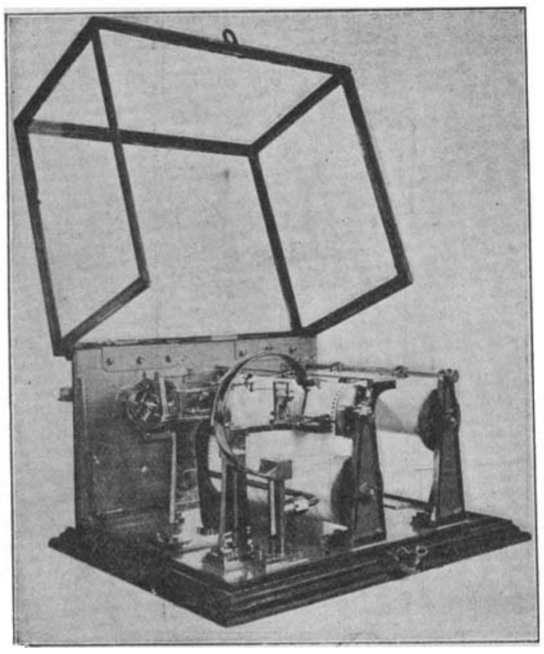
A NEW APPARATUS FOR DETERMINING THE RESISTANCE OF ROAD VEHICLES TO TRACTION.

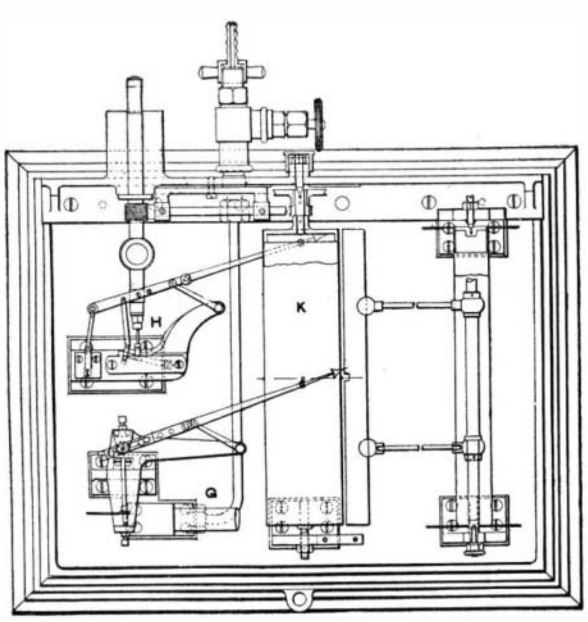
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Some interesting experiments have been carried out for some time past in Great Britain by Prof. Hele-Shaw and a committee of engineering experts, to determine the resistance of road vehicles to traction. Although the scope of these investigations has been conducted upon an extensive basis, they will be of value chiefly to chauffeurs.



GENERAL VIEW OF THE RECORDER.

For the purpose of his investigation Prof. Hele-Shaw devised a new dynamometer specially made for these experiments concerning the resistance of road vehicles to traction. The apparatus comprises a castor frame *AA* shown in the diagram, in which frame is mounted the wheel *B*; a system of levers *CC* for transmitting to a small plunger *E* the pull exerted on the wheel; and a recording gage for registering the same, as well as a recording tachometer. The castor frame is rectangular in shape and is constructed of wrought iron. The frame is 6 feet in length. The end plates are drilled with three sets of holes, thereby enabling the sides to be adjusted to 10 inches, 14 inches or 16 inches apart to accommodate wheels of various widths. The axle of the wheel to be used for the experiments is mounted on springs one on either side of the castor frame. These springs can be regulated to any desired strength when a light wheel is inserted in the frame, or when a light load is used, by simply removing some of the plates; while if so desired, the axle can be mounted without the springs.



TOP PLAN OF THE RECORDER.

The frame is loaded by bolting a number of 28-pound weights of cast iron to the channel sides of the frame. These weights are made only two inches in thickness, so that when the iron scrolls of the springs do not interfere, 52 or thereabout can be attached, thus giving an aggregate load of 13 hundredweight in addition to the weight of the frame and wheel. This gives a weight corresponding to 3¼ tons on a four-wheeled vehicle. By this system of loading, the weights can be varied by steps of 56 pounds, the weight being always placed equidistant on either side of the frame, so that perfect equilibrium is constantly maintained.

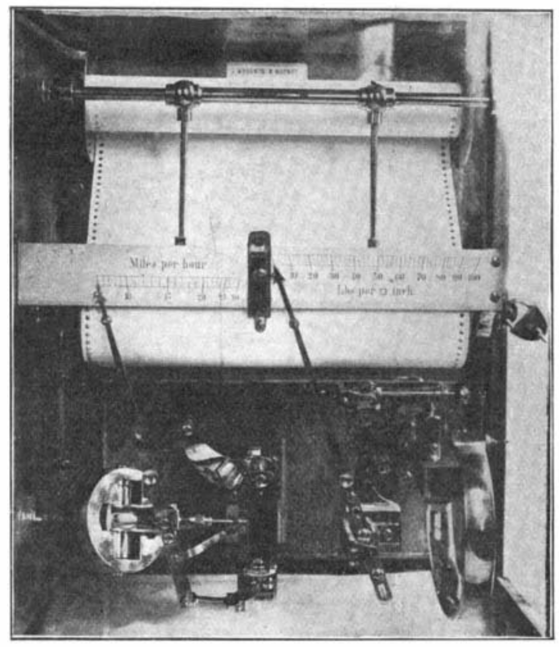
The castor frame is attached to the car by fixture to the levers, which transmit the force to the water by means of a swivel joint *D* so that freedom is given to vibration or vertical bouncing, such as is encountered when traveling over rough, uneven ground, while furthermore it enables the car to follow freely round any curve without disrupting, the records being so held that the experimental wheel is always vertical.

The system of levers is arranged in such a manner that the frame can be raised or lowered to accommodate a wheel of any diameter or any angle of draft without disturbing or altering the leverage of the mechanism. The arrangement of these levers may be described as follows: There is a fulcrum which may be raised or lowered in a vertical slot in a steel casting firmly fixed on the back of the car, upon which is fixed a pair of bell-crank levers. The lengths of these levers from the fulcrum are respectively 14 inches and 28 inches. The longer arm is vertical, and the other smaller lever is horizontal. Two parallel vertical rods of steel, which may be adjusted as desired, are attached to the shorter arm. These rods transmit the pull on the frame to the end of a small horizontal lever, to the other end of which the hydraulic plunger is attached. The fulcrum of this lever is provided with four positions, so that the pressure on the plunger may be made equal to one, two, four, or eight, times the pull exerted on the castor frame. By this arrangement the apparatus may be employed over a wide range of experiments for tractive efforts from 5 to 500 pounds.

The hydraulic plunger *E*, which is 2.6 inches in diameter, exerts pressure upon a rubber diaphragm inclosing a space filled with water, and it is the pressure of this plunger upon the water that is recorded. Two pipes are connected to this water space, the objects of which are to transmit the recorded pressure to the gage, and the other to fill the space with the requisite water. A rubber ball or bulb filled with water is fixed to one end of this latter pipe, and when the ball is squeezed the water is forced through the system and out of a small hole in the Bourdon tube. All air is thus excluded, and the system is then closed and the water retained.

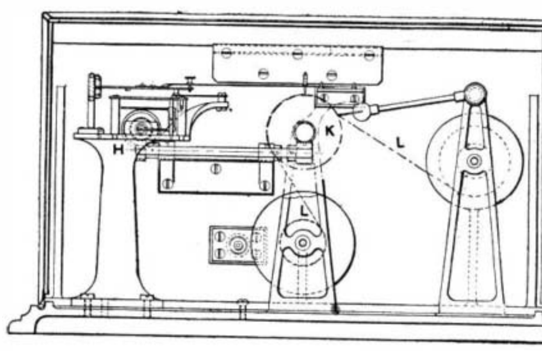
The recording apparatus consists of a combined pressure gage and tachometer mounted on a common base and recording upon an identical horizontal drum carrying a band of paper 8½ inches wide. On one side of this paper is the graph of tractive effort space, and on the other the velocity space. The drum is revolved off the tachometer spindle, so that its motion is identical with the motion of the car, a length of 10.3 on the paper corresponding to a mile of road. This instrument is mounted in a glass case upon a pneumatic cushion with a flexible shaft driving to the drum and tachometer. By this arrangement steady records may be obtained when driving at a high speed over a rough road. Undue shocks on the gage are prevented, by means of stops, which obviate too excessive a movement on the levers. The revolutions of the experimental wheel are also independently obtained by a revolution counter, and this register serves as a check on the record of the apparatus.

The dynamometer was calibrated in the following manner: The car and dynamometer were brought into position on a smooth horizontal floor, and a 40-inch lorry wheel was placed in the castor frame. The car was fixed so as to prevent its moving backward, and a predetermined load was fixed to a wire connected to the top of the wheel and passed over the tire so that it depended vertically; this position exerting the tendency to pull the frame away from the car. A load was applied, and the apparatus submitted to a severe vibration, so as to prevent all possibility of its sticking in any way, the paper at the same time being

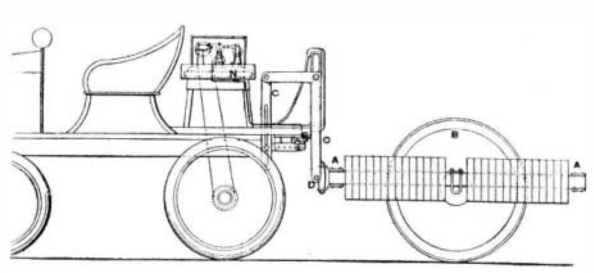


TOP PLAN VIEW OF THE RECORDER, SHOWING THE DRUMS FOR RECORDING THE MILEAGE PER HOUR AND THE POUNDS PER SQUARE INCH.

moved steadily and uniformly until the pencil of the gage occupied the position of equilibrium. This was the *modus operandi* with every reading. During the calibrating of the leverage of 8 to 1, additions of 2 pounds were employed in nearly every case from 0 to



SIDE ELEVATION OF THE RECORDER.

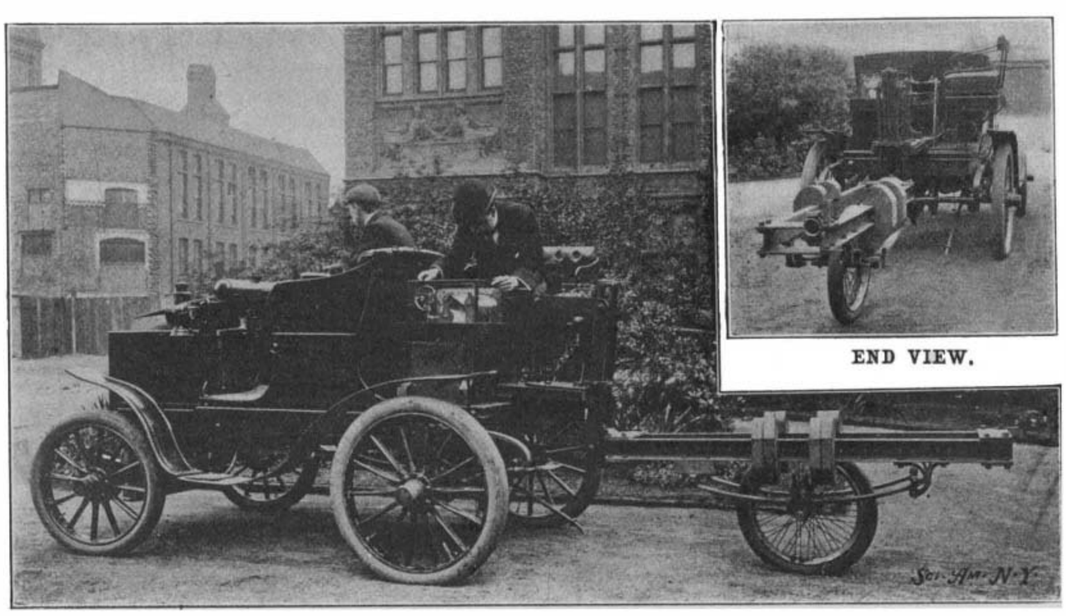


THE DYNAMOMETER APPLIED.

28 pounds. For the 4 to 1 leverage calibration, increases of 14 pounds were taken; after 14 pounds had been reached the highest reading being 168 pounds. The 2 to 1 leverage had 14-pound increments, the maximum being 280 pounds; and the 1 to 1 leverage had increments of 28 pounds up to a total of 580 pounds.

To calibrate the tachometer, an electric motor was utilized. A stop watch for readings of 10, 15, 20, 25, and 30 miles per hour, was employed to time exactly the three revolutions of the drum. Three revolutions of the latter correspond-ed to 315 revolutions of the tachometer spindle. The mean diameter of the rear wheels of the car is 842 mm. when the car was bearing a normal load, and the tires were normally inflated. The diameter of the pulley on the back axle is 225 mm.; and the diameter of the tachometer pulley is 75 mm.

To operate the dynamometer and the tachometer during a trial, the castor frame is forced toward the car so as to push the ram as far out of the cylinder as it will go. The bulb, which has previously been filled with water, is then squeezed, thus forcing the water into the cylinder, then through the connecting



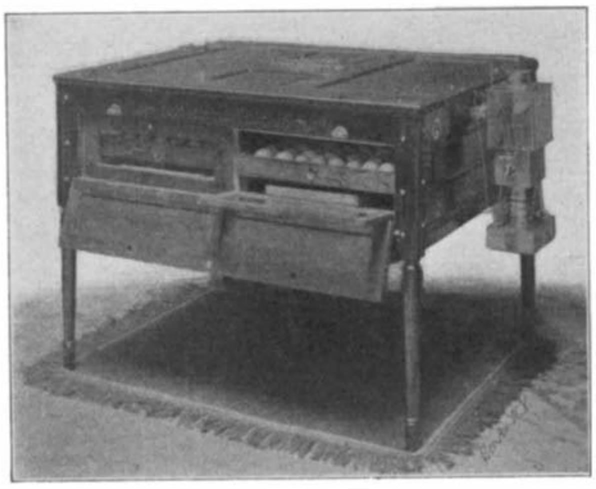
THE DYNAMOMETER ON THE ROAD.

END VIEW.

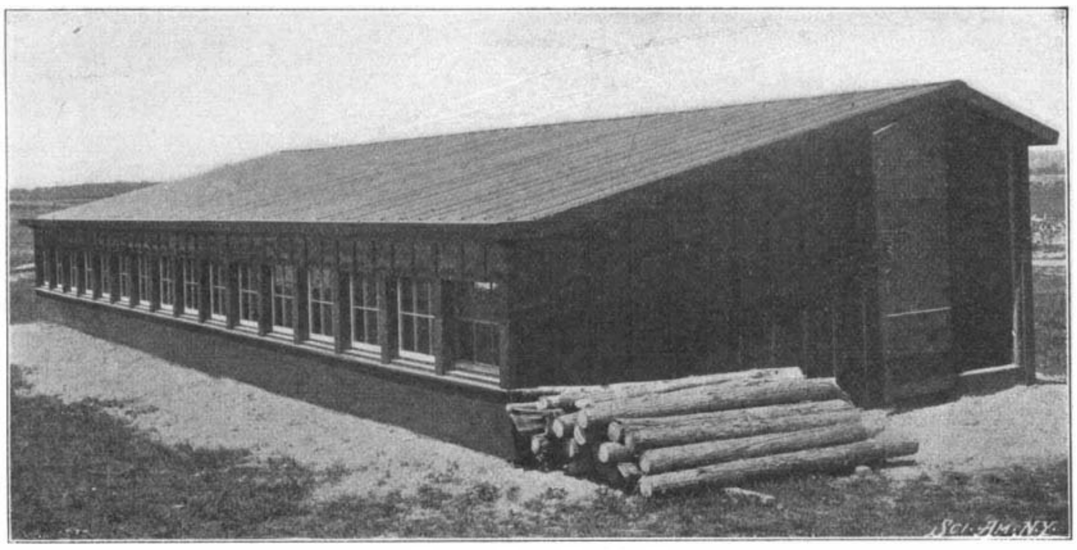
tubing, finally escaping through the pressure gage, as already described. When all the air has been expelled from the cylinder, the cocks at either end of the system are closed. The stops are then adjusted so that the maximum pressure of the water cannot exceed a pressure of 100 pounds per square inch, this precaution being taken to prevent the pressure gage being destroyed, as might possibly otherwise be the case in the event of a greater pressure being exerted. Adjustments completed, a stretch of road is selected for the car to run over for a certain distance, and then back again to the starting point. The return journey is made for the reason that by taking the mean values for the run there and back, it is possible to eliminate the effect of inclines, and thus obtain a perfectly correct result. The load on the car is then augmented and the journey made again, and so on in the same manner, as desired.

The first run was made with a light lorry wheel of 40 inches diameter shod with a 3-inch iron tire mounted on springs of 3 feet 2 inches centers each, with six plates $2\frac{1}{4}$ inches by 5-16 inch. Three runs were made with this wheel with three loads—$3\frac{1}{2}$ hundredweight, $5\frac{1}{2}$ hundredweight, and $8\frac{1}{2}$ hundredweight respectively. The first trial was not attended with any conspicuous success, but another run with exactly the same mountings upon a road paved with sets, the weights being 6 and $8\frac{1}{2}$ hundredweight respectively, at speeds varying from 5 to 14 miles per hour, showed that the tractive effort increased rapidly with the velocity, and at the same time was fairly proportional to the load.

The next experiment was made with a pneumatic wheel measuring 24 inches in diameter by $2\frac{3}{4}$-inch diameter tires. The springs were exactly the same, but there were only two plates. A macadam road was selected. The run was made with a given load at a constant speed for a distance of about one-half a mile and then back again, the runs being subsequently repeated at speeds of $6\frac{1}{2}$, 8, 10, and 14 miles per hour with loads of 315, 427, 539, and 651 pounds with a leverage of 4 to 1. The result of this test was analogous to the results of Michelin's investigations. The tractive effort was directly proportional to the load, but showed a slight increase with the velocity. Several other experiments of a similar nature have been carried out with highly interesting results. The apparatus works very satisfactorily. The experimental wheel mounted in the castor frame runs very steadily, even under a heavy load and at a high speed. The best-running wheel, however, is the pneumatic-tired, it being found that the lorry wheel oscillates somewhat when running over certain descriptions of roads. The pneumatic cushion is very useful in permitting the recording instrument to work successfully under varying conditions. It prevents the apparatus being subjected to any severe concussions or vibrations, such as might be experienced when running over rough roads, but enables the apparatus to swing gently from side to side. Several further important investigations are to be carried out with the apparatus this year, which it is anticipated will yield valuable information relative to the resistance of road vehicles to traction.



One of the Incubators.

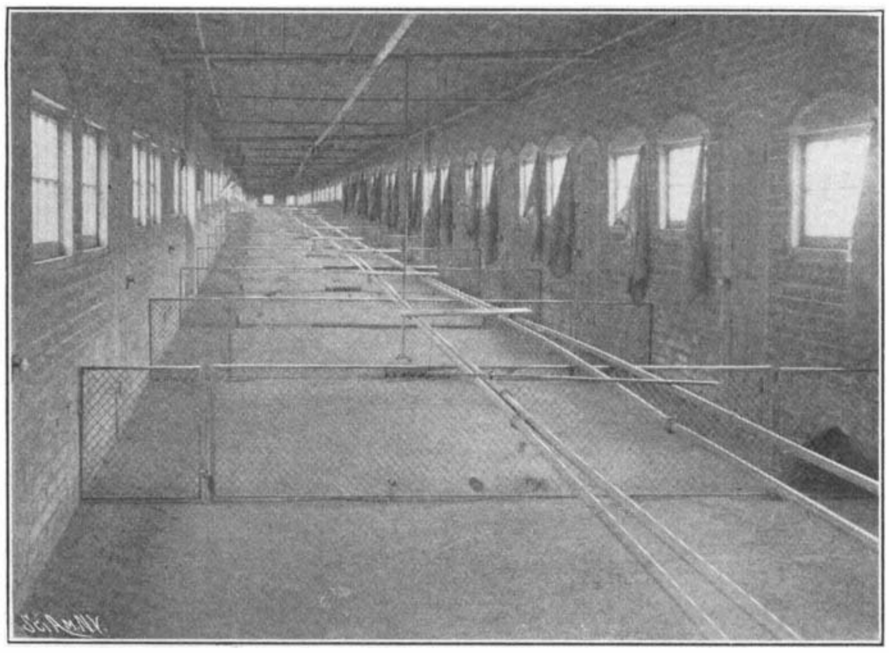


A Modern Poultry House.

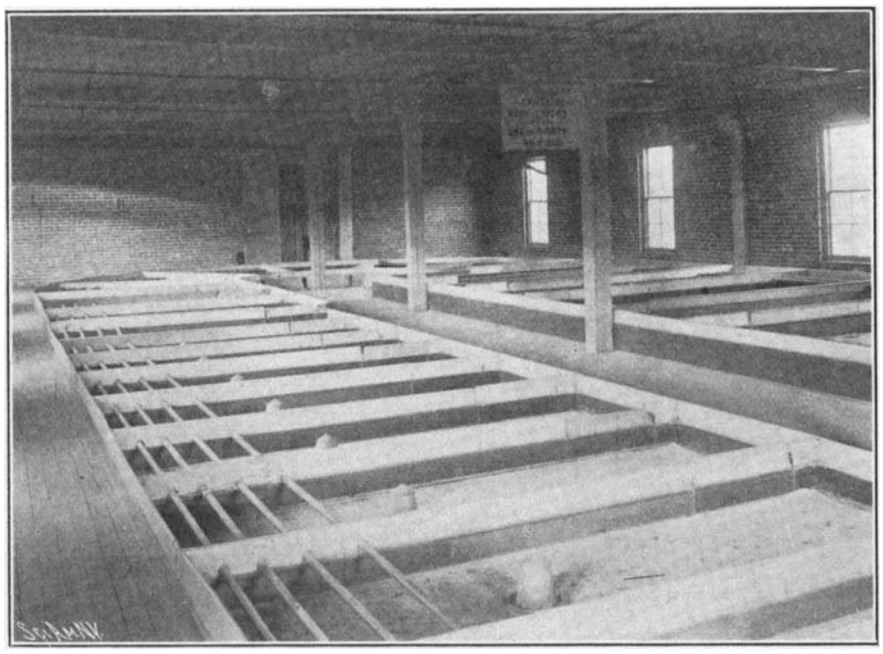
SCIENTIFIC POULTRY RAISING.

The tremendous growth, during recent years, of the poultry and egg industry, which, in point of value of the product, now ranks as one of the leading American wealth-producing activities, has resulted in the introduction of modern scientific methods, which are quite as markedly in contrast to former practices as the advances in any other progressive field of endeavor. Indeed, to present-day achievements in this direction must be attributed the recent development of the American export trade in eggs, which has recently invaded markets as far distant as the Orient.

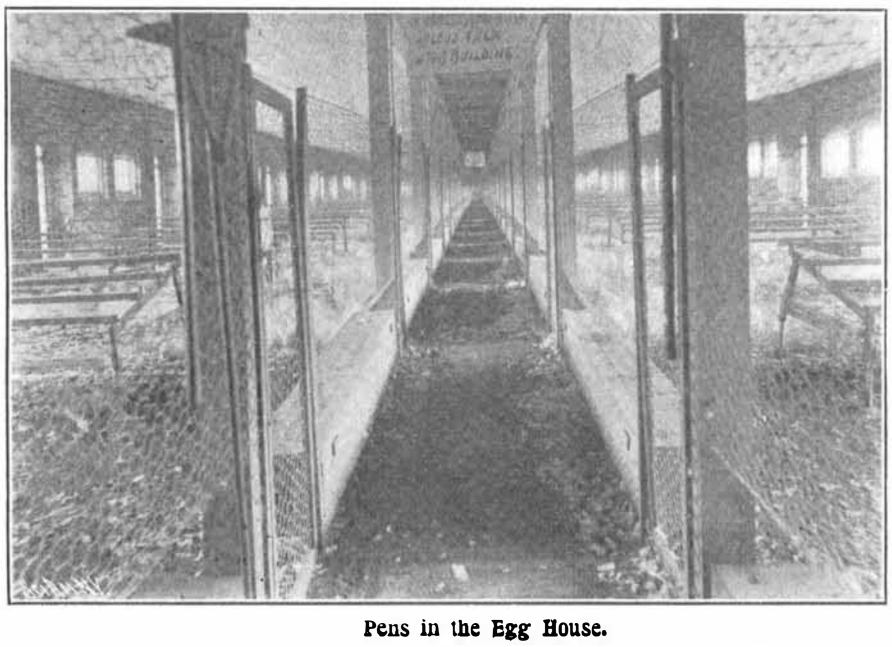
Perhaps the most convincing demonstration of what scientific methods are accomplishing in the poultry industry is afforded by the unique poultry farm at Sidney, Ohio, which ranks as the largest in the



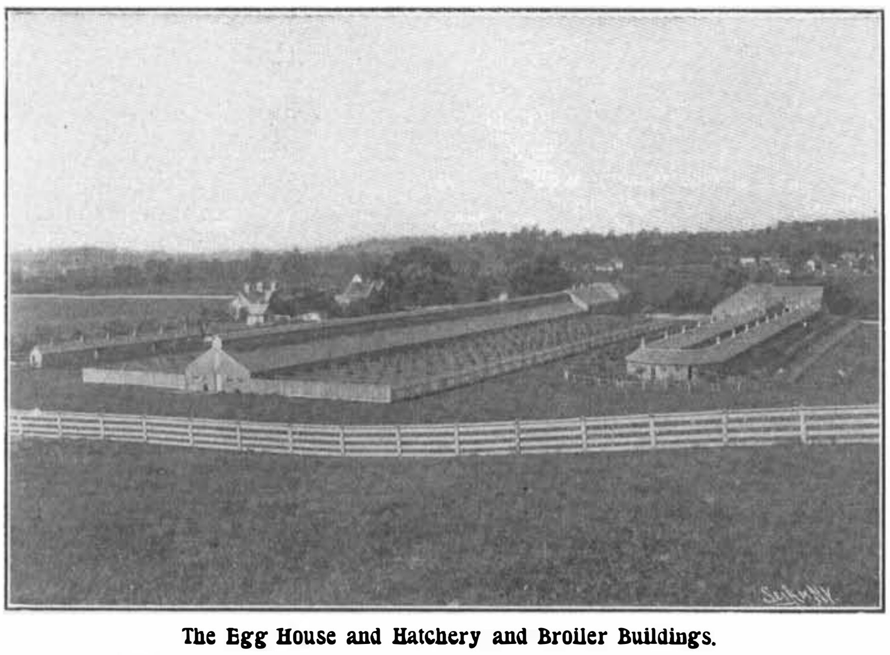
Pens in the Broiler Building.



The Nursery for Newly-Hatched Chicks.



Pens in the Egg House.



The Egg House and Hatchery and Broiler Buildings.

SCIENTIFIC POULTRY RAISING.