size, extent of surface, and mode of union, of its component bones. These, in their turn, are correlated with the articulation of the lower jaw, and with the amount of surface presented by the ascending ramus; with the neighboring fossæ, crests, and processes; with the dental series; and necessarily with the muscles concerned in mastication, varied as they are in their action.

The jugal arch, as it exists in the order of the *Carnivora*, offers perhaps the most instructive example of the various points to be considered in its morphology. Take the cranium of the tiger as a type of the cats (*Felidæ*). In this, the arch, composed of three bones, —the squamosal, malar, and maxilla.—presents an extraordinary, horizontal curvature, thereby vastly increasing its expanse, giving great width to the temporal fossa, and consequently allowing a corresponding development of the temporal muscle, which, taking its origin from the largely expanded surface of the parietal, and from the occipito-sagittal crest, passes forwards and downwards, to be inserted into the high, wide, oblique, coronoid process of the mandible.

The increase in length of the arch, due to the great horizontal curvature, is also seconded by the advanced position of the orbit upon the skull, and to its height above the level of the articulation of the mandible.

The vertical curvature of the arch, with the convexity above and the concavity below, denotes increased power of resistance to the strain produced by the muscular fibres of the masseter, which, springing from the under side of the arch, are carried obliquely backward and downward to be inserted into the deeply grooved ascending ramus. The action of the pterygoids, which is similar to that of the masseter, is also relatively powerful. The fibres rising from the pterygoid fossæ and plates are inserted into the inside of the angular portion of the lower jaw, and into the neck of the condyle. The suture by which the jugal process of the squamosal and the malar are joined extends very obliquely through a greater portion of the arch; this obliquity imparting much strength to the bony structure, and giving force to assist the pressure upward.

The convex surface of the transverse condyle of the mandible, received into the deeply grooved glenoid cavity, forms the hinge-like articulation fitted for the vertical action of the jaw, and which is necessary for the prehension, tearing, and division of the flesh by means of the characteristic incisors, canines, and molars.

In the order of the *Edentata*, the cranium of the great ant-eater (*Myrmecophagus jubata*) exhibits a jugal arch which is the extreme opposite of that which has been thus partially described. In the ant-eater the arch is very incomplete, consisting of a short styliform process given off by a very rudimentary jugal, and of an extremely small, tuberous, zygomatic process from the squamosal, no union being formed between the two. There is no post-orbital process of the frontal, and indeed no separation between the orbital and temporal fossæ. Under these circumstances, the muscular development concerned in the preparation of the food is very feeble, correlated as it is with the entire absence of teeth, and any necessity for mastication.

Between these two extreme modifications there are many intermediate forms of the jugal arch. In some of the *Rodentia*, although the arch is relatively weak, as shown by the downward convexity in its vertical curvature, the masseter has other points of fixed insertion, by which means the masticatory powers are fully sustained. Moreover, the antero-posterior form of condyle is received into an undefined fossa situated upon the side of the cranial wall, whereby a corresponding amount of dental energy is imparted, suited to the habits of the rodent. Cope and Ryder have attributed the peculiarities of the dental system in this order to the mechanical consequences of an increase in the length of the incisors, which increase is due to their continued use. By a similar process of reasoning it may be shown that the imperfect condition of the arch in some of the other orders is correlated with an entire absence of the teeth, with a feeble muscular energy, and a loss of mastication, all being the result of continuous disuse.

In short, it may be said in general that the great development of the arch is dependent upon modifications which are strictly due to use, while its weakened and imperfect condition is equally the result of modifications which are due to disuse.

There seems as yet no evidence afforded by paleontological research to show that the jugal arch has undergone any special changes since the days of the *Creodonta*, the ancestors of the cats. We may therefore conclude that the phylogenesis of the *Carnivora*, at least, remains essentially the same, so far as this portion of the skull is concerned.

D. D. SLADE.

Cambridge, Mass., Dec. 5.

BOOK-REVIEWS.

A Revision of the South American Nematognathi or Cat-Fishes. By CARL H. EIGENMANN, Ph.D., and ROSA SMITH EIGENMANN. San Francisco, Cal. Acad. Sci. 8°. $3.

THIS extensive work will be highly welcomed by ichthyologists. It is based on several thousand specimens from the Museum of Comparative Zoölogy at Cambridge, Mass. The material was collected chiefly during the Thayer Expedition. Besides that, numerous other collections were studied; for instance, that of Senhor Honorario, made in Goyaz, that made by his Majesty Dom Pedro II in Rio Grande do Sul, and that made in Lake Titicaca by Professor Alexander Agassiz and Mr. S. Garman.

In all, 101 genera and 467 species are enumerated. Full descriptions of most of the species in the Museum of Comparative Zoölogy are given. The synonymy is treated in full, and the bibliography is given at the end of the volume. In this we should like to add Dr. C. B Bruehl's "Osteologisches aus dem Pariser Pflanzengarten" (Wien, 1856), containing descriptions and figures of the osteology of *Aspredo*, *Loricaria*, and *Hypostoma*.

Besides the index of species and genera, a geographical index is added, and a map with especial reference to the localities where collections have been made. Both will be of great help to the student.

The different forms are referred to eight families, seven of which are confined to tropical America. The relationship of families and subfamilies is expressed by a phylogenetic diagram.

The nearly cosmopolitan family *Siluridæ* (it is only absent in Australia) reaches its greatest development in South America, where it is represented by six subfamilies. The *Bunocephalidæ* are found in the whole course of the Amazon and in Guiana. The *Diplomystidæ* are represented by a single genus and species from Chili, the *Diplomystes papillosus*, Cuv. The family *Hypophthalmidæ*, with the genera *Hypophthalmus* and *Helogenes*, is confined to the northern Amazon and Guiana. The *Pygidiidæ* contain eleven genera, and are found in mountain-streams of Chili and the Argentine Republic. The *Argiidæ*, the anatomy of which needs further study, have only three genera. They are characteristic of the Andes of Peru, Ecuador, and Colombia. The *Loricariidæ*, with twenty-four genera, occur east from the Argentine Republic to Central America, west in Ecuador and Colombia. The seven genera of the *Callichthyidæ* extend from La Plata to Rio Orinoco, and in the Amazon as far as Nauta.

The authors may be congratulated on this work, which will be of the greatest value to the student of fishes. Thanks are due to the California Academy of Sciences for publishing this work. It forms Volume I. of a new series of publications, called "Occasional Papers of the California Academy of Sciences."

AMONG THE PUBLISHERS.

"FROM Babel to Comparative Philology" is the title of a chapter in Dr. Andrew D. White's "Warfare of Science," which will open the January *Popular Science Monthly*. It gives the origin of the legend in regard to the great tower and the confusion of tongues, and also traces the early history of the belief that Hebrew was the only language spoken by God and men before Babel was undertaken. The second article in the great series on "The Development of American Industries since Columbus" will also appear in that number. The special topic is "Iron Mills and Puddling-Furnaces," being a part of the general subject of iron and steel, which is being treated by Mr. William F. Durfee. Like the opening paper, it is copiously illustrated, and much more readable than the title would indicate. Professor Huxley has attacked the idea that the people who spoke Aryan were one distinct race. His discussion of this point will be printed in the *Popular*

Science Monthly for January and February, under the title "The Aryan Question and Prehistoric Man." The storage of electricity will be explained in a fully illustrated article by Professor Samuel Sheldon of the Brooklyn Polytechnic Institute, in the January number.

—The president of the Royal Geographical Society declared in 1889 that "the most salient event of the year has been the daring journey of Fridtjof Nansen and his little party of Norwegians and Lapps across the inland ice of Greenland." Dr. Nansen's fully illustrated account of his adventures and of his extraordinary success will be published shortly, both in London and New York, by the Longmans.

— The action of Congress in setting apart a reservation of California forest land considerably larger in extent than the State of Rhode Island furnishes a theme for the leading editorial in *Garden and Forest* for Dec. 3. Some of the other subjects discussed are "House Gardening in Cities;" "The Trees of Kansas;" "A Fatal Disease of the Cranberry;" notes on orchids, ferns, wild-flowers, and chrysanthemums; and seasonable counsel for all interested in trees and shrubs. The principal illustration is of a vase of chrysanthemums, which is an object-lesson in the decorative value of these favorite flowers.

— The American Academy of Political and Social Science at Philadelphia is doing a valuable work in publishing material of value to students of economics and politics. It is making a specialty just now of the railroad problem. The July number of its proceedings contained an account of the reform in railway passenger tariffs recently introduced into Hungary. The January number will contain an account of the system just introduced into Austria. The work of the academy is all the more valuable on account of its strictly scientific character. The organization takes no sides, but contents itself with an objective presentation of the facts relating to the subject.

—Among the matter which has recently appeared in the *American Naturalist*, and which is in preparation, the following titles may be mentioned: "The Evolution of Mind from a Neo-Lamarckian Standpoint," by Professor E. D. Cope; "The Effects of the Electric Current on Kemmler's Body," by Dr. E. C. Spitzka; "On the Languages and Lore of the Zuñi Pueblos," by Dr. J. W. Fewkes of Harvard University; "On a Family of Hermaphrodites," by Dr. Luce; "The Wild Buffalo of Mindoro," by Professor J. B. Steere; "The Physiological Effects of Special Feeding on Bees," by Professor A. J. Cooke of Michigan State Agricultural College; and "The Metamorphic Forms of the American Newt," by Professor Simon Gage of Cornell University.

— Messrs. Ticknor & Co. have secured the exclusive sale for America, and will publish, by arrangement with Mr. B. T. Batsford, the London publisher, a limited edition of "Architecture of the Renaissance in England," by J. Alfred Gotch and W. Talbot Brown. The first part will appear immediately, and the others at intervals of two or three months.

— Last week's number of *The Illustrated American* is styled the "Naval Number," because sixteen pages are dedicated to naval matters. "Where We build our War-Vessels" is a description of the New York Navy Yard, illustrated; and "Our Battle-Ships" describes and illustrates the new battle-ship designed for the Bureau of Construction at Washington, and the most formidable war-ships of the foreign powers. A portrait of Admiral David D. Porter serves as the frontispiece. The wonders of the Nile are continued in an illustrated article describing hundred-gated Thebes.

— Lieut. Willoughby Walke, instructor in charge of the United States Artillery School laboratory, has made a series of experiments with the object of determining the strength of various newly invented or patented explosives. The composition of these new explosives, says *Engineering*, differs much; but they have all one feature in common, viz., that their inventors all claim that

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Publications received at Editor's Office, Nov. 24–Dec. 6.

BAKER, D. W. History of the Harvard College Observatory during the Period 1840–1890. Cambridge, Harvard University. 32 p. 8°.
BALDWIN, J. Harper's Sixth Reader. New York, Harper. 504 p. 12°. 90 cents.
BRACKETT, C. F., and others. Electricity in Daily Life. New York, Scribner. 288 p. 8°.
CAJORI, F. The Teaching and History of Mathematics in the United States. Washington, Government. 400 p. 8°.
CENTURY Dictionary, The. Vol. IV. M–P. New York, The Century Co. 1324 p. f°. $10.
COLLEGE Advance, The. Vol. i. No. 1. Winfield, Kan., E. H. Vaughan. 4 p. f°. 25 cents per year.
EDDY, H. T. Maximum Stresses under Concentrated Loads. New York, Van Nostrand. 100 p. 8°.
GILMAN, N. P. Industrial Partnership or Profit Sharing. Boston, G. H. Ellis. 18 p. 24°.
HARVARD COLLEGE, Annals of the Astronomical Observatory of. Vol. XXI. Part II. Investigations of the New England Meteorological Society in the Year 1889. Cambridge, W. H. Wheeler, Pr. 273 p. 4°.
——Same. Vol. XXX. Part I. Observations made at the Blue Hill Meteorological Observatory, Massachusetts, in the Year 1889. Cambridge, John Wilson & Son, Pr. 75 p. 4°.
HUDSON, H. N. The Ancient Mariner. Boston, Ginn. 21 p. 12°.
LANGE, Helene. Higher Education of Women in Europe. Tr. by L. R. Klemm, Ph.D. (International Education Series.) New York, Appleton. 186 p. 12°. $1.25.
MACAULAY'S Second Essay on the Earl of Chatham. With Notes and a Sketch of Macaulay's Life by D. H. M. Boston, Ginn. 91 p. 12°.
MCMILLAN, W. G. A Treatise on Electro-Metallurgy. London, Charles Griffin & Co.; Philadelphia, Lippincott. 387 p. 12°. $3.50.
MACOUN, J. Catalogue of Canadian Plants. Part V. Acrogens. Montreal, W. Foster Brown & Co. 428 p. 8°.
MODIGLIANI, E. Un Viaggio a Nías. Milan, Fratelli Treves. 726 p. 8°.
NICOLSON, F. W. P. Terenti Afri. Phormio. Boston, Ginn. 66 p. 12°. 30 cents.
PEARSON, W. H. List of Canadian Hepaticæ. Montreal, W. Foster Brown & Co. 31 p. 8°
PICKERING, E. C., and WENDELL, O. C. Results of Observations with the Meridian Photometer during the Years 1882–88. (Annals of the Astronomical Observatory of Harvard College. Vol. XXIV.) Cambridge, John Wilson & Son, Pr. 267 p. 4°
ROLFE, J. C. P. Terenti Afri. Heavton Timorvmenos. Boston, Ginn. 61 p. 12°. 30 cents.

their product is as powerful as dynamite. The principal difficulty in arranging the experiments was to decide in what way the strength of the explosives should be tested, as no method yet invented can be considered entirely satisfactory. Finally Lieut. Walke decided to use the Quinan pressure-gauge. The instrument used consisted of a heavy block of wood upon which was bolted a cast-iron block. In this block four wrought-iron guides were twisted around the circumference of a circle four inches in diameter, and were connected by a ring at their outer ends. A steel plate was let into the block, and was flush with its upper surface. The piston, which rested on a plug of lead, was of tempered steel four inches in diameter and five inches long, and moved freely between the guides. It weighed twelve pounds and a quarter. On the top of this piston was a parabolic cavity to hold the charge of explosive. The shot, made of tempered steel, was four inches in diameter and ten inches long, weighing four pounds and a half. It was bored down its centre to receive a capped fuze. To operate the instrument, a plug or cylinder of lead was placed on the steel plate, and the piston lowered gently down on it. The charge of explosive being placed in the cavity, the shot was gently lowered upon the piston. On firing the charge, the shot is thrown out and the piston forced down on the lead plug, which it compresses, the amount of compression being a measure of the strength of the explosive. Twenty-seven explosives in all being tried, the results were compared with those obtained with a sample of nitroglycerine, the strength of which was reckoned as 100. The results placed explosive gelatine and hellhoffite first with a strength of 106.17; gun-cotton and dynamite had each a strength of over 80; emmensite, a new American explosive, one of nearly 78; bellite, one of 65 70; and melenite, the famous French explosive, which is not nearly so safe to handle as bellite, had a strength of only 50.82. The above figures are of course not absolute, but they, at any rate, show the order in which the various explosives come.

INDUSTRIAL NOTES.

A Model Electric-Light Plant.

IN April of last year the electric-light system of the Eureka Electric Light Company of this city, then known as the Loomis system, was illustrated and described in these columns. Since that time the progress of the Eureka Company has been steady, though not as rapid, perhaps, as that of its older and larger competitors. Lighting and power plants have been installed in many parts of the country, and many improvements, both mechanical and electrical, have been made in minor details of the apparatus.

One of the latest of the Eureka Company's installations is a five-hundred light plant in the Vanderbilt Building, a large office building on Nassau Street, this city. The dynamo, of five-hundred-light capacity, is driven by a fifty-horse-power Fitchburg engine the Evans friction cone (also described in these columns some time ago) being used instead of belting, to transmit the power from engine to dynamo. This friction cone admits of a very compact arrangement of machinery, much less floor-space being required, as the engine and dynamo stand close together. This is an important consideration in modern office buildings, especially where space is valuable. The installation as a whole is one of the simpler and yet most complete, both electrically and mechanically, to be found in this city.