A CHICKEN-FEEDING MACHINE.

BY W. FRANK M'CLURE.

Fattening fowls for the market by means of machinery, on first thought to most people seems ridiculous, hardly more so, however, than the hatching of chickens by means of an incubator a few years ago. The incubator has come to stay, and the chicken feeder, although an innovation, has found a place in some of the largest poultry yards. Modern genius in recent years has affected the poultry farm just as decidedly as it has the apiary or the stock farm, and its problems have offered a wide field for scientific study.

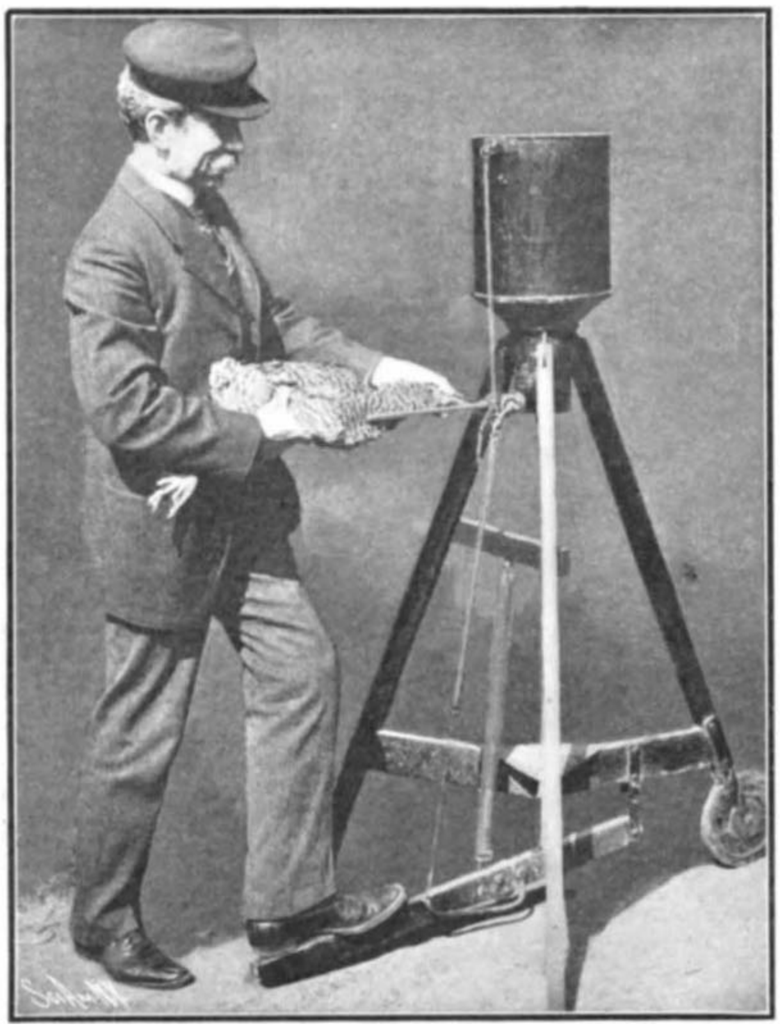
It is claimed that chickens fattened by machinery comprise sweeter and tenderer meat than those fattened in the ordinary way. Fowls are fed in this manner for two or three weeks prior to killing, and in that time increase in weight from two to three pounds. The chickens are not allowed exercise in this time, and are allowed no other food than that which is received from the machine. The feeding is done twice a day, and one man can feed 300 chickens in a day. It is a patent liquid food that is fed in this manner, the ingredients of which, of course, are known only to the maker.

The feeding machine is nicely illustrated in the accompanying photograph. The food is forced through a tube by means of a suction pump, which in turn is operated by a foot pedal. The tube, which is about ten inches in length, reaches through the chicken's mouth into its crop. In the photograph this tube is shown on the outside of the fowl's neck, reaching to about the same point as when inserted in the mouth. When the crop is full the flow of liquid food stops instantly, and the chicken is not injured in the least. This feeding by machinery is done chiefly in the preparation of roasters for the market and for finishing the fattening of broilers.

Notable progress has also been made among poultry raisers in the increased production of eggs. It is claimed to-day that it is within the power of the poultry owner to make his hens lay an average three years' crop in two years, and that even molting is controlled at the will of the owner. This is an important discovery in this day, when the demand for eggs is so enormous and the price so high. In the last annual report of the Secretary of Agriculture, a statement is made which gives an idea of the size of the annual consumption of eggs in this country. This report states that the hens of the United States lay 1,666,000,000 dozens of eggs a year, the value of which in one month is enough to pay the interest of the entire national debt for one year. There is little question that the scientific study that has been given the subject of poultry raising in recent years has added materially to this annual egg production over what it otherwise would have been. Proper housing, for example, has come to be recognized as an absolute essential. Also, as pure air is required for the healthy human being, so also the well-bred fowl to-day is given plenty of fresh air, while at the same time drafts are avoided.

It is not unusual nowadays to see numerous small chicken houses scattered over a large field where the poultry business is carried on upon an extensive scale. This arrangement, of course, admits of the various flocks being housed separately. Artificial heat is seldom resorted to in heating these houses, except in extreme cold weather. With all surroundings conducive, it is not unusual for one hen to lay sixteen dozen eggs in one year, and even better records than this are often made. Few poultrymen, however, attain such records with their flocks unless they have made a study of the numerous scientific methods of caring for them.

A new application of wireless telegraphy has been introduced by two English inventors. The device is purely for entertaining purposes, consisting of the operation of musical boxes placed at different points from one common center. There is a receptacle in which the coin is placed, and immediately a musical box placed at a distance, such as in another room, commences to play.



A CHICKEN-FEEDING MACHINE.

NEW CŒLOSTAT AND HORIZONTAL TELESCOPE OF THE ASTROPHYSICAL OBSERVATORY OF THE SMITHSONIAN INSTITUTION.

A novel form of cœlostat has been designed by Mr. S. P. Langley, of the Smithsonian Institution, for the study of the absorption of the solar envelope and for measuring the energy of sun-spot spectra. Mr. C. G. Abbot describes this instrument as follows in the Smithsonian Miscellaneous Publications:

The beam is reflected due south from a rotating mirror and thence due north from a second mirror over the top of the first. The beam from the first mirror shoots upward at an angle with the vertical equal to the sum of the angles of latitude and declination; and for the sun at Washington this angle is about 62 deg. at summer solstice and 16 deg. at winter solstice. Therefore to give a horizontal northerly directed beam the second mirror is to be inclined forward 14 deg. at the former period and 37 deg. at the latter.

In this form of cœlostat the moving mirror is never used in very different positions, so that owing to the consequent probable constancy of figure in the mirror it seems to be well suited to long exposures in stellar photography.

At noon of the equinoxes the second mirror if exactly south of the first would cut off the beam, and at summer solstice it must be further south than in winter to reflect the beam clear over the first mirror. Accordingly the second mirror is provided with a carriage and two pairs of tracks at right angles like the slide rest of a lathe, so that the mirror may be displaced to the west a little before noon when the sun is in its southern declinations, and can be shifted back to the east a little after noon. The north and south track is for the purpose of shifting the second mirror for different declinations of the sun, the mirror being at the south end of the track at the summer solstice.

As it has been thought that this solution of the difficulties attending the use of the cœlostat will prove of interest and value to astronomers, a large instrument of this type was ordered from the J. A. Brashear Company and sent for exhibition to the recently-closed Louisiana Purchase Exposition. The accompanying engraving is reproduced from a photograph of this cœlostat as now being tested at the Astrophysical Observatory, in connection with the long-focus mirror above mentioned. There is also shown in the illustration a portion of the "churned" tube of the horizontal telescope, of which more will be said later. The cœlostat carries a thirty-inch and a twenty-five-inch mirror, the former turned by a polar axis driven at the rate of one complete rotation in forty-eight hours, the latter mounted on a carriage with traverse motions at right angles like the slide rest of a lathe. The cell of the second mirror is carried by trunnions in a fork, itself capable of turning about a horizontal north and south axis, and by these two motions of rotation, with their fine adjustments, the beam may be sent in any direction whatever, though most favorably in a nearly northerly one. In actual use the reflected beam is depressed about 6 deg. from the horizontal to feed the long-focus mirror, which is 55 feet north and about 3½ feet below the center of the first mirror of the cœlostat, directly under which the beam passes toward a focus on the third pier, some 85 feet further south. To provide for this depression of the beam from the horizontal, the north and south, or declination, track of the cœlostat is inclined upward at a corresponding angle, so that the reflected beam may always clear the first mirror. The length of travel of the lower base of the second mirror on this north and south track is five feet and the lower base itself has an east and west track six feet long on which the upper casting is moved to and fro to allow for avoiding the shading of the main cœlostat mirror by the cell of the twenty-five-inch mirror between 11 o'clock and 1 o'clock near the times of the equinoxes.

Early experiments on an artificial star with the long-focus mirror, before the completion of the cœlostat or the installation of a tube, showed conclusively that the "boiling" caused by irregularities of the atmosphere over the grass-grown soil between the mirror and its focus was far too great to permit anything like satisfactory definition on the solar image, and therefore the novel device of a tube with provision for stirring the air by means of a blast was ordered. It consists of a main horizontal tube 24 inches in internal diameter with diaphragms at five-foot intervals, and with an inclined flared tube uniting with the main tube at the north end close in front of the concave mirror. At intervals of about five feet, five-inch ducts lead to air-mains 14 inches in diameter, which in turn at length unite in two twenty-inch mains leading to the intake and blast respectively of a twenty-nine-inch fan blower with direct-connected 2½-horse-power electric motor. It is so arranged that the openings in the telescope tube communicate with the blast and suction of the blower alternately, so that the air within the tube is repeatedly carried through the system and churned over and over. Thus the path of the beam from the cœlostat to the focus of the mirror is thoroughly stirred, but nothing has been done as yet to introduce stirring between the cœlostat and the sun. It is possible that an attempt will be made later to stir the path of the beam in the eighty feet immediately above the cœlostat, if it is found impossible to get good enough definition with the present arrangements.

It should be recalled that the conditions required for bolometric work are quite different from those suited to direct eye vision or to photography. Bolometric studies require unchanging transparency of the air, else difference in the galvanometer deflection may be due to alterations in transparency of

THE TWO-MIRROR CŒLOSTAT OF THE SMITHSONIAN ASTROPHYSICAL OBSERVATORY.

the intervening medium and not to the properties of the source of light. Thus those times when thin cirrus clouds, fog, or smoke cover the sun, which are well known by solar observers to be the times when "boiling" is apt to be diminished, and which are the most favorable opportunities for visual and photographic observations, are quite unsuitable for bolometric work. Indeed, the best time for this is somewhat after noon on those clear October days when "boiling" is apt to be at a maximum, but cloudiness at a minimum, and it is probable that the definition obtained in such conditions will never be the best.

Trials made thus far have demonstrated the great value of the stirring apparatus, not only to diminish "boiling," but to preserve a constant focal length and tolerable definition. "Boiling" is still of course noticeable, because the long reach of air above the cœlostat is not stirred, but the image is far better than could be obtained with the earlier appliances, and owing to the massive piers and to the simplicity of driving mechanism, it is less subject to jars and wandering.

THE BRONTOSAUR. HOW A GIANT PREHISTORIC ANIMAL WAS DISCOVERED, TRANSPORTED AND RESTORED.

In 1897 Mr. Walter Granger, of the expedition sent out in that year by the American Museum of Natural History of New York, found in the southeastern part of central Wyoming, not far from the Medicine Bow River, the first fruits of the greatest collection of the fossilized remains of extinct reptiles that has ever been discovered in any one locality. Previous prospectors had taken fossils from the region, but had abandoned it for other fields, so that Mr. Granger really rediscovered it. It will be remembered, from various accounts published since then, that weathered fragments of dinosaur bones were so common at this place that they were taken for bowlders of peculiar shape, and that a couple of Mexican sheep herders had used these fossils for the foundations of their hut. This Bone Cabin Quarry, as it came to be called, was about ten miles south of the famous Como Bluffs, from which a considerable number of fossilized skeletons had previously been taken. The finest specimen among these is Prof. Marsh's *Brontosaurus excelsus*, now one of the treasures of the Yale Museum.

When fossil bones of one kind are found in different places within a reasonable distance of one another, they usually occur in one stratum, which has cropped out at different points. This is true of the remains found at the Como Bluffs and at the Bone Cabin Quarry, the bone layers there exposed being of the same age, and originally an unbroken level stratum which may be designated as "the dinosaur beds." When the contiguous Laramie Mountains and the Freeze-Out Hills were formed by the shrinking of the earth's crust, this stratum was correspondingly warped and wrinkled into numbers of great folds or rock waves. Surface erosion of wind and water has been responsible for the subsequent removal of great portions of the crests and upfolds or "anticlines" of these waves, thus exposing the edges and allowing the weathering out of the fossilized contents of the strata. This layer, usually about two hundred and seventy feet in thickness, is entirely of fresh-water origin, but both above and below it are strata which show that there had been previous and subsequent invasions of the sea, the first forming the ichthyosaur and the latter the mosasaur beds. Owing to the uplift of the various mountain ranges, this great dinosaur graveyard is found to crop out along the entire eastern face of the Rocky Mountains, around the Black Hills and in all parts of the Laramie Plains. Dinosaur bones may be found almost everywhere, but up to the present, in no locality have they been seen in such profusion as in the two well-known places mentioned before.

In the excavations at the Como Bluffs the remains were found thoroughly scattered and from twenty to a hundred feet apart, an entire skeleton or even the larger part of one being extremely rare. In the Bone Cabin Quarry, on the other hand, the American Museum expedition found a vast number of skeletons, not only close together, but often closely commingled, remains of most of the animals of that region at that period, from the largest of the giant dinosaurs to the smallest and most bird-like kind. The Bluffs appear to represent the ancient shore line of a muddy estuary or lagoon, such as is depicted in the accompanying drawing of a Brontosaurus restoration by Charles R. Knight. Prof. Henry Fairfield Osborn, curator of the Department of Vertebrate Palæontology at the American Museum, believes that at the Bone Cabin Quarry, on the other hand, the conditions were different; that this was the area of an old river bar which, in its shallow waters, arrested the more or less decomposed and scattered carcasses that had slowly drifted down stream toward it, from almost the entire region through which the river took its course.

The greatest of these creatures were the giant dinosaurs, and very probably no animals existing on land have ever approached them in size and bulk. The evidence of the freely commingled remains shows us that at least three distinct kinds of these giant dinosaurs existed at the same time in the same region.

The dinosaur named *Diplodocus* by Marsh is most completely known. The American Museum's first find in the Bone Cabin Quarry was the previously unknown hind limb of this dinosaur, a find that showed it was distinguished by relatively long, slender members and may popularly be called the "long-limbed dinosaur." The major portion of a great skeleton unearthed in the Bluffs and a larger one found about ten miles north of the Bone Cabin Quarry furnished practically complete knowledge of the great bony frame of this giant lizard. By contrast the second, the Brontosaurus, or "thunder saurian" of Marsh, was relatively shorter in body and more compactly built, but more massive in structure. Considerable portions of the skeletons of perhaps a score of the great herbivorous dinosaurs are preserved in the Yale, Carnegie (Pittsburg), Field Columbian and American museums, while much less abundant and more incomplete remains have been found in England near Oxford. Of another type, and much smaller in size, were the carnivorous dinosaurs. They were bipeds with bird-like feet and sharp claws, and, in contrast with the two foregoing types, had large heads with sharp, pointed teeth. The marks of these teeth have been found upon the tail vertebræ of both *Diplodocus* and *Brontosaurus*, showing that if the carnivora did not destroy the ponderous and slow-witted lizards of the other types, they at least fed upon their carcasses.

In 1898 the largest known and at the same time the most complete Brontosaurus skeleton was discovered about three miles west of the Bone Cabin Quarry. It was worked out with great care, and is now being restored and mounted complete at the American Museum under the direction of Prof. Osborn. When finished it will be the only mounted skeleton of a Brontosaurus in the world, though at the Yale Museum the pelvis and hind legs of a dinosaur of this kind are mounted, and another splendid skeleton of a Diplodocus is being reconstructed at the Carnegie Museum, Pittsburg.

As can be readily understood, the natural processes incident to the preservation of these fossils almost preclude the possibility of finding an entire skeleton. Especially is this true of the smaller bones, such as those of the head, or those not firmly bound together by strong ligaments. These often become scattered or so badly crushed by the weight of the strata which accumulate above them that it is not worth while to mount or even reconstruct them. The Brontosaurus now in course of erection at the American Museum is unusually well preserved, and it is, fortunately, of nearly the same size as the Yale Museum specimen. This fact smoothed over a number of difficulties. The skull was not found, and in fact is known only by incomplete portions of the jaw and of the back of the head. The reconstructed skull is based on these fragments and on the known skull of a nearly related species. The heads of these herbivorous dinosaurs, by the way, were comparatively small in size and altogether out of proportion with the ponderous body. We can hardly understand how this very small head with its light jaws and slender, spoon-shaped teeth could adequately supply the food necessary to nourish the great creature. Prof. Osborn is of the opinion that the animals fed on some very plentiful and nutritious water-plant, which was swallowed in large quantities without mastication, there being no grinders or molars in the head.

The Brontosaurus was among the most highly specialized of the herbivorous dinosaurs—probably the last of the race. Evidence of this is found in the wonderful construction of the bones, especially of the vertebræ. The bones were excessively light for their size and strength. They are so shaped that every unnecessary particle is dispensed with, are hollowed out wherever possible and braced wherever necessary, and are porous in the centra. The accompanying photograph of the vertebræ clearly shows the remarkably efficient construction, from an engineering standpoint, to withstand the enormous strains and stresses incident to moving the huge bulk of a creature from 60 to 70 feet long. It shows also how similar the principle of structure is to the modern T-iron one. From the tip of the tail to the head the structure of the vertebræ changes with the mechanical requirements. Exactly what these were, however, has not been thoroughly studied, as little is known about the musculature of the body. A further demonstration that the Brontosaurus was highly specialized is given by the pelvis. In primitive vertebrates there is little connection between the pelvis and the backbone. Here the pelvis and the adjacent vertebræ are intimately connected. The anterior tail vertebræ are peculiarly shaped to strengthen the pelvis, and the one nearest to this is, in fact, a part of it. The lateral flange of this vertebra is in part probably a modified rib, being deepened to give added strength with which to resist the tremendous torsional strains on this portion of the frame, the pivotal center of motion undoubtedly being at the hips.

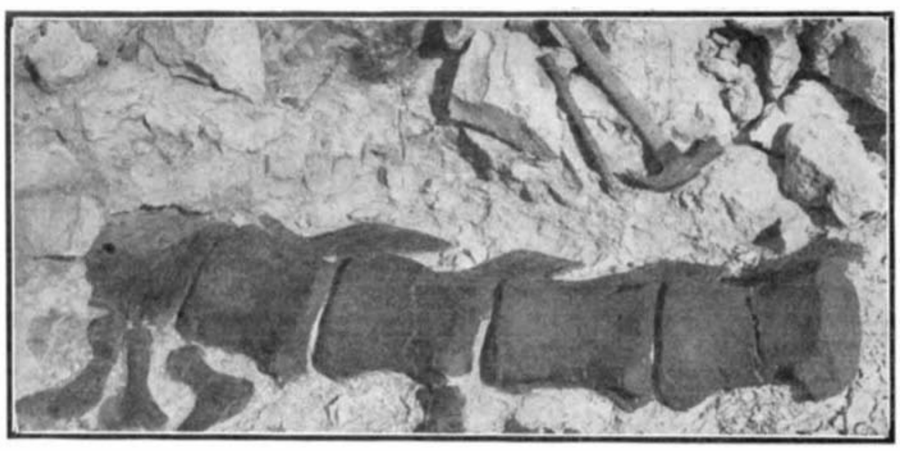
It is supposed that the two inverted V-shaped prongs under the hind legs were used to rest upon in a sitting posture, and that there was a great pad of cartilage or connective tissue at the point of each V. It is not believed that the Brontosaurus was able to sit up on the hind legs and tail like the modern kangaroo, as at no point of the tail is found the peculiar bend or the fusion of vertebræ usual in this case.

The Brontosaurus was supposedly aquatic, but not marine. As in most aquatic animals, the ends of the bones at the joints are rough instead of smooth. It is, in fact, beginning to be doubted whether it ever came out on land, though the comparative lightness of its bones, usual in walking or flying animals, but not in swimming ones, seems to indicate that part, at least, of its life was spent out of the water. The five toes on the hind feet are thought to have been used to force the body along the muddy bottoms of the shallow lagoons which the Brontosaurus supposedly frequented. Palæontologists have not, however, accounted for the single claw on each forefoot. The fact that there really was only one claw on each forefoot is proven by the numerous fossilized footprints that have been found.

The mental and physical labor, the time and patience necessary successfully to complete a restoration of this kind, can hardly be appreciated by the layman. The expeditions that are sent out each year to search for fossils or to recover those already found, entail great labor and expense. The real work begins, though, with the removal of the fossils from the rock, clay, or shale matrix, and this excavation is a very

Covering the Excavated Bones with Plaster of Paris.

The figures on the plaster show what each bone is and where it was found.



Appearance of the Fossil Bones when Uncovered.

THE RESTORATION OF THE GIANT LIZARD, THE BRONTOSAUR, AT THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.