AMERICAN MUSEUM OF NATURAL HISTORY

The Sequoia

A Historical Review of Biological Science

BY

George H. Sherwood, A.M.

Assistant Curator

SUPPLEMENT TO AMERICAN MUSEUM JOURNAL

VOL. II, No. 8, NOVEMBER, 1902

Guide Leaflet No. 8

American Museum of Natural History.

Officers.

President,
Morris K. Jesup.

First Vice-President,
William E. Dodge.

Second Vice-President,
Henry F. Osborn.

Treasurer,
Charles Lanier.

Director,
Hermon C. Bumpus.

Secretary and Assistant Treasurer,
John H. Winser.

Scientific Staff.

Director,
Hermon C. Bumpus.

Department of Public Instruction.
Prof. Albert S. Bickmore, Curator.

Department of Geology and Invertebrate Palæontology.
Prof. R. P. Whitfield, Curator.
Edmund O. Hovey, Ph.D., Associate Curator.

Department of Mammalogy and Ornithology.
Prof. J. A. Allen, Curator.
Frank M. Chapman, Associate Curator.

Department of Vertebrate Palæontology.
Prof. Henry Fairfield Osborn, Curator.
W. D. Matthew, Ph.D., Associate Curator.
O. P. Hay, Ph.D., Assistant Curator.

Department of Entomology.
William Beutenmüller, Curator.

Departments of Mineralogy and Conchology.
L. P. Gratacap, A.M., Curator.

Department of Invertebrate Zoölogy.
Prof. Hermon C. Bumpus, Curator.
George H. Sherwood, A.M., Assistant Curator.

Department of Anthropology.
Prof. Frederic W. Putnam, Curator.
Prof. Franz Boas, Curator of Ethnology.
Marshall H. Saville, Curator of Mexican and Central American Archæology.
Harlan I. Smith, Assistant Curator of Archæology.

Library.
A. Woodward, Ph.D., Librarian.

THE FALL OF "MARK TWAIN"

The noble specimen of Sequoia which forms the subject of this paper was given to the Museum, in 1893, by the late Collis P. Huntington. The Museum is indebted to Mrs. Collis P. Huntington for the funds necessary for its preparation and installation.

THE SEQUOIA.

A Historical Review of Biological Science.

By George H. Sherwood, A.M.,
Assistant Curator, A. M. N. H.

The *Sequoia* constitute a group of trees which in past ages was abundant in temperate climates of Europe, Asia and America, but which during the glacial period were all but exterminated, only two living species, the "Redwood" (*Sequoia sempervirens*) and the "Big Tree" (*Sequoia gigantea*), surviving to represent the genus. Both are very limited in numbers and in distribution.

The Redwood is found only in a narrow tract of land extending from the southern border of Oregon to Monterey Bay, while the Big Tree is still more restricted, being confined to but ten isolated groves situated between the altitudes of 4000 and 8000 feet above the sea, on the western slope of the Sierra Nevada mountains (see accompanying map). This area is bounded on the north by the American river, and on the south by Deer Creek, and the total distance from the most northerly group (North grove) to the most southerly (Tule River grove) is only 260 miles. The King's River and Kaweah River grove is the largest both as to area and number of trees. The extent of this district is four or five miles in width, and eight or ten miles in length. It has a variation in altitude of 2500 feet. It is an interesting fact that as one proceeds from north to south the Big Trees flourish at higher and higher altitudes.

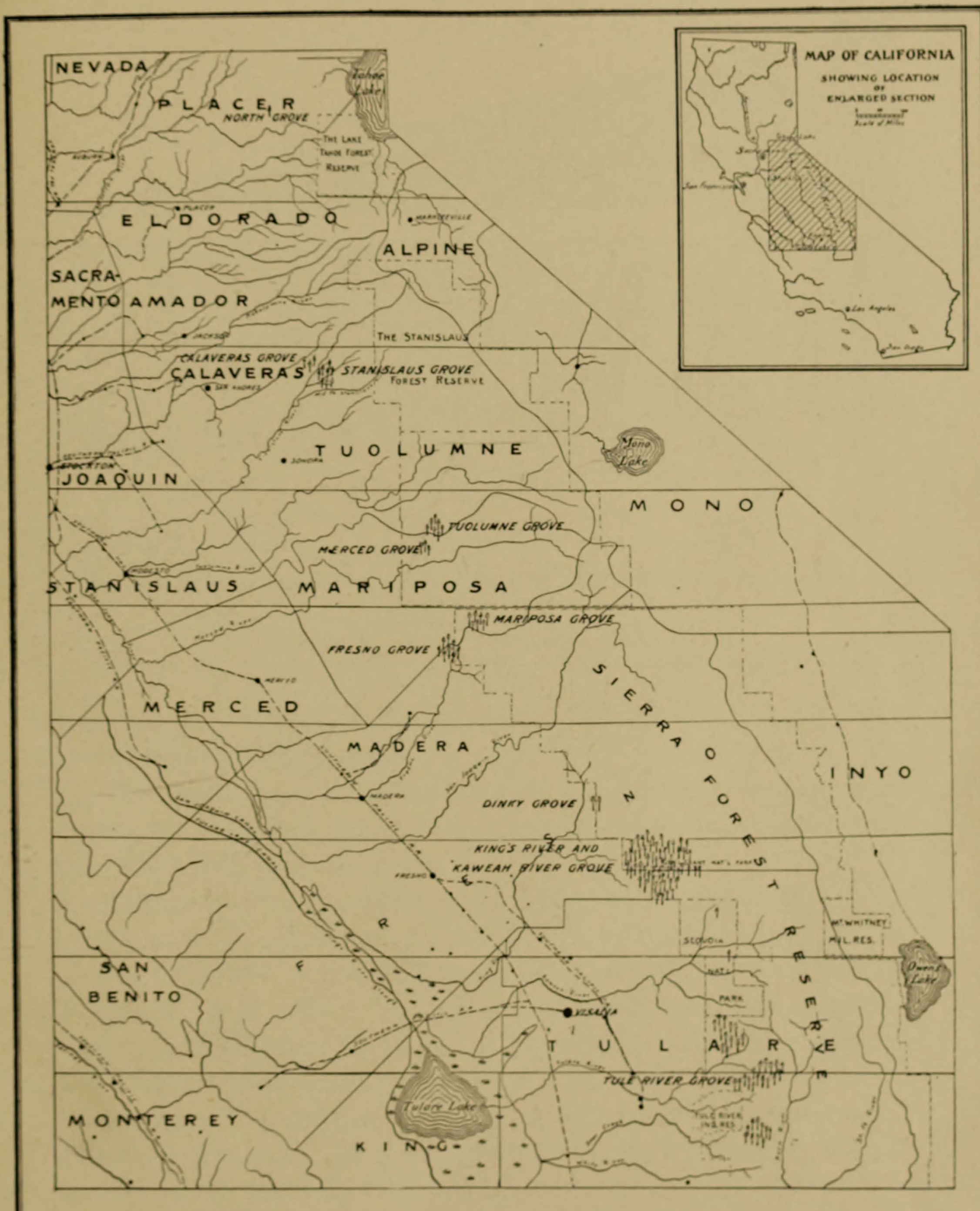
Quoting from Bulletin No. 28 of the United States Department of Agriculture (1900): "The Big Trees are unique in the world,—the grandest, the largest, the oldest, the most majestically graceful of trees,—and if it were not enough to be all this, they are among the scarcest of known tree species and have the extreme scientific value of being the best living representative of a former geological age." Professor Sargent describes the wood as follows: "The wood of the Big Tree is very light, soft, not strong, brittle, and coarse-grained, but very durable in contact with the soil. It is bright clear red, turning darker on exposure, with thin, nearly white sapwood, and contains thin, dark colored conspicuous bands of small summer-cells and numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.2882, a cubic foot weighing 17.96 pounds. Manufactured into lumber, it is used locally for fencing and in construction, and is made into shingles."

The reproduction of the Big Tree is so slow and uncertain, and the methods of the lumbermen in cutting the timber so destructive, that it is probable that in a short time these veritable giants of the forest will become extinct, unless protected by law. Fortunately both the State and national governments control some of the groves, although not the grandest.

For the purpose of procuring a specimen of this remarkable tree for the American Museum of Natural History, S. D. Dill was sent to California in the summer of 1891. Through the courtesy and liberality of A. D. Moore, owner of one of the largest groves of Big Trees, and his son (manager of the King's River Lumber Company), Mr. Dill was permitted to select the tree he might desire. After diligent search, he found a fine specimen growing at an altitude of 7000 or 8000 feet and bearing the name "Mark Twain." Nearly all the large trees have been christened by hunters or tourists, and several are marked with marble tablets. Such names as "Bay State," "Sir Joseph Hooker," "Pride of the Forest" and "Grizzly Giant" are familiar.

"Mark Twain" was a tree of magnificent proportions, one of the most perfect trees in the grove, symmetrical, fully 300 feet tall, and entirely free of limbs for nearly 200 feet. Eight feet from the ground the trunk was 62 feet in circumference, while at the ground it measured 90 feet. Mr. Moore kindly took the contract of felling the tree and shipping to the Museum a section suitable for exhibition. The accompanying instantaneous photograph gives a vivid picture of the fall of this noble giant.

The section on exhibition was cut from the trunk about 12 feet from the base, and is 4 feet in thickness. Its estimated weight was 30 tons, and for easier transportation it was split into ten pieces. The face of the specimen as it now stands is 16 feet



MAP SHOWING DISTRIBUTION OF THE "BIG TREE"

An enlargement of the cross-lined area of the accompanying map of California. The relative sizes of the groves are indicated by the number of trees on the map.

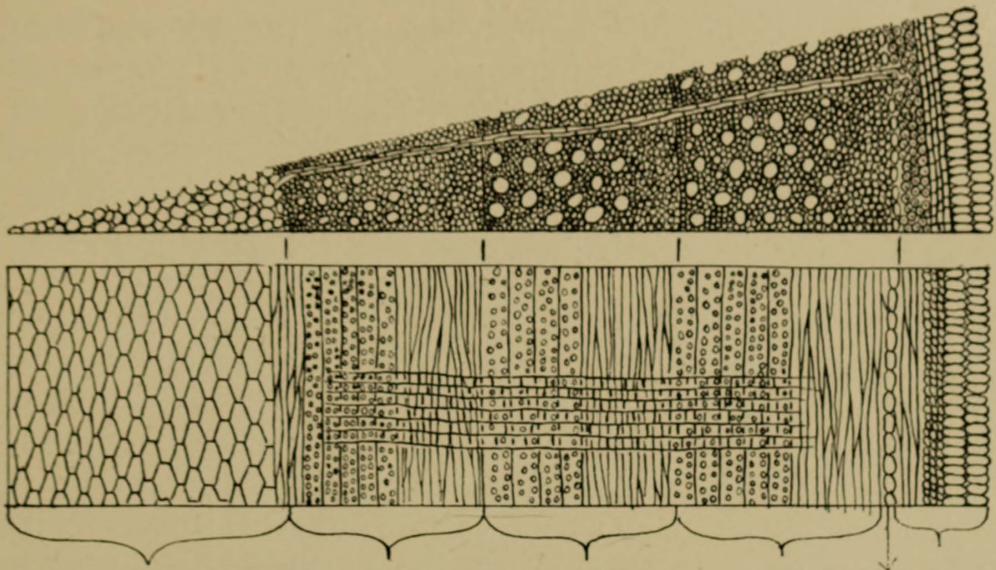


DIAGRAM OF THE STRUCTURE OF THE STEM OF AN EXOGENOUS TREE OF THREE YEARS' GROWTH

Modified from a cut in "Encyclopedia Britannica"
p, pith; cc, Cambium cells; b, bark; 1, 2, 3, growth of wood during first, second and third year.

2 inches in diameter, measured inside the bark, which in places is nearly a foot in thickness.

The Big Tree, like most trees of temperate climates, is exogenous, as is indicated by the concentric circles of wood beautifully shown in this specimen.

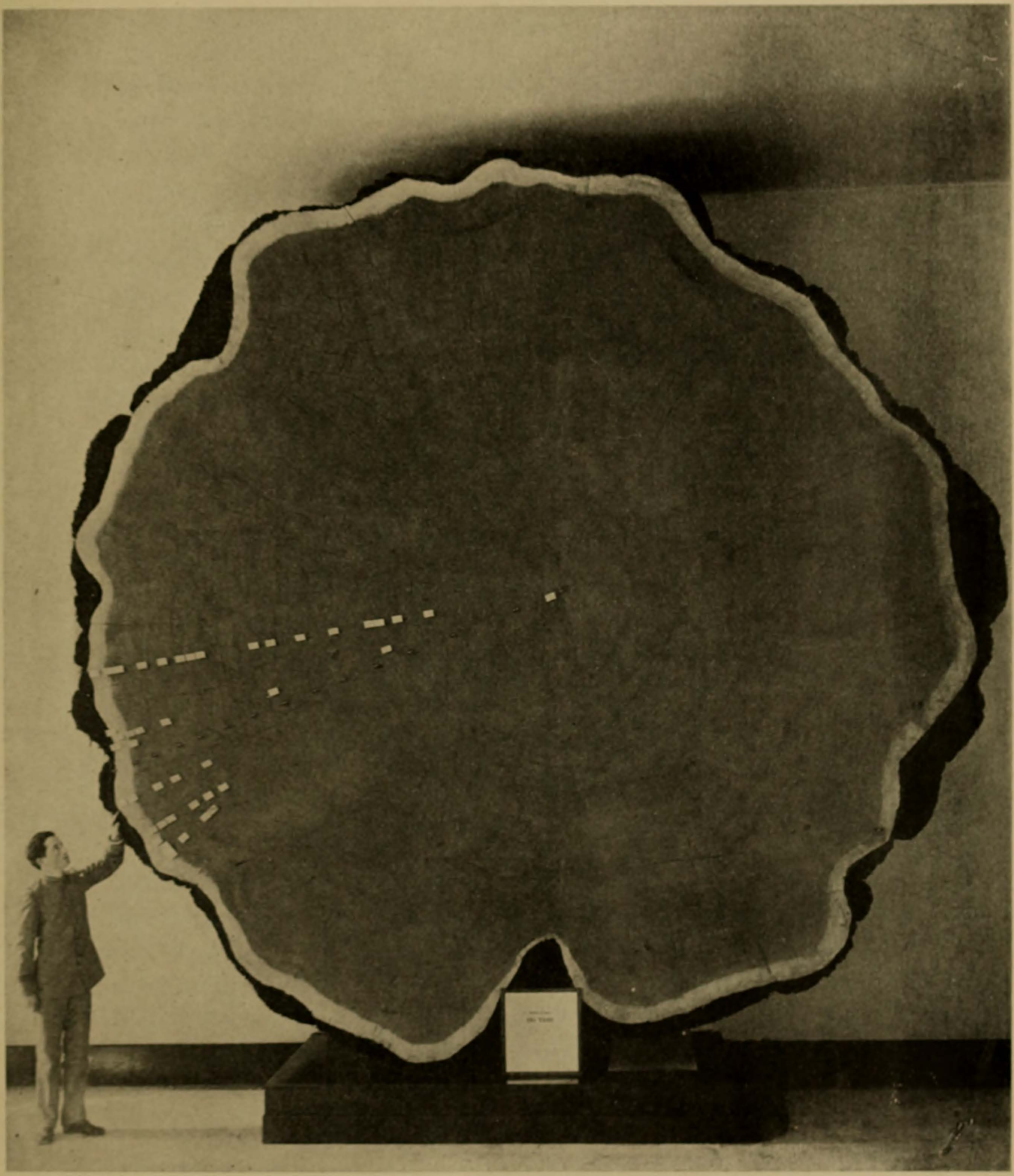
A transverse section of the stem of any exogenous tree of one year's growth consists of three distinct areas or zones. In the center is the pith, around this a ring of wood, and surrounding the whole the bark. Each of these layers consists of cells which are variously modified to carry on their respective functions. Uniting the bark and the wood are delicate thin-walled cells, filled with protoplasm and nutrient matter, which constitute the *zone of growth* of the tree. The innermost cells of this *Cambium layer*, as it is called, form the new wood, while the outermost renew the bark. The oldest wood, then, is that nearest the pith, while the oldest bark forms the exterior of the trunk. During the spring, when the sap is running, the multiplication of Cambium cells is very rapid, and consequently more wood and bark are laid down than during the fall and winter, when the tree receives little nutrition. These periods of interrupted growth are represented in trees of several seasons' growth by distinct lines separating the rings of wood. In the trees of cold-temperate climates, where the contrast of seasons is great, the rings of wood are very distinct, as, for instance, in the Big Tree. In many trees the increase in the wood forces the bark asunder, which, through the action of the weather, becomes rough and rugged. If it were not for the constant renewal of the inner layers by the Cambium cells, the bark might entirely disappear.

In the case of the wood it is quite different. The inner rings, which are the older, are entirely surrounded by the outer rings of fresh young sap-wood, by which they are protected from climatic changes. Every new circle of wood moves the zone of growth farther from the center. The central wood undergoes a change, its cell walls becoming thicker and the calibre of the ducts or vessels smaller. It usually takes on a different color from the sap-wood. This is now called heart-wood, although it performs no vital function in the life of the tree and is practically dead.

In some of the Big Trees much of the heart-wood has decayed and disintegrated, with no more injurious effect upon the tree than a weakening of the trunk. So much of the heart-wood had decayed in one specimen, which was blown down by the wind, that men on horseback were able to ride into the trunk a distance of seventy feet, and pass out through a hole in the side.

Injuries to the wood are sometimes repaired by the deposit of new layers of cells. It is even possible to determine the year when such injuries occur by merely counting the rings of repair. On the extreme right of the specimen in the Museum are two such wounds. In each of the two places marked with a cross a bullet was found, but the wounds had been covered by at least five years' growth of wood. That the bullets did permanent injury to the wood in the immediate vicinity is indicated by the change of sap-wood into heart-wood, which in these places extends nearly to the edge of the bark.

Since, therefore, the rings of wood correspond to periods of vegetable growth, which are seasonal, and the lines of separation



THE SECTION OF THE "BIG TREE" IN THE MUSEUM

The uppermost series of cards represents events in General History ;
The light cards immediately below represent changes of thought in the Philosophy of Biology ;
The small black cards mark the succession of centuries in the life of the tree ;
Of the cards below the black,
The first row indicates the advance of General Biology ;
The second, that of Comparative Anatomy ;
The third (one card) the discoveries of Palæontology ;
The fourth, the Progress of Embryology.

represent periods of interrupted growth, a tree carries its biography within itself. During more favorable seasons, the circles are wider, and the intensity of the winter intensifies the outlines of the rings.

"Mark Twain" upholds the reputation of the Big Tree for longevity. The rings show that it was 1341 years old when cut down in the fall of 1891. Thus it must have begun its life in A. D. 550, or only seventy-four years after the Fall of Rome. Practically all of medieval history, as well as modern, must be included in this period, while Natural Science or Biology may be said to have developed during its old age.

The small black cards which have been placed on the tree mark the successive centuries and give the growth of the tree during each hundred years. The uppermost row of white cards

> 1619
>
> **HARVEY**
>
> **Discovers circulation of the blood**

indicates political events and discoveries which have had influence on the progress of civilization since the year 550. The remainder show the progress in biology. The group immediately above the black cards represents the change in thought in philosophical biology, while those below give a history of biology proper.*

When the tree was a mere sapling, Europe was overrun by the Goths, Vandals and Franks, and a state of almost universal war prevailed. About twenty years later Mahomet was born,

* Each card is mounted on a pin which is stuck into the ring of growth corresponding to the date on the card. For example, in the accompanying sketch: 1619 is the year that William Harvey announced his discovery of the circulation of the blood. The pin attached to the card is inserted into the ring of wood which represents the growth of the tree during the year 1619. In some instances it has been necessary to put two dates on a card. In these cases the pin has been stuck into the ring of growth of the earlier date.

and then followed the establishment of the Mohammedan religion, which, during the next one hundred and fifty years, reached the zenith of its power and threatened to overrun the whole world. This Saracenic invasion was checked at the battle of Tours (732), in which the Franks under Charles Martel overwhelmingly defeated the Mohammedans. The beginning of the next century was marked with the crowning of Charlemagne on Christmas day, 800. This monarch made a noble effort to educate his people by establishing a school at his court and inviting thither the few learned men of his time.

The climatic conditions in California during A.D. 800 and the year preceding must have been very favorable for the growth of our tree, which had already attained the size of a large elm. Its growth during these two years, indicated by the large rings, was phenomenal.

During this century occurred also the effort of King Alfred to establish schools in England. The hardy Norsemen began their bold voyages in quest of treasure and adventure, colonized Iceland in 874, discovered Greenland (981), and pushing farther westward probably sailed down along the eastern shore of America.

The Crusades, begun in 1096 and continuing for almost 200 years, brought the various European peoples into intercourse, which resulted in exchange of ideas and helped prepare the popular mind for the discoveries which were soon to follow.

The first half of the thirteenth century saw the founding of the universities. First, the University of Paris (1200), which became the center of theology; a few years later were founded the University of Bologna, famous for law, and the University of Padua, which attracted the greatest students in medicine. In England, Oxford University was founded in 1249.

The fifteenth century brought those marvelous discoveries which were of so much importance in the advancement of civilization, and which contributed to the growth of science. Printing with wooden block type was introduced by John Gutenberg in 1438, and his invention was followed in 1450 with the use of metal type, making the general dissemination of knowledge possible.

Columbus' discovery of America (1492) was followed by Magellan's famous trip around the world to the westward (1519–1522), during which he discovered the Philippines; and about the same time Cortez conquered Mexico. The New World was soon explored for its reputed hidden treasures, and astronomers' search of the heavens for an orderly movement of planetary bodies resulted in the elaboration of the system of Copernicus (1543). Keppler announced his laws of planetary motion at about the same time (1609), and in the latter part of the seventeenth century Newton enunciated the law of gravitation. The increasing freedom of thought was expressed in the American and French Revolutions.

The rapid course of invention during the nineteenth century is too familiar to require detailed mention. The period of the tree's growth, however, is represented by only a few inches in its total diameter.

The cards representing the growth of biology are arranged in two groups. Those above the line of black cards represent the change of thought in the *philosophy* of biology, while those below the line indicate some of the great discoveries which have made the science what it is to-day. The latter have been divided into three rows, the uppermost representing General Zoölogy, the middle Comparative Anatomy and Palæontology, and the lowest series the evolution of Embryology.

Very strikingly is it shown that not only the scientific side of all branches of biology, but also the philosophical or speculative side, has been developed during the old age of the tree, or during the last 300 years. In fact, modern zoölogy and inductive methods may be said to have begun with William Harvey in the seventeenth century.

It is true that when the tree began its life, men had ideas and conceptions of the principles underlying nature, but most of these were crude and inaccurate, based on mere hearsay or tradition, and differing but little from those held before the beginning of the Christian era.

The science of anatomy had been at a standstill since the time of Galen (A.D. 130). This brilliant anatomist, it is true, advanced the study of anatomy by his careful dissections of apes and some of the lower animals, and he also wrote extensively on physiology; but accurate as some of his observations were, his errors, particularly in physiology, were many. His works, however, remained authoritative for fully 1400 years; his statements overruled the demonstrations of nature, and he was so reverenced that whoever had the courage to dispute him was liable to persecution and ostracism.

Physiology was not materially different from metaphysics, and both were affected with superstition. The ancient belief that the body contained *four humors*—"blood," "phlegm," "yellow bile," "black bile"—was held, and Galen had added to these a "pneuma," which pervaded the whole body, mingling with the humors and supporting life. The proper mixture of four elements—heat, cold, wetness and dryness—constituted the normal individual. The administration of drugs was in accordance with this belief. Systematic zoölogy did not exist. There was no true conception of species, no accurate description of animals, and no adequate system of classification. The naturalists were merely compilers and copyists of Aristotle and other ancient writers.

The philosophical or speculative in biology was retained by the clergy, almost the only persons really interested in the conservation of documents, and as a class the only ones able to read and write.

Some of the Greeks had had explanations of the succession of organisms on the globe. Aristotle believed that the first animals arose from the ocean, and that low forms of life were constantly springing into existence by spontaneous generation, a fallacy which was not completely rooted out of biology until the nineteenth century. Aristotle also perceived the principle of adaptation in nature, and considered the universe as the result of Intelligent Design. These ideas of the Greeks had a marked influence on Christian thought for many centuries. Augustine (fifth century) believed that a living substance had been made by the Creator, and that from this had developed all the diverse organisms of the present time. Two other famous churchmen advocated similar views, Erigena in the ninth century, and

42123

FELLING THE TREE

Thomas Aquinas in the thirteenth, each the foremost scholar of his day. But naturally a wider and deeper knowledge of biological phenomena was necessary before philosophical biology could have a strong foundation. Hence the philosophy of zoölogy dates from the awakening of science in the seventeenth century.

From the time that the Big Tree was a mere seedling up to the time that it measured fully 13 feet in diameter, there was scarcely a single discovery in the field of natural science worthy of record. One event, however, which occurred when the tree measured only 12 inches in circumference is of some interest. Silk was one of the treasures obtained from the Far East. Its production was carried on solely by the Chinese, who jealously guarded the silkworms and their eggs. The story is that two monks travelling in China succeeded in smuggling some eggs out of the country by concealing them in a hollow cane, and brought them into Europe. In the warm climate of the south the eggs developed into strong healthy worms. From such a humble beginning arose the extensive silk industry of southern Europe.

The stagnation of the study of anatomy for more than a thousand years was due to an extravagant admiration of Galen, over-confidence in his writings, and the failure of men to make observations for themselves, or to believe what they saw with their own eyes. Vesalius (born in 1514) was the first anatomist to assert independence, and to him is due the credit of laying the foundations of modern anatomy. Vesalius dissected the human body and accurately described what he found. He established a school of anatomy at Padua, and among his students was Fabricius, the teacher of Harvey, who startled the world in 1619 with his discovery of the circulation of the blood. This discovery, which revolutionized the study of physiology, and gave new impetus to the study of anatomy, met with bitter opposition from the followers of Galen, but Harvey successfully defended himself.

The opposition to Harvey set men to thinking, and investigation began. All forms of life were studied with all available means. Harvey, from an investigation on the development of the chick, laid the foundations of the study of embryology, one of the four great supports of the theory of evolution; and propounded the theory of *Epigenesis*, a theory vigorously argued by philosophers for many years. The compound microscope, already mentioned, was applied to the study of organisms by Leeuwenhoek and Malpighi. The former demonstrated capillary circulation (1690) and discovered red blood corpuscles, infusioria and spermatozoa (1677). These spermatozoa were regarded by some as parasites of animal bodies, by others as embryos which only needed nourishment to develop into an adult form. Malpighi applied the microscope to the study of the chick, and his observations led him to announce the theory of *Preformation*, which was opposed to the epigenesis of Harvey.

The preformationists contended that a given species contained within its sperm or ovum all the descendants of that species, with all organs and parts fully formed. In other words, embryos were only miniature adults, and were contained one within another like a series of Chinese boxes, in successive grades of size. The doctrine of epigenesis was that each sperm or ovum contained a *homogeneous* living substance which became differentiated by gradual changes into an individual resembling the parent. Preformation was supported by Spallanzani, Bonnet, Haller and even Cuvier. Its absurdity was shown by the work of Wolfe (1759), who firmly established the doctrine of epigenesis as it is believed to-day, although more frequently known as *embryological development.*

The stimulus given to research by Harvey's discovery, the intercourse and exchange of views among men, and the voyages to all parts of the world resulted in an accumulation of a great mass of facts, which were of little value unless classified. Conrad Gesner (in 1551–1558) had given a complete bibliography of zoölogy, and was the most important of the earlier naturalists. About a hundred years later Ray, an English zoölogist (1670), made an attempt to establish a "system of classification," but he had no true conception of species. It remained for Linnæus to complete a system which served its purpose so well that it has remained practically unchanged to the present time.

Linnæus recognized that certain groups of animals were subordinate to other groups, and by his *binomial nomenclature* he provided a place in his system for every species. To each species two Latin names were given; the first, always beginning with a capital, was the name of the genus; the second, now usually spelled with a small letter, that of the species. For example, the scientific name of our Big Tree is "*Sequoia gigantea,*" that is, *Sequoia* is the name of the genus, and *gigantea* the name of the species. (To avoid confusion, it is customary now to add the name of the scientist who first describes the species; thus, "*Sequoia gigantea* Decaisne," indicates that Decaisne was the naturalist who first described and named the Big Tree.)

The first edition of Linnæus' "Systema Naturæ" was published in 1735. Linnæus was a firm believer in the special creation of each species, and in one of his books says, "We reckon as many species as issued in pairs from the hands of the Creator."

Among the naturalists of the eighteenth century, Goethe and Cuvier are conspicuous. The former (1796), although a great poet, made valuable contributions to science. He introduced the word "morphology" as a designation of the study of form or structure, and was the first to advance the *vertebral theory* of the skull, that is, that the skull represents modified vertebræ. He recognized the significance of vestigial organs, for example, gill slits in human embryos, appendages in whales, etc., and predicted the discovery of the premaxilla in man—the supposed absence of which was considered to be a character which distinguished man from the apes.

It was, however, Georges Cuvier (born in 1769), the famous French naturalist, who was the leader in science for more than half a century. He stands as a striking example of a man who was remarkably correct in his observations of nature, but equally incorrect in his generalizations. His work on the Tertiary mammals of France marked the beginning of palæontology. He was the first to point out the resemblance between "*Anchitherium*" and the modern horse, a fact which is one of the strongest evidences of evolution. He was a preformationist and believed in *Catastrophism* (the theory that the earth as it is at present is the result of successive catastrophes), rather than *Uniformitarianism* (the belief that the present condition of the earth has been brought about by a gradual, uniform change). The work of Cuvier in comparative anatomy is also important, and he is called the founder of this science. He recognized the principle of correlated growth, and in "Le Régne Animal" improved the classification of animals.

The last century of our tree's life was remarkable for the discoveries in all branches of natural science. De Blainville (1839–1849) and Lyell (1797–1875) made valuable contributions to palæontology and geology. Lyell's "Principles of Geology" (1830–1833) dealt a death blow to catastrophism, and is a work second only in importance to the "Origin of Species."

Milne-Edwards (1800–1818) enunciated the principle of the physiological division of labor.

Von Baer (1828) announced the law that bears his name, namely, "individual development is a recapitulation of race development."

Schleiden and Schwann (1838–1839) discovered cells in plants and animals, and propounded the cell theory.

Valentin (1839) named the "nucleus," and was the first to speak of the "cell theory."

Purkinje and von Mohl (1840) named the substance of the cell *protoplasm.*

Serres (1842) asserted that all missing links would be found in embryology.

De Barry (1843) observed the union of sperm and ovum.

Kölliker (1846) demonstrated that sperm are developed from the tissues of the testes.

Owen (1846) pointed out the difference between *homologous organs*, for example, the arm of man, fore limb of horse, and wing of bird, organs which are formed on the same structural plan, and *analogous* organs, for example, wing of bird and wing of butterfly, organs differing entirely in structure, but performing the same function.

Remak (1850) described "three germinal layers," and Huxley (1859) homologizes them in the lower animals.

THE SECTION BEFORE SHIPMENT

Rapid strides were made also in systematic zoölogy and in zoö-geography. The relations of the lower animals were worked out by Leuchart, Vaughn Thompson, Dujardin, Agassiz and a host of others.

Expeditions were sent out to explore the earth and the sea. Famous among these are the voyage of the "Beagle," on which Darwin served and did some of his earliest biological work; and the voyage of the "Rattlesnake," on which Huxley was Assistant Surgeon.

In 1859 Darwin published his "Origin of Species," a book which is universally admitted to have had more influence on human thought than any other work of the century.

Darwin's theory of the "Origin of Species" may be stated briefly as follows: All species tend to vary. No two individuals of the offspring of a pair are exactly alike. On account of this variation in structure or function, certain individuals are better able to thrive than their fellows. These animals transmit these characters to their offspring, which in turn survive in the struggle with their fellows. Thus nature eliminates those variations which are disadvantageous to the organism, each individual being tested in its struggle to maintain its existence. The accumulation of these favorable variations through many generations is supposed to produce an organism quite different from the original stock, or, in other words, a new form.

Few works have been constructed with more care and skill. For twenty years Darwin collected facts from all available sources, and made innumerable observations himself. The evidence in support of his theory was drawn from all branches of natural science: comparative anatomy, embryology, palæontology and zoö-geography. So numerous were the facts that he presented, and so careful was the exposition of his theory, that in less than twenty years it became the working hypothesis of nearly every biologist.

Long before Darwin's time the resemblance between groups of animals had been recognized, and many new facts made known by investigators from Vesalius onward emphasized these resemblances. In 1620 Bacon published "Novum Organum," in which he advocated the unity of nature. Descartes (born, 1596) attempted to explain the universe on natural laws. Leibnitz (born, 1646) advanced a theory of the continuity of organisms. The term "*evolution*" was introduced by Bonnet as a name of the process by which organisms had become differentiated. He expressed this relationship by introducing the idea of a "scale of beings," which formed the links of a chain. This conception has persisted up to the present time, in the expression "the missing link."

It was Lamarck (1809), the contemporary and fellow-countryman of Cuvier, who was the first to express the blood-relationship of organisms, as is done to-day, namely, by means of the *genealogical tree.* This eminent anatomist and investigator held views much in advance of his time. He rejected entirely the fixity of species, and believed that all animals now existing had been derived from a common stock by a process of gradual change. In one place he affirms that "Nature needs only matter, time and space to produce all changes." The two factors which he believed most important in producing these modifications were the reaction of the organisms to their environment and the inheritance of the modifications resulting from this reaction and of the effects of use and disuse of organs.

Lamarck's theory was partially smothered in the ridicule which Cuvier heaped upon it. Cuvier was a firm believer in the immutability of species and his great authority in biological subjects made him a powerful dictator of public opinion.

From Lamarck to Darwin there were few philosophers of note. Erasmus Darwin (1794) and Oken (1805) embodied in their writings the idea of the continuity of life.

In 1844 a book called "Vestiges of Creation" appeared and caused quite a sensation. That this was published anonymously is significant of the attitude of the public toward the idea of evolution.

Naturally the "Origin" met with a storm of opposition, but it was vigorously defended by Huxley. He it was who perhaps more than any other scientist secured for the "Origin of Species" a fair and impartial treatment and thus aided the cause of truth.

THE STUMP OF "MARK TWAIN"
Ninety feet in circumference

Among the earlier champions of Darwin's theory, were Lyell, Tyndall, Hooker and Spencer.

More recently the philosophy of zoölogy has centered around the question of the inheritance of characters acquired during the life of the organism, and biologists at present are divided into two schools; one, nominally led by Herbert Spencer, contend that such characters are inherited; the other, of which August Weismann is the head, deny the inheritance of acquired characters and affirm that "natural selection," acting on congenital variations, is sufficient to produce the diverse organic forms.

Since Darwin's time the growth of biology has been phenomenal. This is due to the enthusiasm of the great number of investigators in every branch of science, and to the application of modern inventions in methods of research. Governments, as well as private individuals, have contributed generously to aid the work. Expeditions for exploring the depths of the sea and the remotest parts of the world have been organized and successfully carried out.

A. R. Wallace in 1876 published his "Distribution of Animals," which was the first complete treatise on zoö-geography, one of the pillars of evolution.

The "Challenger" expedition (1872–1876), sent out by England, obtained more than 8000 species new to science.

The United States Fish Commission, established by the Government, through the energy of Professor S. F. Baird, as well as the National Museum and the Geological Survey, have made valuable contributions to science.

Among the seashore laboratories, that founded at Naples in 1870, by Professor Dohrn, is most famous.

Palæontology too has had a rapid growth. Cope in this country discovered and described more than a thousand new species of vertebrates, many of which are on exhibition in the Hall of Fossil Vertebrates. In invertebrate palæontology James Hall was one of the leaders, and a large proportion of the material upon which he did his monumental work is displayed in the Geological Hall.

The researches of Louis Pasteur have revolutionized both the theory and practice of medicine, and bacteriological discoveries of the past decade have probably done more to alleviate human suffering than all the efforts of any previous century.

In short, every sphere of human activity, social, religious, industrial and intellectual, has felt the influence of and has been profoundly modified by those marvelous discoveries of science which have occurred even since this Sequoia attained gigantic proportions.

THE AMERICAN MUSEUM JOURNAL.

EDMUND O. HOVEY, *Editor*.

FRANK M. CHAPMAN,
LOUIS P. GRATACAP, } *Advisory Board.*
WILLIAM K. GREGORY.

Issued monthly, except from July to September, inclusive.

Subscription, One Dollar per year.

For sale at the Museum at ten cents per copy.

Subscriptions should be addressed to The Editor, American Museum Journal, American Museum of Natural History, 77th Street and Eighth Avenue.

Guide Leaflets.

Issued as supplements to THE AMERICAN MUSEUM JOURNAL.

No. 1. THE BIRD ROCK GROUP. By FRANK M. CHAPMAN, Associate Curator of Mammalogy and Ornithology. October, 1901.

No. 2. THE SAGINAW VALLEY COLLECTION. By HARLAN I. SMITH, Assistant Curator of Archæology. December, 1901.

No. 3. THE HALL OF FOSSIL VERTEBRATES. By W. D. MATTHEW, Ph.D., Assistant Curator of Vertebrate Palæontology. January, 1902.

No. 4. THE COLLECTION OF MINERALS. By LOUIS P. GRATACAP, A.M., Curator of Mineralogy. February, 1902.

No. 5. NORTH AMERICAN RUMINANTS. By J. A. ALLEN, Ph.D., Curator of Mammalogy and Ornithology. March, 1902.

No. 6. THE ANCIENT BASKET MAKERS OF SOUTHEASTERN UTAH. By GEORGE H. PEPPER, Assistant in the Department of Anthropology. April, 1902

No. 7. THE BUTTERFLIES OF THE VICINITY OF NEW YORK CITY. By WILLIAM BEUTENMÜLLER, Curator of Entomology. May, 1902.

No. 8. THE SEQUOIA. A Historical Review of Biological Science. By GEORGE H. SHERWOOD, A.M., Assistant Curator.

American Museum of Natural History.

WHAT IT IS DOING FOR THE PUBLIC :

Gives free admission to its halls on Wednesdays, Thursdays, Fridays, Saturdays and Sundays.
Provides for free illustrated lectures on Tuesdays and Saturdays.
Provides for free illustrated lectures to teachers on Saturdays.
Provides instruction to school children when accompanied by teachers.

WHAT IT IS DOING FOR ITS MEMBERS :

Gives free admission at all times.
Provides special courses of illustrated lectures.
Gives free use of Library. Issues the Journal.
Distributes Guide Leaflets.

WHAT IT IS DOING FOR SCIENCE :

Maintains exploring parties in various parts of the United States and in :
Siberia, British Columbia, Alaska, Peru,
China, Mexico, Bolivia, Central America.

Maintains scientific publications :
Memoirs—eighteen numbers have been issued.
Bulletin—fifteen volumes have been issued.
Journal—one volume has been issued.

What the Museum Needs.

Additional members.
Increased subscriptions to defray expenses of exploring expeditions.
Funds to make additional groups similar to those in the Bird, Mammal, and Ethnology Halls.
Small sums sufficient to preserve the records of the Indians of New York.
Means for collecting and preserving representative examples of animals on the verge of extinction.
Means for collecting fossils and geological specimens.

Membership Fees :

Annual Members,	$ 10.
Life Members,	100.
Fellows,	500.
Patrons,	1,000.

All money received from membership fees is used for increasing the collections.

Publications.

The publications of the Museum consist of an Annual Report, in octavo, about 80 pages ; the Bulletin, in octavo, of which one volume, consisting of about 400 pages, and about 25 plates, with numerous text figures, is published annually ; the Memoirs, in quarto, published in parts at irregular intervals; an Ethnographical Album, issued in parts, and the American Museum Journal.