from that of a feral type? After what manner may one expect taxonomic characters modified in these generations of prisoners?

The nature of malignant growths, it is not improbable, would find a solution in a line of research based upon a similar proposition. What proportions of malignant growths, such as the sarcomata, are met with in the feral state of quadrupeds as compared with those in the domesticated or the captive state? Can experiments be devised by which we may expect to cause these growths to appear by creating the favoring conditions? Can we study the genesis of the sarcomata to better advantage than has hitherto been done, by outlining the biography, the lineage, and to some extent possibly the destiny, of these tumors, by applying to them experimental methods of research?

Medically trained men are not apt to become pure morphologists. The underlying thought is of *function* through which *structure* is modified. In its best sense, therefore, physiological anatomy is the branch of science that would be most developed. Let us suppose that John Hunter had lived in 1891 and had essayed his work by all the aids of modern science, and had undertaken a plan of investigation for the continuation of his labors: might he not have accepted some such scheme as I have feebly attempted to portray? With the admiration we feel for his genius, let us not only have Hunterian orations, but in each medical centre a Hunterian laboratory and a Hunterian museum.

"I am so utterly opposed to those cloud-builders who would divorce physiology from anatomy," says Haller, "that I am persuaded that we know scarcely anything of physiology that is not learned through anatomy" (quoted from R. Cresson Stiles's "Life and Doctrines of Haller," New York, 1867).

In Solomon's house, in the "New Atlantis," in which Bacan essayed a scheme for intellectual advancement, we read of "parks and enclosures of all sorts of beasts and birds, which we use not only for view or rareness, but likewise for dissection and trials, that thereby we may take light what may be wrought upon the body of man; we have also particular pools where we make trials upon fishes, as we have said before of beasts and birds."

I hear objections that this scheme is visionary and impracticable. How is the money to be obtained by which it can be rendered feasible? Where is the teaching-force to be recruited? My answer is that if the need of establishing such a course be acknowledged, the accomplishment of the end in view is no more difficult than in any other branch of pure science. A few years ago the establishment of seaside laboratories would have been thought chimerical. Now they are assured successes.

If I am told the results obtained will appeal to but few, I reply that important projects must be supported in proportion as they so appeal, until such time as they shall have proved their right to exist. HARRISON ALLEN.

TIME-SERVICE OF HARVARD COLLEGE OBSERVATORY.

THE time-service of this observatory has been maintained for nearly twenty years upon the system originated by the late Professor Joseph Winlock. Continuous signals, that is, signals throughout the entire twenty-four hours instead of for a short time each day have been furnished to the cities of Boston and Cambridge, and have been used to strike the bells of the fire-alarm daily at noon. For many years a time-ball has been dropped, thus furnishing a precise time-signal to many citizens and to the shipping in the harbor. The continuous signals have been sent also to the railroads centring in Boston, and to the Boston office of the Western Union Telegraph Company, and have been distributed by them over a large part of New England. Many cities and corporations, although not subscribing for the time-signals, have been in the habit of taking them from the railway and telegraph stations, thus extending their use. The time-service in New York City was thus supplied with our signals for many years. The signals, again, have been furnished to the principal jewellers in Boston and vicinity, and used by them in the rating of fine watches. The lines transmitting the time-signals in these various directions affected the telephone lines by induction and otherwise, and thus many other persons obtained the signals by merely listening at the telephone.

The subscriptions of the city of Boston and of the railroads, and the receipts from the jewellers were sufficient to defray the cost of furnishing the exact time, and for some years formed a source of revenue to the observatory. No charge was made to the city of Cambridge or to the Western Union Telegraph Company. The expenses were, however, large, since it was necessary to duplicate the instruments and clocks employed, although the cost of the necessary duplication of the lines connecting the observatory with Boston was diminished by the arrangement with the Western Union Telegraph Company. For several years, also, the city of Cambridge rendered similar assistance. Although the best clocks were used and mounted in vaults specially constructed so as to secure a uniform temperature, great care was necessary to keep not only the errors, but also the changes in daily rate, as small as possible. It was necessary to compare the clocks frequently, and to determine their errors by observations of the stars at short intervals. Especially after several days of cloudy weather, the first opportunity was taken to secure observations, although this often occurred at inconvenient hours. Frequent interruptions took place on the lines, and it was therefore necessary constantly to have men ready to detect and repair breaks, crosses, and other injuries.

The general introduction of standard time was considered at the observatory some months before this step was taken. Since the same signals could be used throughout the entire country, it was recognized as a source of danger pecuniarily to the time-service. This argument, however, was allowed to have no weight, since it was believed that the change would be a benefit to the public. As it happened, this observatory was enabled to take an active part in making the change, since all of the railroads centring in Boston assented only on condition that our signals should be sent according to the new system. When the change had been decided upon, various steps were taken by the officers of the observatory to secure the general and simultaneous adoption of the new time by the country.

A new source of difficulty and danger in distributing time-signals has arisen during the last few years. The great increase in the number of telephone and other wires has rendered it much more difficult to maintain an unobstructed circuit. Breaks and crosses are continually occurring, especially in stormy weather; and the privilege of placing wires on housetops is every year less willingly granted. Recently a more serious danger has arisen. The currents of high tension carried by electric-light and electric-railway wires, in case of a cross, may be transmitted indefinitely, causing danger of fire, bodily injury, or even loss of life. Pecuniary liabilities in such cases may be very great. The financial officers of the university regard such risks as more than offsetting the receipts for the time-signals.

One of the greatest advantages of the time-service to the observatory has been that it kept before the public the practical value of astronomical work. Many thousands of persons who take no interest in work of a purely scientific character recognize the great financial value to the public of an accurate system of time. The observatory desires to confer this benefit on the public, and it would be ready to do so even at a financial loss. But recently the time-signals of the United States Naval Observatory have been offered to the public at very low rates, through the Western Union Telegraph Company. This can the more readily be done since the expense of furnishing the time is borne by the people through a government appropriation, while the company has the largest facilities for the maintenance of telegraphic connections. The Harvard College Observatory is therefore relieved of this duty. If the public is to be the gainer, signals of equal accuracy and continuity must be furnished. Unfortunately, signals sent to a great distance are liable to frequent interruptions from trouble with the telegraph lines, and therefore secondary clocks must be used in each large city if continuous signals are to be distributed. These clocks must be constantly compared and corrected if great accuracy is to be attained, and it is still a question whether satisfactory results can be secured outside of an astronomical observatory. If the results prove unsatisfactory, however, the responsibility for trying the experiment will not rest upon this observatory.

In view of the facts stated above, it has been decided to discontinue the time-signals furnished by this Observatory after March 31, 1892. An earlier date would have been selected, but for the desire to give our subscribers sufficient time to make other arrangements for securing signals.

The most important events in the history of the time-service are given below. The first transmission of time from the observatory to Boston was over a line hired for the purpose and used occasionally for the comparison of clocks in Boston with the standard clock at Cambridge. From 1856 to 1862 the observatory owned a line for the same purpose. Up to the close of 1871, no charge was made for the time thus furnished, which was used for many years for striking the fire-alarm bells of Boston at noon, and for other purposes. The regular transmission of signals and the receipt of compensation for them began in 1872, the service being under the direct care of Professor Winlock, who had devised the system. After his death in 1875, Professor W. A. Rogers took charge of the service and introduced the custom of telegraphing information as to the error of the signals at a given hour daily. In 1877 Dr. Leonard Waldo took charge, and during the next year, with the liberal co-operation of the Equitable Life Assurance Company, the Boston Time-Ball was erected on top of the building of that company. In 1878, also, a correspondence was opened with the railways of New England relative to a uniform system of time and the practicability of introducing it by legislation. A plan for establishing a bureau for the testing of fine watches and thermometers was considered, and abandoned on the ground that such work would be commercial rather than scientific, and therefore not within the scope of the observatory. In 1879, Professor Frank Waldo, who had previously assisted his brother, took charge of the time-service. The error of the standard sidereal clock was determined every day at 10 A.M. from the latest comparisons with the stars, assuming the rate to continue uniform. The mean-time clock was compared with this, and for several years the difference had been communicated every day by telegraph. This practice was abandoned, since it was easy to reduce this difference to zero, and it did not indicate the true error of the clock. Especially during continued cloudy weather, large changes might take place in the rate of the sidereal clock, which could not be determined until observations could be made of the stars. At this time the signals were sent to New York, and were used in the time-service of that city in combination with similar signals sent from the Naval Observatory and Allegheny Observatory. It developed the interesting fact that the differences, sometimes amounting to several seconds, were much greater than were expected, or than would be derived from combining the supposed errors of the different time-services. This was regarded as a preliminary trial of a plan which was developed later, and appears to be the only way of effecting a great increase in the accuracy of time-signals. It is easy to keep the errors of a clock small if the weather is clear, and frequent comparisons can be made with the stars. During long periods of cloudy weather, however, when no observations of the stars can be made, it is very difficult. The slight changes of rate to which even the best clocks are liable may cause serious errors at the end of several days. The remedy is co-operation between observatories so distant that it would seldom happen that clouds would prevent observations at all of them. The time would be determined at each observatory every evening, when it was possible, and the result transmitted telegraphically to a central station; also when called for, as soon as it cleared, whatever the hour. The central station would report daily to each observatory either the results of each observation received or a corrected error derived from them all. Each observatory might send its own time or receive signals from a normal clock at the central station. Mr. J. Rayner Edmands, who has had charge of the time-service from June, 1881, to the present time, rendered important aid in forming this plan. He postponed the record of the errors occurring during cloudy weather until observations could be made for determining them. The apparent errors were thus increased, but the actual errors were represented with much greater accuracy. The practice of making the error at 10 A.M. especially small was abandoned, and attention was given to keeping the signals as accurate, and the daily rate as small as possible at all hours. The general introduction of standard time was effected at noon on Nov. 18, 1883. After the change was decided upon, a large part of Mr. Edmands's time for several weeks was devoted to securing the assent of the public throughout New England to the proposed change. In 1885, a new time-ball was erected on the Boston post-office building, with the aid of an appropriation from the city of Boston. Experiments were made in various matters associated with the distribution of accurate time. Among others, a delaying apparatus was devised, by which the signals of a clock could be retarded by any desired fraction of a second, so that, without disturbing a clock, its apparent error could be varied at will. In 1889 some interesting experiments were made by Mr. W. P. Gerrish on distributing time accurately by flashes of magnesium powder. Signals were thus sent from a station on Blue Hill, twelve miles distant. They were readily visible, and the exact time to within a fraction of a second could be taken from them. These flashes were also seen from Princeton and Mount Wachusett, forty-four miles distant, and from numerous nearer points. From an early period in the life of the time-service, the telegraphic lines have been in charge of the electricians, Messrs. Stearns and George, and their successor, Mr. C. L. Bly.

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NOTES AND NEWS.

MR. J. L. KIPLING says of the monkeys of India: "They have a game like the English boys' cock of the dung-hill or king of the castle, but instead of pushing each other from the top of a knoll or dust-heap, the castle is a pendant branch of a tree. The game is to keep a place on the bough, which swings with their weight as with a cluster of fruit, while the players struggle to dislodge one another, each, as he drops, running round and climbing up again to begin anew. This sport is kept up for an hour at a time with keen enjoyment, and when one is nimble as a monkey it must be splendid fun."

— In 1890 was published the important discovery by Behring and Kitasato that blood serum taken from animals that had been rendered immune to tetanus and diphtheria was capable of curing other animals suffering from those diseases. Drs. G. and F. Klemperer (*Berliner klinische Wochenschrift*, Aug. 24 and 31, 1891) publish a research carried out in regard to pneumonia, with the object of discovering how immunity against the pneumococcus could be best produced, whether recovery from the disease rendered an animal immune, and whether it was possible to cure pneumonia by the blood serum of animals that have recovered from the disease. Their experiments, which were confined to rabbits, revealed that every nutrient medium in which the pneumococcus has been cultivated will, if inoculated, render an animal immune against pneumonic septicæmia, even after the cocci have been removed by filtration. The power of producing immunity is more speedily acquired, and is increased if the infected nutrient medium (before or after removal of the cocci) is exposed to a temperature of between 41° and 42° C. for two or three days, or of 60° for an hour or two. In every case, however, it was found necessary that some interval (varying from three to fourteen days) should elapse between the inoculation and the production of immunity. Hence it was too late to cure a diseased animal or even to prevent the onset of an attack if the injection was given simultaneously with the outbreak of the disease. On the other hand, serum taken from animals enjoying immunity was found able, especially when introduced directly into the circulation, to cure pneumonic septicæmia. The serum was injected twenty-four hours after infection, while the animals had a febrile temperature of between 105° and 106.5° F. Eight cubic centimetres were injected, with the result that the temperature gradually sank during the next twenty-four hours. In twelve successive cases a successful result was obtained. This research therefore confirms, in regard to pneumonia in rabbits, what Behring and Kitasato did for tetanus and diphtheria. Drs. Klemperer next studied the question how the blood serum of an immune animal cures an attack of pneumonic septicæmia, and discovered that when the pneumococcus is introduced into the body of an animal it generates a poisonous substance which can be isolated, and to which the name of "pneumotoxin" has been given. This pneumotoxin sets up a febrile condition which lasts several days, after which another substance is found to have been produced called "antipneumotoxin," which is able to neutralize the pneumotoxin. The serum taken from an immune animal contains this antipneumotoxin, and it is by means of this substance that it cures an attack of pneumonic septicæmia in other animals. The relation of pneumonia as seen in rabbits with that met with in man was next investigated, and the conclusion arrived at that the disease in both cases is produced by the pneumococcus, but that the human body is much less susceptible to the latter than the rabbit is. Thus it was found that serum taken from pneumonic patients after the crisis could cure pneumonia in rabbits; moreover, pneumotoxin and antipneumotoxin were found to be present in human serum as in that taken from rabbits. The crisis of pneumonia, according to Drs. Klemperer, takes place as soon a antipneumotoxin is produced in sufficient quantity to neutralize the pneumotoxin. Why immunity against further attacks lasts so short a time in man is still uncertain, but possibly less antipneumotoxin is formed in man than in rabbits in proportion to the pneumotoxin. Some attempts have already been made to cure patients suffering from pneumonia with the help of antipneumotoxin, but further observations are necessary.

— It is a well known fact that, with the same temperature by the thermometer, one may have, at different times, a very different feeling of heat and cold. This varies with the temperature of the skin, which is chiefly influenced (according to M. Vincent of Uccle Observatory, Belgium), by four things: air-temperature, air-moisture, solar radiation, and force of wind. M. Vincent recently made a large number of observations of skin-temperature in the ball of the left hand, and constructed a formula by means of which the skin-temperature may be approximately deduced from those four elements. He experimented by keeping three of the four constant, while the fourth was varied, and a relation could thus be determined between the latter and skin-temperature. One fact which soon appeared was, that the relative moisture of the air has but little influence on skin-temperature. It was also found that for every 1° C. of the actinometric difference (excess of black bulb thermometer) the skin-temperature rises about 0.2°; and with small wind-velocities, every metre per second depresses the skin-temperature about 1.2°. In testing his formula M. Vincent found, with cold or very cold sensation, considerably greater differences between the calculated and observed values than in other cases. This he attributes to the great cooling of the relatively small mass of the hand. Taking the cheek or eyelid the results were better, says *Nature*.

— Last winter, in December and January, M. Chaix made a number of observations of the temperature of the air, the snow, and the ground at Geneva, of which he has given an account to the Physical Society there. He observed the air at four different heights; granular, pulverulent, and bedded snow, on the surface and at different depths; and the surface of bare ground as well as of ground covered with snow. There was no difference in mean temperature between the air at one and two metres; and very little between the former and that on the snow surface. The surface of the ground was 4.265° C. warmer than the surface of the snow (0.13 m. above), through arrest of radiation. But the bare ground was not cooled so much as the snow surface, and it was only 2.04° colder than the snow-clad ground. This shows the frigorific influence of snow on climate. Air passing over bare ground would have been 2° warmer than if it passed over the snow. The snow surface was sometimes warmer, sometimes colder than the air one or two metres above. In the dry winters of Siberia and Sweden, the snow-surface is generally (according to Woeikof) much colder than the air. M. Chaix explains the variations observed at Geneva by fluctuations in the relative humidity, involving alternate vaporization and condensation at the snow-surface. In two-thirds of the cases, indeed, abnormal cooling of the snow corresponded with a low humidity, and heating with a high humidity, and often formation of hoar frost at the surface, according to *Nature*.

— An illustration of the height of breaking waves is afforded by the following paragraph, which we take from the San Francisco *Chronicle* of Jan. 6: "Portland, Jan. 5 The lighthouse tender 'Manzanita' reached Tillamook Rock Sunday for the first time in six weeks, and brought away the keeper, George Hunt, who has been on the rock for four years, and has been transferred to the Cape Mars Light. He says, in the storm of Dec. 7 the waves swept clear over the house, washing away their boats, and tearing loose and carrying away the landing platform and tramway, which were bolted to the rock. On the 29th the waves were still higher, and streams of water poured into the lantern through the ventilators in the balloon top of the dome, 157 feet above the sea-level. The lighthouse was shaken to its foundation by the impact of seas against it, and the water found its way into the house. Men were on duty all night to keep the lamp burning, and but for the wire screen the shutters of the lantern would have been demolished."