

as to produce a compression between the segments of 12,000 pounds to the square inch without exceeding the elastic limit of the weapon.

In the manufacture of the 10 inch Brown gun the production of the segmental core is the most novel feature. The segments, which are made from open hearth steel, are cold drawn and are tapered and beveled in the working. This is done so accurately that no machining is necessary. They are assembled vertically, with the large end down, in much the same way as a cooper assembles a barrel, and are temporarily held together with three-part clamps placed one foot apart. The core is then put in a lathe, the two ends are machined, and the breech and muzzle nuts are shrunk on. The lathe is then set at the taper of the finished gun, and the outside of the core is turned down

from nothing at the breech nut to a depth equal to the thickness of the wire, at twelve inches from said nut. Here the operation is again repeated for another twelve inches, and so on until the muzzle nut is reached. The steel wire is $\frac{1}{4}$ of an inch square in section, with a sectional area of $\frac{1}{16}$ of an inch. The end of the wire is keyed into the gun at the breech nut and it is wound on at the required tension by means of the automatic winding machine shown in the accompanying cut. When the wire reaches the shoulder it is tightly wedged in against it, turned over, and keyed into the gun. The next layer is started at the second shoulder, 24 inches from the breech nut, and wound back to the breech. The third starts at the breech and runs to the third shoulder, the successive layers running in contrary directions until the necessary amount of wire is laid on. The gun is then bored out, heated internally by gas, and shrunk onto a thin steel liner. The chase jacket is shrunk on in two foot sections. The trunnion jacket is interlocked at the breech end by shrinking on, and fits with a slip joint over the chase. The breech closure is screwed into the projecting end of the jacket, and the trunnion ring is screwed on over the front end of the same jacket, as shown, so that the recoil of the gun is taken up directly by the jacket and transferred by the trunnions to the gun carriage. The longitudinal stress is taken in part by the longitudinal segments. In addition to this, the method of cross wrapping the wire in itself imparts considerable longitudinal strength to the gun.

The winding of the wire at a constant tension is done by the ingenious machine shown in the engraving. It consists of a stout frame, bolted to the lathe carriage, which is provided with a large overhead spool to carry the wire, and a small car which runs on a track at right angles to the axis of the gun. Upon the car are journaled two sets of adjustable steel rollers, between which the wire passes and by means of which the necessary tension is given to the wire as it passes to the gun. The

pressure between the rollers is regulated by means of coil springs, controlled by thumbscrews. The two sets of rollers are geared to two brake wheels, which are seen above and below the car. The upper brake wheel has a fixed brake. The lower brake is automatic in its action and is controlled by the position of the car. From the rear of the car a set of wires passes over the pul-

ly and 60 per cent of the elastic strength of the gun. If the segmental wire gun has the necessary endurance, and the army trials at Sandy Hook demonstrate that it has, its superiority over the hooped system of construction is obvious, and explains why the English navy has adopted the Armstrong wire gun as its standard weapon. For with the higher velocities of

which the wire-wound gun is capable, the energy of the projectile per ton weight of the gun is enormously increased, with the result that of two ships of equal size, carrying the same total weight of guns, the ship armed with the segmental wire gun will have an enormous superiority of fire. For the same weight it can carry more weapons of equal power, or the same number of weapons of greater power.

This can best be shown by a comparison of the naval 10 inch

gun, Mark II, of 28 tons weight, and the Brown 10 inch gun of 30 tons weight which is now being built. The hooped navy gun has a muzzle energy of 15,285 foot tons, whereas the Brown gun, which is only 2 tons heavier, will have 37,800 foot tons energy, which, be it said, is over 4,000 foot tons greater than the energy of the 13 inch hooped gun now in service.

Limits of space prevent any further discussion of this very live question. Enough has been said to show that the government is fully justified in its determination to build a gun of large caliber and give it a thorough test. It is not enough to say that our hooped guns are the best of their kind; we must have the best of any kind, and if the performance of the segmental wire gun is as good in the large as it has

as the service weapon for both army and navy.

THE TOMB OF THEODORIC AT RAVENNA.

There are few places which impress one with the idea of age more than Ravenna, the old Gothic city by the Adriatic. Even Rome itself with its modern improvements seems vastly nearer in time than the city of Theodoric and the Exarchs. Ravenna is enshrouded in an atmosphere of history and romance. Here was the seat of the later Roman emperors, and the center of the elaborate machinery of the state. Here Odoacer obtained his decisive victory, and where he was himself defeated and afterward assassinated by Theodoric the Ostrogoth; and afterward Ravenna became the governing center of the Byzantine dominion in Italy. Later memories are linked with the battle of Ravenna, when the flower of chivalry, Gaston de Foix, was killed, and here Garibaldi sought refuge. Ravenna has more peaceful memories, for here the exiled Dante wandered in the Pinetum, that glorious pine grove, extolled by the poet himself, and by Boccaccio, Dryden and Byron; and in Ravenna Dante lies buried, while in far away Florence the descendants

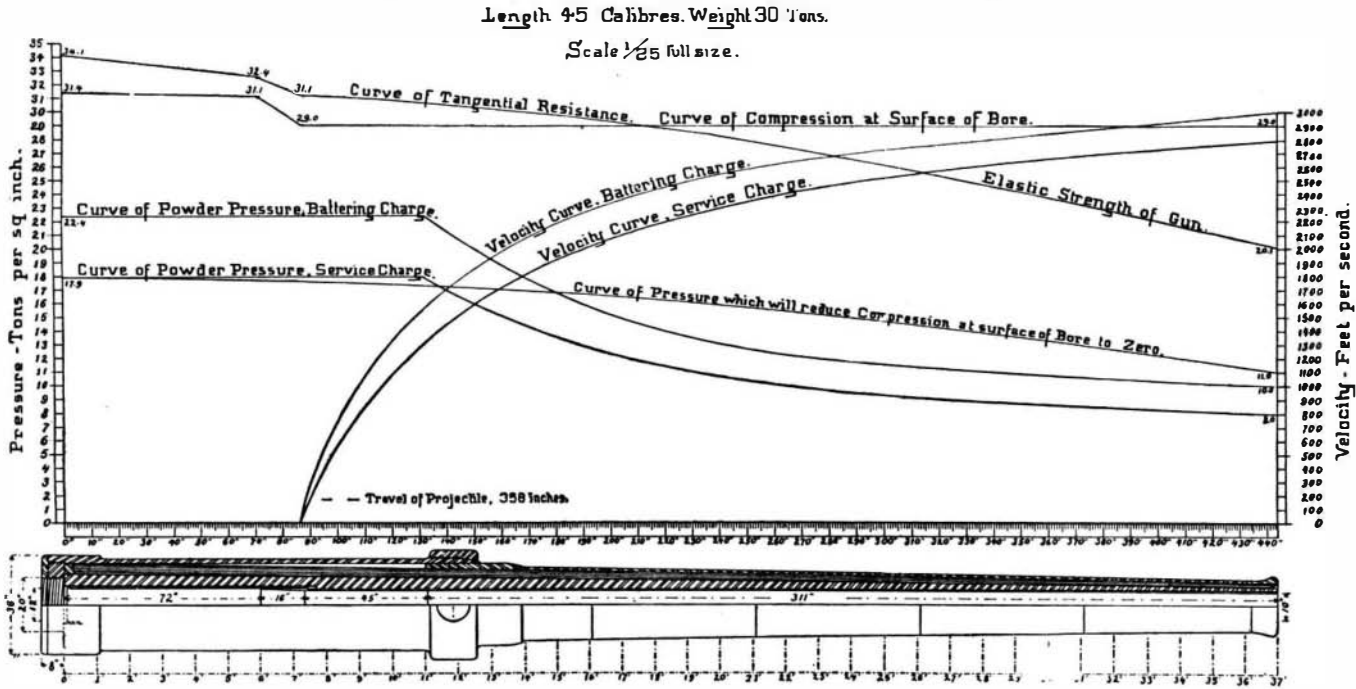


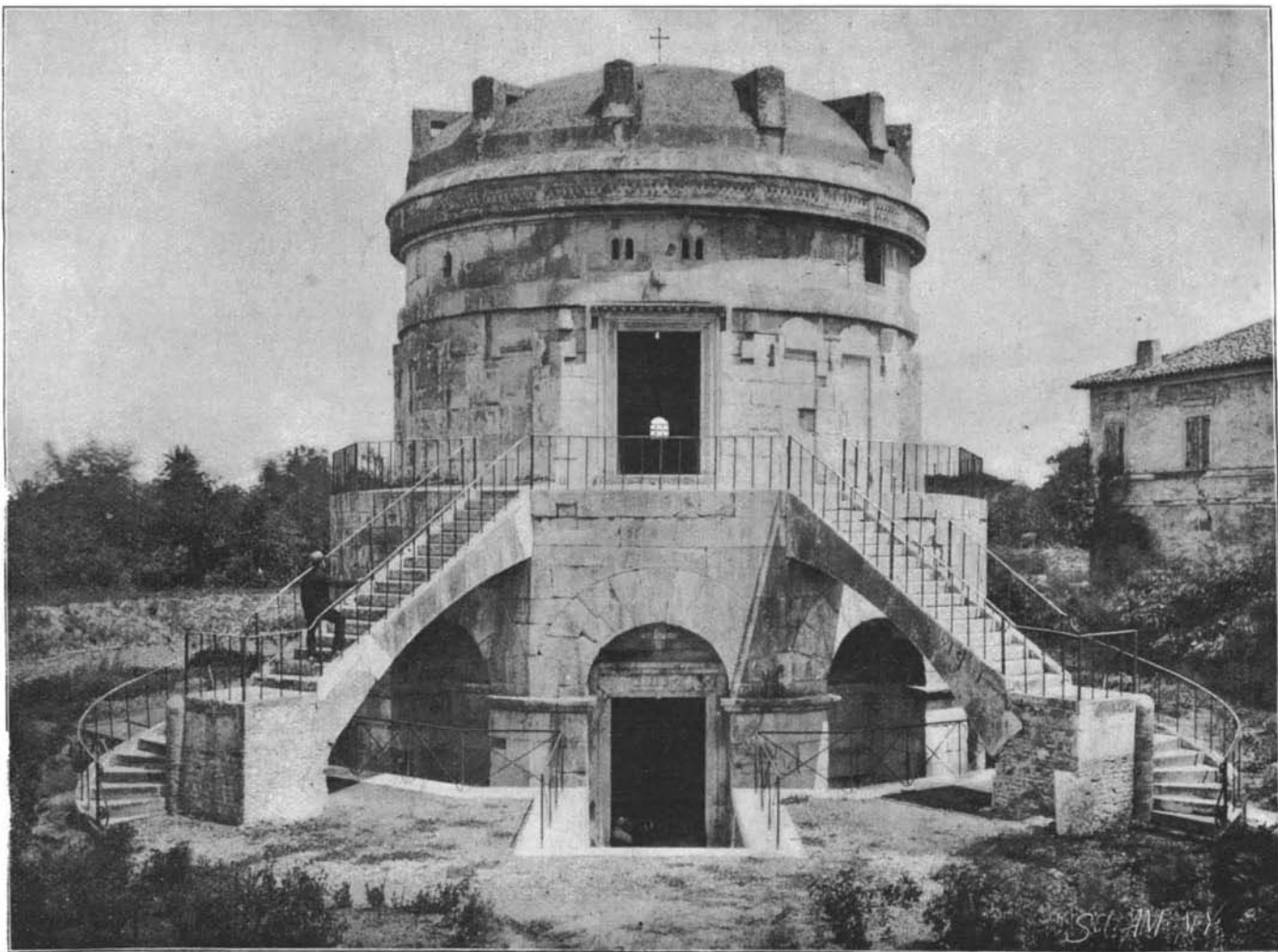
DIAGRAM SHOWING CURVES OF PRESSURE, VELOCITY AND RESISTANCE OF THE TEN INCH BROWN SEGMENTAL WIRE GUN.

ley which is seen suspended between the vertical frames, and down to a bracket which carries a certain amount of dead weight. The winding is started with the weight resting on the floor. The hand wheel on the brake is then turned until the weight is raised, when the tension in the wire equals the weight. As the car travels toward the gun, the brake wheel is released by an automatic gear and the car soon finds a position of equilibrium. The brakes are kept cool by the water pipes shown in the engraving.

The wire used in the construction of the 10 inch gun will have a total length of 75 miles.

The high quality of steel which it is possible to use in the segmental wire gun is evident from the official tests of the metal put into the 5 inch gun of this caliber. The segmental gun showed an elastic limit of 176,000 pounds per square inch and an ultimate strength of 262,000 pounds per square inch; the wire shows an elastic limit of 230,000 pounds and an ultimate strength of 262,000 pounds per square inch.

We would direct our readers' attention, bearing these figures in mind, to the accompanying diagram showing the curves of velocity, pressure, and resistance, from which it will be seen that, when using the battering charge, which gives the enormous velocity of 3,000 feet per second, the curve of powder pressure is never be-



THE TOMB OF THEODORIC THE GREAT AT RAVENNA.

of the men who exiled him have erected statues and memorials, but have been unable to obtain the ashes of the great poet, which is at least poetic justice.

In the history of art Ravenna occupies an important place. Indeed, in the history of art of the fifth to eighth centuries it is the most important place in Italy next to Rome, and the relation of Roman and Byzantine art may best be studied in Ravenna—the connecting link. The splendid basilicas, the fine mosaics, render this city one of the most interesting in Italy, but it pays the inevitable penalty of being off the main line by not being visited.

Ravenna owes its great historical importance and its present obscurity, from a commercial point of view, to the sea. It is situated on an alluvial plain, which was formed and extended by the deposits of the streams which have their origin in the Apennines, but what the sea and the rivers have given they have also taken away, and the once important seaport is now six miles inland and is connected with the Adriatic only by a narrow canal. The whole country around is intersected by dikes and is none too healthy.

Up on the marshy ground near the present port and railroad station is a monument, the like of which does not exist in Italy or in all Europe for that matter. This is the tomb of Theodoric the Great, which forms the subject of our illustration. Ravenna was the chief place of residence of the great Ostrogothic king, who reigned from 493 to 526 A. D. This may be considered as the greatest period of splendor in the history of Ravenna. He built himself a large palace, portions of which still remain; but this is inferior in interest to the massive mausoleum in the style of the tomb of Hadrian, at Rome. It was probably erected by Amalasantha, the emperor's daughter, about 530. The substructure is of decagonal shape, and it is surmounted by an enormous monolithic flat dome, 36 feet in diameter, brought from the quarries of Istria. The weight of this enormous block of stone is variously estimated at from 300 to 470 tons. How this stone was ever quarried, transported and erected is an interesting problem. Some of the remains of the colonnade which shaded the balcony round the upper story are now preserved in the interior. The substructure, with its ten arches, long lay half under water. The upper part is approached by a double staircase of marble erected in 1780. The body of Theodoric was cast forth from this tomb, probably during the troublous times of the siege of Ravenna by the imperial troops, and the tomb became a place of worship, and is now called S. Maria della Rotonda, or generally called the Rotonda.

Toning Lantern Slides.

Th. J. Placzek, of Vienna, gives the following directions for the toning of collodion transparencies. If pyrogallie acid be used, instead of iron, for development, a pleasing blue-black deposit results, that can be easily toned with neutral chloride of gold, chloride of palladium, etc.; but the large addition of glacial acetic acid to the developer makes double the exposure necessary as compared with iron development. In consequence of this, attempts have been made to tone the grayish-black image of iron-developed positives, and the following bath has been found very useful:

Solution of potassium chloro-platinate (1:50).....	4 c. c.
Nitric acid.....	12 drops.
Solution of chloride of gold (1:50).....	3 c. c.
Distilled water.....	550 to 600 "

The plates, after fixation with hyposulphite of soda, or preferably cyanide of potassium, are well washed, and while still wet placed in the toning bath for one to two minutes. They acquire a blue-violet tone, which is found very suitable for lantern slides or stereoscopic transparencies. Dry collodion plates may also be toned in this bath, but the process is much slower, owing to the horny character of the collodion film, which resists the penetration of the solution. A bath of potassium chloro-platinate (1:1400), slightly acidified with hydrochloric acid, gives a blacker tone. A solution of—

Water.....	500 parts.
Sulphocyanide of ammonium.....	20 "
Hyposulphite of soda.....	¼ part.

added in equal quantity to the following:

Water.....	500 parts.
Chloride of gold solution (1:50).....	30 to 40 "

gives gray-blue tones. Platinum and gold toning is very successful with these baths.—Photographische Correspondenz.

An Elk Horn Fence.

At Mammoth Hot Springs, in Yellowstone Park, says the Kansas City Star, there is a fence made of elk horns. It incloses the greater part of the grounds of photographer F. Jay Haynes' studio. The fence is composed of over three hundred selected elk horns. All of them have twelve points, and a great many have the royal fourteen points. They were shed in March, 1895, and were gathered in June of the same year by Mr. Haynes and three of his men, within a radius of ten miles of Mammoth Hot Springs and within four days' time. There are about 2,500 elks in the park now. Each pair of horns would bring \$7.50 at the railroad at Cinnabar, about eight miles, or at least \$10 a pair in the East or South.

Correspondence.

Nest Building Fishes.

To the Editor of the SCIENTIFIC AMERICAN:

On seeing the article with the above heading in your issue of August 1, I thought to find a description of the good old stickleback, but on reading it I find it is *Ospromenus olfax* which is alluded to.

May I, as an early observer of the habits of this fish, correct a few of the statements made by your correspondent?

Os. ol., to begin with, can hardly be called a nest builder, as he builds absolutely no nest, the eggs do not rise when laid, and the female does not try to swallow them.

What really happens is that immediately after impregnation a batch of eggs is laid; as these sink slowly they are seized by both male and female in their mouths and expelled against the under side of some concave surface, either leaf or stone.

The eggs adhere to this, and when a considerable number have been deposited, the female rises to the surface and brings down air in her mouth, which she lets go under the eggs and which remains there in the form of bubbles, this being constantly repeated until it overflows, leaving just the exact amount which the concavity can hold.

The male, I believe, assists in this work, and otherwise makes himself useful in hunting away his near relations, who, not themselves engaged in breeding, look upon the stray eggs as a special luxury.

There are many remarkable points about this fish: in the adult stage it appears to use its gills when the water is wholesome, but takes no harm in water which would kill any other fish, as it then rises to the surface and appears to breathe atmospheric air.

The continuous aeration of the ova is not easily understood, and it would seem as if the same result would be arrived at—with considerably less trouble, and no increase of risk—if the eggs were rafted as in some other species.

Finally, this fish, though normally reaching a weight of twenty pounds, attains maturity, under certain conditions, and breeds when weighing less than one-eighth of an ounce.

There are other peculiarities which render it worthy of close study, but, so far as I know, it has not yet built a nest, which brings us back to the beginning.

CHAS. F. GILBERT, M.I.C.E.

Ex Eng Toungoo, L. Burma.

Remarkable Discoveries in Babylonia.

A correspondent of the London News gives the following account of the great success which has attended the work of the American explorers under the direction of Rev. Dr. Peters and Prof. Hilprecht in Babylonia.

"The discoveries made by two expeditions that have been and are still working in Babylonia are certain to arouse general interest. A French expedition has for some time been at work at Telo, and has been remarkably successful. But the American expedition has produced even more remarkable results. The firman authorizing the Americans to explore the mound of Nippur, or Niffur, was granted eight years ago. It was at Nippur where Sir Henry, then Mr. Layard, nearly lost his life from the attacks of the Arabs. The University of Pennsylvania undertook an expedition at its own expense, and the Rev. Dr. Peters, an Episcopal clergyman, now in charge of a church in New York, was placed at the head of an exploring party intended to excavate at Nippur. He was aided by Mr. Haines, a young man who had been a tutor in Robert College, and who still continues connected with the explorations. At present the head of the expedition is Prof. Hilprecht, an American, who occupies a foremost place in everything relating to Babylonian archaeology. Upon him has devolved the task of classifying and deciphering the enormous number of inscriptions which have been found at Nippur. The labor of piecing together the thousands of fragments of vases and other objects, and of deciphering the inscriptions upon them, has during the last winter nearly cost him his eyesight. Happily he is now recovering, and is at present in Constantinople arranging and classifying the inscriptions and objects of priceless value, which, under the conditions of the firman, become the property of the Imperial Museum.

"Prof. Hilprecht informed me that it will be years before the Pennsylvania University will be able to publish all the inscriptions which have been deciphered, but the publication has already begun and gives promise of a rich harvest. The first and most notable result of the excavations is that the history of the Babylonian people, as recorded in cuneiform writing on tablets, is carried back at least 2,250 years further than it had yet been known. In other words, there is now abundant written evidence that the Babylonian people existed and were civilized enough to be able to write at least 7,000 years before Christ. In conversation with the professor, who in all matters of archaeology is cautious, I asked whether he could say that the written records did not go further back. He replied that, in his judg-

ment, they probably went back as far as 8,000 years B. C., but that in his published records he was unwilling to print anything which could not be amply borne out by evidence. To have pushed back written history at one stroke by 2,250 years is, however, enough to make a reputation. In reply to my inquiry how it happened that his predecessor had not found the many objects belonging to this early period, he explained that Dr. Peters, to whom he attributed great credit for the manner in which he had opened out the great mound at Nippur, had worked down to a certain floor or platform which he and others had taken to be the ground level of the ancient city. One of the party, however, suggested that this level should be penetrated and digging continued until rock or virgin soil was reached. This suggestion was adopted, and to the delight of all concerned it was found that what had been taken for the level of the ancient city was only the level of a comparatively modern city built over the ruins of an older one or a succession of older ones. The excavations above the level or platform had gone through 36 feet of debris. They were now continued to a depth of 30 feet below it. The excavations above the platform discovered remains which covered a period of 4,000 years of Babylonian history. Below the platform to the virgin soil was an accumulation of drains, preserved and broken pottery, and various other objects of interest. Twenty-three feet below the platform Mr. Haines came upon the most ancient keystone arch known, an arch which Prof. Hilprecht thinks cannot be later than 5000 B. C. Last summer Mr. Haines, who has spent the last three years in continuous work at Nippur, excavated the lower part of the marvelous wall of the city. Its foundations were found to be 16 feet below the level of the desert; the wall itself was 17 feet high and 45 feet wide. Upon the top of this wall was another of unknown height. These walls were built of bricks 20 inches square—probably the largest bricks ever used. The most valuable finds, however, were the inscriptions upon broken vases, bricks, tablets and other objects, and from these it is confidently predicted by Prof. Hilprecht that a continuous history of Babylonism will be able to be written.

"Among the recent finds of the French expedition which has been and is still working at Telo are a number of dated cuneiform tablets of Sargon I and of his son, Naram-Sin. These have now reached Constantinople, and within the last two months have been submitted to the examination of M. Hauzey, director of the Museum of the Louvre, and of Prof. Hilprecht, who has been retained by the Turkish government to decipher and classify the objects found by both expeditions. By this important find all questions as to the mythical character of Sargon are put an end to, and he is shown to have been a real person. The contents of the so-called Oman tablet are definitely decided to be historical and not mythical. One of the new tablets speaks of 'the year when Sargon marched against Palestine' (Martu). This was 3800 B. C. Even were no other finds to be made, the inscriptions gathered by the two expeditions will add largely to the knowledge possessed of the history and civilization of Babylonia. The truth is, however, that there is every reason to suppose that there exists an untold store of archaeological riches buried along the shores of the Euphrates and Tigris. Books on the subject which were up to date three years ago already require revision, and there is reason to believe that the efforts which the Americans and the French are making in a field first opened by Layard will be amply rewarded."

Learning to Ride a Bicycle.

A writer in our English contemporary *St. Paul* says: I can never understand the difficulties some beginners meet with. I know one lady who took four weeks before she could "ride alone," without being held. The time should be about four hours. Of course it takes a couple or three weeks' steady work before any one can ride really well. In my opinion it is a great mistake to learn in a riding school. The only way to ride well, with confidence, power, and ease, is to struggle alone, with an experienced friend at hand to tell you what to do. It is useless to sit on a cycle and be pushed along a flat road. Take your cycle into a field. If you are a woman, leave your skirt at home. There try a mount. Go on trying until you succeed. Never mind a fall, it will teach you how to fall with safety when you really meet with an accident. When you can mount, ride as far as you are able. Proceed until you can turn corners and feel confidence in your machine. Then ask your friend to mount his machine and ride toward you so that you have to get out of his way. Three days of this work will turn you into a very fair cyclist; a month will find you proficient.

Street Railways of Berlin.

The street railways of Berlin, Germany, comprise 55 different lines, of an aggregate length of 226 miles. One hundred and sixty-four millions of passengers were carried in 1895. The number of regular employes is 4,951. The heaviest traffic is at the Potsdamer Platz, where there is an average of 244 cars per hour.—*Uhland's Wochenschrift*.