INOCULATING ANIMALS AGAINST DISEASE.

Of recent years practical attempts have been made to use the antitoxin treatment for the prevention of disease in animals of the lower orders, and many domestic pets have been inoculated in order to ward off the various complaints to which they are peculiarly subject. The laboratories making a business of preparing such serums are now putting up animal antitoxins as a regular thing, and are said to experience no difficulty in disposing of them.

The originators of the idea reasoned, and apparently correctly, that if antitoxins were beneficial to the man, they must be to the dog and cat. The only difference would be in the material of the serum. Mr. George Cugley, who has made animals his life study, began two years or so ago to experiment with antitoxins intended for the lower animals, and he now claims that complete success has attended his efforts.

The method is simply to inject the serum hypodermically into the blood of the animal by means of a needle-pointed syringe. The "vaccination" in the case of a dog or cat does not "take" as it does with human beings. There is no eruption. The serum is injected into the blood, and according to the advocates of this method of treatment, renders the animal immune from the attack of the disease it is intended to fend off.

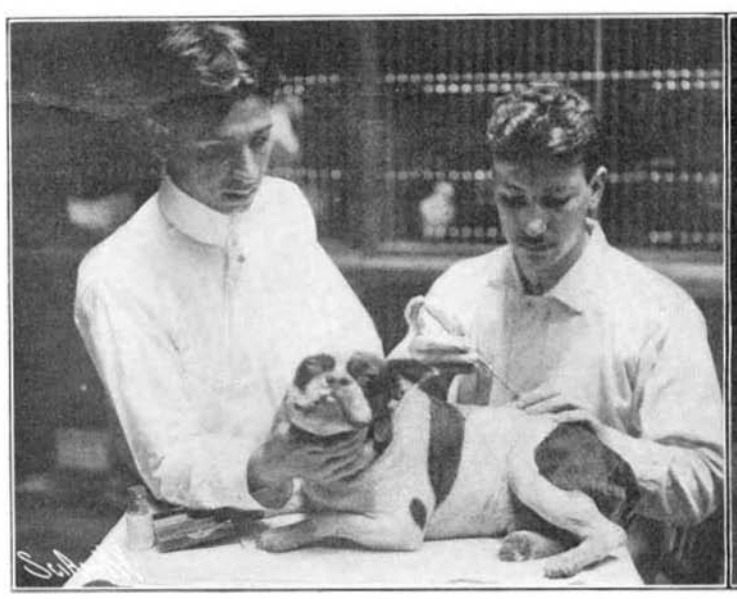
The greatest demand is said to be for distemper antitoxin. Despite the fact that innumerable distemper cures are advertised, the animal experts know that it is scarcely worth while trying to save a dog when once he has contracted this very common complaint. Animal dealers themselves, notwithstanding the long list of "guaranteed cures" for distemper, have about agreed that the most satisfactory method of dealing with a dog who has contracted distemper is to put him out of his misery at once, as the difficulty of curing the animal, combined with the immense trouble involved in treating him and the danger of other dogs contracting the disease, makes it poor economy to attempt to save the animal's life.

It is another matter, however, to successfully prevent the contracting of the disease, and this, it is claimed, is now possible by means of the inoculation method. Instead of deliberately exposing the puppies to the danger of contracting distemper in order to have it over and done with, no matter whether the dog live or die, the owners will now be able to have the animals hypodermically treated with an antitoxin that, it is claimed, has proved efficacious in many cases. In pursuing the investigations, experiments were made in which healthy animals, some inoculated with the serum and the others without it, were confined with dogs afflicted with the disease. In no case did an inoculated animal contract distemper, while those not treated with the antitoxin did so freely. The complaints to which cats are subject are very much the same as those that attack dogs, and the antitoxin has been adapted for use in the feline family. Monkeys and rabbits are also inoculated as a safeguard against various diseases peculiar to the species. A monkey is a delicate little creature, and is subject to many ills. As they are rather valuable pets, it is therefore very desirable to insure the animal's life as far as it can be done by inoculation.

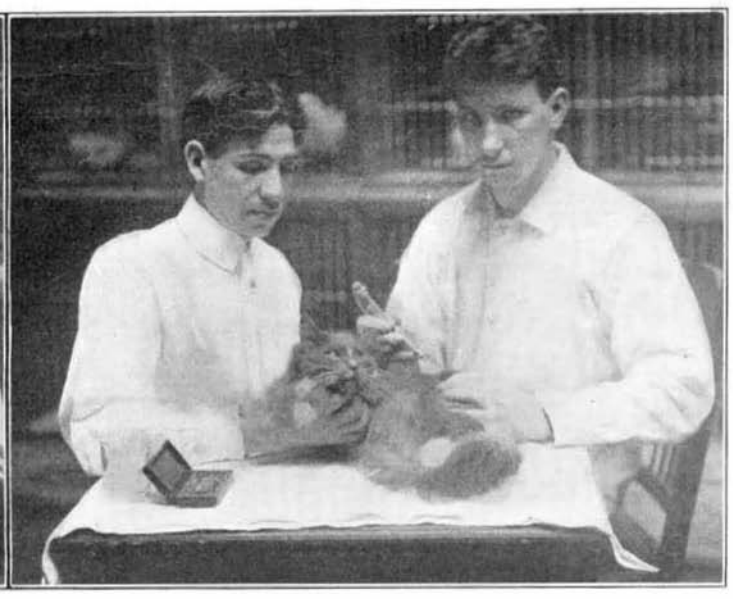
OLD CLOCK OF THE CITY HALL OF ULM.

More important than the prevention of diseases of the common variety in the domestic animals, is a series of experiments now being conducted to determine whether or not there is any means of eliminating the scourge of rabies from the list of evils to which the canine race is subject. Strangely enough, it is a subject on which there is little reliable information, and around which controversy rages. Some medical men declare that there is no such thing as hydrophobia in the human family, and others contend that frequent cases of the disease in human beings result from mad-dog bites. Regardless of these theories, the prevalence of rabies among dogs is recognized, and earnest work is being done on the problem of procuring a serum that will kill the disease in the canine family. Beginning with the theory that dogs are no more subject to attacks of rabies in what are known as the "dog days" than at any other time of the year, the investigator argues that the disease does not originate spontaneously, but is communicated only by contagion, extremes of temperature having little to do with its propagation.

In Russia, where the disease is quite prevalent, being spread chiefly by the wolves, it rages most violently after an excessively hard winter. This is thought to be due to the fact that hunger encourages the wolves on such occasions to roam more freely than usual in the inhabited regions in search of food, thus distributing the contagion. Statistics that have been compiled show that apparently just as many persons are bitten by dogs supposedly mad, during the months of April and May, as in the hot months. If this belief that the question is one of contagion is correct, there may be grounds for thinking it possible to find an antitoxin that will kill the germ, and destroy this phantom that causes disquietude in every household in which there is a pet animal. And as animals have been inoculated with a serum making them immune against one complaint, it appears to be only a step to the discovery of an antitoxin that will make hydrophobia a dread of the past in dogdom.

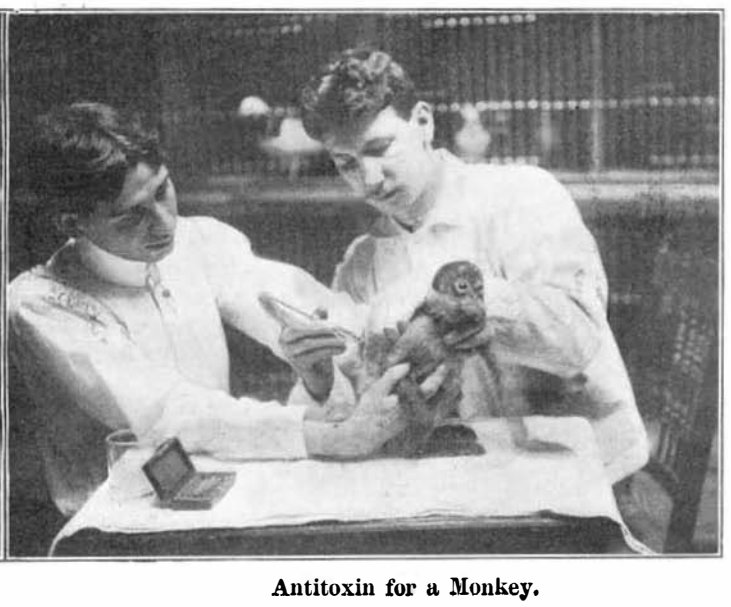


Giving a Dog an Injection.



Inoculating a Pet Maltese Cat.

Fortifying a Rabbit Against Disease.



Antitoxin for a Monkey.

INOCULATING ANIMALS AGAINST DISEASE.

THE ASTRONOMICAL CLOCK OF THE CITY HALL OF ULM.

BY CHARLES A. BRASSLER.

Visitors to Ulm, a city of the olden time, cannot but be struck with its quaint architecture, its crooked streets, and the "go-as-you-please" manner of its busy inhabitants. Almost unconsciously they drift to the business center of the town, where they find the ancient Rathaus situated on one side of a spacious square, raising aloft its high peaked roof and towers. The astronomical clock installed in the eastern end of the old hall is a noteworthy production of the clockmaker's art, and dates from the beginning of the sixteenth century, it having, according to information there obtained, been thoroughly repaired in 1549. At that time there could be found in Ulm no horologist or clock-maker competent to undertake the reconstruction of the complicated mechanism. Application to the adjacent towns of Tübingen and Kirchheim were likewise without result. Finally the common council, in 1580, commissioned the most famous German clock-maker of the day, Isak Habrecht, of Strasburg, the builder of the famous clock in the cathedral of that city, to effect the necessary repairs, which he did to the perfect satisfaction of all concerned. On the 12th of April, 1581, so the story goes, he was paid 200 thalers and allowed to leave the city. From an artistic point of view this clock is a masterpiece; it shows not only the passing hours of the day but also the diur-

nal and annual revolutions of the earth as well as the movements and phases of the moon.

The zodiacal circle is highly artistic. Made of beaten copper, the twelve signs are executed in fine style and move upon a star-spangled blue ground which represents the firmament.

The dial plate is essentially of copper, the indices, as well as the hands, are of pure copper enhanced by a washing of gold.

In the outer circle we find the quaint old Roman numerals from I to XII. Equally spaced between them are rosettes which serve for the half-hours. Behind this is the blue background with its galaxy of sparkling stars over which, as indicated above, move the signs of the zodiac.

Just within this is a smaller circle containing the 24 hours of day so arranged that the number 12, indicating the hour of noon, falls under the Roman XII at the top of the dial and the 12 of the midnight hour is just above the VI at the bottom of the dial. To the right and the left and half way between these two, are placed the figures 6, which respectively represent the morning and the evening hour. The innermost field of the dial is divided into two sections, one of which is painted white, the other black. The white represents the horizon. Mounted upon this inner field are two gilded rings of which one represents the Tropic of Cancer, and the other the equator, while the raised ring, also gilded, between the white field and the 24-hour circuit, represents the Tropic of Capricorn. Beginning from the bottom the first movable object we have on the dial is the circle containing the signs of the zodiac. This ring is supported upon two crossed iron rods, and they are so arranged that one of them passes through the vernal point on one side while its opposite end runs through the autumnal point on the other. Of the other rod the two ends pass respectively through the summer and winter solstices. The signs are arranged in a consecutive order contrary to the motion of the hand of the clock; thus we have first Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, and Pisces. The outside edge of the zodiacal circle is supplied with a graduated scale of 360 deg., which is intended for the Dragon hand. Supported also upon the crossed rods that carry the zodiac is an eccentric circular band called the calender disk, because upon it the days and the months are engraved, and these are so ordered that the rods pass through the dates of March 21, the first day of spring; September 23, the beginning of autumn; June 21, the commencement of summer, and December 23, the first day of winter. Next above the zodiac is the dragon belching forth flames of fire, its head reaching over the zodiac as far as the graduated scale, while the writhing tail extends backward among the signs. This dragon hand is intended to represent the path of the moon. Directly above this hand is placed the sun indicator. It consists of a plain iron rod supporting at one end the radiant face of the sun made of embossed copper and handsomely gilded. This face reaches to the lower rim of the zodiac. Next above the sun hand is that of the moon, likewise a thin iron rod, bearing upon its end a hollow hemisphere of which the rounded half is gilded while the plane surface is painted black. This supporting rod is hollow, and through it runs a movable rod to which the moon is attached, and upon which it revolves, thus showing its phases. The miter wheels at the center of the clock, that produce this motion of the moon, are attached to the sun hand. The moon is also arranged so that it too appears to pass through the signs of the zodiac. Revolving above the moon arm is the regular hour hand of the clock, and this takes the form of a human hand with extended index finger, placed also upon the extremity of a simple iron rod. This finger just reaches to the feet of the Roman numerals. When looking at the dial, to experience its full effect, the observer must imagine himself as standing upon the earth at the center of the dial. Then the whole system, except the hour hand, will make one complete circuit in 24 hours. The zodiac revolves once in a sidereal day, which is 23 hours and 56 minutes, while the sun requires 24 full hours to get around. He thus loses 4 minutes every day, and being retarded by that much passes consecutively through each zodiacal sign until at the end of 365¼ days he will have completed the circuit and reached again his original starting point. In its procession through the zodiac the sun hand moves over the calendar ring and indicates the date; when the sun hand is tangent to the calendar ring in the white field it shows the time of sunrise; when the same tangentiality takes place in the black field it shows the time of sunset. The sun hand then indicates first the annual motion of the sun in the zodiac, the twenty-four hours of the day, the date, and sunrise and sunset for every day in the year.

The moon falls so far behind the sun hand in its procession through the zodiac that in 27½ days, an ordinary month, it is again at its starting point, and in 29½ days it is again in conjunction with the sun or has completed a synodic month. During this turn around the face of the clock it makes one complete revolution upon its own axis, thus displaying its phases to the observer. When it is directly over the sun it presents its black or dark side to the observer, and it is then new moon; after about 7⅜ days it is at right angles to the sun, then half the gilded and half the black side are visible—in other words, it is in its first quarter; 7⅜ days later it will be directly opposite the sun and the whole of its gilded side will be presented to view; it is now of course full moon. Since the orbit of the moon is inclined to the orbit of the earth, otherwise called the ecliptic, by an angle of about 5.9 deg., the moon's orbit cuts the ecliptic at two points. Consequently the moon in its passage will be half the time above the ecliptic and during the other half fall below it. The first point is termed the ascending node, and the other the descending node. The revolution of the moon through its nodes is called the dragon month, and this is shown, as we indicated above, by the dragon hand. These nodes are also known as the dragon's head and the dragon's tail. The line connecting these two nodes is called the line of the moon's nodes, and this is what the dragon shows upon the dial. When the moon passes over the dragon's head it is just then going through the ascending node; when, on the contrary, it crosses the dragon's tail it is going below the ecliptic or is at its descending node.

The line of the moon's nodes changes its position in the ecliptic very quickly; it turns in a direction contrary to the succession of the zodiacal signs, wherefore the dragon hand hurries on in advance of the zodiac, contrary also to the direction of the sun, and consumes 18½ years for a complete circuit through the zodiac. An eclipse of either the sun or the moon can only take place when the moon is either at new or full moon and is passing through one of its nodes. For this reason in an eclipse of the sun, which can only take place at new moon, the moon being at the same time at its node, the sun hand, the moon hand, and the dragon will be directly over each other whether at the ascending or descending node. An eclipse of the moon, on the contrary, can only take place at full moon, the satellite being, of course, at the moment, at one of its nodes. This case will be indicated by the clock by bringing the sun over the head of the dragon while the moon will be over its tail, or, *vice versa*, the sun over the dragon's tail with moon over its head. In this wise, then, the dragon shows the motion of the moon through its nodes, the procession of these nodes in the ecliptic, as well as the lunar and solar eclipses.

The calculation of the clockwork is so worked out that a new adjustment of the hands need only take place after the lapse of 100 years.

The Julian year of 365¼ days was selected, and this will differ from the Gregorian century by just one day in 100 years.

At present the astronomical part of this wonderful clock is temporarily inoperative. This portion of the works has been sent to a manufacturer of turret clocks in the city of Ulm to be set in order and refurbished, and it is hoped that the clock will soon again indicate all that we have described above with the minute exactness with which it has been credited in former years.

Upon a stone balcony just under the clock panel, the ceremony of offering allegiance to each new Kaiser has been performed, by the city fathers and the citizens ever since 1473. On either side of the clock were painted heralds or kings at arms bearing aloft the standards of the empire and of the city of Ulm, and in the gable just below the present small clock face was a procession of the three Magi of the East in their adoration of the Holy Child. Above this was a sun-dial, and topping all peered through an opening in the wall a figure of a human face which was doubtless connected with the clockwork and moved from side to side to tell the time on the sun-dial. Upon the ridge of the gable is a small belfry of which the roof was at one time gilded. In this little house was hung the poor sinner's bell. The bell tower proper is a slim ridge-turret that sits upon the ridge of the highest roof finished with glazed tiles.

The Current Supplement.

An illustrated article on the Japanese hydro-electric power plant at Kyoto opens the current SUPPLEMENT, No. 1524. The carbureting of heavy oils is a subject well discussed by R. Desmarest. Prof. Dewar's discoveries of new uses for liquid air will be read with interest by students in physics. The Warren rotary engine, which has been successfully used in actual practice, is described and illustrated. Dr. F. M. Perkin gives some valuable hints on electrotyping. How a simple, effective, and inexpensive lightning recorder may be constructed is told by Henry G. Alciatore. Prof. Vivian B. Lewes, whose work in the chemistry of gases is known to every scientist, writes on the theory of the incandescent mantle with the forcefulness and originality characteristic of all his work. The last installment of an article on Lhasa and Central Tibet is presented. Many illustrations of Tibetan scenes also appear. A most entertaining article is that bearing the title "The Good Old Times," which shows that whatever our fathers may think of the degenerate conditions in which we now live, we have reason to be thankful that we belong to the twentieth century. Mechanically considered, the most valuable article is one by Thornton Knowles on Epicyclic Trains. Diagrams are, of course, presented to illustrate the text. An article on "Elements Verified and Unified" presents an account of modern physical conception.

A STUDY OF THE BROOKLYN BRIDGE PROBLEM.

BY EDWARD WHITEHEAD CURTISS, M.E.

The city bridge department, knowing the bridge is loaded to near the maximum load it was designed to carry, as a cautionary measure, to prevent overloading, has made rules as to loading. At least 102 feet of empty track space must exist between every two trolley cars on the bridge, and but one elevated train on each track is permitted upon the center span at the same time. These rules are necessary, as the load on the bridge during periods of heaviest traffic is within 125 tons of the maximum load the bridge was intended to carry. A single elevated train or a few street cars would exceed this margin of weight, and if through carelessness they should move onto the span before the train ahead has left the span, the bridge would be overloaded. If it were thus overloaded, it would not, however, be in danger of failure, because it was built with a large factor of safety. But that was twenty-two years ago. What is its factor of safety now? The bridge department should be the best authority. During several administrations it has enforced precautionary rules. The chief engineer stated before the State Railroad Commission: "The Brooklyn Bridge is an antiquated structure, unfitted for the demands made upon it, and should be rebuilt after the completion of the Manhattan Bridge within the next five years." The problem involves a combination of difficulties. The solution is to transport the people over the bridge as fast as they arrive. The factors in the problem are: 1. Safety of passengers. 2. Weight of load on the bridge. 3. Number of persons to be transported. 4. Number of cars required. 5. Speed of cars necessary. 6. Time required for loading and unloading cars. 7. How to make the change without interrupting transportation. 8. Cost of the new system. 9. Time required to put a new system in operation. 10. A proper terminal station. Lack of cars moving over the bridge, and not lack of loading facilities, is the cause of the congestion. More cars and lighter cars is the only remedy. This forces us to a plan for special bridge cars without heavy machinery.

The system of transportation illustrated on the front page of this issue is designed to meet all the above-named conditions. An endless train of cars is operated across the bridge with a circular loop at each terminus, cable traction is used, and the motors, brakes, third-rails, trolley-wire supporters, wires, etc., are dispensed with. Light trucks with small wheels are substituted for the heavy ones now used, and more than double the number of cars can be operated, without increasing the weight; and by operating them on one set of tracks we have an endless train of cars, and may increase the speed with no danger of collision. But this requires that the train shall not stop, and we are forced to use a slowly-rotating loading-platform with access to it by stairways located at the center, where motion is slow. Two cables would be used, driven by electric motors, the motors and cable in duplicate to be used on alternate days. This would reduce the danger of a "tie-up" to a minimum. The electric current could be independently generated, or purchased from power companies. This plan includes no untried feature, unless it be in the combination. Moving sidewalks were tested at the Chicago and Paris expositions, with difference in speed between adjoining platforms of three miles an hour. These cars are inclosed, and the difference in rotary speed of stairways is reduced to one-half mile an hour. Such a plan as this would accommodate all the present passenger traffic on the tracks used by the elevated trains, and the space now used by trolley cars could be used for vehicle traffic, and the capacity of the bridge would be doubled. As the number of cars would be more than double that now used, more than twice the number of persons could be transported without increasing the load on the bridge. A speed of ten miles an hour would do this, but the speed could be changed to meet the changing demands for transportation. All the time now wasted by stopping, starting, backing, switching, and waiting trains would be devoted to moving the people over the bridge, and the motive power required to do it would be less.

At each terminal station there is a circular platform, 200 feet to 400 feet in diameter. The platforms are kept in constant rotation. They ride on wheels, which roll on tracks laid in concentric circles, and the whole is carried on an elevated structure. Stairways at the center of the platforms give adequate and convenient means of access to the rotating platform from the street below and from passageways above from and