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CONTENTS:

*THE MORPHOLOGICAL MUSEUM AS AN EDUCATIONAL FACTOR IN THE UNIVERSITY SYSTEM.**

THE educational value of the modern morphological museum has of late years received such general recognition that we may well regard its position as established in the university system. Not only do the departments of undergraduate instruction draw more and more extensively upon this portion of the university equipment for the illustration of courses and demonstrations, but the museum itself has assumed its proper relation to independent scientific research and to the investigation of biological problems. It has seemed to me desirable to present to this association—whose members are so largely both teachers of anatomy and investigators of the science—some account of the progress made during the last decade in museum work in the department of vertebrate morphology. More especially does it appear proper at this time to note the present stage of development of the modern anatomical museum, because we have, I think, reached a period at which we can look back over a series of busy years and gauge correctly the value of the results obtained, as well as forecast the probable future development of this work. Ten or fifteen years ago the morphological

* Address of the President before the Association of American Anatomists at the Fourteenth Session, held at Baltimore, Md., Dec. 27–28, 1900.

museum—established on lines of modern thought and research—existed in an embryonic form in only a few of our institutions of learning. From this period date a number of excellent monographs—in which the authors outline the plans of a proposed anatomical museum designed to meet the requirements demanded by the advance of the biological sciences—from the standpoint both of the teacher and the investigator. Prominent among these interesting publications are the following :

'Outlines for a Museum of Anatomy. Prepared for the Bureau of Education,' by R. W. Shufeldt. 1885.

'Die Aufgaben der anatomischen Institute,' by Professor A. Koellicker, 1884. An address delivered at the opening of the new anatomical institute in Würzburg on November 3, 1883.

'The Educational Museums of Vertebrates,' an address before the Section of Biology of the American Association for the Advancement of Science, at Ann Arbor, August, 1885, by Professor B. G. Wilder.

'The Synthetic Museum of Comparative Anatomy as the Basis for a Comprehensive System of Research,' by John A. Ryder, Professor of Comparative Embryology at the University of Pennsylvania, Philadelphia. 1893.

As I look over the list of these and other contributions to the literature of the anatomical museum I am tempted to characterize the period between 1885 and 1895 as the prophetic era, foreshadowing the establishment and recognition of the most essential and valuable aid to scientific anatomical instruction and research which our universities to-day possess. When we analyze the great and radical changes which our methods of morphological teaching have experienced since that time, we shall, I believe, agree that the demonstrative and objective instruction which has replaced so largely the old didactic lecture is intimately and organically connected with the evolution of the modern anatomical museum. It will perhaps best serve the purpose of my communication if in the following I confine myself to the facts as they are most familiar to me in the case of my own university, which, I believe, may fairly be taken as a concrete example of the general progress which has marked the period in question in the scientific institutes throughout our country.

The establishment of a museum of vertebrate comparative anatomy, on lines designed to illustrate and demonstrate to the fullest extent possible the morphological truths embodied in the doctrines of evolution, heredity and descent is an undertaking requiring years of careful and successful work before even a satisfactory beginning is made. The foundation of the museum at Columbia University was laid in 1889, and, while in many directions our progress has been rapid and the results gratifying, yet we feel that to-day but the outlines exist along which future growth is to take place.

I. PLAN AND SCOPE OF THE MUSEUM AND ITS RELATION TO ANATOMICAL INSTRUCTION.

I may in the first place call your attention to the general plan and purpose of the museum, in accordance with which the objects have been collected and prepared, and to the relation existing between the museum and the undergraduate instruction in anatomy.

The following considerations present themselves :

1. The fundamental plan of the museum includes in the first place a general exposition of the vertebrate classes, whose purpose is to present the cardinal points in the anatomical structure of the great vertebrate classes and subclasses.

Each vertebrate class, subclass and order

is represented by one or more typical forms in preparations illustrating as fully as possible the skeletal and locomotory apparatus, the circulatory and nervous systems, and the alimentary, respiratory and uro-genital tracts.

This display forms the guiding thread to the study of the individual forms—in respect to typical structures, *i. e.*, the fundamental anatomical characters of the mammal, bird, reptile, amphibian and fish are grouped together to afford a comprehensive view of the entire organism, from which starting point the detailed investigation of characteristic structures in their various modifications is to be followed through the series of species belonging to the *same class.*

To illustrate: the typical structure of the avian pectoral girdle is represented in the collection by the girdle of *Palamedea cornuta*, the horned screamer. It is here shown to contain three elements, the scapula, coracoid and furcula.

Turning to the corresponding series demonstrating the successive modifications of this structure, we find it as a link in the group devoted to the development of the vertebrate shoulder girdle. The various modifications in shape, extent and sternal attachment of the complete furcula are first illustrated, together with preparations of the membranous and ligamentous structures, which have a bearing on the general morphology of the episternal apparatus.

In the next place the avian girdle is found to pass from the type represented by *Palamedea*, in which all three skeletal elements are fully developed, to the intermediate condition seen in the toucan, where the furcula is developed as a bilateral structure, the two segments not fusing over the sternum, until we come to the brevipennate group of birds, of which *Dromœus* still has rudimentary anterior collar bones, whereas in *Struthio*, *Rhea* and *Casuarius* these have lost their identity by becoming fused with the scapula.

In the second place this division of the museum affords the basis for broad comparison between the organizations of the different vertebrate classes. For example, the comparison of the entire anatomical system of a typical reptile, bird and mammal will show why reptiles and birds, although differing widely in structural detail, yet have sufficient general morphological characters in common, as against the mammal, to entitle them to be grouped under the single broad head of the Sauropsida.

Then again, this portion of the museum is designed to elucidate the important problems of derivation of vertebrate sub-classes.

2. The second main division of the museum deals with the development, evolution and comparative structure of single organs and systems. The homologies in the different classes, and the modifications of the typical structures in each class, are here demonstrated as completely as possible. In many respects this portion of the work is educationally the most important. We draw most extensively upon it for our anatomical undergraduate instruction in the elucidation of problems in human morphology. I cannot take time in even superficially outlining the detailed development of this division of the anatomical museum. The enumeration of a few of the principal series must suffice.

I may instance the series dealing with the morphology of the alimentary tract, and especially the group devoted to the structure of the ileo-colic junction, cæcum, vermiform appendix and the allied segments of the large intestine. This series, including at present over 600 preparations, and beginning with type forms illustrating this portion of the alimentary canal in fishes, amphibia, reptiles and birds, passes to a complete demonstration of the structures in mammals, terminating with several speci-

mens of the four anthropoid apes and leading up to the detailed study of the human cæcum and appendix, the numerous variations of which are all represented by one or more type specimens. In the same way the various forms of the stomach and the modifications of small and large intestine constitute a series of great morphological interest.

Other series deal with the vertebrate respiratory apparatus, especial stress being laid on the clear demonstration of the development, evolution and structure of the mammalian lung. Closely connected with this group is the serial exhibit dealing with the heart and circulatory system. Other series include the nervous system, the genito-urinary tract, the pelvic and pectoral girdles, the mammalian temporal, periotic and tympanic bone, etc.

Special attention is given in this department of the museum to the demonstration of human anatomy. Eventually it is hoped that every portion of man's structure will be fully and exhaustively illustrated by perfect preparations. The museum should afford the medical student the opportunity of directly verifying his text-book information and should be a most valuable guide and aid to the practical anatomical study of the individual in the dissecting room. Moreover, many structures, as we all realize, are never fully examined or completely demonstrable to the student in the dissecting room. Aside from the individual differences in the cadaver in respect to development and state of preservation, and in the element of alteration of structure by diseased conditions, certain parts require special methods of preparation, such as the auditory apparatus; others necessitate for their exposition the sacrifice of surrounding structures to a degree not warranted by the practical requirement of getting the greatest amount of detail from the dissection of a single cadaver. Moreover, even the structures, which are ordinarily fully examined and demonstrated in the dissecting room on the fresh subject, can be shown with great profit in the museum in various preparations by different methods. For example, the museum contains hardened situs preparations, organs hardened, distended and fenestrated, injection and corrosion preparations, etc., to illustrate fully the anatomical structure of each part and to enable the student to extend and amplify his observations on the cadaver.

Again, in connection with this department of the museum, I find it of distinct advantage to establish small comparative series designed to illustrate the development and normal anatomy, as well as the more important variations, of certain adult human conditions. These groups are accompanied by tablets, describing as fully as necessary the purpose of the exhibit, and drawings which emphasize the points at issue.

Thus, for example, under the heading of the cardinal sinus of the adult human heart —as part of the series exhibiting cardiac anatomy—the following group is placed with full explanatory text:

1. Heart and vascular system of *Raja ocellata*—various preparations to show embryonic type of mammalian heart before septal division, ducts of Cuvier and symmetrical cardinal veins.

2. Heart of *Python molurus*—hardened and distended, with sections showing: (*a*) sinus venosus of right auricle; (*b*) valves of sinus venosus and their relation to the Eustachian and Thebesian valves of the mammalian heart; (*c*) pulmonary veins; (*d*) persistent left precava.

3. Heart of *Struthio africanus*—injected, showing persistent avian left precava—with its relations to pericardium and coronary vein.

4. Ruminant heart (*Antelope cervicapra*) —mammalian type of normal persistence of left precava.

5. Series of normal human hearts—showing, in various preparations, coronary sinus, Thebesian and Eustachian valves—both fœtal and adult.

6. Series of well-developed folds of Marshal in fœtal and adult hearts.

7. As soon as obtained the final member of this group will be added as a preparation showing the normal persistence of the left precava in the adult human subject.

Instances in which a similar limited and selected group of preparations may be with advantage established for the elucidation of special details in human anatomy could be almost indefinitely multiplied.

I have noted at random:

1. Development of axis and atlas.

2. Ligaments and tendons of shoulder joint.

3. Greater and lesser sciatic ligaments and relation to hamstring muscles and coccygeus.

4. Postcava and variations.

5. Carpus and tarsus.

6. Sacrum and vertebral variations.

7. Aortic arch and variations of primary branches.

8. Various myological problems.

9. The peritoneum.

The question as to the practical application of this educational material to the requirements of undergraduate instruction in anatomy deserves careful consideration from several points of view:

1. Primarily the museum should afford a consecutive and logical serial exhibition, arranged and administered in such a manner that for both undergraduates and advanced students the preparations should be readily accessible and capable of being examined with only such restrictions as the safety of the object demands. The museum should be the reference library of the student in the widest sense, where the undergraduate can review and extend his anatomical knowledge on the hand of the actual object of his study, and where the advanced worker will find the necessary material in directing and supplementing his research in any given problem under investigation.

2. In the demonstrative teaching of the anatomical course the material of the museum in our experience can best be utilized in two ways:

a. It is our custom, in approaching any one of the large subdivisions of the course—such as the respiratory and circulatory system, the alimentary canal or genito-urinary tract—to devote a portion of the available time to a preliminary general consideration of the development, peculiarities of morphological structure and the physiological significance of the parts involved. For this purpose a judicious selection of a limited number of the museum preparations is made, and the objects are arranged in the form of a series, each number of which distinctly and forcibly illustrates a developmental stage or a significant and important structure or functional fact. It is necessary to limit the preparations thus selected in number to avoid confusion and superfluous expenditure of time, but it is surprising how clearly and convincingly the main broad lines of vertebrate development and evolution and the relation between structure and function can be brought out in a comparatively short series of selected preparations. Every teacher knows and appreciates the difference in the quality of instruction and its results between a demonstration of models and drawings, schematic or otherwise, and one referring directly to the natural object. The most important function of the museum, as an integral part of the educational system of the university, is exerted in supplying the material necessary for this kind of demonstrative teaching. Practically I find in the schematic blackboard sketch or the more carefully

prepared colored chart a most valuable adjunct. The drawing should, however, be made directly from the actual preparation demonstrated and the student should have the opportunity of directly comparing both. In this way salient points can be accentuated and the attention properly and immediately directed to the important facts which the preparation is designed to illustrate.

b. In connection with the class-room demonstration it is at times desirable to deal with general problems of vertebrate morphology from the higher standpoint which, on the hand of a more extensive series, affords a wider view of the structures concerned. I find that this can best be accomplished by a photographic lantern slide demonstration, in which a very considerable number of forms can be exhibited to the class in a comparatively short time. It has been our practice to photograph the preparations when finished, but before they are permanently mounted or included in the museum series. As a practical matter the best results are obtained by vertical exposure, the object being placed in suitable trays and covered by clear fluid—water or alcohol. In this way the disadvantage, resulting from the distorsion and reflection of the jar containing the specimen when finally mounted, is obviated.

The resulting photograph forms part of the museum record and is useful in many ways. Properly labeled, it forms an excellent guide to the study of the preparation and it can be used directly for reproduction in publications or be made the basis of the drawing. Finally, as the completion of the series warrants it, the negatives yield a set of lantern slides which can be used in the teaching of the department as well as in extending the use of the museum material in other institutions.

3. The special courses in comparative anatomy and embryology, which are offered as optionals, electives, or for the higher university degrees, make demands which the museum should meet as fully as possible. In the first place, I find that the forms which can readily be obtained in numbers, and supplied to the students for their actual personal use in the laboratory courses, require in many cases comparison with allied types which, by reason of their rarity and value, can only be represented in the permanent collection of the museum. The courses can thus be extended and made infinitely more valuable and instructive. Again, every practical laboratory teacher will know the value of placing before the student a carefully and clearly executed preparation and reviewing the structures which he is to expose and determine for himself by the dissection of the fresh material on hand. This use of the museum is entirely apart from the valuable and instructive deductions which a series of significant variations of normal structures will enable the student to make.

Moreover, in many respects the museum fulfills one of its most important practical functions in enabling the teacher to direct the student's attention, at the proper points in any laboratory course, to the corresponding structures and their modifications in selected preparations ranging throughout the entire vertebrate series. The broad and general application of the knowledge gained by the detailed study of any individual form can only by these means be impressed on the student, and it is thus that the anatomical museum accomplishes one of the main purposes of morphological study.

II. Relation of the Museum to Original Research and Advanced Study.

Of equal importance with the value of the museum for undergraduate instruction is its influence in promoting original investigation and advanced morphological study. Its very existence carries this with it. It constantly opens up, in creating the

nucleus around which the institution is to grow, lines of investigation and research which ultimately return their products to the museum as permanent records of the work accomplished, and thus prove sources of continual and valuable additions.

The museum in itself forms the basis for a progressive extension of morphological investigation. It accomplishes this in several directions. In the first place, the generalization of the structures presented by different types, which marks the central purpose of the institution, forms a circle from whose circumference at any point the line of a new and more extended investigation can be drawn. In fact, if the museum is to grow and develop according to its original intent, it is requisite that such enlargement should take place.

As the museum grows the vital questions of derivation and ancestry of forms must be investigated on the hand of constantly increasing material, which will open up points of view heretofore unattained. With each new accession to any group the capacity of the museum for extension of original thought and investigation increases. Any research opens at some point in its course side lines which may be of the utmost value. It is here that the immediate possibility of serial comparisons on a large scale afforded by the museum becomes of the greatest importance. The museum represents in its complete condition a morphological reference depository. It functions in connection with the morphological library, but it possesses the inestimable advantage of presenting the actual objects instead of plates and descriptions, often at variance with each other, incorrect and incomplete in detail and failing to elucidate just the question which it is desired to solve.

In this sense the museum fulfills its highest functions, stimulating and directly promoting investigation and rendering such investigation fruitful and effective by contributing the series necessary for comparison and reference.

It may hardly be necessary to touch on the effect of this work on those who are engaged in it. It attracts men whom the university is glad to number among its students and graduates, and who in other institutions—as teachers and investigators—will reflect credit on their training. If from among the growing numbers of our medical students even a few are made to develop into scientific workers, I should yet hold those few—in their prospective value to the university and to science—as balancing the long list of medical graduates whom we annually send out at our commencement.

III. RELATION OF THE MUSEUM TO OTHER DEPARTMENTS OF THE UNIVERSITY.

There is scarcely a department of biological or medical instruction and investigation which is not in intimate relation with some portion of morphology, and which will not benefit by a connection with the museum and by access to its collections.

In physiology, the science dealing with the function of the machine which itself is the object of the study in morphology, the connection is obvious. But the tremendous advantage which will accrue to each of these sciences by closer mutual association, through the link of the comparative anatomical museum, can scarcely be estimated. Morphology offers in the series of modifications which different forms present in their structure, a field of nearly unlimited choice for the interpretation of the physiologist. The physiological study of an organ in a certain form—as the dog—may lead the investigator to certain results which apply in the first plan to the species examined. If now the morphology of the organ is accessible to the physiological investigator not only in a complete series of

the dog's own order, the Carnivora, but through the entire mammalian class, and beyond this limit, so as to include the homologous structures, in other vertebrate classes, the result of the investigation becomes potentially amplified to a corresponding degree. The investigator can not only reason from analogy as to the results of similar experiments extended as far as deemed advisable through the vertebrate classes and orders, but he can also, guided by the morphology of the structure under consideration, select types which, from their anatomical configuration, promise unequivocal confirmation and extension of the results yielded by the first experiment. How frequently the success of an investigation depends on details of anatomical structure every physiologist will attest. It is often the question of the length of an arterial vessel without branches, or the arrangement of a duct, or the combination of several peripheral nerves. The museum of comparative morphology converts a haphazard search for a suitable form into one which will select the most desirable type with certainty.

In turn the generalized view of organized structure obtained in the comprehensive system of the museum will afford to the morphologist the aid which is to be found in the broad physiological interpretation of the modifications exhibited. Thus these two fundamental departments will be brought into closer contact with each other, a contact which cannot fail to redound equally to the benefit of both. I believe that a closer association of anatomy and physiology, such as is afforded by the link of the museum, is of very distinct advantage in undergraduate instruction. The modern development of science inevitably leads to a high degree of specialization, which naturally becomes apparent in the teaching of any department. The general advantage of this is obvious, provided touch is not lost with cognate branches. The morphological museum preserves this vital connection between anatomy and physiology more than any other single factor in the university equipment. Moreover, the museum has important relations to the practical departments of medical teaching and to pathology. Nearly all important advances, especially in departments such as diseases of the eye and ear, the diseases of women, surgery in general and in its specialized branches, depend primarily on some morphological question for their inception, rendering this or that proposed operative interference proper and advantageous, or interdicting it.

A museum which offers to the medical specialist not only the normal and variant human structures which constitute his field of work, but which enables him at the same time to examine the homologous parts of other vertebrates for the purpose of gaining clearer insight into obscure morphological conditions and the origin of aberrant formations, will certainly be an aid to practical advance which can be obtained by no other means. It is needless to point out further connections of a similar character, or to more than touch upon the line along which pathology and embryology meet, a line which is sufficiently extensive, but obscure because the assistance which vertebrate embryology can afford to the pathologist is only rarely attainable in the form which the museum proposes to offer, viz., complete sets of serial preparations. As the museum develops it is proposed to take successively certain portions of the subject, such as eye, ear, larynx, brain, genito-urinary tract, etc., and to develop these as fully as possible, demonstrating the results in the form of an exhibition to a selected number of scientific men who are directly interested in the matter as expert specialists. The importance of this feature of the museum work will thus be brought more

particularly to the attention of those best able to judge of its value and to profit by the same. I have no doubt that from this class of men valuable work in investigation will be secured.

IV. UTILIZATION FOR THE PURPOSES OF THE MUSEUM OF THE MATERIAL OBTAINED FROM THE DISSECTING ROOM, AND REFERENCE COLLECTION IN OSTEOLOGY.

The question has at times been discussed whether the morphological museum should take its place in the university system as part of the departments of general biology and zoology, or as an integral division of the department of anatomy in the medical school. I am unhesitatingly of the latter opinion. Aside from the obvious relation to undergraduate medical instruction which I have attempted to outline above, the mere fact that man, the highest vertebrate of the series, forms the object of study in the medical curriculum, assigns to the morphological museum its logical place in the university system. The human material necessary for the completion of the museum series is to be obtained from the supply of the medical school. The typical preparations are, of course, from specially selected subjects set apart for the purpose. Besides this, however, one of the important functions of the museum is to supervise the records of the dissecting room, to collect and arrange the statistical information afforded by the constantly repeated examination of the human body, to acquire for its own purposes the preparations which either illustrate normal structures unusually well or demonstrate important and significant variations. Part of this material is capable of direct incorporation in the museum series after removal from the cadaver and proper preparation. For other objects the method of plastic reproduction by means of casts is invaluable. This applies especially to the great group of myological variations. Not only are the objects bulky and not well adapted for preservation as moist specimens, but casts actually better serve the purposes of the museum in exhibition and instruction. In the comparative myological series, with which human muscular variations are necessarily brought into intimate relation, the method of plastic reproduction is an essential. The full utilization of rare and valuable animals requires this method because superficial structures must be removed before the deeper parts can be reached. As the superficial muscles are exposed casts of the different regions are taken in various positions. In the same way, by casting the deeper layers as they are successively reached, permanent records of the greatest value for myological study and reference are attained. The casts, together with the notes and drawings of the dissection, form a complete and readily accessible record far exceeding in value and accuracy any other method of illustration. Again, for example, in dealing with the development and modifications of the extremities in the vertebrate classes, each group is accompanied by casts of the entire hand and foot, forming, together with the preparations of the soft parts, muscles and ligaments and the skeleton of the extremities, a complete series. For purposes of instruction this method has proved itself very valuable. Thus a carefully prepared and hardened liver showing the natural surfaces and impressions, which are ordinarily lost in the organ removed from the body before hardening, and which are hence not ordinarily recognized, has been cast and reproductions prepared in sufficient numbers to allow one to each student for personal examination during the demonstration of the organ to the class. This plan, when extended as purposed by the museum, will vastly add to the effect and value of our demonstrative teaching.

The development of the facilities for plastic reproduction of morphological objects enables the museum to enter into connection with other institutions for purposes of exchange and scientific intercourse.

In connection with the utilization of the human material for the museum I desire to mention briefly the Reference Collection in Osteology, as part of the plan of offering opportunities for extensive morphological and anthropological research. This collection includes:

1. The disarticulated skeletons of vertebrate animals.

These are kept in boxes, arranged like the books of a library, accurately catalogued and indexed, so that any desired skeleton can be immediately found and used. The collection is placed in the osteological laboratory. It is proposed to make the collection thoroughly representative, and to include sufficient individual specimens of each form to avoid erroneous deductions possibly based on unusual variations.

2. The department includes, in the second place, a reference collection of human bones, on a scale which renders possible a thorough comparative study in reference to racial character, variations, reversions, age and sex differentiations, etc. The collection is now approaching the limit which we originally designed for it, viz., 5,000 specimens of each of the bones of the human body, but will be extended beyond this point. I am gratified that this material has afforded one of our members, Dr. A. Hrdlicka, opportunity for some very interesting researches, some of which have already been presented to this association, while his more recent results are to come before us at this meeting. The value of the collection is greatly increased by our system of record-keeping, which makes the material available for anthropological study in the widest sense. We obtain now, from the hospital records, the necessary data as to parentage, age, birthplace, etc., of each subject delivered at the college. These data are entered upon the record under a running number, which follows each bone on a lead tag through all stages of maceration and preparation until it is turned into the reference collection as finished. Consequently this collection does not represent merely a catacomb of human bones indiscriminately packed together, but each bone, with its origin and history clearly indicated, becomes a member of a series available for scientific comparative work.

The same system is applied to all variations of the soft parts obtained from the dissecting room, and the variation collection of the general museum becomes in a like manner the means of promoting scientific inquiry into the causes and conditions at present operative in human evolution.

V. DEPARTMENTAL LIBRARY.

I may merely mention that a good working morphological library, containing the standard works and the more important current periodicals, forms part of the accessory equipment of the museum.

VI. LABELING AND CATALOGUE.

In conclusion I may briefly refer to the method of labeling and cataloguing the collection which we have found most useful.

The catalogue is divided into the *general* and *accession catalogue*. Each specimen as received is given an *accession number*. On the card slip, corresponding to the number in the accession catalogue, are entered all the data concerning the animal, as source of supply, date of receipt, weight of body and of individual parts, presumable age, sex, method of preparation, individual peculiarities, etc., and finally a complete list of the finished preparations derived from the

animal as they are incorporated in the museum.

The general catalogue carries on each card the running number of the preparation and beneath the same the accession number of the animal from which the specimen is taken. It is thus possible, while avoiding needless repetition, to ascertain at once the details concerning any preparation by reference to the accession catalogue. The cards of the general catalogue are arranged in accordance with the serial exhibition of the museum. The running number of the general museum and the accession number appear on the label of each preparation. In addition the individual preparations carry two small disks of a bright color with a number. These are the complementary numbers of the preparation, referring it to some other group with which it is related, as well as indicating its position in its proper series. For example, the shoulder-girdle of the armadillo assumes its proper place in the series demonstrating the structure of this portion of the vertebrate skeleton, and is numbered accordingly on a green disk, so that its own place in the series is preserved, green being the color of that division of the museum which deals with the development of the pectoral and pelvic arches. If the armadillo's number in the series is 17, and an additional preparation enters the series next to it, it receives green number 17a, etc.

In addition to the green number a small red disk on the armadillo preparation carries a number which refers the preparation to its proper place in the series illustrating the general anatomy of the Edentates, red being the serial color of that division. So if it is desired to put together at once for comparison all the material contained in the museum for illustration of the Edentate type, every preparation carrying a red disk is taken out of its own series and the resulting group, when arranged in the sequence of the red numbers, forms the logical series treating of Edentate anatomy.

This plan makes every portion of the museum easily and at once accessible, and arranges the series in such a manner that each shall prove complementary to all the others.

By varying the shape of the colored labels and the character of the numerals sufficient range is obtained to meet all requirements.

In addition—as the series develop—more extensive typewritten tablets are introduced, giving the general features of the group and indicating the purpose for which it was assembled.

Photographs and drawings of the preparations, carefully labeled, are used for indicating points of special importance, in such a manner that they can be readily identified in the actual preparation. These accessories prove of aid in the use of the museum for individual study and during informal demonstrations and conferences.

I have attempted to outline for your consideration the present status of the morphological museum and its relation to the system of the university. I am convinced that the practical value of the institution will continue to make itself more and more felt, and its general adoption and development will be one of the prominent features marking our educational and scientific progress during the next decade.

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*SUGGESTIONS FOR AN ATTEMPT TO SECURE A STANDARD COLLEGE ENTRANCE OPTION IN BOTANY.**

THE rapid advancement of any science depends not only directly upon the re-

* Read before the Society for Plant Morphology and Physiology at the Baltimore Meeting, December 28, 1900.