMICAL FIRE-EXTINGUISHER.

Fig. 1 is an elevation of one form of fire-extinguisher. Fig. 2 is a view showing another form.

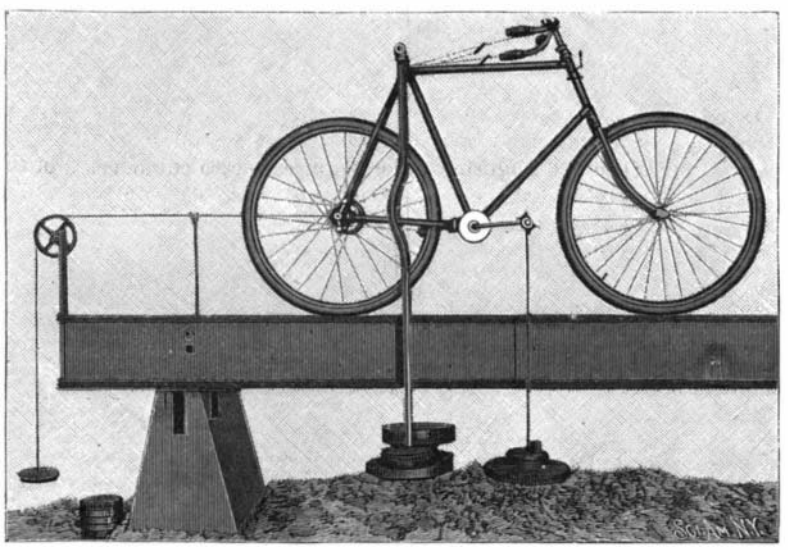
The fire-extinguisher illustrated in Fig. 2 consists of a cylinder provided with a cover and connected, by means of a valved pipe, with a water-supply pipe extending upwardly through the building. At its bottom the cylinder is connected with a hose. The cylinder is designed to hold a perforated cartridge containing suitable chemicals, such as ammonium chloride and sodium chloride, mixed in proper proportions.

In the extinguisher shown in Fig. 1, two cylinders are employed, connected by valved branch-pipes with a water-supply pipe leading to a hydrant. The covers of these cylinders are connected by bails so that they may be quickly removed in recharging the cylinders. At their bottoms the cylinders are connected with a discharge pipe to which a hose is attached.

In the operation of the form shown in Fig. 2, the valve in the pipe connecting the cylinder with the water-supply is opened to permit the water to saturate the chemicals contained in the cartridge. The water containing the dissolved chemicals is then discharged through the hose.

In the fire-extinguisher illustrated in Fig. 1, the chemicals contained in one cylinder are first used; and when these are exhausted, the contents of the second cylinder are used. It is for this purpose that the arrangement of valved pipes already referred to has been devised. If it be so desired, the water can be used directly from the hydrant by closing the valves in the pipes leading to the cylinders and opening the valve in the supply-pipe.

This fire extinguisher has been patented by Abram H. Van Riper and Patrick F. Guthrie, Nutley, N. J.



THE TESTING APPARATUS.

NOT every one is aware that the opening years of the next century will witness the completion of the first milliard of minutes since the beginning of our chronology. From approximate calculations it would seem that the one billionth minute will be reached at 10:40 A. M. on April 30, 1902.

An Educational Index.

For some time past educators have felt the need of a catalogue of popular scientific papers. Mr. J. C. Packard, M.A., has prepared such a catalogue, with special reference to the instructor, librarian and pupil. This catalogue, which is now ready for distribution, is published under the auspices of the Science Committee of the Brookline, Mass., Educational Society, of which Mr. Packard is the chairman.

The booklet comprises forty pages and is small enough to go in the vest pocket. The subjects, which have been selected from the SCIENTIFIC AMERICAN SUPPLEMENT, are classified under such heads as "Archæology, the Science of Antiquity," "Facts About Familiar Elements and Substances," "How to Make Things," "How Things are Made," "Transportation," etc.

The Current Supplement.

The current SUPPLEMENT, No. 1221, is of extraordinary interest; the first page article is "The New German First-class Battleship 'Kaiser Friedrich III.'" It is accompanied by a spirited picture of the vessel at sea. "The Palatine Hill of Rome" is illustrated by many excellent engravings showing the present condition of the ruins and by a clear plan. The text deals with all of the principal remains. Wilson's "Prehistoric Art" is the conclusion of a review of an important book, and is accompanied by nine most interesting engravings. "Wave Action in Guns" is an article by F. H. McGahie, M.E., and is referred to editorially elsewhere. Other articles are "British Coal Supplies," "Electric Hacks at Paris," "The Love Gifts of Birds," "Cultivation of the Vanilla Bean in Mexico," etc.

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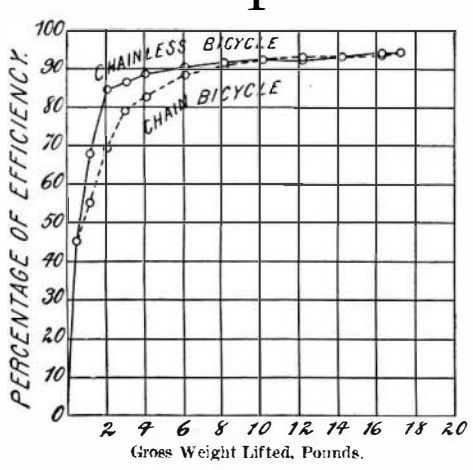

Chain and Chainless Bicycles.

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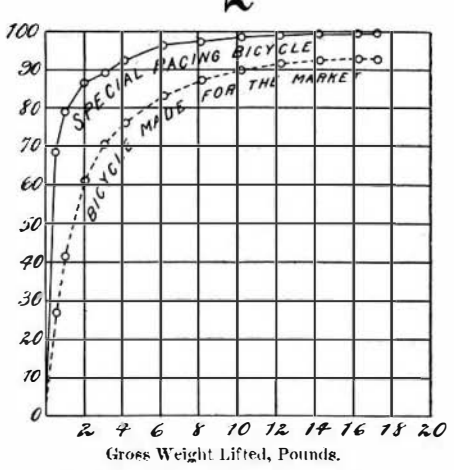

Special and Common Bicycles.

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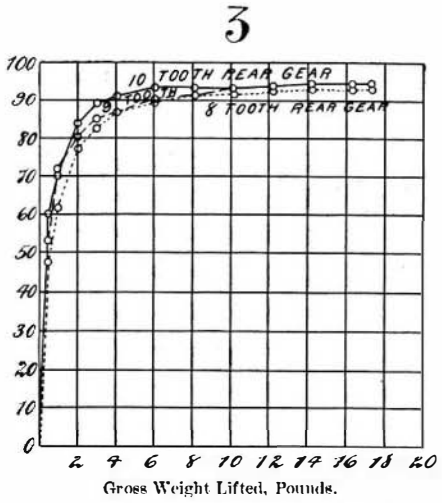
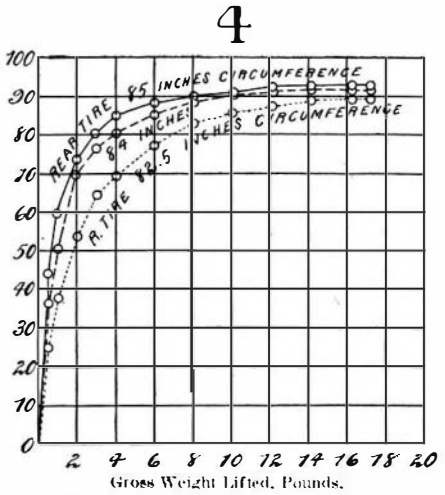


20-tooth Front Gear, with 8, 9, and 10-tooth Rear Gear.

4



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