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CONTENTS OF VOL. I.

THE ANATOMICAL RECORD.

No. 1. November 24, 1906.

ANNOUNCEMENTS.

The American Journal of Anatomy will set aside a few pages in each number to form a special section under the heading "Anatomical Record." The Record, as the term implies, will contain brief preliminary reports; short reviews or estimates of really noteworthy publications; critical notes on topics of iterest to anatomists; concise statements of courses, laboratory plans and events, appointments, etc.; and occasional brief notes on Technique. It should develop into something more than a mere perfunctory collection of news items, and it is hoped that favorable notice of a publication in these pages will come to be regarded as an honor. The Journal would aid in directing attention to problems affecting the development of the science of Anatomy, the organization for teaching it, and its relations with other branches. While not attempting to dictate, the Journal may well be useful in assisting the forming of opinion by serving as a medium of expression for all well-considered views on anatomical matters.

While contributions are thus sought, it will be necessary to insist that all material for the Record be prepared with special care, and submitted in final and finished form.

H. McE. Knower.

ANNOUNCEMENT OF THE NEXT MEETING *(DECEMBER, 1906)* OF THE AMERICAN ANATOMISTS.

The twenty-first session of the Association of American Anatomists will be held in affiliation with the American Association for the Advancement of Science in the Department of Anatomy of Columbia University, 437 West Fifty-ninth street, New York City, Thursday, Friday, and Saturday, December 27, 28, and 29, 1906. Details concerning transportation, the usual smoker, headquarters, arrangements for forwarding material to be demonstrated will be given in the preliminary program to be sent to members in advance of the meeting. Members of the Association desiring to present papers or give demonstrations are requested to notify the secretary at as early a date as possible It is desirable to send out the preliminary programs on about December 15. Titles of papers and demonstrations should therefore be in the hands of the secretary some days before this date. A special effort will be made to associate cognate communications in groups and for this reason also an early notification of the title of papers is desired. The limited time at the disposal of the Association for the reading of papers makes it desirable that these be abriged as much as possible, and members are urged to bear this in mind in preparing communications.

Members who have attended recent meetings of the Association have become convinced of the desirability of making demonstrations a prominent part of the program. The place of the coming meeting gives opportunity for an excellent exhibit which will cover methods of morphological museum technique and their application to teaching purposes and research. Ample room for making demonstrations will be available and time will be reserved in the program for the same. The proper arrangements for the demonstrations will be greatly facilitated if members will notify the secretary as early as possible of their desire to make demonstrations, of the character of the same and of their need of apparatus, microscopes, etc.

Members are urged to propose for membership in this Association persons eligible for the same. Article V of the Constitution (see Vol. V, No. 2 of this Journal) gives the necessary information. Application blanks may be obtained from the secretary. Applications for membership may be sent to the president or secretary of this Association, who will present the same to the Executive Committee for consideration. The attention of members with dues in arrears is called to the fact that the annual dues for 1906 became due in January last. In view of the fact that the American Journal of Anatomy is sent to members on payment of the annual dues to the Treasurer of the Association of American Anatomists and, as it is eminently desirable to close all the accounts of the Association with the American Journal of Anatomy at the end of the fiscal year, the members with dues in arrears are urged to pay these promptly. The numbers of Vol. V of the American Journal of Anatomy not yet sent to members with dues in arrears will be forwarded them on payment of dues.

G. Carl Huber, Secretary-treasurer,
1330 Hill Street, Ann Arbor, Michigan.

THE COMMISSION FOR BRAIN INVESTIGATION.

On May 27 the third meeting of the Commission for Brain Investigation was held at Vienna. This commission is one of several established by the International Association of Academies and has for its purpose the advancement of neurological research, especially by the establishment of central institutions in the various countries, as well as by the coordination of investigations in the field of neurology.

The first session was held in the Imperial Academy of Sciences. Professor Waldeyer presided and there were present:

Donaldson (*Philadelphia*), Ehlers (*Göttingen*), Flechsig (*Leipsic*), Langley (*Cambridge*), *v.* Monakow (*Zurich*), Munk (*Berlin*), Obersteiner (*Vienna*), Retzius (*Stockholm*).

The members of the commission unable to attend were:

Bechterew (*St. Petersburg*), Edinger (*Frankfurt-am-Main*), Van Gehuchten (*Louvain*), Golgi (*Pavia*), Mall (*Baltimore*), Minot (*Boston*), Ramon y Cajal (*Madrid*), Raymond (*Paris*), Sherrington (*Liverpool*).

The first session was devoted to the further organization of the commission and to the presentation of reports on the scientific and financial resources of the several institutes and laboratories there represented. Steps were taken also to facilitate intercommunication between the various institutes.

May 28 the second session was held in the Neurological Laboratory directed by Professor Obersteiner. The commission was enlarged by making the number of members from each country more nearly representative of the extent of the neurological work.

At the suggestion of Professor Langley a committee on the revision of some points in the neurological nomenclature was formed, with Professor Waldeyer as chairman.

It was decided to make English, French, German, or Italian the official language of the commission, according to the place of meeting.

The commission then adjourned to meet three years hence at the call of the academy in charge.—*Science, July 6, 1906.*

ABSTRACTS AND REPORTS.

THE ORIGIN AND NATURE OF THE BLOOD PLATES.

"*The Origin and Nature of the Blood Plates*" has been published by James H. Wright, of the Harvard Medical School, in the Boston Medical and Surgical Journal (Vol. 154, pp. 643-645, June, 1906).[1] In this important preliminary communication it is announced that "the blood

[1] A translation of this is published in Virchow's Archiv f. Pathol., Oct., 1906.

plates are detached portions of the cytoplasm of those giant cells of the bone marrow and spleen, which have been named *megakaryocytes* by Howell." With a special stain the plates, in sections, appear as small bodies generally circular in outline, each having in its center an aggregation of red or violet granules suggesting a nucleus; sometimes vacuoles occur among the granules. The periphery of the plate is translucent and stained blue, having a smooth or an indented border. The indentations are due to amœboid activity, as was observed on a warm stage. A plate therefore consists of two parts, a central granular portion and a rim which is homogeneous and hyaline.

The cytoplasm of the giant cells, in its central and larger part, contains many red or violet granules like those of the plates. The periphery is a narrow, hyaline, blue-stained zone with a smooth or indented margin. Most of the giant cells are spherical but a minority have pseudopodia and "present all the varieties of form and outline shown by a motile amœba." On the warm stage their activity was observed. The granular protoplasm forms an axial core within the pseudopodia, and is surrounded peripherally by the hyaline layer. The pseudopodia may extend clear across the field of an immersion objective, and sometimes they project far into the lumen of a blood vessel. They may become detached from the giant cells, and free pseudopodia were found in the capillaries of the lungs. "A comparison of these pseudopodia, especially the slender ones, with the blood plates shows the most striking similarity in composition and structure," even to the vacuoles in the granular portion. In a few of the pseudopodia, corresponding in diameter with the plates, one or more short lengths of the granular part are marked off by constriction or segregation so that the pseudopodium appears as a chain of plates. Round bud-like processes of the pseudopodia, or of the bodies of the giant cells, are also in every respect like blood plates. As already noted, only a small proportion of the whole number of giant cells exhibits pseudopodia. Embryologically the plates appear at the time when the giant cells are differentiated in the blood-forming organs. Various mammals were studied, but especially the cat, in which the blood plates are particularly large.

The photographic figures accompanying the article are unsatisfactory, but the preparations from which they were made are convincing and conclusive. Dr. Wright has stated that his final publication will probably not appear within a year.

Frederic T. Lewis.

REVIEWS.

"ANATOMY IN AMERICA," by Dr. Charles Russell Bardeen, Professor of Anatomy in the University of Wisconsin. Bulletin of the University, No. 115, Madison, September, 1905. 125 pp.; price, 50 cents.

This Bulletin contains an address upon the present status of anatomy in America, with numerous notes relating to the history of the subject. This store-house of facts, brought together for the first time, is arranged as an argument in favor of great anatomical departments in which the science is developed in all of its subdivisions. Not only should there be a museum and the teaching of medical students, but the members of the staff should be actively engaged in research in one or more of the subdepartments of anatomy. These, Bardeen enumerates as follows: special human anatomy, comparative organic anatomy, histology, cytology, embryology, neurology, experimental morphology, teratology, and variation and heredity. The scope of the work as here outlined certainly requires the capability of the ablest investigator, and we have every reason to hope that within a decade a number of institutions as pictured by Bardeen will be found in America.

It is interesting to note, as is pointed out in this admirable publication, that the productive work in America was but one per cent. of the total world's work in 1880-90, four per cent in 1890-1900, and five per cent since then. Also that the total cost of the anatomical work in our medical schools and universities probably exceeds $750,000 a year, a sum twice as great as that expended in Germany, which should really put us in the lead in scientific achievement, and in practical results in teaching. At present we barely support a journal and most of our energies are devoted to the drilling of "Gray" into the heads of medical students.

The fact that nearly all of our contributions to the science of anatomy were made by men who are still living, gives us every reason to hope that a greater development of anatomy in America awaits us. Strong institutions are widening their scope to extend their work, and the smaller ones are often consolidating in order to unite their forces to develop better departments, manned by abler anatomists than before. What has taken place in the development of physiology and pathology is being repeated in anatomy. The greatest recent advance in the development of anatomy is in our state universities, one of which launches a strong department each year, a brilliant example being that in Wisconsin under the direction of Bardeen.

Professor Bardeen has done the cause of anatomy a great service in publishing these data, which are so difficult to obtain. Future students of anatomy will thank him for this record, and I sincerely hope that others may also put into a permanent form the facts which may be at their disposal.

Franklin P. Mall.

"The Nervous System of Vertebrates," by J. B. Johnston, Ph. D., Professor of Zoology in West Virginia University. With 180 illustrations. 12mo., 460 pp. Cloth, $3.00 net. P. Blakiston's Son & Co. *(See advertising pages of this Journal.)*

Among the contributions of American men of science to morphology, none is more distinctive than the recent elaboration of a functional analysis of the vertebrate nervous system. Beginning with a study of the components of the peripheral nerves, it soon extended to include the unravelling of the central connections of the functional systems found in the cranial nerves. The successful accomplishment of these results in a broad way in the lower vertebrates has made it possible to draw up an entirely new set of schemata for the plan of the vertebrate nervous system—schemata in which the unit is the functional system of neurones. The lower vertebrates are found to conform to a single type with remarkable fidelity, in spite of their great differences in organization. How far this type is applicable above the Amphibia has been a matter of speculation, for none of the higher forms have been examined from this point of view. The human brain furnishes a partial exception, though here the analysis has been only fairly successful on account of the bewildering complexity of structure.

Starting on the firm foundation of the functional analysis of the ichthyopsid type of brain, as already elaborated, Professor J. B. Johnston has made an examination of the whole phyletic series from the lowest vertebrates upward and published his results in the form of a manual on the 'Nervous System of Vertebrates' (see advertising pages of this Journal) which is more than an excellent text-book. It is an important positive contribution to vertebrate morphology and will unquestionably have a large influence in shaping the course of research in vertebrate neurology, both human and comparative.

The earlier works on nerve components and functional divisions of the brain were hard reading. The first step in this work was the elaboration of a new nomenclature in which to clothe the new morphological ideas, and perhaps partly on this account, many neurologists have failed entirely to get the point of view from which these researches have been undertaken. Johnston's book has opened up this field in a way which should be immediately fruitful. He has sketched in bold outlines a picture of the functional divisions of the vertebrate type of brain and of the evolutionary history of each system in detail. For the first time human and comparative neurology have been co-ordinated in a thoroughly practical way. The co-ordination is doubtless very imperfect and many of Johnston's homologies must be accepted merely as suggestions of a program for future research. But as such they represent not only a pioneer endeavor, but a well thought-out and correlated system of principles which rest on the sure foundation of extensive and controlled study of the lower vertebrates. Probably few morphologists not directly engaged in the study of the brains of the Ichthyopsida realize what an extensive literature has grown up within the past decade in fish neurology and how completely the functional analysis outlined by Strong in 1895 has been confirmed and reinforced by these exceedingly laborious researches. The extension of this functional analysis into the central nervous system has given the key to many of the most baffling problems of comparative neurology.

Johnston's book has not only made the results of these researches available to morphologists in general, but he has given to physiologists and psychologists, especially comparative psychologists, and insight into the organization and phylogeny of the vertebrate nervous system which cannot fail to supplement in a helpful way their existing literature.

C. Judson Herrick.

ANATOMICAL COURSES IN THE UNIVERSITY OF WISCONSIN.

Anatomy at the University of Wisconsin is taught from the biological, *i. e.,* scientific standpoint. The relation which it bears to medicine, however, is constantly kept in view. Few lectures are given; the laboratory method of instruction being closely followed.

In the freshman year the student takes the course of general biology which runs throughout the year, five days each week. This course, required of all science students, is equally divided between botany and zoology and is given by the members of the biological department.

The sophomore year is given up to vertebrate anatomy. In the first semister mammalian anatomy is studied; in the the second, typical forms of the lower vertebrates. This course gives the student a broad foundation on which he can build the more highly specialized courses of the junior and senior years.

Histology and organology form the studies of the first semister of the junior year; embryology the second semister. The development of the frog, the chick, the pig, and man are studied.

The greater part of the senior year is given up to gross human anatomy. Abundant material is provided and dissections occupy five afternoons each week, from the last week in September to the middle of April. The remainder of the year is given up to a special course in neurology which occupies the same afternoon hours.

In addition to the courses outlined above, opportunity for advanced work and original investigation is provided and is taken advantage of by students and independent workers.

One very important feature of the anatomical work at the University of Wisconsin is the opportunity afforded for human dissection during the summer session. During the past season students from various parts of the country have taken advantage of this opportunity. The dissecting rooms are artificially cooled and with the well embalmed material the summer work is made exceptionally pleasant.

STAFF AND COURSES.

C. R. Bardeen, M. D., Professor of Anatomy.
W. S. Miller, M. D., Associate Professor of Anatomy.
B. M. Allen, Ph. D., Instructor in Anatomy.
D. A. Crawford, B. A., Assistant in Anatomy.
G. T. Kline, Technical Assistant.

1. Comparative Anatomy, Dr. Allen, 10 hours a week throughout the year.
2. Vertebrate Embryology, Prof. Bardeen, February 15 to June 15, 10 hours a week.
3. Histology and Organology, Prof. Miller, October 1 to February 15, 10 hours a week.
4. Gross Human Anatomy, Prof. Bardeen and Mr. Crawford, October 1 to April 15, 15 hours a week.
5. Neurology, Prof. Miller, April 15 to June 15, 15 hours a week.
6. Advanced Work and Investigation, Prof. Bardeen, Prof. Miller, Dr. Allen, by special arrangement.

SUMMER SESSION.

1. Mammalian Anatomy, 10 hours a week.
2. Histology and Organology, 15 hours a week.
3. Gross Human Anatomy, 30 hours a week.
4. Modern laboratory methods, hours arranged by consultation.

W. S. Miller.

THE ANATOMICAL RECORD.

No. 2 January 1, 1907.

A RECENT TENDENCY IN DESCRIPTIVE NEUROLOGY.

It has been the custom in describing and teaching the central nervous system to divide the brain and cord into the gross morphological units—cerebrum, basal ganglia, thalamus, mid-brain, pons, cerebellum, medulla oblongata and spinal cord with its four regions and two enlargements. These divisions are studied in detail, and it is shown how the various masses are derived from a simple neural tube and its three "primary" vesicles. Extraordinary emphasis is laid on the mechanics of the mysterious chorid plexus and the foramen of Monroe. Having completed the identification of such macroscopic features it is customary to determine microscopically the internal structure of these separate divisions, proceeding from the cord toward the brain or in the opposite direction. Descriptions then usually conclude with the enumeration and course of the projection fibers and paths connecting the morphological divisions. In other words we are accustomed to descriptions of the nervous system based essentially on form, and we visualize it as a piece of inert architecture.

Inasmuch as our first knowledge of the central nervous system pertained to its form it is natural that the first descriptions should take on a morphological character—both in the human brain, toward which attention originally was almost exclusively directed, and also in the case of the comparative and embryological studies which have appeared later. As a consequence we have at our disposal an "orderly" arranged mass of strictly morphological details that may be said to have reached a high degree of completeness. The little that has in the meantime been discovered by other workers concerning the functional significance of the various brain parts has until recently had but small influence on our analysis of the nervous system. The priority and predominating bulk of the morphological matter have completely controlled the custom of descriptive treatment.

The first break in the traditional treatment was about ten years ago when Edinger published his enlarged book of lectures.[1] He had discovered the advantage of combining the study of form and function, and produced a work best characterized as an embryological and comparative anatomy illuminated by experimental and clinical data. Though he does not succeed in entirely breaking away from the time-honored method of dividing the brain, yet he does succeed in making one constantly feel that the brain is a living mechanism. The immediate acceptance of this book and its consequent wide circulation and numerous editions testify to the appreciation of the innovation on the part of his readers.

It was the same feeling for the functional character of the nervous system that influenced Meyer in his paper on brain structure.[2] He is more radical than Edinger, and discards the morphological divisions such as the pons, mid-brain, etc., as units of description. In place he proposes to divide the nervous system into a series of functional transverse laminæ or segments. These do not necessarily correspond to metameres. In the spinal region the portion of cord which corresponds to a single nerve root constitutes a segment. The cranial region he divides into five segments, based on their peripheral connections:

1. Visceral segment, regulating the mechanism of respiration, of articulation and deglutition.

2. Auditory-facial-abducens segment, regulating equilibrium, hearing, and the movement of eye, face, and ear muscles.

3. Mastication segment, regulating movements of jaw and sensation of face and fauces.

4. Optic segment, with optic nerve and muscles of eye-ball.

5. Olfactory segment, the only segment that has afferent fibers alone.

These divisions are shown in the accompanying figure, which is based on Meyer's Fig. 6, the cerebral and cerebellar mechanisms having been omitted.

In these functional segmental units Meyer sees a repetition of type which he resolves into the following elements:

1. Segmental neurones—efferent and afferent nerves.

[1] Edinger, L., Vorlesungen über den Bau der nervösen Zentralorgane des Menschen und der Tiere, Leipzig, 1896. This was preceded a few years by a smaller book of ten lectures for physicians.

[2] Meyer, A., Critical review of the data and general methods and deductions of modern neurology, Jour. of Comp. Neurol., Vol. VIII, 1898.

2. Intersegmental neurones—means of coordinating various segments, *e. g.*, ground bundles.

3. Supersegmental neurones—elaborated centers for special mechanisms, *e. g.*, cerebellum.

With this framework he sketches out the nervous system of low forms, such as the worm, and then proceeds to higher forms, working in, in a general way, the details of the most highly organized nervous system. His proposed analysis possesses many features that commend it for clinical and didactical use.

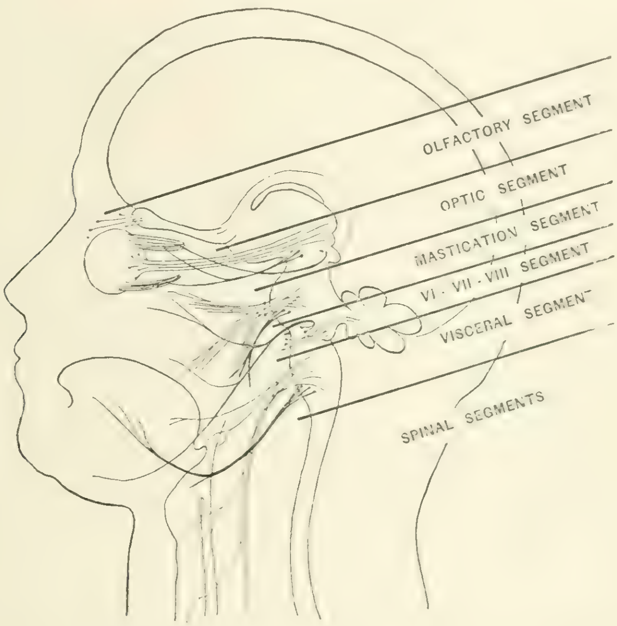

Fig. 1. Diagrammatic profile of the head, showing the subdivisions of the central nervous system proposed by Meyer. Sensory fibers are indicated by fine lines, and motor fibers by heavy lines. The term "segment" is not used in a metameric sense.

A third notable stride toward a functional description of the central nervous system has just been made by Johnston, in a book which is likely to receive much consideration.[3] Like Meyer, he discards the customary morphological method of treatment and traces its structure and phylogenetic history entirely on the basis of function. His functional

[3] Johnston, J. B., The nervous system of vertebrates. Philadelphia, 1906.

units, however, differ from those of Meyer in being made in a longitudinal direction, while those of the latter consist as we have seen of transverse segments.

There are, according to Johnston, two main activities in the vertebrate organism: first, actions in relation to external world (somatic), and secondly, internal activities having to do with processes of nutrition and reproduction (visceral). In each case there is a two-fold activity on the part of the nervous system; reception of stimuli and motor responses. Thus the nervous system consists of four functional divisions:

Somatic sensory elements.
Somatic motor elements.
Visceral sensory elements.
Visceral motor elements.

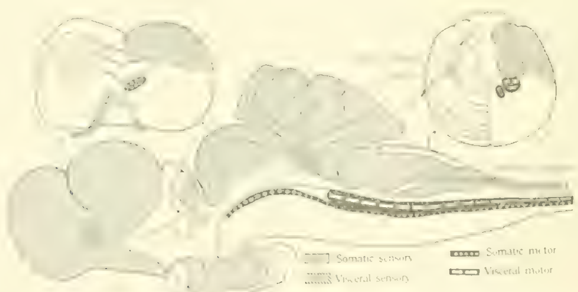

Fig. 2. Profile and two transverse sections of a simple vertebrate brain, showing arrangement of the four primary divisions of the nervous system. After Johnston.

With certain exceptions each of these divisions is represented in each segment of the nervous system, and all of the segments of a given division are serially homologous. Structurally and functionally they constitute bilaterally four longitudinal columns, which, according to him, are the primary elements of the nervous system and are more fundamental than the metamerism of the body. The arrangement of these divisions is shown in Fig. 2, which is taken from Johnston's book.

In addition to the four primary divisions there are the group of brain centers and tracts which perform functions of correlation and also the specialized sympathetic system. Under these headings then he classifies the whole nervous mechanism. The method of treatment adopted by him is an outgrowth in part of his previous studies and in part is based on the work of others, among whom are Strong, Herrick, C. J., and especially Gaskell, who deserves credit for first showing the identity of the visceral and somatic divisions. This, however, is the first time that the whole vertebrate nervous system has been gone over and functionally divided and described in longitudinal systems as has been done in the book under discussion.

Though it is probable that Meyer's system of segments could be readily adapted to didatic purposes by those working with the human brain and would be of immediate advantage clinically; yet the serial overlapping of structures makes any system based on transverse laminæ difficult to apply for purposes of finer analysis. Meyer encounters this difficulty in his facial-abducens-auditory segment. The facial nerve and its pars intermedius belong functionally and structurally to the glossopharyngeus and vagus group, and aside from position, have nothing in common with the vestibulo-cochlear apparatus, with which, however, in his system he is forced to include them. This difficulty is avoided in Johnston's scheme. His longitudinal divisions seem to be completely adequate in the cord and hind-brain. There is much, however, in the fore-brain that such a system leaves involved in difficulties, and in some of his interpretations other people may disagree with him. Thus, regarding the olfactory apparatus, which he classes under the visceral sensory system, there are those who may be inclined to consider it, like the optic apparatus, as belonging to the cutaneous or somatic sensory system. It may be expected that such complexities will be straightened out as we lessen the amount of functional ignorance that still persists concerning this region. Judging from Johnston's success thus far in demonstrating one fundamental (functional and structural) character of the four primary longitudinal systems, we have reason to hope that that there is here an adequate basis for the analysis of the central nervous system.

The work of the writers that have been referred to in this paper indicates that there is a wide-spread feeling of dissatisfaction with the existing cumbersome and lifeless descriptions in neurology; and though it is not safe to predict what the details of the future analysis are to be, it is, nevertheless, evident that the said analysis will be made in terms expressing function.

George L. Streeter.

REPORTS.

COMMUNICATION BETWEEN THE RIGHT PULMONARY VEINS AND THE SUPERIOR VENA CAVA.

This rare specimen came from the cadaver of an adult in the dissecting room of the Western Reserve University. Nothing is known of the condition of the circulation during life. The left pulmonary veins communicate with the left atrium as usual, but the right veins, three in number, take an abnormal course. One communicates high up with the left atrium, but the other two open close together into the superior vena cava just before it enters the heart. In cases like this, described by others, it is always found that the atrial septum is incomplete, thus permitting equalization of the circulation. In this specimen, however, the atrial septum is complete, but the vena cava superior communicates with both atria just over the septum, thus allowing the excess of blood brought to the vena cava to be distributed to both atria.

His has shown that the pulmonary veins arise from a single stem which communicates with the left atrium near the septum. Later the stem merges with the atrium and then the four or five veins communicate with the left atrium through two short trunks. Subsequently these also are incorporated with the atrium. It is easy to imagine that while this transformation was taking place the right pulmonary vein was shifted across the septum upon the wall of the vena cava superior leaving the vein to communicate directly with both atria. At any rate these structures are very close together in the embryo and shifting of the main trunks takes place in normal development, and a little over-shifting will explain the conditions found in this anomalous heart.

N. W. Ingalls.

THE COLLECTION OF HUMAN EMBRYOS AT THE JOHNS HOPKINS UNIVERSITY.

During recent years many human ova and embryos have been sent to the Anatomical Laboratory and those which are especially valuable have been preserved and catalogued. This record of 379 numbers includes nearly all of the specimens less than three months old and the older ones which are accompanied with a history. Short notes which are of use in determining the age of the specimen or the cause of their abortion, together with many photographs and drawings, fill five large volumes and add much to the scientific value of the collection.

Over half of the embryos (230) were presented by physicians residing in Maryland; 34 specimens came from New York; 25 from the District of Columbia; 23 from Massachusetts; 22 from Ohio; 13 from Pennsylvania; 8 from Iowa; 7 from Illinois; 5 each from Michigan, Maine, California, New Jersey, Tennessee and Missouri; and the rest from twelve other States and countries. A large number of embryos which were first sent were injured, through careless methods of preservation, but recently, since the ten per cent solution of formalin is used as a fixative, nearly all specimens arrive in excellent condition.

In the collection there are 96 normal specimens which are accompanied with the necessary data to determine their age. Such data are difficult to obtain, and it was often necessary to write a number of letters for them. If physicians would take greater pains to add the date of the last menstrual period as well as that of the abortion, to the embryos they send, a satisfactory time curve of growth, which is still wanting, could be constructed.

Among 407 specimens collected there are 156 which are pathological, that is 38 per cent. Of these there are 267 specimens less than three months old, among which there are 130 pathological (48 per cent). The percentage of those of the second month is exactly that of the whole number (38 per cent), while in the first month (108 specimens) it rises to 66 per cent.

All of the pathological embryos have been cut into serial sections and in many instances sections have been cut from the membranes. A study of them, which is in progress, indicates that in many instances the malformed embryos are caused by inflammatory and hemorrhagic changes in the chorion following uterine disease.

Unexpectedly, therefore, we have found that nature has made for us an experiment in human embryology, which may contribute much to the casual study of teratogenesis, a subject which has always been very perplexing.

Eighty-six normal embryos have been cut into serial sections, about half being in the transverse, and the rest in the sagittal and coronal planes. Most of the series are good and some are excellent. Arranged according to their age they number as follows:

Age in weeks,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14.
Number of embryos,	1,	15,	14,	7,	12,	14,	6,	5,	2,	3,	4,	2,	1.

They have been stored and catalogued carefully and are constantly used here by students of human embryology. They are also being loaned to investigators in other laboratories.

F. P. Mall.

REVIEWS.

"Hand Atlas of Human Anatomy," by Werner Spalteholz. Edited and translated from the fourth German edition by Lewellys F. Barker. Second edition in English. Three volumes, 972 pages, 935 figures. Price, $10. J. B. Lippincott Company.

The appearance of the second edition of Professor Barker's translation into English of Spalteholz's atlas brings attention to the fact of the widespread usefulness of the book in America. There have been a few changes in the book, all of them tending to enhance its value. For example, in treating the skull, colors have been used to advantage to bring out more sharply the area of each bone. A new page to illustrate the morphological value of the single parts of the vertebræ after Quain, gives an interesting suggestion for study to the student. A few of the figures have been improved by being redrawn. An especially good new figure is one showing the relation of the parts of the pectoralis major muscle to its tendon of insertion. It illustrates the point so well that no description in words is necessary.

The value of an anatomical atlas such as that of Spalteholz has been demonstrated beyond question. It rests on two things: first, the advantage of graphic, life-like figures, both to stimulate observation in the dissecting room and to aid memory; and, second, the use of the revised terminology both from the point of view of simplifying the terms and of better representing the normal. Beside these two points we may well call attention to the beautiful printing of the book from the point of view of its educational value. According to Professor Loeb the instinct of workmanship is one of the fundamental instincts, and skilled workmanship in any line always gives pleasure. But beside this, the example of anything perfectly done is always stimulating. Each page of the atlas is beautifully printed, the letters clear and well spaced. Black type is used only to give proper emphasis and never in amounts to offend the eye. In the use of parenthesis there is the same good taste, and every detail of type, punctuation, and the use of capitals has received careful attention. Especial skill has been shown in the leaders on the figures; by three devices, the use of dark lines in the light, and of light lines in the dark, and the use of small crosses to mark the end of the leaders a double result has been brought about. Not only are the leaders inconspicuous, not detracting from the figures, but they point with absolute clearness to the exact spot to which each legend refers.

To realize that the atlas is raising the standard of work in all the dissecting rooms where it is used must repay Professor Spalteholz for the enormous amount of work in producing such a book, and Professor Barker for making it available to American students.

F. R. Sabin.

"AN ATLAS OF HUMAN ANATOMY FOR STUDENTS AND PHYSICIANS," by Carl Toldt, assisted by Professor Alois Dalla Rosa. Translated from the third German edition and adapted to English and American and International Terminology, by M. Eden Paul, M. D. Brux., M. R. C. S., L. R. C. P. New York, Rebman & Co., 1904. Six parts, 985 pages, 1505 figures. Price, $18.

To one familiar with the beautiful and artistic German editions of this atlas the very first glance at the English and American edition gives an extremely unpleasant impression. The volumes are larger and clumsy and have lost their artistic value. On the cover of Part I we find printed "Regional Anatomy," a flagrant misuse of terms, for on opening the volume it appears that the translator evidently uses this title instead of "Regions of the Human Body," not realizing that the two titles have quite distinct meanings. The printing of the plates is much inferior to the German edition, and as in such figures as 102 and 103 where the skull has been enlarged from one-third to two-thirds natural size, the details are much less clear in the larger than in the smaller German figures. But perhaps the greatest defect is a stupid repetition of the legends by printing in heavy black ink the English terms just over the International, even when such terms are exactly the same or only differ in the endings or order of the words. This addition about the figures of twice as much ink as we find in the original fairly buries the plates in their legends. One-half of the names, for example, of figure 139 are alike except for the order and endings of the words, and again there is a foolish repetition of such figures as 1, 2, 3, 4, and 5, where, for example, in 4 and 5 all the terms are identical except for the Latin endings and the order of the words. The translator's notes at the end of each part are more suitable for a text-book than an atlas and unnecessarily increase the bulk of the edition.

One returns to the original German editions with a feeling of relief and can give his unstinted praise to this great work. The German editions of Toldt's Atlas have been used by many of the students in our dissecting rooms for a number of years, side by side with the German and American editions of Spalteholz's Atlas, and have proved of great assistance to both teacher and student. The evident superiority of the Toldt comes into daily notice and I find myself constantly referring students to his figures for comparison with, and as an aid to the dissections. The greater completeness, the better selected views, the more natural delineation, and often greater extent of the figures leads me often to refer students to Toldt's figures even when they have another atlas at hand.

Had we an American edition of Toldt translated as well and printed as beautifully as Barker's edition of Spalteholz and for sale at a reasonable price as is the case with the Spalteholz, it would undoubtedly have a very wide circulation and be of great service to both students and teachers of anatomy.

Warren H. Lewis.

COURSES IN ANATOMY AT THE JOHNS HOPKINS UNIVERSITY, 1906-7.

STAFF.

Franklin P. Mall, M. D., Professor of Anatomy.
Ross G. Harrison, Ph. D., M. D., Associate Professor of Anatomy.
Warren H. Lewis, M. D., Associate Professor of Anatomy.
Florence R. Sabin, M. D., Associate Professor of Anatomy.
Henry McE. Knower, Ph. D., Instructor in Anatomy.
Robert Retzer, M. D., Instructor in Anatomy.
Arthur W. Meyer, M. D., Instructor in Anatomy.
Max Brödel, Associate Professor of Art as Applied to Medicine.
William S. Miller, M. D., Fellow by Courtesy.
Benson A. Cohoe, M. D., Assistant in Medicine.
Charles M. Miller, Technical Assistant.

Courses of instruction are provided in various anatomical sciences—embryology, histology, microscopic anatomy, neurology, and gross human anatomy—and opportunities are afforded for advanced work and investigation in these sciences.

Since 1894 the courses of the first two years in medicine have been concentrated, and a liberal system permits the student to elect a variety of advanced courses after he has finished the required work either here or elsewhere. Thus, in special cases a student may undertake research work in anatomy before beginning his clinical work. The required courses in anatomy (I to V) for candidates for the medical degree may be completed by working all day from October 1 to March 15. During the forenoons of the rest of the year and most of the forenoons of the second year those who have completed the required work may elect other courses in anatomy. Since the introduction of this system it has been found that on an average one-third of the students' time is filled with elective work.

Physicians, candidates for the degree of Doctor of Philosophy, and other students, may be admitted to any of the courses by special arrangements with the instructors and may undertake advanced work and original research.

I. Systematic Course in the Anatomy of the Arm and Wall of the Thorax. October 1 to March 15, forenoons.

Section a, Professor Mall.
Section b, Professor Lewis.
Section c, Dr. Knower.
Section d, Dr. Meyer.

The student makes a complete dissection of all the structures, using atlases and text-books as guides. The work of each student is largely independent, and when his dissection has been completed he changes to a different section in Courses II or III.

II. Systematic Course in the Anatomy of the Leg and Abdomen. October 1 to March 15, forenoons. Sections and arrangements are the same as those for Course I.

III. Systematic Course in the Anatomy of the Head, Neck and Thoracic Viscera. October 1 to March 15, forenoons. Sections and arrangements are the same as those for Course I.

IV. General Histology. Professor Harrison, Professor Sabin and Dr. Retzer, October 1 to December 1, Monday, Wednesday and Friday afternoons.

V. Histology of the Organs. Professor Harrison, Professor Sabin and Dr. Retzer, December 1 to February 11, Monday, Wednesday and Friday afternoons.

VI. Lectures on Neurology. Professor Sabin, February 11 to March 15, three times weekly.

VII. Neurology. Professor Sabin, Professor Harrison and Dr. Retzer, February 11 to March 15, Monday, Wednesday and Friday afternoons.

VIII. Lectures on Histology and Organology. Professor Harrison, October 1 to February 11, Tuesday and Thursday at 2 p. m.

IX. Recitations in Anatomy. Dr. Meyer, October 1 to Christmas, Tuesday, 12-1.

X. Study-Room Course in Anatomy. Professor Lewis, October 1 to June 1, forenoons.

XI. Conferences upon Special Topics in Anatomy. Dr. Meyer, January 1 to March 15, Tuesday, 12-1.

XII. Topographical Anatomy. Professor Lewis, January 1 to March 15, forenoons.

XIII. Histological Technique. Dr. Retzer, Thursday, forenoons, October 18 to December 20. Limited to 10 students.

XIV. Special Courses in Gross Anatomy. Professor Lewis. Especially for physicians.

XV. Lectures on Embryology. Dr. Knower, April 1 to June 1.

XVI. Practical Embryology. Dr. Knower, April 1 to June 1, forenoons.

XVII. Medical Anatomy. A special course given by Dr. B. A. Cohoe, once weekly, from April 1 to June 1.

XVIII. Anatomical Drawing. Professor Brödel, October 1 to June 1, Thursday forenoon and Saturday afternoon.

XIX. Experimental Embryology. Professor Harrison, March 15 to June 1.

XX. Advanced Human Embryology. Professor Mall, October 1 to June 1.

XXI. Anatomical Seminary. Professor Sabin, November 1 to March 15, Mondays, 12 o'clock.

XXII. Advanced Neurology. Professor Sabin, March 15 to June 1, forenoons.

XXIII. Original Investigation. October 1 to June 1, daily.

NOTES.

Yale University has conferred the degree of Doctor of Science upon Professor Henry H. Donaldson, recently installed as the head of the neurological work in the Wistar Institute of Anatomy, Philadelphia.

Upon the occasion of the opening of the new Anatomical Laboratory, Harvard University conferred the degree of LL. D. upon Professor F. Keibel, of Freiburg, Germany. During his visit to America Dr. Keibel spent some weeks in observing the methods of research and teaching found in the laboratories which he visited in this country.

Prof. W. S. Miller, of the University of Wisconsin, is devoting some months to research as "Fellow by Courtesy" in the Anatomical Laboratory of the Johns Hopkins University.

Prof. R. J. Terry, of Washington University, St. Louis, is carrying on research as Austin Teaching Fellow in the laboratory of Comparative Anatomy of the Harvard Medical School.

"Science" announces that the Nobel prize of $40,000 in medicine for 1906 will be divided between Professor Ramon y Cajal (*Madrid*), and Professor Camillo Golgi (*Pavia*), both honorary members of the American Association of Anatomists, in recognition of their epoch-making investigations on the structure of the central nervous system.

APPOINTMENTS.

Each year more of our Anatomical laboratories are organized on a scientific basis and become centers of productive activity in research. In these places Anatomy is no longer merely a dissecting-room routine, delivered over into the hands of busy practitioners. The staff is composed of trained specialists, who are devoting their lives to this department of science. Applied Anatomy has found its place as subordinate to the comprehensive science from which it springs and to which it refers. Here is created a stimulating environment and we even see investigators from outside visiting these laboratories to profit by special conditions or methods of research.

Such development gives rise to no special comment when seen affecting the University Medical Schools. In these we expect, as a matter of course, each fundamental scientific department to stand on this modern plane. A special significance, however, must attach to the appointment of Dr. E. A. Spitzka as professor of General Anatomy in an independent, or purely professional school, like the Jefferson Medical College, Philadelphia. This school has constantly striven to uphold a high ideal of medical education throughout its previous history, and has equipped its graduates well and practically for their professional careers. So when Jefferson fills the vacant chair, as she has, we have an especially encouraging recognition of the practical value of the type of laboratory organization sketched above.

Dr. M. T. Sudler is Professor of Anatomy and Dean of the Scientific Department in the University of Kansas.

Dr. R. G. Whitehead is Professor of Anatomy and Dean of the Medical Faculty of the University of Virginia.

Dr. C. M. Byrnes (M. D., Johns Hopkins, 1906), has been appointed Adjunct Professor of Anatomy in the University of Virginia.

Dr. F. T. Lewis has been advanced to the Assistant Professorship of Embryology in the Harvard Medical School.

Dr. George L. Streeter is Associate in the Wistar Institute of Anatomy, Philadelphia.

THE ANATOMICAL RECORD.

No. 3. April 1, 1907.

PROCEEDINGS OF THE ASSOCIATION OF AMERICAN ANATOMISTS.[1]

TWENTY-FIRST SESSION.

In the College of Physicians and Surgeons, Columbia University, New York City, December 27, 28, and 29, 1906.

At its business sessions the Association took the following actions:

The minutes of the secretary as printed in the American Journal of Anatomy, Vol. V, pages II, III, and IV, were on motion approved.

The secretary presented upon behalf of the executive committee for consideration by the Association the following motion: Moved that the Association of American Anatomists withdraw from the Congress of American Physicians and Surgeons. After a discussion of this motion, Dr. Bardeen moved that the motion presented by the executive committee be passed by the association; seconded by Dr. Spitzka. On vote the motion was unanimously passed.

The executive committee recommended the acceptance of an invitation extended by President Van Hise upon behalf of the University of Wisconsin to hold a western meeting of the Association of American Anatomists at Madison, Wisconsin, in affiliation with the Central Branch of the American Society of Zoologists and other societies during the last week in March. Dr. Huntington moved that the invitation be accepted; seconded by Dr. McMurrich. Carried.

The nominating committee, consisting of Drs. Spitzka, Bardeen, and F. T. Lewis, reported the name of Professor Simon H. Gage for member of the executive committee for the term expiring in 1911.

On motion the secretary was instructed to cast a ballot for the election of Professor Gage.

Twenty-three new members were elected.

[1] The revised list of members of this Association will appear in the next number of the Anatomical Record.

TREASURER'S REPORT FOR THE YEAR 1906.

Total receipts for the year 1906	$1140.10	
Balance on hand December 27, 1905	103.64	
Total	$1243.74	$1243.74
Expenditures for the year 1906:		
Smoker, Ann Arbor meeting	$20.00	
Paper, envelopes, and printing	17.75	
Stamps	16.00	
To AMERICAN JOURNAL OF ANATOMY for subscriptions and reprints of proceedings	1043.03	
Supplement to JOURNAL OF ANATOMY (paid to Treasurer)	1.00	
	$1097.78	$1097.78
Balance on hand December 24, 1906, deposited in Farmers and Mechanics' Bank, Ann Arbor, Mich.		$145.96

The report of the treasurer was referred to an auditing committee consisting of Drs. H. H. Donaldson and George S. Huntington, who reported "Audited and found correct."

On motion of Dr. Minot the report of the auditing committee was accepted and adopted.

At the close of the meeting Dr. McMurrich moved that the Association thank Dr. Huntington for the excellent arrangements made for the various sessions and demonstrations and for the generous hospitality shown.

ON SOME POINTS OF IMPORTANCE TO ANATOMISTS.

ADDRESS OF PRESIDENT, PROFESSOR FRANKLIN P. MALL,
Johns Hopkins University.

It has been said that the president of a scientific association should not burden its meeting with an address in case the communications to be made to it are numerous and of value. If this be true it seems to me that we have reached a stage at which silence on my part would be appropriate, but I can not resist the temptation to exercise my right to speak, for a few minutes only, regarding some points which I consider to be of vital importance to our profession and to this Association.

I think we have safely passed the pioneer stage in the development of scientific professions in America and it is unnecessary now to formulate the forces which have brought this change about, for they are known to us all. However, during the development of a science, it is well for the workers in it to meet from time to time to pass judgment upon the recent progress that has been made. Their approval, given on such an occasion to an investigator, is a most encouraging stimulus and election by his colleagues to the presidency of such a meeting is the highest honor a scientist can receive. I accept with gratitude this elevated post to which you have appointed me and regard it not as approbation of myself, but rather as a mark of appreciation of the co-workers, whom I have had the good fortune to have associated with me in Baltimore, and of their contributions to anatomy.

More than a century ago the status of anatomy in America compared favorably with that in Europe, but the degeneration of medical education which followed rapidly and successfully pushed anatomy into an inferior position. This decay in medical instruction reached in America as low a level as the civilized world has perhaps ever seen about the time of our civil war. At this period the chair of anatomy was almost always used as a stepping stone to that of surgery and under these conditions the quality of the teaching was rarely good. A certain type of surgical anatomy developed from this combination and but very few contributions to the science were made. Too often, however, there was a mere exploitation of the chair of anatomy, the teaching was poor, and the practical work in the dissecting room was neglected. Since then there has been a gradual improvement in medical education due largely to the cultivation of its underlying sciences. During all those dark years, however, there was one place in which the light of anatomy shone continuously; thither Caspar Wistar carried it and there the Wistar Institute is located.

Caspar Wistar, the second professor of anatomy at the University of Pennsylvania, did much to perpetuate the good traditions of Benjamin Franklin, John Morgan, and William Shippen. He was a man of great influence, took a lively interest in natural history, and made many anatomical specimens, some of which may still be seen in the Wistar Institute. He wrote an excellent text-book of anatomy, which was used by many students. He was succeeded first by Physick and then by Horner, who made a number of important discoveries in anatomy. Horner was followed by Dr. Leidy, who held the chair for nearly forty years. During all these years the chair of anatomy became notably conspicuous on account of the luster shed upon it by the eminence of its occupants. The greatest of this brilliant group was Leidy, in fact he was the greatest teacher of anatomy to medical students this country has seen. His ideals were of the highest and his scientific discoveries were numerous and accurate, contributing much to comparative anatomy and zoology. The good influence he exerted upon the various institutions in Philadelphia has been extended over the nation through this Association, of which he was one of the founders. It is also fitting, and by no means accidental that the Wistar Institute is located in Philadelphia. Few, perhaps, are aware of what has really taken place at this great foundation for scientific anatomy. Thanks largely to the far-seeing policy of its present director, Dr. Greenman, the first division of its staff has been manned by the ablest investigators in neurology, and the Institute has been made the central institution for America by the Commission for Brain Investigation appointed by the International Association of Academies. I sincerely hope that our society will give full support to the Wistar Institute, for its work will be national as well as international.

On account of the low ebb of medical education at the period mentioned a certain dividing of the ways occurred, best illustrated, perhaps, by what happened at Harvard. At this college there fortunately appeared the ablest anatomist this country has yet produced, but the Medical School saw fit to duplicate his chair for reasons that are not clear to me. There existed in Harvard College and Harvard Medical School, side by side, Jeffries Wyman, the scientific anatomist, with but few students, and Oliver Wendell Holmes, the poet anatomist, with many of them. This unwise arrangement, it seems to me, delayed the revival of sound medical education in this country for a number of years. However, the presence of Jeffries Wyman in the Hersey chair of anatomy was of the greatest significance in founding the American school of zoology. Wyman graduated from Harvard Medical School in 1837, and after having been Warren's demonstrator of anatomy succeeded him in 1847. During the following quarter of a century he made numerous important discoveries in comparative anatomy and embryology and contributed also to teratology and ethnology. The loss of the influence of this great philosopher and teacher upon medical students has been one of the misfortunes that medicine in this country has sustained. But it was in zoology in America that scientific anatomy was temporarily preserved and extended rather than in the departments of anatomy in the medical schools. The American anatomists should emulate Jeffries Wyman and our first president, Joseph Leidy.

Under the conditions which prevailed it was quite natural that the better work of Europe—the work of anatomists like Blumenbach, Ernst Heinrich Weber, Meckel, Johannes Müller, Schwann, and Kolliker—barely reached this country, for the little anatomy that was cultivated subserved the surgical art. This arrangement may possibly have been beneficial as a training school for surgeons, but it was so bad for anatomy that as a science and as a profession it gradually fell into disrepute among most of the people. This conception of anatomy as a mere maid-servant of surgery is still entertained by some of our colleagues in other sciences. In nearly all of the medical schools anatomy settled down to a dead level, the so-called "practical," and, during the second half of the past century most of the progress made in Europe found its way to America not by way of American anatomists but through our zoologists, pathologists, and physiologists. Fortunately, many of the latter have kept their membership in this society, for while this Association consists of anatomists, a perusal of the list of members shows that some are also distinguished as physicians, surgeons, physiologists, pathologists, zoologists, anthropologists, or psychologists. This I consider to be a fortunate circumstance, for it will prove to be a most potent factor in the re-organization and development of anatomy in this country and in its consequent broadening influence upon medical education. However, the catholicism in our society is not properly appreciated by educated people in America, for we often hear it said that our more prominent members are not anatomists but biologists or something else. Let me illustrate: probably the most typical anatomist of us all, a man of the widest culture and a profound scholar, a scientist known as an anatomist the world over, a member of our executive committee for eight years, a founder of the American Journal of Anatomy, and my predecessor in office, has been wrested from our ranks and called a zoologist by a recent writer in his study of American scientists. That a single writer should do this would be of no special importance, were it not that this view of the scope of anatomy is entertained by so many Americans of prominence that it interferes very much with the development of our science as a profession. Those who hold this narrow and perverted view of anatomy can not be familiar with its history, its present status in Europe, nor its recent development in America. It is the duty of the members of this Association to correct this erroneous conception of anatomy by precept and by example. I have full confidence that this can be done with ease.

That anatomy played so important a rôle in the development of our school of zoology (was absorbed in it, some will say) while it was fossilizing in medical schools can be viewed as a fortunte condition from a number of standpoints. For us it hastened the destruction of certain traditions, which can now be ignored while we are constructing a new anatomy and establishing a new *modus vivendi* with the medical disciplines. With this change we are placing ourselves in a new and a better position than ever before. While anatomy is well represented in college and university departments not connected with medical schools we must look for the highest development to anatomy in connection with medical education. In order to be more effective in the training of scientific physicians, we are gradually making our anatomical instruction more and more inductive and this naturally reacts upon the instructor in a beneficial way.

To bring about the desired reform it is necessary to have represented in an anatomical department, even in a medical school, all which naturally belongs to this science. The study of anatomy begins with the cell, ends with the entire individual, and includes man. In fact the greatest anatomical problems almost always involve a consideration of human anatomy. The teachers and students in an anatomical department should be given a free hand; they should not be retarded by arbitrary lines; they should dissect sometimes with the scalpel, sometimes with the microtome knife; they may look through spectacles or through the microscope and they may study the arm of a human embryo or the negro brain. In other parts of the world this liberty is a self-evident necessity and has always been granted. It follows from what I have said that an anatomical department must include histology, histogenesis, and embryology; in a medical school it must cover vertebrate anatomy in the fullest sense. In general, due to the influence of this society, an unrestricted anatomical department has found its way into nearly a dozen important universities during recent years. Among the universities in large centers those in this city are the only ones in which the scope of the anatomical departments is still limited, since here histology and embryology are not included. Our wandering society, meeting as it does, in different portions of the country, will be, I believe, a great force in helping to perfect and to extend anatomical departments.

This is not the time to enumerate the really good anatomical departments, nor those that have been markedly improved in recent years, but I must not fail to note the great advancement which has been made in our state universities, due to the enlightened policy of their presidents, who are of the opinion that a professor of anatomy should be a specialist ranking high in his profession. It is safe to say that those departments in which the staff is actively engaged in scientific research are contributing most to medical progress and are exerting the best influence upon medical students. Yet, American anatomical departments taken as a whole are rendering an unsatisfactory account of themselves, and it is eminently desirable that this should change. In our wanderings as an Association during the last dozen years we have had good opportunities to witness the improvements and growth which have taken place from year to year in the better universities. During this period we have met at Columbia three times, and it is a pleasure to me to acknowledge to Professor Huntington the obligations of this society for the splendid example he sets before us.

It is stated in our constitution that "the purpose of this Association shall be the advancement of anatomical science." I firmly believe that such advancement can be made through scientific investigation only, but we must provide a suitable atmosphere for our investigators. It seems to me that certain conditions, which are necessary to make a good atmosphere, are as yet, lacking in many institutions. Probably the most serious defect in our anatomical departments is due to the appointment of men in active medical practice to the chairs of anatomy. Unlike professional anatomists, they rarely have the time to devote to teaching students, nor the requisite training to enable them to develop the department properly and anatomy necessarily suffers. However, I regard it as fortunate that circumstances have placed us into a position from which there is no retreat. To carry on the campaign, now so well started, we must have many more productive anatomists. In order to obtain them and to make the efforts of our present investigators more effective, we must use all our influence to bring the greatest opportunities and the best men together. A highly cultured community naturally desires the ablest man. My earnest hope is that those in authority in various communities will recognize that our idea of the scope of anatomy is correct, and that they will seek productive anatomists, when vacancies occur, so that our grand science may be raised to the level it has always held in Europe.

ABSTRACTS OF PAPERS PRESENTED.

DEVELOPMENT OF POSTCAVA AND TRIBUTARIES IN THE DOMESTIC CAT.

By George S. Huntington. *Columbia University, New York,* and C. F. W. McClure. *Princeton University.*

This investigation was undertaken primarily for the purpose of satisfactorily explaining the numerous variations of the adult venous system encountered in the dissection of over 600 examples of the cat, reported in another communication by Dr. Darrach. This re-investigation of the development of the postcava and tributaries has not only entirely satisfied the original purpose, but has also made it necessary to modify the prevailing conception as to the interpretation of the postrenal segment of the adult vessel.

A bilateral and originally symmetrical venous channel develops dorsomedial to the primitive postcardinal vein by longitudinal anastomoses between somatic postcardinal tributaries. This secondary vein channel forms what we have termed the supracardinal system of veins. It extends from the level at which the posterior limb veins open into the postcardinals to a point cephalad where it joins that portion of the postcardinals which alone persists to form the anterior end of the adult Azygos. Between these levels the supracardinal veins enter into the definite organization of both the adult post-cava in its postrenal division and of the Azygos in its lumbar and part of its thoracic segments, entirely replacing in these districts the primitive postcardinal veins. The postrenal division of the adult postcava is formed as the result of a secondary median fusion by means of transverse anastomoses dorsal to the aorta of the postcaval portions of the supracardinals, the primitive postcardinal veins not entering into the formation of this portion of the main trunk of the adult vessel.

It is important to note that in our interpretation the supracardinal veins are not in any sense merely synonyms for the dorsal limb of the peri-ureteric ring described by Hochstetter and others as surmised in the discussion following the presentation of our paper, but comprise a continuous and morphologically uniform system of longitudinal vein channels contributing, as above outlined, to the establishment of the adult condition in both the post caval and in the azygos areas.

VARIATIONS IN THE POSTCAVA AND ITS TRIBUTARIES AS OBSERVED IN 605 EXAMPLES OF THE DOMESTIC CAT. By William Darrach. *College of Physicians and Surgeons, Columbia University, New York.*

1. *Variations in the position and ureteral relation of the main postcaval trunk.*

(a) *Ureter Islands.*—In three cases (.5%) the cava was right-sided but double, the ureter passing between the two trunks. In one there was a short single trunk in the region of the ilio-lumbar entrance which soon divided, the two trunks again uniting well below the renal level. The right sex vein entered the more ventral of the two trunks. This corresponds to Fig. 6 of Gage. In the second case the two trunks were more distinct, the lower union being by means of a short anastomotic vessel passing from right to left, containing a small arterial island at its upper end. The two right sex veins emptied into the more ventral of the two trunks, both of which were to the right of the aorta beyond the anastomosis.

(b) *Right postcava* with *ureter dorsal* was found in 22 cases (3.6%). This condition differed from the normal only in that the ureter passed at first dorsad of the cava, then mesad and ventrad, again crossing ventrad of the common iliac vein to reach the bladder. This condition would obtain if the dorsal of the two trunks in the island formation were omitted.

(c) *A left postcava* with the *ureter ventral* was found in 21 cases (3.4%). Here the cava, after its formation by the union of the two common iliacs, as normally, passed cephalad lying to the left of the aorta, receiving the left sex vein. The right sex vein in 13 cases opened into the renal and in the remaining 8 cases into the cava.

(d) *A left postcava,* the *ureter* lying *dorsal* was found in 7 cases (1.15%). This variety was similar to type *c,* except that the ureter passed dorsad of the cava. In four of these the right sex vein entered the cava as well as the left. In the other three it emptied into the right renal, and in two of these it was associated with a spinal or somatic branch.

(e) *A double postcava,* both *ureters* being *dorsal,* was found in 20 cases (3.3%). In 14 cases there were two separate trunks which continued the common iliac trunks on cephalad to the renal region without anastomosis. In the remaining six the two trunks were connected by cross anastomoses, sometimes double and once triple. In two of the cases the two trunks were asymmetrical, the right being the larger. The point of fusion of the two cavæ varied, being either above, at, or below the right renal entrance, but always above the left renal level.

(f) *A double postcava,* one *ureter* being *ventral* and the *other dorsal,* was found in three cases. In one the ureter was dorsal to the left cava and ventral to the right with no cross anastomosis. In the second the same ureteral relation existed, but there was a large vessel connecting the left common iliac with the right trunk and containing an arterial island. In the third case the condition was reversed, the ureter being dorsal on the right side and ventral on the left. The two trunks were asymmetrical here also, the right being the larger of the two.

(g) *A double postcava* with *both ureters ventral* was found partially represented in one case where, after a rather high fusion of the common iliacs, the cava again split into two unequal trunks, both of which were free of the ureters. There was a large cross anastomosis at the level of the inferior mesenteric artery and the caudal veins entered at different levels into the two trunks.

2. *Variations in the sex veins.*

Out of the 100 variants both sex veins entered the cava in 12 cases, all being in left cavæ, 8 with the ureters normal and 4 dorsal.

In 14 cases the sex veins were multiple. In two cases bilateral and in two triple.

A vein draining the region caudad of the kidney (called capsular) emptying into the sex vein is almost constant. A cross anastomosis between the two sex veins was present in two cases out of 286. In the same number a communication was found between the sex vein and the ilio-lumbar vein. A ureteric vein was very frequently found entering the sex vein. Occasionally the latter is associated with a somatic vein near its entrance.

3. *Island formation.*

Besides the ureter islands already mentioned, islands were found in the regions of the ilio-lumbar entrance, common iliacs, iliac fusion and in the main caval trunk. The common iliac islands may transmit the whole internal iliac artery or only its dorsal branch, either with or without the obturator nerve. It may be unilateral or bilateral. Islands in the region of the iliac fusion are quite complicated, depending on cross anastomoses at different levels, and either dorsal or ventral to the caudal and internal iliac arteries. In two cases a small island was found in the main caval trunk transmitting a small somatic artery. The frequency of occurrence of these islands is shown in the following table:

Ureter Islands	.5%	in	605	cases.
Iliac Fusion	4.0%	"	375	"
Common Iliac	4.0%	"	375	"
Ilio-lumbar	2.7%	"	375	"
Caval	.53%			

4. *Variations in arterial relations.*

In two cases out of 286 the sex artery passed cephalad of the left renal vein. In three cases out of 78 the right sex artery was dorsal to the Cava. In one case out of 605 the ilio-lumbar vessels on both sides passed dorsal to the psoas minor muscle, corresponding to the Marsupial condition. In one case out of 605 the left ilio-lumbar artery passed dorsal to the left caval trunk. In three cases out of 605 a spinal artery passed ventral to a caval trunk. In two cases out of 605 the right renal artery was given off at the level of the inferior mesenteric artery and passed cephalad and dorsal of the Cava. In one case out of 605 the right renal artery passed ventrad of the Cava 1.4 cm. caudad of the right renal vein.

THE INTERPRETATION OF VARIATIONS OF THE POSTCAVA AND TRIBUTARIES OF THE ADULT CAT, BASED ON THEIR DEVELOPMENT. By GEORGE S. HUNTINGTON. *Columbia University, New York,* and C. F. W. McCLURE. *Princeton University.*

The explanation of the adult variations encountered in an extensive series of adult examples of Felis domestica is fully afforded by the comprehensive system of embryonal vein channels normally and functionally present during certain ontogenetic stages in the cat. The acquisition of what is regarded as the normal type of adult postcava in this animal depends on the selection and continued development in the majority of individuals of certain of these embryonic pathways, the remainder undergoing degeneration and affording, as will be shown in a subsequent communication, the possibility for the correlated development of the main adult lymphatic channels. The average individual thus assumes the venous and lymphatic type considered normal for the species. In the case of individuals variant in the structure of the adult postcaval system, any one or several of the temporary early venous pathways, present normally in typical consecutive embryonic stages, may abnormally persist and by continued development give rise to the relatively enormous series of graded adult variants observed in the series of 600 dissections reported by Dr. Darrach. The details of this process of atypical selection of embryonal channels normally destined to become obliterated during the development of the adult venous type, are so closely dependent upon the ontogenetic changes involved that the full consideration of this topic is deferred to a subsequent publication, fully illustrated by typical sections and reconstructions. It has, however, been possible for us, by means of the large series of cat embryos examined and reconstructed, to produce a composite reconstruction of all the possible and available venous pathways of the embryo, and to thereby interpret all of the observed adult variants as examples of atypical persistence of early channels normally destined to disappear in course of further development, but capable, by continued and unusual growth, of affording all of the variations of the adult venous system observed in the cat. These observations also make it extremely probable that in the case of corresponding variations in the adult human subject we are dealing with developmental factors of exactly identical force and influence.

THE RANGE OF VARIATIONS IN MONOTREMES AND AUSTRALIAN MARSUPIALS. By HERMANN VON W. SCHULTE. *College of Physicians and Surgeons, Columbia University, New York.*

This examination of the postcava in monotremata and Marsupialia was undertaken at the suggestion of Dr. Huntington in connection with an embryological and morphological investigation of the mammalian venous system by himself and Dr. McClure.

Monotremata.—Material: Echidna setosa, 2 adult males; Ornithorhynchus paradoxus, 2 adult males and 2 adult females.

The postcavæ are double to renal level. The dorsal walls of pelvis and iliac fossæ are covered by a fan-shaped rete mirabile in which distinct venous districts are hardly to be distinguished. Proximally the vessels from the iliac fossa pass dorsad to the psoas minor, corresponding in position to the transverse lumbar of Marsupials. There is also a slight interval between the external and internal iliac vessels near their point of union, while distad they anastomose freely. The external iliac vessels differ from those of the Marsupials in position, passing ventrad of psoas minor. A line of demarcation between internal iliac and caudal veins cannot be drawn. The postcavæ are formed by the convergence of these three sets of tributaries. There are regularly more or less extensive anastomoses between those of the two sides both ventral and dorsal to the caudal artery which is thus surrounded at its origin by a venous ring.

In Ornithorhynchus, dorsal to the aorta, there are several very large transverse anastomoses between the postcavæ, though there is a tendency for adjacent vessels to approximate and fuse partially or completely, in which case the emergence of the somatic arteries may be taken as the line of fusion. These channels are all directed cephalad from left to right—returning blood from left postcava to right and explaining the larger size of the right vessel. The postcava of this form cannot therefore be explained as a longitudinal fusion of the postcavæ dorsal to the aorta as Hochstetter[1] has done, but these dorsal anastomoses must be recognized as a discrete element. The sex veins open into the angle of union of renals and postcavæ or slightly distad to this point. A very small vessel accompanying the sex artery opens on each side a little cephalad above the midpoint of the postrenal segment of cavæ. Into the unpaired postcava above the renal level empties on the left side, approximately at the level of the left renal vein, a very small somatic tributary which descends to the left of the omphalomesenteric artery.

[1] F. Hochstetter.—Beiträge zur Entwickelungsgeschichte des Venensystems der Amnioten. III, Säuger. Morpholog. Jahrbuch, XX, pp. 591 and 624.

In Echidna, in addition to a venous ring about the caudal artery, there was in one specimen an anastomosis between internal and external iliac veins ventral to the common iliac artery on both sides. In the second this was partially interrupted so that the left internal iliac was free ventrally. These two adults thus correspond respectively to the two fœtal conditions observed by Hochstetter. Dorsad of the aorta the transverse anastomoses are very rudimentary. All the somatic tributaries, however, open into the right postcava. In one specimen in addition to the renal transverse anastomosis, there is a second ventral anastomotic vessel of large size passing from the left postcava at about its midpoint to open into the cephalic extremity of the right.

A number of large somatic tributaries empty into the unpaired postcava, uniting to the left of the omphalomesenteric artery and apparently emptying into cava by vessels passing cephalad and caudal of the artery, which thus comes to be surrounded by a venous ring as in reptilia. Owing to the imperfect preservation and injection of our material this point requires further investigation.

Marsupialia.—Material: 3 Petrogale; 1 Bettongia; 2 Macropus; 7 Trichosurus; 2 Pseudochirus; 2 Petauroides; 1 Petaurus; 3 Phascolarctus; 1 Perameles; 2 Dasyurus; 2 Sminthopsis. Total, 26.

In both specimens of Petauroides volans, which is the Taguan flying phalanger described by Hochstetter, the postcava is formed on the placental type which may, therefore, be taken as constant in this form. The postcava lies to the right and dorsad of the aorta and is formed by the dorsal union of common iliacs.

In the closely allied Pseudochirus, one specimen conforms strictly to this type. In the second there is an extensive formation of venous rings about the termination of aorta and the iliac arteries—recalling the condition of the 8 mm. Digdcephis embryo (McClure) and affording a transition to the usual Marsupial type.

All the other specimens examined conform to Dr. McClure's type *A* for the opossum—the iliac union being situated ventral to the aorta and the resulting postcava having a median position which it gradually abandons as it proceeds cephalad to assume a right-sided position above the renal level. The caudal vein offers a considerable number of variations, emptying ventrad or dorsad of the arteries into right or left common iliac or internal iliac veins. In one Wallaby, it is continued dorsad of the hypogastrico-sacral trunk as small paired vessels which anastomose; from the anastomosis, three vessels proceed to open, one into each common iliac, and one into a somatic tributary of the left side. In

Sminthopsis, one specimen, the caudal vein opens in common with a somatic vessel into the right common iliac.

In all these forms, the external iliac vein lies mesad to the external iliac artery—the relation being reversed in Didelphis (McClure). In one Macropus, in two Trichosurus, and in one Pseudochirus, a small vessel runs laterad to external iliac artery anastomosing with the external iliac vein distally, to empty into the transverse lumbar vein.

In two Wallabies and one Macropus, in addition to the usual sex veins, a large vessel empties into the common iliac vein, which is made up of two tributaries, one from the sex vein and one from the ureteric plexus—thus agreeing with the usual sex vein in its make-up.

The morphological consideration of these conditions is reserved for publication in extenso.

THE DEVELOPMENT OF THE MAIN LYMPH CHANNELS OF THE CAT IN THEIR RELATIONS TO THE VENOUS SYSTEM. George S. Huntington. *Columbia University, New York,* and C. F. W. McClure. *Princeton University.*

Among the investigators who have studied the development of the lymphatic system the names of Budge,[1] Ranvier,[2] MacCallum,[3] Sala,[4] Sabin,[5] and Lewis[6] may be mentioned. With the exception of Sala and Lewis most of the above mentioned investigators employed the method of injection for the study of the lymphatics.

Two main views prevail regarding the development of the lymphatic vessels: (1) The view maintained by Sala that the lymphatic vessels in the chick (thoracic duct and posterior lymph heart) are formed independently of the venous system as the result of excavations in mesenchyma; (2) the view first advanced by Ranvier that the lymphatic system is a derivative of the venous system. As Sabin and Lewis are the more recent adherents of the second view the principal results obtained by them will be briefly considered while a more critical estimate of their work, as well as of that of other investigators, will be left for a subsequent paper.

Sabin studied the development of the lymphatic system in pig embryos,

[1] Archiv. f. Anat. u. Phys., Anat. Abthg., 1880 and 1887.

[2] Comptes Rendus, 1895 and 1896; Archiv. d'Anatomie, Tome 1, 1897.

[3] Archiv. f. Anat. u. Phys., Anat. Abth., 1902.

[4] Richerche n. lab. di anat. norm. d. r. Univ. di Roma, Vol. VII, 1900.

[5] American Jour. of Anat., Vol. I, 1902. Vol. III, 1904. Vol. IV, 1904.

[6] American Jour. of Anat., Vol. V, 1905.

and the main results obtained by her may best be expressed by a quotation from her first paper (page 387): "The lymphatic system of the embryo pig begins at two blind ducts which bud off from the veins in the neck. At the very start the openings of these ducts into the veins are guarded by valves formed by the direction which the endothelial bud takes as it grows from the vein. In the ducts themselves there are no valves at first. From these two buds and later from two similar buds in the inguinal region ducts grow toward the skin and widen out to form four lymph sacs or hearts and from these sacs the lymphatics grow to the skin and cover its surface. At the same time there is a growth of ducts along the dorsal line following the aorta to make a thoracic duct from which the lymphatics grow to the various organs. Thus the ducts of the lymphatic system gradually invade the body, but there are certain tissues which they never reach even in the adult, for example, the cornea and cartilage."

In a more recent paper on the development of the lymphatic system in rabbits Lewis states that in following the transformations of the subcardinal veins in rabbits a portion of these veins seemed to become detached from the venous system, and to be transformed into lymphatic vessels. The principal results obtained by Lewis are contained in the summary of his paper (page 110), which we quote in full.

"The lymphatic system of rabbits begins along the internal jugular vein as a detached sac formed by the coalescence of several venous outgrowths."

"Similar though smaller sacs arise from the subcardinal and mesenteric veins at a slightly later date."

"Subsequently lymphatic vessels develop along the courses of the azygos and cutaneous veins, apparently from independent venous outgrowths. All of these vessels unite with one another to form a continuous system, which acquires new and permanent openings into veins near the subclavian termination."

"The first lymph nodes observed are two pairs, one beside the subscapular vessels, and the other beside the ilio-lumbar vessels."

"In order to facilitate comparison with Prof. Sabin's work, the following conclusions may be added:

"The lymphatic system does not arise from the venous system by four outgrowths, but by several. It is not always in communication with the veins. The outlets of the thoracic and right lymphatic ducts are not persistent primary openings. An identification of mammalian lymph hearts, comparable with those of the amphibia, should not be made on the evidence now available. Judged by their relation to the early lymph-nodes, the jugular sac is not comparable with the lymphatics along the ilio-lumbar vein. However, the study of rabbit embryos confirms the chief conclusion established by Prof. Sabin, that the lymphatic system is a derivative of the venous system."

As will be shown in the following pages, the results obtained by the present writers differ fundamentally from those of former investigators.

This investigation was begun two years ago and has, thus far, been based solely upon a study of serial sections of a complete series of cat embryos. Reconstructions in wax, after a modification of Born's method, have been made of all the critical stages in the development of the venous and lymphatic systems and the reconstructions themselves, 35 in number, exhibited before the Association of American Anatomists at this present Meeting in New York.

The development of the main lymphatic vessels of the cat occurs in close association with the formation of the early venous channels. The main features of this process may be summarized briefly as follows:

In the early stages (embryos up to 7 mm.) only veins are present. In embryos of 8 and 8.5 mm. the first indications of the lymphatics appear in the region of the precardinal veins. As the result of shrinkage and condensation of the primitive redundant precardinal vein-channels, oval or spindle-shaped spaces appear along the course of the veins. These spaces are situated without the intima of the veins in the peri-intimal adventitious tissue, and are not to be confounded with the mesenchymal spaces of Sala since they develop in territory formerly occupied by the veins themselves. As the intima recedes, following the blood-column, these spaces increase in size and number, and later become confluent, forming in the precardinal region large irregular channels on each side, the "anterior lymph-hearts" of previous observers. Smaller lymph channels develop in the later stages (12-18 mm.) in exactly the same manner along the path of the internal and external jugular, subclavian and innominate veins. The large size of the primitive anterior lymph-sac is due to a series of changes involving the precardinal vein. In the earlier purely venous stages this vessel is relatively very large and incompletely divided into a dorso-lateral and a ventro-medial segment by the nerve-trunks which penetrate it through a series of fenestræ. The ventro-medial portion is later condensed into the internal jugular vein, while the dorso-lateral division is for the most part entirely replaced by the extra-intimal development of the primitive large anterior lymph-sac, a much smaller lymphatic channel developing along the course of the internal jugular vein proper. At a point corresponding to the subsequent junction of the internal jugular with the common trunk formed by the confluence of the external jugular and subclavian veins, an abrupt break in the dorso-lateral precardinal channel leaves a small cone-shaped portion of this channel, ending blindly, in connection with the ventro-medial permanent vessel (Int. Jug.).

Cephalad of this point the primitive dorso-lateral division of the precardinal undergoes the above described replacement by the large anterior lymph-sac. Subsequently the independently formed lymphatic channels become confluent with each other and establish a connection with the blind end of the cone-shaped recess on both sides. This is the fundament of the typical adult veno-lymphatic tap of the thoracic duct and the right lymphatic duct. The blind recess of the early stages is in no sense an out-bud from the primitive precardinal vein, but a remnant of the originally continuous dorso-lateral segment of that vein, which has retained its connection with the permanent (internal jugular) channel, while cephalad of this point it has been replaced by the extra-intimal formation of the large anterior lymphatic compartment. Subsequently, with the descent of the heart and the resulting elongation of the vessels, the lymphatic recess, receiving the termination of the main lymphatic trunks on each side, becomes, by a species of intussuception of the walls, deeply invaginated into the angle of confluence of the jugulo-subclavian trunks and opens into the vascular lumen by a very narrow slit-like aperture, surrounded by a valve, formed by the invaginated portion of the walls.

We have at several additional points observed in embryos of various stages exactly similar "taps," the details of which are reserved for the publication of the paper in full. These additional taps are quite sufficient to account for adult variations in the termination of the main lymphatic channels. The element which seems to determine the selection of the typical point of junction of the thoracic and right lymphatic ducts is the return from the relatively large anterior limb-bud of the correspondingly large lymph-vessel developed along the main limb-vein. Caudad of the jugulo-subclavian angle and the entrance of the main lymph-channel the thoracic ducts extend at first symmetrically along the precardinal veins. Later, owing to the formation of the left innominate anastomosis and the consequent shrinkage of the left precardinal caudad of this point, the lymphatic duct of the left side increases more rapidly in size along the pathway of the abandoned vein. The same influence on lymphatic development is also seen in the other typical regions of transfer of the venous current to the right side, as the Hemiazygos and Iliac anastomoses. The total or partial obliteration of early functional veins affords the opportunity for more rapid and complete extra-intimal space-formation, constituting the basis for the development of the larger lymph-channels of the adult. Hence in the final normal disposition of the two systems, the main venous line is on the right side, while the main lymphatic vessels occupy the abandoned vein-field of the left side.

The basic principles involved in the development of the principal lymphatic channels of the cat may therefore be summed up as follows:

1. The lymphatics begin as extra-intimal spaces along the course of the primitive embryonal veins. They subsequently become confluent and form continuous vascular channels.

2. The same process is active in different degrees in two well-defined areas of the developing lymphatic system:

(a) Small lymphatic vessels form along embryonic veins which are destined to persist as permanent components of the adult venous system.

(b) Very much larger lymph-vessels form along embryonic veins which are temporary and are subsequently abandoned, entirely or in great part, when the shifting of the main venous line to the right changes the primitive symmetrical bilateral venous plan of the early embryo to the typical dextro-venous adult condition by the development of the Innominate, Hemi-azygos and Iliac cross-anastomoses. Hence in typical adults the main lymph-ducts are on the left, the main veins on the right side, the abandoned embryonal veins of the left side affording the path for the more extensive sinistral lymphatic growth. At the same time, in variant individuals, with abnormal persistence in the adult of veins usually obliterated, it is highly probable that more extensive researches will reveal a corresponding adaptive change in the organization of the lymphatic vessels. It is also probable that further observations will establish a morphological basis, as above outlined, for the correct interpretation of adult lymphatic variations.

3. The adult connections of lymphatic and venous systems are not due to endothelial "out-buds" from the embryonal veins, but occur at points where the remnant of a temporary embryonic vein remains in connection with the permanent venous channel and establishes secondary communications with the pre-formed extra-intimal confluent lymph-spaces. These connections may occur at several points. The entrance of certain main secondary lateral tributaries appears to determine which of these points is to become the site of the principal adult opening. Thus

the secondary lymph-channel formed along the main vein of the anterior extremity determines normally, by its point of confluence with the precardinal lymph-vessel, the position of the usual termination of the thoracic and right lymphatic ducts.

4. The lymph-nodes develop by secondary growth of adenoid tissue, invading the extra-intimal spaces.

THE ATRIO-VENTRICULAR BUNDLE AND PURKINJE'S FIBERS. By ROBERT RETZER. *Department of Anatomy, Johns Hopkins University.*

The author agrees with Tawara[1] that the atrio-ventricular Bundle and Purkinje's fibers belong to the same system. He finds the Purkinje's fibers also in the human heart beneath the endocardium of the ventricles and in the false tendons, which run from trabeculæ to the papillary muscles and to other trabeculæ. Contrary to Tawara he finds the fibers all through the atria and auricles.

The Purkinje fibers differ very markedly in their structure in the various mammals. They are most like the ordinary heart muscle in the human heart and most highly differentiated in the sheep's heart. They also differ in their appearance in various portions of the same heart.

In a previous paper[2] the author's statement that the bundle does not differ from ordinary heart muscle was based on the examination of hearts in which there is very little difference (human, Guinea-pig, rabbit, and kitten) or in other words of those hearts in which Purkinje's fibers were thought not to exist.

THE PLANTAR MUSCULATURE. By J. PLAYFAIR MCMURRICH. *University of Michigan.*

In 1878 and more at length in 1882 Cunningham set forth his views concerning the morphology of the mammalian plantar muscles, regarding them as divisible into (1) an extrinsic group, consisting of all the muscles plantar to or connected with the long flexor tendons, and (2) an intrinsic group, composed of the muscles situated dorsal to the long flexor tendons. The latter group he regarded as derived from three primary layers, the adductor hallucis from a plantar or adductor layer, the plantar interossei and flexor brevis quinti digiti from an intermediate or short flexor layer and the abductors and dorsal interossei from a dorsal or abductor layer.

[1] Das Reizleitungssystem des Säugetierherzens, 1906.

[2] Arch. f. Anat. u. Phys., 1904.

As a result of studies extending over amphibia and reptilia as well as Mammalia, I have shown in an earlier paper (1904) that the crural muscles primarily stop at the ankle joint, inserting into the plantar aponeurosis or the tarsal bones, and it therefore follows that a division of the plantar musclature into extrinsic and intrinsic groups is erroneous, all parts of it being really intrinsic, with the exception of the quadratus plantæ, which is primarily a crural muscle. Viewed from this standpoint, the plantar musculature of the human foot may be regarded as arranged in six layers. The most superficial layer, the *flexor brevis superficialis, stratum superficale* is represented by the flexor brevis digitorum, abductor hallucis, abductor quinti digiti and the medial head of the flexor brevis hallucis. The second layer, the *flexor brevis superficialis, stratum profundum,* is represented by a single muscle which fuses with the slip of the flexor brevis digitorum passing to the third digit. The third layer, the *flexor brevis medius, stratum superficiale* consists of the lumbricals and the lateral head of the flexor brevis hallucis, the tendons of the long flexor from which the lumbricals arise being differentiations of the deep layer of the plantar aponeurosis. The fourth layer, the *flexor brevis medius, stratum profundum* is represented by the adductor hallucis, including both the oblique and transverse heads. The fifth and sixth layers, the *flexor brevis profundus* and *intermetatarsales,* together form the interossei, portions of the fifth layer uniting with the intermetatarsales to form the dorsal interossei, while the remaining portions persist as the plantar interossei and the flexor brevis quinti digiti.

A full discussion of the data upon which these conclusions are based will appear in a forthcoming number of the AMERICAN JOURNAL OF ANATOMY.

THE SEGMENTAL FLEXURES OF THE NOTOCHORD. By CHARLES S. MINOT. *Harvard Medical School.* With 6 figures.[1]

The following note records observations on several species of mammals, in all of which they have demonstrated the existence of segmental flexures of the notochord in early embryonic stages. The general character of these flexures is the same in all cases.[2] The notochord is confined to the median plane and makes a bend in the ventral direction corresponding

[1] All the figures are from specimens in the Harvard Embryological Collection, to the catalogue of which the numbers refer. The figures are all oriented alike, the cephalad end up, the dorsal side to the left, and are uniformly magnified, 35 diameters.

[2] Except in the pig, as detailed below.

to the center of each segment, and makes a series of corresponding bends in the dorsal direction, the apex of each dorsal bend being in the intervertebral disk. The general character of these flexures and of their relations to the vertebral and intervertebral structures is well shown in Fig. 2. Since the flexures have been found in all the species of mammals examined, it seems to me probable that they occur in all mammals at corresponding stages. The species examined are:

Pig,	Dog,
Sheep,	Rabbit,
Cow,	Man,
Cat,	Opossum.

The exact observations made may be briefly stated as follows:

Pig.—At 5.5 mm. (sagittal series 916) the metameric curves of the notochord are just beginning to show clearly, for in each segment the notochord is bowed ventralwards, making a slight but distinct curve. The distance of the outer somewhat irregular surface of the spinal cord from the notochord is less than the diameter of the latter. The floor of the spinal cord is parallel to the notochord and makes a series of small segmental bends, yet in the frontal series of these stages (No. 917) I see no evidence of neuromere formation in the lateral walls of the spinal cord, although the metamerism in the median ventral wall is perfectly distinct.

At 6.0 mm. the conditions are very much the same, but the notochord is larger, its sheath more distinct and its curves more evident. In the median line there are still no blood vessels near the wall of the medullary tube, although they are present on both sides. There are as yet no clear evidences of intervertebral differentiation. We have, therefore, the noteworthy fact to record that *the metamerism of the notochord and of the adjacent floor of the spinal cord both precede in their development the formation of the vertebral anlages.*

In an embryo of 7.0 mm. (Series 11) the segmental curves are again a little more distinct than in the earlier stages; the notochord is thickened and its distance from the spinal cord has increased; capillaries have appeared in the median line under the spinal cord; the mesenchyma above the notochord is still of a very loose texture, but below the notochord it is slightly condensed, and on careful examination it can be recognized that this condensation is greater underneath the summit of each ventral bend of the notochord. The notochord itself, which in earlier stages was still somewhat flattened, has now become nearly circular in cross section.

In slightly older embryos (7.5 mm., No. 756, and 7.8 mm., No. 429,) conditions are nearly the same as in the 7.0 mm. specimen, but in both of these series the flexures of the notochord are very distinct and regular, as shown in Fig. 1. They make a series of rounded waves; the dorsal

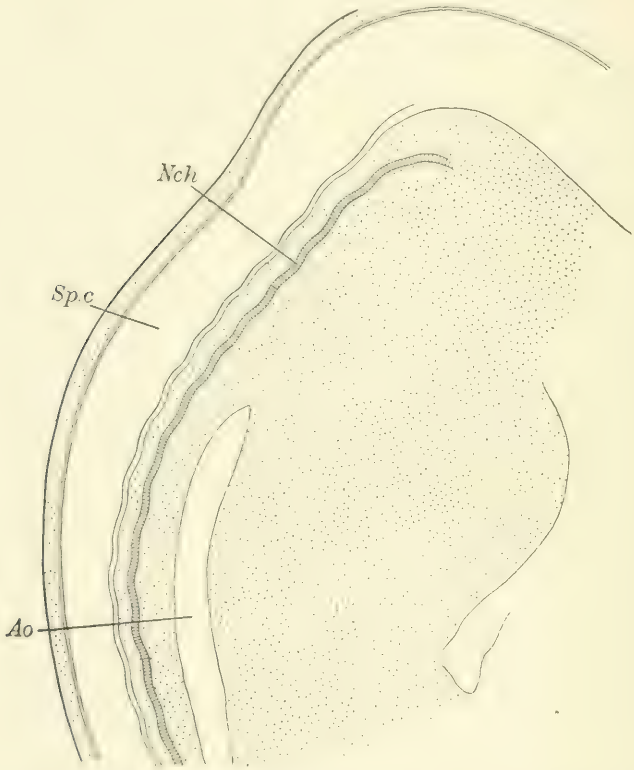

FIG. 1. Pig, 7.8 mm. Sagittal series 429, median section reconstructed from the actual sections, 89-102. *Nch.*, notochord; *Sp. c.*, cavity of the spinal cord, bounded by thin median walls; *Ao.*, main dorsal aorta.

summit of each wave corresponds to an area of lighter mesenchyma; the ventral depressions are each lodged in condensed mesenchyma, and each patch of condensed mesenchyma is continued a little distance below the notochord by bands of smaller condensed tissue which unite with the mesenchyma specialized around the two adjacent depressions or ventrad curves of the notochord.

At 9.0 mm. (series 53) the notochordal waves are more pronounced. the distance between the notochord and the spinal cord has increased and the areas of condensed mesenchyma are more definitely indicated and at earlier stages. The areas of condensation are easily recognized as the anlages of the intervertebral ligaments.

From the preceding descriptions it appears that in the pig up to this stage, the ventrad bends of the notochord are intersegmental, whereas. as stated in the opening paragraph, their characteristic position is segmental. It is thus especially interesting to note that at 12 mm. the change in the relation of the flexures to the segments is initiated. This is shown by the fact that the apices of the flexures are moving in each segment towards the head (series 7). Again, in an embryo of 14.2 mm. (series 1130) I find that the apex of each dorsal flexure has moved headwards and lies near the cephalad border of each vertebral body. Similarly the apex of each ventrad flexure has moved towards the cephalad border of the intersegmental anlage (ligament). In consequence of this change, the form of the curves has become more like that observed in the cats (compare Fig. 5). In this embryo and in another of exactly 14.0 mm. (series 66) the flexures are well developed, but the segmental curves of the floor of the medulla, which we found in earlier stages (compare Fig. 1), have disappeared. The intervertebral anlages are very distinct, the cells composing them are much crowded and have smaller nuclei than the cells of the ventral anlage or of the neighboring mesenchyma. The formation of fibers in the anlage has apparently begun, and the differentiation of the vertebral perichondrium is easily recognized.

At 17.0 mm. (series 50) the medullary floor shows no metameric curves. The notochord is remote from the spinal cord; between the two the median blood-vessel is everywhere distinct. The vertebral bodies are clear, light; the intervertebral discs are broad, dark; but not cartilaginous. The relations of the flexures are now changed clearly, in that they have shifted, each dorsad apex being now vertebral in position, each ventrad apex intervertebral, see sections 237-239. In the upper cervical region (section 227), however, the relation is different and seems to be like that in the sheep. Unfortunately the sections are not true to the sagittal plane and the disposition of the cervical notochord is therefore not readily followed.

At 20 mm. (series 60) the notochord shows no distinct flexures in the upper cervical region, but its bends are still to be traced in the dorsal and lumbar regions.

Fig. 2.

Fig. 3.

Fig. 2. Sheep, 14.6 mm. Sagittal series 1109. Reconstruction from sections 190-193.

Fig. 3. Sheep, 26.1 mm. Sagittal series 1112, Section 235.

Sheep.—The flexures are more distinct, that is to say of greater amplitude, in the sheep than in any other species I have examined. We have at present in our collection three sagittal series; the youngest stage is that of 13.7 mm. (series 1107). In this the notochordal waves are more marked than in pigs. The vertebral bodies are well but not sharply defined, the intervertebral disks are wide, and owing to the crowding of their cells, they appear darkly stained. The notochord is of uniform diameter.

The next series (1109) is of an embryo of 14.6 mm. and the condition here found is represented in Fig. 2. The series of flexures, as depicted, is very obvious. It will be noticed that from the fifth vertebra on, the segmental flexures are quite regular, there being a bend towards the ventral side in each vertebral body. In the first vertebral body we find the first dorsal flexure; in the second, third, and fourth vertebral bodies the same is true, but in the fourth the apex of the dorsal flexure lies more cephalad. In the fifth body this change is still more marked, and in the sixth we find that the ventrad flexure has become vertebral. This is the relation which we find throughout the rest of the vertebral column. In the cervical region, then, the flexures are not strictly segmental; we have for the six main vertebral bodies six and one-half waves. Whether this irregularity is the result of the peculiar development of the atlas and epistropheus or not, I am unable to say, but it is a natural supposition to connect the two phenomena.

In a sheep of 26.1 mm. (series 1112) I find the notochord beginning to degenerate, but its course, as shown in Fig. 3, is still traceable with certainty. The segmental flexures are conspicuous. In each vertebra the notochord makes a long ventrad bend, and where these bends unite in the intervertebral ligaments, there is typically a sharp apex formed, as is clearly shown in the figure. The differentiation of the vertebral cartilage has commenced. In no other animal which I have examined have I found the flexures so conspicuously developed as in this sheep.

Cow.—Of the cow only a single sagittal series is at my disposal (No. 1126). The length of the embryo is 17.0 mm. The specimen has been hardened in formalin and its preservation was not very good. The notochord had shrunken within its sheath and I think it probable that in mounting the sections the two halves of the vertebral column have become a little more widely separated, so that the notochordal space has a greater diameter than is perhaps natural. Fig. 4 shows, however, that the notochordal flexures are present and characteristic; the ventral bend being vertebral, the dorsal intervertebral. It is noteworthy that in this specimen the fibrous differentiation of the intervertebral ligament is already quite distinct, although in the much larger sheep embryo (Fig. 3) it is hardly begun.

Cat.—At 6.2 mm. (series 397) the flexures may be observed in both the cervical and dorsal regions, though not yet very perfectly developed. They already differ in form from the wave-like flexures seen in ungulates. The dorsad apices are intervertebral and tend to lead off from the side towards the head into steep descents and towards the tail with

Fig. 4.

Fig. 5.

Fig. 4. Cow, 17.0 mm. Sagittal series 1126, Section 150. The uppermost vertebra in the figure is the sixth vertebral body.

Fig. 5. Cat, 10.7 mm. Sagittal series 475. Reconstruction from Sections 153-155.

more gradual slopes; the resultant forms are shown in Fig. 5. The difference noted will be evident in comparing this figure with Fig. 2.

At 10.7 mm. (series 475) the vertebral bodies and intervertebral disks are well defined. (See Fig. 5). The notochordal flexures are well marked in the dorsal region, but are much less well marked in the lumbar region. This is the reverse of the difference between the two regions in the rabbit.

At 12.0 mm. (series 400) the ventrad curves in the vertebræ are bow-shaped, while the intervertebral summits of the curves are somewhat pointed, as in the sheep. This is the condition to be seen in the dorsal and lower cervical vertebræ. In the lumbar region the flexures are indistinct, perhaps owing to the less advanced stage of vertebral development.

At 15.0 mm. (series 437) a slight trace of the flexures is still visible in the lumbar region, but they are a little more distinct in the cervical region: the long limb of the vertebral flexure tends to make a slight dorsad convexity.

Finally, in an embryo of 24.0 mm. (series 467) I find no trace of flexures; the vertebral notochord has become a mere thread, and the intervertebral notochordal expansion is large.

Dog.—The single series at my disposal is an embryo of 12.5 mm. (No. 179). It shows perfectly clearly the slight segmental flexures of the notochord as a series of shallow waves. The specimen was hardened in picro-sulphuric acid, and there is no shrinkage of the notochord within its sheath, such as I have seen in many other specimens, even those hardened in Zenker's Fluid.

Rabbit.—At 12.5 days (series 150) the intervertebral condensations are beginning; the notochordal flexures are unquestionably present, but are very slight; their dorsad summits are intervertebral, their ventrad summits vertebral.

At 14 days (series 156) the flexures are more distinct though still much slighter than those which we observed in the pig.

At 15 days (series 159) the notochord in the dorsal region is nearly straight and shows slight vertebral enlargements, but from the level of the liver down towards the tail the segmental flexures are still distinct —a series of gentle waves.

As pointed out in connection with the description of the conditions in the cat, the two species show reversed relations; the flexures being most distinct in the lower half of the vertebral column in the rabbit, in the upper half in the cat.

At 16 days (series 162) the intervertebral expansions of the notochord are very marked and the degeneration of the notochord in the vertebræ has led to resorption; as at 15 days the notochord is nearly straight in the dorsal region, but in the lumbar and pelvic regions the slight flexures are readily recognized.

Man.—In man at 10.2 mm. (series 736) the notochordal flexures are slight but unmistakable. (Compare section 139). The vertebral anlages are distinct, and so also are Froriep's so-called vertebral bows, but neither are yet sharply defined. The flexures that are present are so inconspicuous they would perhaps hardly be noticed were not attention directed to them by previous acquaintance with the much more clearly defined flexures in other species. The notochord is somewhat larger in diameter than in most mammals. At 22.0 mm. (series 851) I have succeeded in detecting no flexures whatever. This embryo is at the beginning of the chondrostyle stage.

Opossum.—At 8.0 mm. (series 718) we notice at once that the notochord is much larger than in the placental mammals and that it is histologically more like that of reptiles and birds. I have found no notochordal flexures; they seem to be wholly lacking. On the other hand, at 11.0 mm. (series 925) the embryo being in the chondrostyle stage, the flexures are indicated because the intervertebral thickenings of the notochord have appeared and each of these thickenings extends farther dorsad than ventrad. The same condition recurs in an embryo of 12.0 mm. (series 616) that shows still more clearly. (This condition is represented in Fig. 6.) If we imagine a line traced which would represent the center of the notochord, it would rise towards the dorsal side in each intervertebral anlage and fall towards the dorsal side in each vertebral region, thus making it evident that the course of the flexures in this marsupial is the same as in the other mammals we have considered.

FIG. 6. Opossum, 12.0 mm. Sagittal series No. 616, Section 190.

The detailed observations above briefly recorded, together with the accompanying figures, seem to me to justify the statements made in the opening paragraph of this note.

As to the morphological significance of the flexures and as to the mechanism of their production, my observations have as yet furnished me no clue.

HARVARD MEDICAL SCHOOL, December, 1906.

COMPARISON OF THE ALBINO RAT WITH MAN, IN RESPECT TO THE GROWTH OF THE ENTIRE BODY. By HENRY H. DONALDSON. *Wistar Institute of Anatomy, Philadelphia.*

The general characteristics of the growth curve for the albino rat, are similar to those for man, and in both forms the growth of the sexes is related in the same way. The rat grows for a relatively longer time than does man, but the interval between birth and puberty is shorter than in man. The connection between puberty and accelerated growth, called "prepubertal" in man, seems to have no fundamental significance, as the accelerated growth in the female is completed some time before puberty in the rat, and at an even earlier period in the guinea-pig. Castration in the male rat does not modify the rate of growth, nor the form of the growth curve, and hence these processes appear to be independent of any internal secretion associated with the development of the testes.

BIOMETRICAL STUDIES ON THE SKULLS OF THE ALBINO RATS. By SHINKISHI HATAI. *Wistar Institute of Anatomy, Philadelphia.*

The following measurements were made on 53 male and 51 female albino rats: the length of the entire skull; fronto-occipital length; zygomatic width; length of the nasal bone; height of the skull; width of the cranium or squamosal distance. In order to determine the various constants for the mean, standard deviation, coefficient of variation and also coefficient of correlation, the usual biometrical formulæ were applied. The following were the main results obtained from the present investigation: (1) The male skull as well as its constituent parts is absolutely larger than those of the female; (2) the two sexes are equally variable as to their skull characters; (3) the female cranium is relatively longer and broader than that of the male; (4) the correlation is always positive except in the case of the cranial index and cephalic index where it is negative; (5) the coefficient of correlation is higher in the male than in the female where the entire skull is compared with the other characters. On the other hand the correlation between the fronto-occipital length and height and width and the zygomatic and cranial width are nearly identical in the two sexes if the respective probable errors are considered; (6) the relation between the coefficient of correlation and regression is linear.

THE FORMATION OF THE DECIDUAL CAVITY IN GEOMYS BURSARIUS. By THOMAS G. LEE. *University of Minnesota, Minneapolis.*

Geomys bursarius, or the pocket gopher, is a representative of a distinct family of North American rodents, presenting many interesting anatomical structures peculiar to it. The results presented in this paper are based upon an investigation of a very complete series of pregnant uteri which were obtained after several years of collecting.

Geomys, in its early development, differs markedly from other rodents, and in certain respects from any other mammal yet described. Its early development takes place entirely outside of the uterine cavity in a decidual cavity which is formed in the ventral uterine connective tissue. In this respect it is similar to the guinea pig, and also resembles the human development.

After the blastocyst has become relatively large it perforates the epithelium lining the ventral portion of the uterine cavity, leaving a rounded opening of considerable size which persists for some time and does not close up as in the case of the guinea pig, nor become plugged up as in man.

The epithelial lips of this opening become somewhat thickened and slightly everted. The blastocyst becomes attached to the outer surface of this epithelial lip by means of the trophoblast in a zone a little way external to the germinal area. In this manner the blastocyst is suspended while the vascularization and breaking down of the connective tissue ventral to it is taking place.

Rauber's layer disappears from the surface of the germinal area at about the time of the escape of the blastocyst. The entoderm forms a large vesicle or yolk-sac which becomes invaginated by the sinking in of the germinal area. This gives us one of the simplest types yet described of the so-called inversion of layers.

The outer portions of these amniotic folds composed of trophoblast, unite to form the serosa or false amnion which now covers the perforation opening in the uterine cavity.

There is a well-developed yolk-sac placenta through which the embryo is nourished until it is of considerable size and well differentiated. At a later period secondary folds of trophoblast are formed from the dorsal margins of the serosa, forming first a cup-shaped, later a two-layered mass of trophoblast which becomes changed to a solid rounded disk by cell-proliferation. This disk which constitutes the fœtal portion of the true placenta, comes in contact with the uterine epithelium lining that portion of the uterine cavity dorsal to the point of perforation. The epithelium disappears, and there is brought about a close relationship between this disk and the maternal connective tissue to form the true placenta. The vascular mesoderm connects the ventral side of this plate with the embryo, and thus establishes the true functional allantoic placenta. When this has been accomplished, the yolk-sac placenta gradually atrophies and disappears.

AN ELECTRIC WAX-CUTTER FOR USE IN RECONSTRUCTION. By EDWARD L. MARK. *Zoological Laboratory, Harvard University.*

The wax cutter is made by heating a platinum wire about 0.4 mm. in diameter by means of an electric current regulated by a rheostat consisting of ordinary electric lamps of different candle-powers in multiple.

To give the wire alternating motion parallel to its length it is stretched in a frame made of a bent steel rod, one portion of which is substituted for the "needle bar" of an ordinary household sewing machine. The melted wax is withdrawn through a copper tube, kept hot by passing through a small hot water tank attached to a suction pump of the Bunsen type.

The apparatus will be fully described and illustrated in a number of the Proceedings of the American Academy of Arts and Sciences to be published in February or March.

METHODS OF CORROSION ANATOMY. By E. N. PECK and R. P. HIGGINS. *Cornell University Medical College, Ithaca, N. Y.*

For injecting large cavities and vessels, Huntington's ozokerite mass has been found best. To indicate the course and relations of small vessels a 6 or 7 per cent solution of soluble cotton in alcohol and ether is more satisfactory. The ozokerite gives good casts of the form of cavities and the shrinkage of the collodion in small vessels is unimportant. These may be colored with cinnabar, Berlin blue, lead chromate, or barium sulphate. Metal injection syringes with glass or metal canulas are very satisfactory. The parts should be covered with water at 40°-50° C in the dish in which they are to be corroded. This temperature is imperative with ozokerite and advantageous with collodion. Commercial HCl is best for corrosion with ozokerite and may be used with collodion, but for the latter artificial gastric juice is better since the acid causes greater shrinkage and in certain cases dissolves the collodion. Gastric juice is made by dissolving 10 grams of soluble pepsin in 1 liter of a .05 per cent HCl. Incubate at 40° C. 2-3 days, then replace with a solution of 5 grams of pepsin to 1 liter of .05 per cent HCl and change again every 2-3 days. Total time varies with size of specimen from 5 to 20 days. Ozokerite may be mounted dry, or in a mixture of alcohol and glycerine which alone should be used for the collodion casts.

THE TERMINAL DISTRIBUTION OF THE EIGHTH CRANIAL NERVE IN MAN. By JOSEPH H. HATHAWAY. *Cornell University Medical College, Ithaca, N. Y.*

STATISTICAL STUDIES OF THE BRACHIAL PLEXUS IN MAN. (A Preliminary Note.) By ABRAM T. KERR. *Cornell University Medical College, Ithaca, N. Y.*

These studies are based on the record of 175 plexuses dissected and drawn by students, mostly in the Johns Hopkins Medical School, some in Cornell. The records were verified in order of time by Drs. Elting, Bardeen, and Kerr. This note deals with the type of plexus according to the origin and combination of branches. Seven types are recognized: A, with outer cord formed from the 4th to the 7th nerves inclusive, the inner from the 7th to 9th and the posterior from the 4th to the 8th occurred in .57 per cent of cases; B, like A, except posterior cord which was formed from the 4th to 9th, in 1.71 per cent of cases; C, with outer cord from 4th to 7th, inner from 8th to 9th and posterior from 4th to 9th, in 58.28 per cent of cases; D, like C, except outer cord from 4th to 8th in 2.28 per cent of cases; F, with outer cord from 5th to 7th, inner cord from 8th to 9th, posterior cord from 5th to 9th, in 29.77 per cent of cases; G, like F, except the 5th sends a branch to the 4th, in 6.85 per cent of cases; H, like G, except the outer cord from the 5th to 9th, in .57 per cent of cases. No record was made of the relation of the 10th spinal nerve to the plexus. Attention was also called to the outer head of the ulnar nerve which when searched for will be found in 50 per cent of the cases.

A MODEL OF THE MEDULLATED FIBER PATHS IN THE THALAMUS OF A NEW-BORN BRAIN. By Florence R. Sabin. *Anatomical Laboratory, Johns Hopkins University.*

The model is a reconstruction by the Born method of the fiber tracts of the thalamus that are medullated at birth and shows their relation to the cortex and to the brain stem. In the pons, the medial lemniscus is shown as a band of fibers that separates the nuclei pontis from the tegmental part. On entering the mid-brain, the lemniscus begins to curve lateralward on account of the red nucleus. Just caudal to the red nucleus the lemniscus gives off a small bundle of fibers to the substantia nigra. The main bundle of the lemniscus passes beyond the red nucleus on the way to higher centers and divides into a ventral and a dorsal segment. The ventral segment is Forel's *Feld H*, the dorsal his *BaTh*. The ventral segment gives off a small bundle to the hypothalmic nucleus of Luys, similar to the bundle given off to the substantia nigra; a second larger mass of fibers curves into the hypothalmic region and enters the globus pallidus of the lenticular nucleus. The rest of the ventral segment passes to the ventro-lateral nucleus of the thalamus and its external medullated lamina. The bundles running to this nucleus represent the main tract to the cortex, for from the lateral surface of the ventro-lateral nucleus a large bundle of well medullated fibers passes to the cortex of the lower part of the posterior central gyrus. The sensory path is almost entirely broken in the lateral nucleus. The dorsal segment of the medial lemniscus, Forel's *BaTh*, passes to the *centre médian* of Luys and to the cup-shaped nucleus.

The motor path is medullated only down to the cerebral peduncle. It makes connections with the lenticular nucleus, the hypothalmic nucleus and the substantia nigra. The model shows that the motor and sensory paths are parallel throughout the brain stem. The sensory path is always dorsal to the motor. In the medulla, the paths are adjacent, in the pons they are separated somewhat by the cells of the nuclei pontis, in the mid-brain and hypothalmic region, the substantia nigra and hypothalmic nucleus come in between the two paths, while in the thalamus and subcortical regions, they are adjacent.

In the thalamus, the nuclei that contain medullated fibers from the medial lemniscus are, the lateral nucleus, the *center médian* of Luys and the cup-shaped nucleus. The lateral geniculate body and the pulvinar have medullated optic fibers, while the medial and anterior nuclei contain no medullated fibers whatever. The fasciculus retroflexus stands out very clearly, however, passing through the lower border of the medial nucleus.

DEVELOPMENT OF THE INTERFORE-BRAIN COMMISSURES IN THE HUMAN EMBRYO. By GEORGE L. STREETER. *Wistar Institute of Anatomy, Philadelphia.*

A morphological study of the corpus callosum and the commissure of the hippocampus, based on a series of wax-plate reconstructions of human embryos varying from 80 to 150 mm. in length. All three structures cross the median line in that portion of the brain wall developed from the lamina terminalis. In 80 mm. embryos the corpus callosum consists of a round bundle of fibers lying directly on the commissure of the hippocampus, representing the condition found in non-placental animals. The succeeding growth consists in the lengthening of the fornix and caudal migration of the hippocampal commissure, the latter remaining in close relation to the caudal end of the corpus callosum, which in the meantime, by increase in number of fibers, has extended anterior to the anterior commissure and posterior so as to deck over the region of the third ventricle. The formation of a cavity in the septum lucidum occurs in embryos of about 95 mm. The anterior or olfactory division of the anterior commissure does not enter the olfactory bulb, but is traced to the cortex dorsal to the bulb.

THE RELATIONS OF THE FRONTAL LOBE IN THE MONKEY. By E. LINDON MELLUS. *Anatomical Laboratory, Johns Hopkins University.*

The results of three amputations of large portions of the left frontal lobe in the monkey were presented. A comparison of the degenerations resulting from these experiments shows that no fibers from the frontal lobe reach the pyramid. A small remnant of those passing through the posterior segment of the internal capsule reaches the foot of the cerebral peduncle, but they quickly pass out into the sub-thalamic region, through which they pass to the central gray matter surrounding the aqueduct of Sylvius. They probably come from the cortex of the external surface of the frontal lobe, and, as they are of large caliber, they are presumably the axons of large cells within, or anterior to, the pre-frontal sulcus. It seems reasonable to suppose they may be motor fibers that reach the motor oculi nuclei at a lower level.

In the lower levels of the brain the two main routes for the connections of the frontal lobe with the rest of the brain are the anterior segment of the internal capsule and the two thin bands of white matter outside the lenticular nucleus separated by the claustrum. To some extent fibers having the same destination go by both routes.

The fibers entering the anterior limb of the internal capsule in the highest levels of these lesions apparently divide into two tracts. One of these, occupying the more mesial portions of the anterior limb, passes inward and backward through the external nucleus of the thalamus, to end in and around the ganglion habenula. The other passing through the globus pallidus just external to the genu of the internal capsule enters the anterior portion of the posterior limb and, after a short course downward with the capsular fibers, passes out of the capsule in successive levels, to end in the external nucleus of the thalamus and in the central gray matter surrounding the aqueduct of Sylvius. The latter are joined in the sub-thalamic region by fibers which have passed around the lenticular nucleus by way of the external capsule.

The fibers passing backward external to the lenticular nucleus may be divided into four groups: (1) Those going to the superior temporal convolution; (2) those going to the occipital lobe; (3) those just referred to as joining the fibers from the internal capsule on their way to the central gray matter surrounding the aqueduct of Sylvius, and (4) a group passing inward and downward from the area of Wernicke to end in the superior colliculus.

A RACIAL PECULIARITY IN THE TEMPORAL LOBE OF THE NEGRO BRAIN. By Robert Bennett Bean. *University of Michigan.*

Measurements were made of 236 temporal lobes, 54 from white brains and 182 from negro brains. Six measurements were made from fixed points on each temporal lobe, at three levels, two at the base (antero posterior and transverse), two at 1 cm. toward the pole, and two at 5 mm. from the tip of the temporal lobe. At each level the lobe is smaller in the negro, more nearly approaching the white in size at the base, and diverging from the white in size as the pole is approached. The widest divergence is found in the transverse measurement about the middle of the temporal lobe. There is a variable difference with a mean of about 5 mm. in each measurement. The temporal lobe of the negro is more slender than the white, narrower transversely, and more pointed at the extremity, the length being about the same in each race. The differences in general conform to the other characteristics previously described in the negro brain.

SUPPLEMENTAL REPORT REGARDING THE INNERVATION OF THE LEG OF RANA VIRESCENS. By Elizabeth H. Dunn. *Department of Anatomy, Chicago University.*

A partial report upon this material was made at the 1905 meeting of the Association.

The histological examination of the muscle on the operated side, in which all the efferent neurones were degenerated, shows but a slight change from the normal. The cross striations were not obliterated and the nuclear staining was unaltered. The staining with acid dyes was slightly less deep in the muscles of the operated side. The bulk of the muscle seemed unchanged.

As the counting was done upon osmic acid material only medullated nerve fibers entered into the enumerations. On the intact side both afferent and efferent fibers were present. On the operated side efferent fibers had been eliminated, and the count was of afferent fibers destined for the skin and for the muscles.

Among both the afferent and the efferent fibers, splitting occurred. This splitting was in the main trunks of the various segments of the leg. In both classes the proportion of splitting fibers increases progressively from the thigh to the foot.

A greater amount of splitting occurred among the purely afferent fibers of the operated side than among the mixed nerves of the intact side. Hence the proportion of splitting afferent fibers is greater than that of splitting efferent fibers. This splitting seems to occur in both the cutaneous and muscular afferent fibers. This result carries with it some important physiological correlaries, as for instance that some afferent neurones must have two "local signs" according to the point at which they are stimulated.

In considering the distribution to the various segments, correction must be made for the splitting fibers. When this is done, it is found that the unit area of skin receives the same number of afferent fibers in either the thigh, shank, or foot. In a similar way, a study of the muscular afferent fibers shows that the muscles are uniformly innervated by muscular afferent fibers according to the unit weight of muscle.

EXPERIMENTS IN TRANSPLANTING LIMBS AND THEIR BEARING UPON THE PROBLEM OF THE DEVELOPMENT OF NERVES. By Ross G. Harrison. *Anatomical Laboratory, Johns Hopkins University.*

Braus's[1] experiments were repeated in slightly different manner upon tadpoles of Rana sylvatica and Bufo lentiginosus, but with results which show that his conclusions are not of general validity. The mode of procedure was as follows: The left hind limb bud, taken from a normal tadpole in a stage when the absorption of the yolk was about complete, was implanted into the left side of another individual of the same age and species; and similarly there was transplanted to the right side the right hind limb bud taken from a larva of the same age, from which, however, the medullary cord had been removed shortly after closing over, and which in consequence had developed without nerves. In most cases, owing to a probable injury at time of transplantation, a pair of limbs developed out of each transplanted bud, one by direct development and one by a process of budding or super-regeneration.[2] There were thus usually present in each specimen four distinct kinds of transplanted limbs, which may be termed primary and accessory normal, and primary and accessory nerveless.

The specimens were preserved from four to six weeks after the operation. Examination of serial sections shows that all four of the types of limb may, and in fact usually do, acquire nerves of normal structure and arrangement, and that these nerves are always connected with the nerves of the host. In a typical specimen, in which all four transplanted

[1] H. Braus, Verhandlungen d. Anatom. Gesellschaft, 18. Versammlung in Jena, 1904; Anatomischer Anzeiger, Bd. 26, 1905.

[2] D. Barfurth, Arch. f. Entwickelungsmech., Bd. 1, 1894; Tornier, Arch. f. Entwickelungsmech., Bd. 20, 1905; Braus, op. cit.

legs contained nerves, the primary nerveless limb had a practically complete peripheral nervous system, derived from the sixth, seventh, and eighth spinal nerves, *i. e.,* largely from nerves which normally do not enter the limb. In the accessory limbs of both sides the larger nerve trunks and some of the smaller branches were present, though a number of the branches, especially in the distal part of the limb, could not be found. All of this is contrary to the observations of Braus, who found nerves only in the primary normal transplanted limbs. The difference in the results is due no doubt in a large measure to the fact that Braus did not keep his specimen alive sufficiently long after the operation.

The experiments cannot possibly be interpreted, as Braus interprets his, in accordance with Hensen's theory of the development of the nerve paths. On the contrary, when we consider them in connection with my former experiments,[1] we cannot but conclude that the nerves do actually grow from the host into the transplanted part, and further, that in so growing they are guided to the proper place by the peripheral organs themselves, for, it must be remembered, the nerves of the transplanted limb, except the n. cruralis, are not derived from the same segmental trunks as the corresponding ones of the normal limb, and therefore the mode of branching cannot in any way have been predetermined in the nerves themselves. *A full account of these experiments will appear in the Journal of Experimental Zoölogy, Vol. IV, No. 2. Now in press.*

EMBRYOLOGICAL TRANSPLANTATIONS. By Warren H. Lewis. *Anatomical Laboratory, Johns Hopkins University.*

Read by title.

THE ACTION OF THE X-RAYS ON PARAMECIA. By Charles R. Bardeen. *University of Wisconsin.*

Last Spring I found that ova of the toad, fertilized by spermatozoa exposed to the Rœntgen rays, developed abnormally. I decided to test the action of the Rœntgen rays on uni-cellular organisms to see if the effect of the rays on the nuclei of the cells might not be specifically followed. Paramecia seemed to offer a good opportunity for this because of the macro- and micronuclei.

Schaudin[2] has shown that many protozoa are susceptible to exposure to the Rœntgen rays, while others are not thus susceptible. He tried only

[1] Harrison, Am. Journ. Anat., Vol. V, 1906.
[2] Pflueger's Archiv, 77, s. 29, 1899.

one form of infusoria. Joseph and Prowazek[1] found some apparent physiological changes in Paramecia exposed to the Rœntgen rays. Zuelzer[2] studied the action of radium on a number of protozoa and found some much more resistant than others. She found that multiplication of Paramecium ambiguum was stopped by 24 hours exposure to the rays, but that P. bursaria were much more resistant. A. Veneziana[3] found that Opalina ranarum retains vitality outside the body longer when exposed to radium than when not so exposed.

In my own experiments upon Paramecia and a number of other infusoria (Urostyla, Oxytricha, Halteria, etc.), I found that these organisms are very resistant to the Rœntgen rays. Twelve hours exposure to these rays had no apparent effect either on the morphology of the organisms or on their rate of division in cultures maintained for several weeks. No apparent effect was observed in conjugating individuals exposed to the Rœntgen rays, nor in their offspring. It is, therefore, apparent that there is a great difference in the susceptibility of various organisms to irradiation.

THE PRESENCE OF GRANULES IN THE INTERSTITIAL CELLS OF THE TESTIS. By R. H. Whitehead. *Anatomical Laboratory, University of Virginia.*

Quite definite granules are constantly found in the testis of mammals, including man. They can be demonstrated by iron-hæmatoxylin but are beautifully brought out by Bensley's modification of Reinke's neutral gentian violet, which has been found excellent for staining zymogen granules. In such preparations, the majority of cells contain spherical granules averaging about 1 mikron in diameter, often arranged in clusters. Each granule lies in a vacuole. They are most numerous towards the periphery of the cell, but are not confined to that locality. In the human testis the crystalloids are also stained by this method. The presence of these granules is of interest in connection with recent theories as to the function of the interstitial cells. They are very sensitive to the action of certain acids. Thus strong solutions of potassium bichromate and the common fixatives containing acetic acid dissolve them. They are best preserved by absolute alcohol or formalin. The granules are probably not related to spermatogenesis; for the undescended testis of the pig, in which the seminal epithelium is undeveloped or atrophied,

[1] Zeitschr. f. Allg. Physiologie, I, s. 142, 1902.

[2] Archiv f. Protistenkunde, 5, s. 358, 1905.

[3] Centralblatt f. Phys., 18, s. 130, 1905.

contains the granules in abundance. Their staining reaction and sensitiveness to acetic acid suggest that they may be zymogen granules. If they be granules of zymogen, it is not likely that they are granules of lipase; for, while the interstitial cells of most mammals are loaded with fat, that substance is practically absent from the interstitial cells of the pig's testis.

A CRITICISM OF SOME RECENT LITERATURE ON THE STRUCTURE OF THE LUNG. By WILLIAM SNOW MILLER. *From the Anatomical Laboratory of the University of Wisconsin.*

During the past fifteen years I have made a special study of the lung and have found a more or less spherical space interposed between the air-sacs and terminal bronchus to which I have given the name Atrium.[1]

By reconstruction methods I have demonstrated atria in the lung of the dog, the cat, the ox, the child, and adult man. The size and number of atria connected with a ductulus alveolaris (terminal bronchus) varies in the different lungs studied and even in different parts of the same lung. This is also true of the air sacs connected with the atria.

Two papers of recent date have questioned the presence of this atrium; the one[2] stating that it is a part of the ductulus alveolaris, the other[3] denying its existence, because he failed to demonstrate it by corrosion methods.

It is not necessary to discuss the first paper at length. It is merely a question of words. Schulze has recognized the space described by me and his figures show it, though he, as already mentioned, thinks it should not bear a special name.

Schulze has, however, misunderstood the nomenclature used by me in describing the structure of the lung. Though I stated in my earlier publication that the ultimate arrangement of the air spaces might be compared to a Pompeian house, the terms "peristylum" and "cubicula" were never applied by me to any air space.

In later contributions[4] after the publication of the B. N. A., I ac-

[1] Miller, W. S. The Lobule of the Lung and its Blood Vessels. Anat. Anz., 1892; The Structure of the Lung. Journ. Morphol., 1893.

[2] Schulze, F. E. Beiträge zur Anatomie der Säugetierlungen. Sitzungsber. d. Königl.-Preuss. Akad. d. Wissensch., 1906.

[3] Müller, J. Zur vergleichenden Histologie der Lungen unserer Haussäugetiere. Arch. f. mikros. Anat., Bd. 69.

[4] Miller, W. S. Das Lungenläppchen, seine Blut-und Lymphgefässe. Archiv. f. Anat. u. Physiol., 1900; Anatomy of the Lungs. Reference Handbook of the Medical Sciences, 1902.

cepted without hesitation its nomenclature and published tables showing the relation between it and my former nomenclature. I discontinued the use of the terms "vestibulum" and "faux;" the former because I found it had already been applied to various parts of the lung and led to confusion, the latter because it designated only an opening between air-spaces. For exact description of the lung parenchyma, I still think they could be used to advantage, for they form definite boundary points.

In regard to the second paper, I pointed out in my earliest publications that corrosions led to a misinterpretation of the finer structure of the lung. In complete injections of the lung, whether it be with wax or some one of the fusible metals, the atria are hid from view; in incomplete injections, the atria are usually mistaken for air-sacs.

It was the use of corrosions that led Delafield[1] and Roosevelt[2] into error. In their work they picked wax corrosions apart under a low power lens and found pieces which showed several broken surfaces. On the strength of this, they said that all the air spaces of the lung communicated with each other. A revival of a long forgotten and rejected theory.

Personally, early in my work I abandoned all corrosion methods except for demonstrating the gross arrangement of the bronchi; and even here it may lead to confusion depending on a distended or collapsed condition of the lung.

Because atria can not be easily demonstrated on corrosions is no argument that they do not exist in the lung. I can not agree with the frequent quotation from Toldt,[3] which, by the way, was written before reconstruction methods were in use, "Am besten aber lässt sich die Vertheilung und Anordnung der terminalen Luftwege an Corrosionspräparaten überblicken." Reconstruction, tedious though it is, is by far the best method of studying this complex structure.

THE ELECTRIC ORGAN OF ASTROSCOPUS AS COMPARED WITH THAT OF OTHER FISHES. By CHARLES F. SILVESTER. *Princeton University.*

[1] Delafield, F. Studies in Pathological Anatomy, Vol. I, 1882.

[2] Roosevelt, J. W. The Anatomy of the Thorax and Lungs. Medical Record, 1890; The Anatomy of the Lungs as Shown by Corrosion. N. Y. Med. Journal, 1891.

[3] Toldt, C. Lehrbuch der Gewebelehre, 1888.

CONCERNING A NEW GANGLIONIC MASS OF THE HIND-BRAIN, THE CORPUS PONTO-BULBARE.

By Charles R. Essick. *Student of Medicine, Johns Hopkins University.*

A ganglionic mass, accompanied by a layer of myelinated fibers, is found overlapping the restiform body just caudal to the dorsal cochlear nucleus. It forms a direct lateral process or extension of the ganglion mass of the pons. It is constantly present in all human brains, though in some brains it reaches a greater size than in others. Its relations and general characteristics are constant. It makes its appearance on the ventro-lateral surface of the pons near the emerging root bundles of the trigeminal nerve and extends backward, passing between the roots of the facial and acoustic nerves. It continues caudalward, passing dorsal to the glosso-pharyngeal nerve and ends on the dorsal surface of the restiform body forming part of the lateral boundary of the fourth venticle. It may end as a prominent tongue-shaped mass or may spread out as a thin coating of the restiform body that is only discernible microscopically.

THE MIGRATION OF MEDULLARY CELLS INTO THE VENTRAL NERVE ROOTS OF PIG EMBRYOS.

By F. W. Carpenter and R. C. Main. *University of Illinois.*

In sections of pig embryos 11 mm. long, medullary cells were observed apparently migrating from the neural tube in company with the fibers of the ventral nerve-roots. These cells have been found just inside the external limiting membrane in an intermediate position, half in and half out of the neural tube, and in the base of the nerve root just outside the limiting membrane. A few sections show continuous lines of medullary cells, touching end to end, and reaching from the nidulus across the boundary of the tube into the proximal part of the nerve root. These migrant cells do not appear to be directly connected with the embryonic nerve fibers. A few were observed undergoing mitotic division. Evidence of a similar migration of medullary cells has been seen in sections of a cat embryo.

In these medullary cells escaping from the neural tube we recognize the "indifferent cells" of Schaper. Such cells remaining in the medullary wall become either supporting elements (neuroglia cells) or nervous elements (neurones). Those which escape, in part at least, probably contribute to the formation of the sheaths of Schwann, which are supporting in function. Whether any migrant indifferent cells become the nerve cells of sympathetic ganglia we are at present unable to say.

UPON A POSSIBLE POSTERIOR PANCREAS IN MAMMALIAN EMBRYOS. By FREDERICK W. THYNG. *Embryological Laboratory, Harvard Medical School.*

THE PARA-THYMUS GLAND IN THE SHEEP. By ARTHUR W. MEYER, *Anatomical Laboratory, Johns Hopkins University.*

The term parathymus was first suggested by Remak (1855), to designate paired bodies in embryo cats homologous to those here discussed. It is retained here simply because it differentiates the parathyroids developing from the third branchial pouch in the sheep, goat, etc., from those developing from the fourth pouch. In the course of development the former come into relation with the thymus, the latter with the thyroid, hence the consistency of the terms parathymus and parathyroid. Stieda (1881) unwittingly described both pairs under the heading "glandula carotica." Others who have studied these many-named branchial derivatives are: Fischelis (1885), De Meuron (1886), Prenant (1893-4) Schaper (1895), Groschuff (1896), and Verdun (1897-8).

From careful dissections of a large series of sheep fœtuses of all ages with subsequent microscopical study, it is apparent that the parathymus glands in the sheep usually come into somewhat varying relationship with the cervical part of the thymus and consequently lie behind the angle of the lower jaw. This position is not constant, however, for they may lie anywhere in the region occupied by the thymus itself. As a rule, there are only two glands, as in case of the parathyroids, one on each side, but accessory glands remote in position and, rarely, minute in size, are not infrequently found.

Histologically they resemble the parathyroid glands, and are in certain stages and instances identical in structure, but there is evidence which indicates that degenerative changes of a part or of the whole of the parenchyma, resulting in a complete transformation of the gland, may take place. In adult sheep their size varies from 1.5-3.0 mm. and they are indistinguishable from hæmolymph glands by the naked eye.

GLYCOGEN IN THE NERVE CELLS OF THE BRAIN AND SPINAL CORD OF LARVAL LAMPREYS AND IN THE CENTRAL NERVOUS SYSTEM OF THE AMPHIOXUS FROM NAPLES. By SIMON H. GAGE. *Cornell University.*

A STATISTICAL STUDY OF THE SEX-CELLS OF CHRYSEMYS MARGINATA. By BENNETT M. ALLEN. *University of Wisconsin.*

Sex-cells were counted in embryos ranging in total length from 28 mm. to 18 mm. From the earliest period studied, to a stage of 10 mm. length, there is no multiplication of sex-cells. Great individual variation in their number (from 302 to 1744) was observed in all stages. All gradations between these two extremes were found.

During the greater part of this period in which there is no division of the sex-cells, they are migrating from the edge of the zona pellucida to their final positions in the sex-glands and elsewhere. Upon an average 47.7 per cent of them reach the sex-glands, while the number of such cells reaches the extremes of 24 and 71 per cent. There is a general correspondence in the number of sex-cells in the two sex-glands, the average being 255 for the right one and 231 for the left. No significance is to be attached to this slight difference, since first one side and then the other has the greater number. The greatest asymmetry of number was found in an embryo in which there were 239 sex-cells in the right sex-gland, as compared with 161 in the left. There is great variation in the number of sex-cells found in a given sex-gland, there being a range of from 78 to 601. While there is great variation in the number of sex-cells that reach the sex-gland, there is on the whole a far greater variation in the distribution of those that go astray. These come to rest in the intestine, mesentery and the region between the root of the mesentery, the aorta and the mesonephric Malpighian corpuscles. This region includes the Anlagen of the adrenal bodies. Eggs taken from the same nest show a general correspondence in the total number of sex-cells. In four embryos from one nest the total number ranged from 302 to 528, while in a set of five embryos from another nest it ranged from 1082 to 1740.

Two turtle eggs were studied in which there were two embryos on a single blastoderm. One of these was an egg of Chelydra serpentina, in which the axes of the two embryos were parallel, the embryos facing in opposite directions. The other egg was one of Chrysemys marginata, in which the embryos, likewise parallel, face the same way. In both these cases of double embryos, sex-cells were found normally associated with each embryo. Both of these double blastoderms were killed in the early stages (5 mm. total length), while the sex-cells were still in the endoderm at some distance from the median plane of the embryo. They were counted in the Chrysemys specimen and in two other embryos from the same nest, the following results being obtained:

	Embryo No.	Right Side.	Left Side.	Indeterminate.	Total No.
From same double blastoderm	8	756	364	67	1187
	9	839	329	100	1268
	10	836	401	90	1327
	11	515	364	16	894

It will be seen at a glance that each embryo of the double blastoderm has the normal number of sex-cells.

THE DUCTUS PANCREATICUS ACCESSORIUS IN MAN. By WESLEY M. BALDWIN. *Cornell University Medical School, Ithaca, N. Y.*

This investigation consists of a gross dissection of the ducts of about 100 adult human pancreases, followed by a histological examination of the papillæ and of the terminal portions of the bile and pancreatic ducts. Papillæ are reconstructed when occasion demands.

Six specimens, representing the findings in consecutive dissections, are now presented. All show a smaller minor papilla, generally located about 19 mm. above and in front of the major papilla, also an accessory duct possessing a corresponding relation to the main duct. The accessory duct in two specimens drains the right half, and in two others, nearly the whole of the anterior half of the head; in another it drains the right upper portion of the anterior half of the head. The accessory duct of another drains the whole of the body of the gland and the upper part of the head, does not communicate with the smaller main duct, and approaches the duodenum with a steadily increasing caliber. In one specimen the orifice of the major papilla is a vertical slit 8.5 mm. long; in another, the main duct joins the bile duct 14 mm. from the duodenum; in still another, the accessory duct undergoes a peculiar division and subsequent conjunction of the branches; only one specimen shows an accessory duct with a caliber diminishing from the main duct to its duodenal end.

INSERTION OF THE ABDOMINAL PORTION OF THE PECTORALIS MAJOR MUSCLE IN MAN INTO THE CAPSULE OF THE SHOULDER JOINT AND THE CORACOID PROCESS. By BASIL C. H. HARVEY. *University of Chicago.*[1]

Some fibers of this muscle were found to have this insertion in eighteen of fifty-one subjects examined in the dissecting rooms of the University of Chicago. They were usually found disposed in one of three ways: (1) (Only one instance observed), a layer of muscle in the same plane as the pectoralis minor and separated from it by only a narrow slit-like interval passed from the rectus sheath to be inserted into the crista tuberculi majoris, the tuberculum majus, the tuberculum minus, the joint capsule, and the coracoid process; (2) (common), the tendon of the abdominal part of the pectoralis major gave off at its insertion into the crista tuberculi majoris some fibers which passed upward as a delicate "lacertus fibrosus" to the joint capsule and the coracoid process; (3)

[1] Announced, but received too late to appear on program.

(common), from the posterior surface of the abdominal part of the muscle, some fibers passing upward as an aponeurotic membrane to the capsule of the shoulder joint and the coracoid process. These fibers, when traced downward, were found to curve medialward on the deep surface of the muscle and to be continuous there frequently with muscle fibers.

The first condition has been noted as a variation by Wood and conditions similar to the last two have been noticed by Calori, Varaglia and others. The first two conditions may arise by the persistence more or less complete of the continuity of the pectoralis minor and the abdominal part of the pectoralis major, noted in the human embryo by W. H. Lewis. Fibers in the third condition seem to be homologous with the panniculus carnosus of lower vertebrates.

A PRELIMINARY REPORT ON THE MEASUREMENTS OF ABOUT 1000 STUDENTS AT ANN ARBOR, MICHIGAN. By Robert Bennett Bean. *University of Michigan.*[1]

Measurements were made of 910 boys and 116 girls in the Freshman Class at the University of Michigan in 1905. Records are made of the height, weight, and chest girth, with the color of hair and eyes, and the length, breadth, and height of the head, as well as the shape of the head by outlines taken with lead tape, besides other items. The individuals may be classified in two sets of types, primary European, modified (65%), and mixed types (35%). The primary European types are the Northern (204), who is tall, with fair hair, blue eyes, and a long head; Iberian (180), with medium height, dark brown hair and eyes, and a long head; Alpine (107), of medium height, with brown hair and eyes and a broad head; and Eastern (89), of medium height, with fair hair, blue eyes and a broad head. Besides these there is the Vistulian (43), who is very short, with light hair, blue eyes and a mesocephalic head; a few individuals of other types and the mixed types made up of the combinations of the different other types in varying proportions. Mixed type I (83) has large stature, black hair, light eyes, and is usually mesocephalic; mixed type II (24), having brown hair, light eyes, medium stature, and mesocephalic head; mixed type III (38), having medium stature, blonde hair, dark eyes and a broad head; mixed type IV (12), having short stature, broad head, brown hair and blue eyes; and mixed type V (53), who is tall, with light brown hair, brown eyes, and a long head. A few other mixed types occur in small numbers.

[1] Announced, but received too late to appear on program.

The types are classified according to class standing as follows. The relative number who passed to those who received conditions is given, the latter being taken as 100.

BOYS.

Type	Pass	Con.
Eastern	220	100
Iberian	186	100
Mixed I	159	100
Northern	152	100
Mixed II	149	100
Mixed V	126	100
Alpine	118	100
Mixed III	100	100
Vistulian	77	100

GIRLS.

Type	Pass	Con.
Eastern	900	100
Northern	825	100
Iberian	625	100
Alpine	350	100

The class standing of the girls is higher than that of the boys. The Eastern type is at the top, the Vistulian at the bottom. There are 66 per cent more long heads than broad heads with high class standing and about the same number of each with low class standing. The Northern, Iberian, Eastern, and mixed type I predominate in the professional departments (engineering, law, and medicine), while the Alpine, Iberian, and mixed type II are more numerous in the literary department (languages, literature, and arts). The blondes seem to prefer the physical activity of the professions, while the brunettes prefer the sedentary life and sheltered career of literary work, with its intellectual activity.

There are more dolichocephalic than brachycephalic heads, and more mesocephalic heads than any other form.

The blondes form about 60 per cent of the total number, the brunettes 40 per cent.

REPORT ON THE ANATOMY OF SYMMELIAN. By WILLIAM DARRACH. *Department of Anatomy, Columbia University, New York City.*

NOTE ON THE PAROTID OF HYRAX CAPENSIS. By GEORGE S. HUNTINGTON. *Columbia University, New York City.*

DEMONSTRATIONS.

1. Charles R. Bardeen: Tadpoles developed from eggs fertilized by sperm exposed to Rœntgen rays. (University of Wisconsin.)
2. M. J. Burrows: Injections of the Posterior Cerebellar Artery. (Anatomical Laboratory, Johns Hopkins University.)
3. Charles R. Essick: Models and section of a new ganglion mass of the hind-brain, the corpus ponto-bulbare. (Anatomical Laboratory, Johns Hopkins University.

4. Herbert M. Evans: Injections showing the development of the vascular system of the pig. (Anatomical Laboratory, Johns Hopkins University.)
5. Simon H. Gage: Specimens showing glycogen and fat in the same connective tissue cells in larval lampreys. (Cornell University.)
6. George J. Heuer: Specimens showing the development of the lymphatics in the intestine. (Anatomical Laboratory, Johns Hopkins University.)
7. Eben Hill: Specimens showing the development of the vascular system in the testis. (Anatomical Laboratory, Johns Hopkins University.)
8. J. B. Johnston: Models of the brain of Petromyzon and Acipenser to illustrate the functional columns of the vertebrate brain. (University of West Virginia.)
9. Abram T. Kerr: *a*, Specimens showing ducts of the pancreas and their relation to the duodenum; *b*, Reconstruction of the internal ear of a one-month human embryo showing the terminal division of the eighth cranial nerve; *c*, Corrosion specimens illustrating methods of corrosion anatomy. (Cornell University Medical College, Ithaca, N. Y.)
10. Thomas G. Lee: Early developmental stages in Geomys bursarius. (University of Minnesota.)
11. Frederic T. Lewis: Preparations of Dr. James H. Wright, of Harvard University, illustrating the origin of blood-plates from the giant-cells. (Harvard University.)
12. Edward L. Mark: Electric wax cutter for use in reconstructions. (Harvard University.)
13. Arthur W. Meyer: Specimens showing the parathymus in the sheep. (Anatomical Laboratory, Johns Hopkins University.)
14. William S. Miller: *a*, Model of the lobule of the human lung; *b*, specimens showing the distribution of the bronchial artery in a number of mammals. (University of Wisconsin.)
15. L. L. Reyford: Specimens showing the development of the arachnoid spaces. (Johns Hopkins University.)
16. Robert Retzer: Gross and microscopical preparations of the atrioventricular bundle and Purkinje fibers. (Anatomical Laboratory, Johns Hopkins University.)
17. Florence R. Sabin: Models of the thalamus in the new-born babe. Anatomical Laboratory, Johns Hopkins University.)
18. Charles F. Silvester: Demonstrations of the electric organ of fishes. (Princeton University.)
19. Frederick W. Thyng: Demonstrations of reconstructions of a 17.8 mm. human embryo. (Austin Teaching Fellow, Harvard Medical School.)
20. George L. Streeter: Reconstruction models of the human embryo brain. (Wistar Institute of Anatomy, Philadelphia.)
21. Ewing Taylor: Model of the brain of a human embryo of 22.8 mm. (Department of Anatomy, University of Pennsylvania.)
22. R. H. Whitehead: Specimens showing granules in the interstitial cells of the testis. (University of Virginia, Charlottesville.)

ANNOUNCEMENTS.

An Austin Teaching Fellowship in the Department of Comparative Anatomy at the Harvard Medical School is vacant for 1907-8. The value of the fellowship is $500. The holder of it devotes somewhat less than one-half of his time to elementary teaching in histology and embryology. The remainder of his time must be devoted to an original research approved by the head of the department. Appointment may be renewed for a second year. Applicants should address Dr. Charles S. Minot.

Dr. Frederick T. Lewis of the Harvard Medical School, Boston, Mass., has been appointed Editor of the *American Naturalist*. The Editor desires contributions from "all naturalists who have anything interesting to say." Candidates for the higher scientific degrees are invited to contribute concise summaries of the special literature pertaining to their chosen topics. All manuscripts should be sent to the Editor.

THE ANATOMICAL RECORD.

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PROCEEDINGS OF THE ASSOCIATION OF AMERICAN ANATOMISTS

TWENTY-SECOND SESSION.

In Science Hall, University of Wisconsin, Madison, Wisconsin, March 28 and 29, 1907.

By a vote of the Association of American Anatomists, at its business session, the recommendation of the Executive Committee that this Association hold its twenty-third session in the Anatomical Laboratory of the University of Chicago during convocation week, the last week in December, 1907, was adopted.

ABSTRACTS OF PAPERS PRESENTED.

STUDIES ON THE DEMILUNES OF THE SALIVARY GLANDS. By ROBERT R. BENSLEY. *University of Chicago.*

SOME POINTS IN THE STRUCTURE OF THE GASTRIC MUCOUS MEMBRANE OF MAN. By DANIEL G. REVELL. *Hull Laboratory of Anatomy, The University of Chicago.*

The human gastric mucosa is very subject to pathological alteration, and *post mortem* changes occur rapidly. Very few fixing agents are efficient for the gastric glands; Bensley's alcoholic bichloride-bichromate is the best yet used. The author has studied well-fixed fresh material from gastrotomies and from early autopsies (one on a healthy young criminal executed). The chief cells correspond essentially with those of cat and dog, described by Bensley in 1898. The serous cells contain abundant zymogen and prozymogen. The mucous cells stain deeply in fresh undiluted Mayer's mucicarmin and in Mayer's muchematein of five-fold strength. They comprise: 1. The *surface and foveolar epithelium.* 2. The *chief cells of the neck* of the proper gastric glands (mixed here with numerous parietals). 3. The *pyloric gland cells.* 4. Most of the *cardiac gland cells* (these including also some parietal cells and a few serous acini). More interstitial tissue occurs with the mucous than with the serous cells. This is well seen in the region of the proper gastric glands where occasional long foveolæ or neck segments penetrate nearly to the muscularis mucosæ. These exceptional tubules have a much stronger connective tissue about them than have the adjacent serous tubules. The interstitial tissue is abundant throughout the pyloric and the cardiac mucosa. Everywhere it is most developed in the interfoveolar situation, where cellular elements, especially Unna's plasma cells, are remarkably numerous.

Since the pathological histology of the gastric mucosa must be based on a knowledge of the normal, it has necessarily not yet been written.

THE ECTOBLASTIC ANLAGE FOR THE BULBO-VESTIBULAR GLANDS.

By A. G. POHLMAN. *Indiana University.*

The communication consisted of a report on the relations found in a 22 mm. and a 24 mm. human embryos. The usual description of the origin of these glands (ectoblastic invagination of urogenital sinus) not found. The writer agrees with Keibel's findings in Echidna, namely, that the glands are ectoblastic but differ from the relations found in the monotreme. In the latter the glands form before the ectoblastic invagination; in the former, the glands form after the ectoblast is included. The communication was illustrated by models made by the wax-plate method.

THE STRUCTURE OF THE HARDERIAN GLANDS OF THE OX.

By JOHN SUNDWALL. *University of Chicago.*

This gland is composed of two distinct portions, an anterior and posterior, which are different both in regards to structure and staining reactions.

The anterior portion of the gland forms about two-thirds of the gland mass. It is located at the base and sides of the posterior part of the cartilage in the nictitating membrane. The gland is subdivided into lobules by connective tissue septa derived from the capsule. It is tubulo-acinous in form, resembling very much the lachrymal gland in structure and reactions to stains. Sections fixed in Zenker's solution and stained in muchematein show numerous granules in the cells of intercalary ducts, which are deeply stained. These granules are seen for some distance in the intralobular ducts. No other structures in the gland are stained.

Sections fixed in Bensley's solution, stained in iron hæmatoxylin and counterstained in mucicarmin show granules in the tubules, intercalary ducts, and for some distance in the intralobular ducts. Cells are seen which possess granules stained by the hæmatoxylin only. Other cells possess red granules stained by the mucicarmin, while other cells possess a mixture of granules, some stained black, others red. The distribution of these granules in similar cells and in the different types of cells in the tubules and ducts is irregular.

The posterior portion of the gland is characterized by wide-open tubules lined by a single layer of cuboidal cells. These cells are not stained in muchematein or mucicarmin. Sections prepared by the above method and stained in iron hæmatoxylin or neutral gentian show many of these cells to contain large granules which are few in number. The lumen of these tubules is usually filled with homogeneous substance which has no specific stain. Tubules possessing the structure and staining reactions of the anterior gland are scattered throughout the posterior gland.

THE VASCULAR SUPPLY OF THE PLEURA PULMONALIS. By William S. Miller. *University of Wisconsin.*

Continued experiments confirm the results previously obtained, namely, that in the dog the pleura pulmonalis receives its vascular supply from the pulmonary artery.

Here and there branches of the pulmonary artery extend to the pleura and break into a network of capillaries having a very coarse mesh and which eventually form radicles that empty into the pulmonary vein. The lymphatic trunks also receive a special supply of blood vessels.

In the sheep the blood supply of the pleura is principally derived from branches of the bronchial artery which proceed directly to it from the hilus of the lung and from a main trunk which runs in the ligamentum pulmonale. The main branches of the bronchial artery run nearly parallel to each other; between these branches there is a coarse network of capillaries.

The bronchial artery also provides a special set of vessels for the lymphatics.

In the horse the pleura is supplied directly from the bronchial artery. The branches which pass to the pleura being larger than in any other animal studied.

In man the pleura also receives its vascular supply from the bronchial artery but in a different manner from the sheep and horse.

The artery sends but a few branches directly to the pleura; in some specimens, none. The artery reaches the pleura after having traversed the lung. When the branches of the bronchial artery reach the pleura they spread out palmately and ultimately break up into a coarse network of capillaries.

The lymph trunks of the human pleura have a vascular supply which is derived from the bronchial artery. This differs from that in the dog and sheep in that it forms more of an encircling network of vessels.

In all the forms mentioned the blood is carried away from the pleura chiefly by the pulmonary veins. Only at the hilus of the lung do we find what may be called true bronchial veins. These receive the blood from the first, sometimes from the first two, divisions of the bronchial tree and from the pleura about the hilus of the lung. They empty into the azygos, the hemi-azygos, or one of the intercostal veins.

A SIMPLE ELASTIC TISSUE STAIN. By LYDIA M. DEWITT. *University of Michigan.*

For the last two years we have used, in this laboratory, for tissues to be stained in Van Gieson's acid fuchsin-picric acid mixture, the iron hæmatoxylin modification published by Weigert in Zeitschrift für wissenschaftliche Mikroskopie, Vol. 21, 1904. By this method two stock solutions are made: (1) a 1 per cent solution of hæmatoxylin in 96 per cent alcohol, and (2) an iron solution made according to the following formula, which has been changed from the German to the United States pharmacopeia:

Liquor ferri sesquichlorati (U. S. P.)	40 c.c.
HCl (sp. gr. 1.20)	7 c.c.
Distilled water	950 c.c.

Equal parts of these two solutions are mixed immediately before using. The sections are stained about one hour and then counterstained in the Van Gieson mixture The nuclei are black, while the other tissues appear as in the ordinary hæmatoxylin and Van Gieson stain.

Last year, by a mistake in mixing the solutions, Mr. Snow, the laboratory assistant, obtained a very satisfactory stain of the elastic fibers. Weigert also mentions that the method may be modified to stain elastic fibers, but does not describe the modification and states that he was unable to obtain uniform results.

I was, therefore, led to experiment with the method in the hope of finding a simple method of staining elastic fibers, which might easily be used for class work. The method, as now used, consists in mixing four parts of the 1 per cent alcoholic solution of hæmatoxylin with one part of the ferric chloride solution. The sections are stained in about thirty minutes. Two parts of the hæmatoxylin to one of the ferric chloride solution may be used and the sections then require about one hour in the stain. They are then differentiated for about fifteen minutes or more in the Van Gieson mixture, the differentiation being from time to time controlled under the microscope. The elastic fibers are dark blue to blue black, while the other tissue elements have the colors characteristic for the Van Gieson stain. The color is not easily washed out of the elastic fibers. The sections may also be differentiated in acid alcohol and then counterstained, if desired, in eosin or other red protoplasmic stain.

The method succeeds well after formalin, formalin-Müllers, Müller's, or alcohol fixation and can probably be used after any of the ordinary fixing solutions.

Sections fixed to slides or cover glasses may be used, but a longer time is required and the stain is usually not so complete. I have obtained the best results with relatively thin sections embedded in the photoxylin sheets.

While it is not claimed that this method is as sharp a differential stain for the elastic fibers as, for instance, the Weigert elastic stain, its simplicity commends it for class use.

The advantages of the method then, are:

1. Its extreme simplicity, no special stain, no long time and no difficult technic of differentiation being required.

2. The fact that in the same section all the tissue elements are stained so that the relations of the elastic fibers to the other tissue elements are apparent at a glance.

ON THE VEINS OF THE KIDNEYS OF CERTAIN MAMMALS. By G. CARL HUBER. *University of Michigan.*

A brief report was given of observations made on celluloid corrosions of the veins of the kidneys of the rabbit, guinea pig, rat, cat, and dog, and attention was drawn to three distinct types of venous distribution in the kidneys of the animals studied. In the rabbit, guinea pig, and rat the veins begin in the cortex of the kidney in radial branches, the course of which is similar to the arterial interlobular branches. They end in the arcuate veins, which also receive the venulæ rectæ; the arcuate branches leaving the kidney at the hilum. The diagrams of the veins of the kidneys generally given conform with this type. In the cat there is found immediately under the capsule a system of veins which all along their course receive radicles which drain about the outer half of the cortex.

Another system of veins corresponding to the arcuate veins and situated in the boundary zone between cortex and medulla receive short interlobular veins, which drain the lower half of the cortex and receive also the venulæ rectæ. The two systems unite at the hilum. In this there are found immediately under the capsule relatively large veins, receiving venous radicles which drain about the outer half of the cortex, which do not, however, converge at the hilum as in the cat but form numerous relatively large veins which pass vertically through the cortex to end in the arcuate veins, there receiving also short interlobular branches, which drain the lower half of the cortex as well as the venulæ rectæ, which return the blood from the medulla. A vascular unit consisting of an interlobular artery and several interlobular veins with the intervening uriniferous tubules may be described for the rabbit, guinea pig, and rat, but such a description would not be applicable for the kidney of the cat ana dog. The vascular unit of the kidney is probably much larger than is generally described, it has, however, not been definitely determined.

NOTES ON A PAIR OF FULLY-DEVELOPED CERVICAL RIBS. By J. PLAYFAIR McMURRICH. *University of Michigan.*

A subject recently dissected in the Anatomical Laboratory of the University of Michigan showed a complete development of the costal processes of the seventh vertebra on both sides, each rib terminating in a costal cartilage which united with that of the rib attached to the eighth vertebra immediately lateral to its insertion into the manubrium sterni. The heads of the ribs articulated with the body of the seventh vertebra and each possessed a broad tubercle which articulated with a transverse process of the vertebra. In its general form each rib resembled a normal first rib.

In addition there were twelve other pairs of ribs, the last of which were very short and resembled separated costal processes of a lumbar vertebra. The vertebræ numbered 33. The atlas and axis were normal and were succeeded by 4 non-costiferous vertebræ, upon which followed 13 rib-bearing vertebræ, then 4 without free ribs, then 6 fused to form the sacrum and then 4 coccygeal. There was, therefore, a slight departure from the normal arrangement if the first rib-bearing vertebra be referred to the cervical set. It seems preferable, however, to regard this vertebra as the first thoracic, and the last rib-bearing vertebra as the first lumbar, and furthermore, to consider the additional sacral vertebra to be the first coccygeal, the entire formula being 6 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 5 coccygeal.

Several interesting peculiarities were observed in connection with the soft parts.

1. The vertebral artery entered the foramen of the sixth transverse process.

2. The subclavian artery and the brachial plexus passed over the rib of the seventh vertebra, as is usual in such cases. It may be noted that this relation of the artery is a confirmation of its usual identification as the intercostal artery of the seventh cervical segment.

3. The nerves forming the brachial plexus were those usually contributing to it. The lower trunk was formed by the eighth and ninth nerves, which made their exit below the first and second ribs respectively and passed upwards over the necks of these ribs to join the other portions of the plexus. From the ninth nerve the intercostal nerve for the first intercostal space was given off.

4. The anterior scalene muscle was inserted into the first (the so-called cervical) rib.

5. The first intercostal space was provided with both an external and an internal intercostal muscle. The external intercostal presented the pecularity, however, that its fibers were directed almost vertically downwards, having, indeed, the same general direction as those of the anterior scalene muscle; a fact which may perhaps be regarded as indicating the homodynamy of the scalene and intercostal muscles.

6. The nerves of the lumbar plexus exhibited what may be termed a præ-fixed arrangement. The ilio-hypogastric and ilio-inguinal nerves arose from the 20th nerve, the genito-femoral from the 21st (no filament from the 20th or 22d was observed), the lateral cutaneous from the 21st and 22d, the femoral from the 22d, 23d, and 24th (possibly also from the 21st), the obturator from the 22d and 23d (possibly also from the 21st), and the lumbo-sacral trunk from the 24th.

The occurrence of a cervical rib is, of course, the excessive development of a rudiment normally present, but the conditions which determine or are associated with the undue development are not so evident. Three associated conditions may be imagined: (1) The development of the extra rib may be a local affair not affecting the general segmentation of the body; (2) it may be associated with the intercalation of an additional vertebra, as in several cases reported by Garré and Drehmann in which there was also scoliosis; (3) it may be associated with a more or less distinct forward transference of the characteristics of the segments, the last cervical segment, for example, assuming the characters of the first thoracic and the last thoracic that of the first lumbar.

This last condition, I believe, is that occurring in the present case.

CONGENITAL ADHESIONS IN THE COMMON ILIAC VEINS. By J. PLAYFAIR McMURRICH. *University of Michigan.*

At the Toronto meeting of the British Medical Association, last August, I reported some observations upon the arrangement of the valves of the common and external iliac veins in man, and, at the same time, took occasion to record the not infrequent occurrence of an adhesion of the dorsal and ventral walls of the left common iliac vein, whereby its lumen was suddenly and in some cases greatly reduced shortly before its entrance into the inferior vena cava.

Since then I have been able to extend my observations on these adhesions to a greater number of cases and can now report upon the conditions observed in the veins of 57 individuals. In these the adhesion occurred in 17 cases, and, with one exception, was in the left vein. Expressed in percentage, the adhesion occurred in 29.8 per cent of the cases examined and in 28 per cent of the left veins.

As regards the form of the adhesion three general types may be recognized.

1. In the first type the adhesion occurs at the lateral border of the vein, appearing as a narrow thickening of the vein about 2 mm. or more in length; the diminution of the lumen in cases of this type is inconsiderable.

2. In the second type the adhesion is also situated toward the lateral border of the vein, but is triangular in form; its base corresponds to the lateral border of the vein and has a length of 4 or 5 mm., and the apex projects towards the centre of the lumen, the height of the triangle being about equal to the length of the base. In this type the reduction of the lumen of the vein is considerable, and may amount to a sudden diminution to one-half the original diameter.

3. In the third type the adhesion has the form of a column, measuring anywhere from 1 to 4 mm. in diameter and occurring anywhere from the center of the lumen of the vein to within a millimetre or so of its lateral border. In cases of this type the lumen is divided for a short distance into two portions, and the frictional resistance to the passage of the venous blood must thereby be considerably increased.

A clue to the morphological significance of the adhesion may be afforded by the single case in which the anomaly which I take to represent it occurred in the right vein. In this case the vein was double for a considerable portion of its course, or, to express it slightly differently, it presented a loop formation. What may have passed through the loop I am unable to state (as my attention was not called to the vein until it had been dissected free from neighboring parts, but the student performing the dissection informed me that he found no structure traversing the loop. I take it, however, that the loop represents an embryonic condition, occurring, perhaps, in connection with the primary course of the umbilical artery and that the adhesions represent an imperfect disappearance of the loop, either by a fusion of the two limbs or by a reduction of the lateral limb. The embryonic loop arrangement almost invariably disappears in the right side, but frequently persists in a rudimentary form on the left, the inhibition of development upon this side being probably due to the relation of the right common iliac artery to the vein.

THE NERVES AND NERVE-ENDINGS IN THE MEMBRANA TYMPANI.

By J. Gordon Wilson. *University of Chicago.*

The observations of Kessel, Jacque, and Calumida were noted. In the present communication the nerve distribution is considered: I, in the *membrana flaccida;* II, in the *membrana tensa.*

I. In the *membrana flaccida* the nerves pass over in several bundles and cross the plica anterior and posterior at various points. It is a membrane very rich in nerves, not only because of numerous branches passing down through it, but also because of the plexuses and endings peculiar to itself.

From the bundles nerves pass off to form a *non-medulated* plexus (ground or fundamental plexus). From this plexus branches pass off:

(a) To membrana tensa.

(b) To form a sub-epithelial plexus with inter-epithelial endings.

(c) To end in the sub-cutaneous tissue chiefly as arborisations.

II. The nerves for the *membrana tensa* come from two directions.

From *membrana flaccida.*

From the external auditory meatus at the limbus.

(1) Those coming from the *membrana flaccida* are directed towards the manubrium and reach it not as one but as separate bundles along its upper third. The main trunks may run down one or both sides of the manubrium; from these, branches pass off as follows:

(a) Over the external and internal surface of the manubrium, forming plexuses.

(b) At regular intervals branches pass toward the periphery. Each of these gives off branches and finally arrives at the limbus as a very fine fibril. The branches given off form plexuses in the membrana propria (ground or fundamental plexua).

(2) The nerves which enter from the external meatus enter around

the circumference. As they approach the membrana tensa they break up to form an annular plexus lying on both sides of the limbus. From these, fibers pass directly into the membrana tensa and also into the tympanic cavity. Those passing into the membrana tensa are directed toward the manubrium. As they pass forward they give off branches into the ground plexus and ultimately are lost in the manubrium plexus. Those passing into the tympanic cavity supply the surrounding mucous membrane.

From the ground plexus fibers pass to form a sub-epithelial plexus which give off inter-epithelial endings. No true arborisations are seen. The distribution of the nerves in the membrana tympani is comparable to that of the cornea. The sensation produced by touching the membrana tensa seems also comparable to that similarly produced on the cornea.

A NEW THEORY OF TONE PERCEPTION BASED ON SOME NEW FACTS IN THE RELATION OF THE STRUCTURES FOUND IN THE COCHLEA. By George E. Shambaugh. *University of Chicago.*

In making a study of the structure of the membrana basilaris in the various parts of the cochlea, I have come across conditions which I believe demonstrate that this membrane cannot be the vibrating structure which it was believed to be by Helmholtz. I found that this membrane, at a considerable distance from the point where the cochlear tube begins, became so thick and rigid as to preclude any idea of its being a vibrating structure. In other labyrinths I found in this part of the cochlea complete absence of any structure that could properly be called a basilar membrane. Here the crista of the ligamentum spirale, as seen in a section, tapering gradually to a point, is attached directly to the labium tympanicum. There is no basilar membrane and the perfectly formed organ of Corti rests on the stiff rigid structure of the crista of the spiral ligament.

Since these preparations show conclusively that the stimulation of the hair cells of the organ of Corti in this part of the labyrinth cannot be accomplished through a vibrating membrana basilaris, it is not logical to assume that in other parts of the cochlea, where the membrana basilaris may appear capable of vibrating, the stimulation of the hair cells must be accomplished through this means.

I have found that the membrana tectoria does not float free in the endolymph above cells forming the organ of Corti, but that it is attached by means of the Streifen of Hensen to the supporting cells just internal to the inner row of hair cells, and, furthermore, that the hairs of the hair cells normally project into the under surface of the membrana tectoria. This relation of hair cells and tectorial membrane makes it impossible for the impulses passing through the endolymph to come in direct contact with the hair cells and invalidates the hypothesis that these cells may act as their own agent in selecting their stimuli directly from the impulses in endolymph.

The logical conclusion, since the basilar membrane cannot vibrate, is that the membrana tectoria mediates impulses passing through the endolymph to the hair cells.

The membrana tectoria is found to vary greatly in size from one end of the cochlea to the other. It contains an immense number of delicate fibrils which vary in length with the varying size of the membrane, the longest occuring at the apex, the shortest near the beginning of the basal coil. The fibrils are supported and held together by a homogenous semifluid substance. These characteristics of the membrane tectoria make it possible for the membrane in one part of the cochlea to respond to impulses of a certain pitch and in another part to impulses of another pitch. The impulses being first taken up by the fibrillæ are then transmitted to the membrane as a whole.

The vibrations in the membrana tectoria produced by a particular tone involve a considerable area of this structure and necessarily stimulate a more or less extensive group of hair cells. The nerve impulses arising from all the hair cells thus stimulated come together in the brain center of the cortex when the tone picture forms the final step in the perception of this particular tone.

ON THE RELATION OF THE LECITHIN CONTENT OF THE STROMATA OF ERYTROCYTES. By Preston Kyes. *University of Chicago.*

THE FASCIA ON THE UPPER AND LATERAL PART OF THE THORACIC WALL, AND ITS RELATION TO THE M. SCALENUS MEDIUS AND SERRATUS ANTERIOR. By James Patterson. *University of Chicago.*

In studying the fascia on the upper and lateral part of the thoracic wall, I have made some observations which are to a large extent confirmatory of those reported by Livini, 04. In this region there is a fan-shaped sheet of fascia, attaching above to the anterior surface of the first rib, from the costal cartilage to the insertion of the M. scalenus medius, and extending downward and lateralward to the second and third ribs, and to that part of the M. serratus anterior arising from them. In seventeen of forty-five subjects examined the upper and lateral part of this fascia formed a strong ligamentous band extending from the anterior border of the M. serratus anterior to the first costal cartilage. This band is identical with the fibrous arch between the first and second ribs, from which part of the M. serratus anterior is said to arise. In one other case fibers of the M. serratus anterior were prolonged forward in the fascia to the first costal cartilage. In two cases further the M. scalenus medius was related to this fascia, once extending superficial to it and the M. serratus anterior as far as the second rib, and in the second instance extending to that rib internal to the serratus.

This fascia cannot be regarded as a rudimentary M. supracostalis, which Cals, 02, takes to be a downward prolongation of the M. scalenus medius, because its fibers do not follow the downward and medialward direction of those of that structure, and because the two structures may be coexisting, as is noted above. Neither can it be considered as a cephalad prolongation of the M. rectus abdominis because reported cases of the latter are stronger in the lower than in the upper intercostal spaces, and their fibers pass upward and lateralward in the upper intercostal spaces. The same reasons debar one from homologizing it with the M. sternocostalis externus of lower vertebrates. As we cannot regard it is a derivation of either of these three structures we are limited, in determining its derivation, to a consideration of the M. serratus anterior, a derivation from which is positively indicated by the direction of the fibers, their frequent continuity with those of the muscle or its perimysium, and the occasional prolongation forward in the fascia of fibers of the M. serratus anterior. This derivation may be explained by considering that the serratus premuscle mass becomes attached to the developing first rib of the embryo and that part of this attachment persists as the muscle migrates caudalward to its position in the adult.

THE USE IN THE DISSECTING-ROOM OF AIR-PRESSURE IN DEVELOPING FASCIAL COMPARTMENTS. By Henry J. Prentiss. *State University of Iowa.*

I have found it difficult for my students, particularly of the Sophomore Class, to recognize the necessity of understanding the various fascia, both superficial and deep. By knowing the coverings they necessarily will accurately locate the contained structures. They also have had a very hazy idea of the interesting facial compartments and channels, so important of understanding when related to the various extravasations met with in practice. I therefore developed in my laboratory in the State University of Iowa a system which is here described.

An old water tank of a capacity a 60 gallons was connected to an air pump which works automatically, keeping a steady pressure of about 40 pounds. From the tank ¾-inch iron pipes radiated to the different tables. Flexible tubing leads from the cross arms to each body. A valve placed at the junction of the flexible and iron tube controls the air pressure. At the other end of the flexible tube is attached a cannula with a lumen of 3/32 of an inch. It is also provided with a stop-cock. Thus the student can perfectly control the pressure. It is found a most useful adjunct to the work. The compartments in the neck, in the perineum, in the inguinal region are thus demonstrated and seen. The abdomen with its many fascial as well as peritoneal layers is easily studied. The broad muscle attachments of the trunk and compartments of the extremities are quickly demonstrated. The method can be highly recommended to teachers in other laboratories.

THE FIFTH AND SIXTH AORTIC ARCHES IN BIRDS AND MAMMALS. By WILLIAM A. LOCY. *Northwestern University.*

TELEOSTS WITH A CONUS ARTERIOSUS HAVING MORE THAN ONE ROW OF VALVES. By HAROLD D. SENIOR. *Washington University, St. Louis, Mo.* With 1 figure.

The teleostean genera believed to be most closely related to Amia calva are Elops, Megalops, Tarpon, Albula and Pterothrissus, the first three belonging to the family Elopidæ and the last two to the Albulidæ. In all these genera the heart has a distinct muscular conus arteriosus which is, except in the case of Elops, furnished with two transverse tiers of valves.

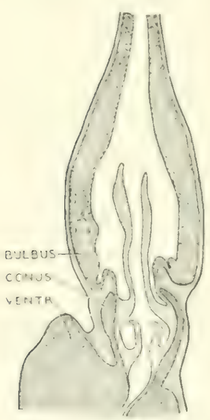
That Butirinus (Albula) differed from the majority of teleosts in having two tiers of valves at the arterial end of the heart, was pointed out by Stannius in 1846. An excellent description of the heart of this fish was given by Boaz in 1880 in the light of Gegenbaur's important work showing the essential difference between comus and bulbus.

Johannes Mueller, Ueber den Bau und die Grenzen der Ganoiden, 1846, remarks that Elops, among other teleosts examined by him, has only one tier of arterial valves, a statement which has been verified by an examination of two specimens of E. saurus.

A description of the conus in Tarpon atlanticus appeared in the Biological Bulletin for last February, and a note on the conus of Megalops cyprinoides will appear in the same journal in April or May. The heart from a specimen of Pterothrissus gissu (Hilgendorf) measuring 24.5 cm. including caudal fin is here described for the first time.

The conus arteriosus in Pterothrissus is plainly visible from the exterior although its base is, ventrally and to the right, to some extent buried in the ventricle. Dorsally and to the left the conus is in contact with visceral pericardium practically from end to end. The bulbus, which is not so dilated as is usual in teleosts, very slightly overlaps the adjacent portion of the conus.

The conus valves are arranged in two tiers, each tier having a right and left cusp meeting, when in apposition, at the mid-sagittal plane. The accompanying figure, showing the ventral surface of a frontal section (X 10) passing through the middle of the valves, indicates the general relations of the conus. The prodigious depth of the distal cusps as compared to the shallower corresponding cusps of Albula, Megalops, and Tarpon, is the most remarkable feature in this heart, and strongly reminds one of the deep distal cusps in Amia.



Frontal section of the conus Arteriosus in Pterothrissus.

The conus is proportionately longer in Pterothrissus than in any other form of teleost. The average length of conus as compared with ventricle (measured from the apex to the root of conus) is as 1 to 3.5. In Megalops this proportion is 1 to 4 (judging from the figures given by Boaz the proportion is about the same or slightly less in Albula); in Tarpon the proportion is 1 to 4-5.

The atrio-ventricular valve in Pterothrissus is placed to the left of the midline and has four cusps.

THE HEREDITARY NATURE OF VARIATION IN THE OSSIFICATION OF BONES. By J. W. Pryor. *State College of Kentucky, Lexington, Kentucky.*

While investigating the time of the appearance of centers of ossification in the bones of the human body, I have made the following observations:

First.—The process of ossification is inaugurated much sooner than hitherto supposed.

Second.—The bones of the female ossify in advance of the male. This is measured at first by days, then months, then years.

Third.—The chronological order in which the bones of the carpus are ossified is different from that formerly supposed.

Fourth.—The bones of the first child, as a rule, ossify sooner than those of subsequent children of the same parents.

Fifth.—Regardless of the variation (normal), the ossification is bilaterally symmetrical.

Sixth.—The union of the epiphyses with the shaft takes place much sooner than formerly supposed.

Seventh.—Variation in the ossification of bones is a heritable trait.

I have based my conclusions on the study of 360 skiagrams of the hands of children ten years of age and younger, 300 of which are under seven years of age.

In this number we have 225 families represented. I have recorded the observations as they occurred. The limits of this abstract will permit a discussion of the seventh conclusion only: Variation in the ossification of bones is a heritable trait. This may be proved in two ways: 1st, by the chronological order in which the bones of the carpus are ossified; 2d, by the appearance of extra epiphyses.

The chronological order in which the bones of the carpus are ossified, that is in the majority of the instances, is as follows: The *Os Magnum* 1st, *Unciform* 2d, *Cunieform* 3d, *Semilunar* 4th, *Scaphoid* 5th, *Trapezoid* 5th, *Trapezium* 7th, *Pisiform* 8th.

This order differs in some respects from the order in which they are placed by others. Some place the Trapezium 5th and the Scaphoid 6th. Others place the Trapezium 4th and the Trapezoid 7th.

I have based my conclusions upon the following. In 174 instances the Os Magnum appeared first 172 times and twice in the second place. The Unciform appeared twice in the first place and 172 times in the second place. In 160 instances the Cunieform appeared in the third place 152 times and eight times in the fourth place. In 133 cases the Semilunar appeared in the fourth place 115 times, nine times in the third place, three times fifth, four times sixth, and twice in the seventh place.

In 72 cases the Scaphoid appeared in the fifth place 46 times, 12 times in the sixth place, 12 times in the seventh place, and twice in the fourth place. In 81 cases the Trapezoid appeared in the sixth place 25 times, 33 times in the fifth, seven times in the fourth, seven times in the seventh, and in nine instances I have classed it doubtful. In 77 instances the Trapezium appeared in the seventh place 25 times, in the fifth place 17 times, in the sixth place 21 times, in the fourth place seven times, and in seven instances it is doubtful. I have never observed the Pisiform in any position but the eighth. This is shown in tabular form on the following page.

The chronological order of ossification does not correspond with the order of Lize, the latter is: Os Magnum 1st, Unciform 2d, Scaphoid 3d, Trapezium 4th, Semilunar 5th, Cunieform 6th, Trapezoid 7th, Pisiform 8th. The rate of deposit of lime salts in the larger bones exceeds that of the smaller.

In proof of this I have several instances in which the nucleus of the trapezoid and that of the trapezium are of the same size, about 1 mm. in diameter. A negative of the same hand taken one year later shows the nucleus of the trapezium very much the larger. Then in those instances in which the unciform has preceded the Magnum, we find the latter will grow faster than the former, when the child is about two years of age the

CHRONOLOGICAL ORDER OF OSSIFICATION.

Position.	Magnum.	Unciform.	Cunieform.	Semilunar.	Scaphoid.	Trapezoid.	Trapezium.	Pisiform.
First	172	2	......	......	......	......	......	......
Second	2	172	......	......	......	......	......	......
Third	......	......	152	9	......	......	......	......
Fourth	......	......	8	115	2	7	7	......
Fifth	......	......	......	3	46	33	17	......
Sixth	......	......	......	4	12	25	21	......
Seventh	......	......	......	2	12	7	25	......
Eighth	......	......	......	......	......	......	......	......
Doubtful	......	......	......	......	......	9	7	......
Total	174	174	160	133	72	81	77	......

Magnum will be the larger. Notwithstanding this is a fact, I have omitted all instances that required this to establish the claim for position and have included only those instances in which the size of the nucleus showed positive evidence of the position claimed for the bone.

While I think the rate of growth is conclusive evidence, I have preferred to omit the element of judgment and use only that of fact.

Had I used the former in at least 200 other instances it would have corroborated the observation made, increased the majority, but would not add weight to the observation. Referring to the table at the close of this article, the first mentioned is that of the family of Prof. M., who kindly gave me the opportunity of examining the hands of four of his children from the age of seven months to ten years. The youngest of these hands is that of P. M., male, age seven months and nineteen days. There is, of course, nothing to be shown in the chronological order in this hand except the appearance of the unciform in advance of the Os Magnum. In the hands of the older brother and sister the order of ossification is alike, viz.: Unciform 1st, Magnum 2d, Cuneiform 3d, Semilunar 4th, Scaphoid 5th, Trapezoid 6th, Trapezium 7th. It may be asked what proof have I that the Unciform preceded the Magnum in these older hands. This could not be proved by these hands but knowing that this is the order in which the youngest brother's bones are ossified, and having

	Name.	Sex.	Age. *Y.*	*M.*	*D.*	Child of parents.	Magnum.	Unciform.	Cuneiform.	Semilunar.	Scaphoid.	Trapezoid.	Trapezium.	Pisiform.	1st Metacarpal distal.	2nd Metacarpal proximal.
1.	R. M.	F.	8	1	6	3d.	2	1	3	4	5	6	7	....	....	....
	G. M.	M.	8	5	11	4th.	2	1	3	4	5	6	7	....	....	....
	P. M.	M.	1	11	16	5th.	2	1	....	....	....	....	....	....	....	....
2.	H. P. R.	F.	5	11	16	1st.	1	2	3	4	7	5	6	....	....	....
	C. R.	F.	3	7	26	2d.	1	2	3	4	....	5	....	....	....	....
	J. K. R.	M.	2	1	7	3d.	1	2	....	....	....	....	....	....	....	....
3.	M. L. B.	F.	8	4	13	2d.	1	2	3	6	5	4	7	....	....	....
	C. B.	F.	5	9	17	3d.	1	2	3	....	5	4	....	....	....	....
4.	A. M. R.	F.	8	2	14	1st.	1	2	3	5	4	7	6	....	....	....
	E. T. R.	M.	5	10	3	2d.	1	2	3	5	4	....	....	....	....	....
5.	M. E.	F.	5	7	0	1st.	1	2	3	5	6	7	4	....	....	....
	J. E.	M.	4	1	19	2d.	1	2	3	....	....	....	4	....	....	....
6.	H. W.	M.	5	2	21	1st.	1	2	3	4	....	....	5	....	....	....
	E. W.	F.	2	11	0	2d.	1	2	3	4	....	....	5	....	....	....
7.	L. B. M.	M.	9	9	14	7th.	1	2	3	4	7	6	5	....	....	....
	R. M.	M.	8	2	25	8th.	1	2	3	4	....	6	5	....	....	....
	W. M.	M.	7	3	25	9th.	1	2	3	4	....	....	....	....	....	....
	E. M.	M.	5	2	12	10th.	1	2	3	4	....	....	....	....	....	....
	J. M.	F.	3	11	22	11th.	1	2	3	4	....	....	....	....	....	....
	L. M.	M.	2	7	19	12th.	1	2	....	....	....	....	....	....	....	....
8.	B. R.	F.	....	....	....	....	1	2	3	4	5	6	7	....	....	....
	E. R.	F.	....	....	....	....	1	2	3	4	5	6	7	....	....	....
9.	M. K. (twins)	F.	....	....	....	....	1	2	3	4	6	7	5	....	....	....
	M. K. (twins)	F.	....	....	....	....	1	2	3	4	6	7	5	....	....	....
10.	B. S. (twins)	F.	6	7	7	8th.	1	2	3	4	5	7	6	....	....	....
	B. S. (twins)	F.	6	7	7	9th.	1	2	3	4	5	7	6	....	....	....

a number of other instances in which the order is preserved, there being also no positive exceptions, we may assume the same to be true here. Referring to the second family in the table, the Trapezoid is in the fifth position, the Trapezium sixth, and the Scaphoid seventh.

The third family presents an unusual order with the Trapezoid in the fourth position, the Scaphoid fifth and the Semilunar sixth. And so through the ten families represented in the table, we have two children in each and one family with three children showing that the chronological order in which the bones of the carpus are ossified is a family trait.

The second reason given for the statement that variation in the ossification of bones is a heritable trait, is the presence of extra epiphyses.

In the first and second families represented in the table we have the presence of two extra epiphyses. There is an epiphysis at the distal extremity of the first metacarpal and a proximal epiphysis to the second metacarpal. These are distinctly seen in the hands of all three of the children of each family.

I ask a careful consideration of the table on page 87.

ON THE COMMISSURA INFIMA OF THE BRAINS OF FISHES. By C. JUDSON HERRICK. *Denison University, Granville, Ohio.*

At the cephalic end of the spinal cord of fishes at the point where the central canal expands into the fourth ventricle of the oblongata, the dorsal commissure is concentrated to form the commissura infima Halleri. Cajal, in 1896, described a similar commissure in the fœtal mouse and demonstrated that it contains root fibers of the ninth and tenth cranial nerves and a nucleus, his commissural nucleus. Cajal's commissure was immediately identified with Haller's commissure by fish neurologists and the conclusion drawn that this structure, which seems to be commonly present in vertebrate brains, is a commissure of the visceral sensory system. Examination of a large number of types shows that this is only a part of the truth. Associated with this visceral commissure is a somatic commissure of the primary tactile correlation centers in the funicular nucleus region. With this somatic commissure there is also associated a nucleus in the middle line, which is a differentiation from the adjacent formatio reticularis grisea. Accordingly, we have in this region (1) a visceral commissura infima, (2) a visceral commissural nucleus, (3) a somatic commissura infima and (4) a somatic commissural nucleus. These structures are very unequally developed in different fishes, forms with elaborate visceral centers showing the visceral element enlarged, while forms with the tactile system well developed show the somatic element enlarged. It is only by taking advantage of this feature that the successful analysis of the complex was accomplished.

CUTANEOUS INNERVATION FROM THE PLEXUS ISCHIO-COCCYGEUS IN THE FROG, RANA VIRESCENS, COPE. By ELIZABETH H. DUNN. *University of Chicago.*

Ecker and Wiedersheim in their classic and voluminous edition of Gaupp's Anatomie des Frosches make no mention of any innervation of the skin from the plexus ischio-coccygeus. This plexus is made up of branches from the tenth nerve, the entire eleventh nerve, and the twelfth nerve if present in the individual. The branches from the plexus are, according to Ecker and Wiedersheim, distributed to the muscles of the pelvic viscera and to the posterior lymph heart.

It was through a seeming disparity of cutaneous pathways to the thigh, in a study of the cutaneous supply to the segments of the leg, that attention was called to the possibility that the skin of the thigh might receive some innervation by pathways not yet recognized in the frog. With a view to tracing such possible fiber pathways osmic acid preparations were made of the skin of the thighs and the body of the frog. In these it was noted that at the edge of the cloacal opening nerve branches appeared that had no apparent origin from the identified cutaneous nerves.

Fine dissection under the dissecting microscope traced these minute branches to the ischio-coccygeal plexus. The chief cutaneous supply from this source is from a terminal branch of the main trunk of the plexus, the trunk termed by Gaupp the nervus coccygeus. This trunk runs deep among the muscles of the pelvic viscera, giving off muscular branches on its way. It breaks up near the cutaneous margin into a number of small branches which innervate a somewhat limited cutaneous area immediately surrounding the cloacal opening. The chief portion of the area innervated lies posterior to the cloacal opening, a region usually reckoned as a thigh area, and so measured in our thigh areas. The usual cutaneous anastomosis is, laterally with the ramus cutaneus femoris posterior, a branch of the nervus ischiadicus, and with the corresponding ischio-coccygeal branch across the median line between the thighs.

The character and richness of the innervation of this cutaneous area can only be suggested by a count at the cutaneous margin. We have still before us the problem of evolving a method which will determine the relation between the number of pathways in a nerve trunk and the number of ultimate nerve endings. The number of fibers at the point beyond the last muscular branch was determined for the two sides of a frog, female, corrected weight 61.19 grams, length 230 mm. The average number for the two sides was found to be 61 fibers. The total number of posterior root fibers of the eleventh nerve for a frog of a weight of 63 grams is given by Birge as 41 fibers. Even in the muscular sensory supply to the viscera is much less than that to the skeletal muscles, division of fibers must have repeatedly occurred in the nerve trunk. Some fibers from the tenth nerve have undoubtedly joined those of the eleventh nerve, but the connecting branch is small and a large number of visceral branches have been given off above the point at which the count was made. A twelfth nerve was not found in this frog.

This cutaneous branch is undoubtedly homologous to the cutaneous branches from the plexus pudendus in homo, and might furnish a basis for an anatomical study of the relations between visceral and cutaneous sensory innervation. At the moment we can do no more than note the presence of such innervation in an animal with so simple a nervous system as has the frog, and to point to it as confirmatory evidence of the value in comparative work of other possible findings in the study of the nervous structures of the frog.

WHAT DETERMINES THE THORACIC INDEX? By C. M. JACKSON. *University of Missouri.*

The thoracic index (i. e., the ratio of the dorsoventral to the transverse diameter) is, as is well known, high in quadrupeds and low in man. This difference has generally been considered as due to the upright posture assumed by man, the mechanical effect of gravity in this position producing a dorsoventral flattening of the human thorax, instead of the dorsoventral elongation similarly produced in the horizontal posture of the trunk in quadrupeds. As other causes of the low thoracic index in man, the action of the musculature of the shoulder girdle, characteristic growth processes in the thoracic skeleton and viscera, and compensatory lateral expansion correlated with the phylogenetic shortening of the trunk have been suggested.

The results of the present investigation show that the characteristic difference in the form of the thorax in man and quadruped (dog) is already evident at birth. The human thorax at birth is already slightly flattened dorsoventrally, the canine thorax at this time being slightly flattened laterally. This difference is therefore evidently due to causes independent of the action of gravity.

In the normal process of growth this characteristic difference becomes exaggerated. In the human species, the thoracic index decreases from about 90 in the newborn to about 70 in the adult. In the dog, the thoracic index increases from about 112 in the newborn to about 135 in the adult.

To determine the effect of gravity in different postures, a dog was maintained with the body in a vertical position during the greater portion of the time from birth until the adult stage was reached. In this animal, the thorax did not, however, become flattened dorsoventrally as in the human type; neither did it become further flattened laterally (except to a very slight extent, index 115,) as in the normal adult dog. The conclusion is therefore drawn that the characteristic difference in form between the human and canine thorax cannot be due primarily to the mechanical effect of gravity in vertical and horizontal postures of the body. In the dog, although the different effect of gravity when the body is maintained upright is very marked, it is evidently hardly sufficient to neutralize the tendency of the thorax (from other undetermined causes) to assume the characteristic form.

The conclusion of Mehnert that the thoracic viscera and the anterior wall of the human thorax continue to descend throughout adult life up to old age, and that the thorax continues to become correspondingly flattened dorsoventrally, is not justified by the data available. A large number of measurements indicates that on the average the thoracic index does not decrease in old people, in accordance with this theory, but on the contrary that it increases to a slight extent. Moreover, a considerable number of observations upon the vertebral level of the sternum in adult cadavers shows no distinct variation according to age.

THE SYNCYTIAL STRUCTURE OF SMOOTH MUSCLE. By CAROLINE McGILL. *University of Missouri.*

In the digestive tract of the pig, the smooth muscle arises, in common with the interstitial connective tissue, from the mesenchymal syncytium surrounding the endodermal tube. The differentiation of smooth muscle begins in the mid-œsophagus of the 5 mm. pig. A condensation of the mesenchyme with an elongation of the mesenchymal nuclei initiates the process. As the nuclei elongate, the myofibrillæ appear in the surrounding protoplasm. They arise as coarse, varicose deeply-staining fibrillæ which run for long distances through the syncytium without regard to cell territories. In later development, these coarse myofibrillæ in large part break up to form finer myofibrillæ, but some may persist as the coarse myofibrillæ of the adult.

The interstitial connective tissue arises *in situ*. Some of the mesenchymal cells in the area of muscle formation do not elongate but persist as the connective tissue cells, connected at least until a very late stage by protoplasmic strands with the muscle protoplasm. In this common syncytium, soon after the muscle begins to form, collagenous fibers arise, and at a later stage elastic fibers develop. Often in a single protoplasmic mass connective tissue fibers and myofibrillæ differentiate side by side. Later most of the connective tissue fibers are crowded out of the muscle bundles by the rapidly developing myofibrillæ, though some may still retain their primitive relations.

As the myofibrillæ form, they tend to run in longitudinal bundles, but always show marked side anastomoses with neighboring bundles. Throughout development and at least in most instances in the adult this syncytium persists. In the adult the syncytial arrangement has been demonstrated in the muscle of the digestive tract of Necturus, dog, cat, and pig.

In general it may be said that uniformity in structure of adult smooth muscle does not exist. In the main there are two types: (1) A very distinct syncytial structure which may be considered a persistence of the developmental conditons; (2) the muscle bundles show few side anastomoses but end to end union, either with or without branching, still exists. As an extreme differentiation of this type, when the anastomoses become few and small, the smooth muscle is apparently made up of individual spindle-shaped elements. It is doubtful, however, whether independent smooth muscle cells ever occur. In macerated material, where the myofibrillæ are destroyed, the branches and anastomoses of the muscle bundles even if present are broken. As a result there is obtained the spindle-shaped muscle cells, which are described in the text-books. It should also be remembered that spindles appearing independent in longitudinal sections of smooth muscle may be due to an oblique cutting of tissue having the structure of type (2) described above, the anastomoses not being visible in the plane of the section.

ON THE USE OF PHENALATES IN EMBALMING MIXTURES. By A. G. Pohlman, for C. C. Grandy. *Indiana University.* Read by Title.

DEMONSTRATIONS.

1. Charts illustrating a Statistical Study of the Sex-Cells of Chrysemys marginata. By Bennett M. Allen, University of Wisconsin.
2. Preparations from Experiments on the Development of the Lens and Nasal Organ in Amphibia. By E. T. Bell, University of Missouri.
3. *a*, Preparations of the Islets of Langerhans; *b*, Demonstration of the Staining Properties of the Demilunes from various Mammalian Salivary Glands. By R. R. Bensley, University of Chicago.
4. Demonstration of Cross-Sections of the Body. By Charles A. Erdman, University of Minnesota.
5. Preparations showing elastic tissue staining. By G. Carl Huber, for DeWitt, University of Michigan.
6. *a*, Histogenesis of Smooth Muscle; *b*, Contraction in Smooth Muscle. By C. M. Jackson, for Miss Caroline McGill, University of Missouri.

7. Experiments to show the relation of Lechithin to the Stromata of Erythrocytes. By Preston Kyes, University of Chicago.
8. *a.* Injected and Dissected Chick Embryos, showing Fifth and Sixth Aortic Arches; *b.* Injected Embryos, showing origin of the Carotid Arteries in Birds. By William A. Locy, Northwestern University.
9. A Historical Exhibit of Literature on the Lung. By William S. Miller, University of Wisconsin.
10. Models of the Development of the Human Cloaca. By A. G. Pohlman, Indiana University.
11. Preparations of the Framework of the Human tunica Mucosa Ventriculi. By D. G. Revell, University of Chicago.
12. Preparations showing the Conus Arteriosus and Valves of Trapon atlanticus, Megalops cyprinoides, and Pterothrissus gissu. By Harold D. Senior, Washington University, St. Louis, Mo.
13. Preparations of the Cochlea. By George E. Shambaugh, University of Chicago.
14. Preparations of Lacrymal Glands. By John Sundwall, University of Chicago.
15. Nerve Ending in the Membrana Tympani. By J. Gordon Wilson, University of Chicago.

CONSTITUTION, OFFICERS, AND LIST OF MEMBERS.

Constitution.

ARTICLE I.

Section 1. The name of the Society shall be the "Association of American Anatomists."

Section 2. The purpose of the Association shall be the advancement of anatomical science.

ARTICLE II.

The officers of the Association shall consist of a President, two Vice-Presidents, and a Secretary, who shall also act as Treasurer. The officers shall be elected by ballot every two years.

ARTICLE III.

The management of the affairs of the Association shall be delegated to an Executive Committee, consisting of seven members, including the President and Secretary, ex-officio. One member of the Executive Committee shall be elected annually.

ARTICLE IV.

The Association shall meet annually, the time and place to be determined by the Executive Committee.

ARTICLE V.

Section 1. Candidates for membership must be persons engaged in the investigation of anatomical or cognate sciences and shall be proposed in writing to the Executive Committee by two members, who shall accompany the recommendation by a list of the candidate's publications, together with the references. The election shall take place in open meeting, a two-thirds vote being necessary.

Section 2. Honorary members may be elected from those not American who have distinguished themselves in anatomical research.

ARTICLE VI.

The annual dues shall be five dollars. A member in arrears for dues for two years shall be dropped by the Secretary at the next meeting of the Association, but may be reinstated, at the discretion of the Executive Committee, on payment of arrears.

ARTICLE VII.

Section 1. Five members shall constitute a quorum for the transaction of business.

Section 2. Any change in the constitution of the Association must be presented in writing at one meeting in order to receive consideration and be acted upon at the next meeting; due notice of the proposed change to be sent to each member at least one month in advance of the meeting at which such action is to be taken.

Section 3. The ruling of the Chairman shall be in accordance with "Roberts' Rules of Order."

Orders Adopted by the Association.

The election of delegates to the Executive Committee of the Congress of American Physicians and Surgeons shall take place every three years.

Newly elected members must qualify by payment of dues for one year within thirty days after election.

The maximum limit of time for the reading of papers shall be twenty minutes.

The Secretary and Treasurer shall be allowed his traveling expenses and the sum of $10 toward the payment of his hotel bill, at each session of the Association.

That the Association discontinue the seperate publication of its proceedings, and that the American Journal of Anatomy be sent to each member of the Association, on payment of his annual dues, this journal to publish the proceedings of the Association, including an abstract of the papers read.

Contributors of papers are requested to furnish the Secretary with abstracts within a fortnight after the meeting.

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CHARLES S. MINOT..............Term expiring in 1908.
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SIMON HENRY GAGE.............Term expiring in 1911.

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Member of Smithsonian Committee on the Table at Naples.

GEORGE S. HUNTINGTON.

For addresses of officers, see list of members.

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	1888	1891	1892	1894	1895	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906
Pennsylvania	23	19	21	18	17	14	15	9	9	9	10	15	16	21	21
New York	12	19	22	21	24	28	40	35	39	38	35	36	39	40	43
District of Columbia	9	17	16	17	17	17	17	14	14	9	11	10	10	9	8
Massachusetts	8	7	7	9	9	9	9	10	9	11	13	15	19	25	25
Canada	3	3	4	3	3	4	5	6	6	6	6	6	6	4	4
Illinois	3	4	5	3	2	4	4	4	8	16	19	18	24	29	30
Virginia	3	3	3	2	3	5	5	5	5	4	5	[illegible]	[illegible]	[illegible]	3
Connecticut	2	3	2	5	5	5	5	4	3	3	4	4	3	3	3
California	2	1	1	1	..	1	1	1	1	3	4	4	5	6	6
Louisiana	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Missouri	2	1	1	4	4	5	5	3	4	5	5	6	12	21	19
Colorado	1	1	1	..	1	1	1	1	1	..	1	1	..	..	..
Kansas	1	1	1	1	..	..	..	..	..	2	1	..	..	..	1
Maryland	1	1	..	1	1	..	3	4	8	8	9	12	19	22	25
Minnesota	1	1	2	1	1	1	1	1	1	1	2	2	2	2	3
Michigan	1	2	..	1	1	1	2	2	1	2	3	4	6	8	7
Nebraska	1	..	..	..	..	..	..	..	..	..	..	..	1	1	1
New Jersey	1	..	1	1	1	..	..	..	..	..	1	..	1	2	2
New Mexico	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ohio	1	2	2	4	6	5	5	5	5	4	4	4	5	8	8
Tennessee	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Texas	1	1	1	2	1	3	3	2	1	1	2	3	2	2	2
Wisconsin	1	1	1	1	1	1	1	2	2	2	2	2	5	5	4
Maine	..	2	2	3	3	5	5	6	6	6	7	9	9	9	7
Iowa	..	1	1	1	1	..	..	..	..	..	..	..	1	2	2
Arizona	..	1	1	1	1	..	..	..	..	..	..	..	..	..	..
West Virginia	..	..	1	1	1	..	..	..	..	..	..	..	..	2	2
South Carolina	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Oregon	..	..	1	..	..	..	..	..	1	..	..	..	1	1	1
New Hampshire	..	..	..	..	1	1	1	1	1	1	1	2	2	2	2
Georgia	..	..	..	..	..	..	1	1	1	1	1	1	1	1	1
North Carolina	..	..	..	..	..	..	..	..	..	..	1	1	1	1	
Indiana	..	..	..	..	..	..	..	..	..	..	..	1	3	4	4
Washington	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Utah	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Montana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Kentucky	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Alaska	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1

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JOSEPH LEIDY.[1]

BY

WILLIAM KEITH BROOKS,

Henry Walters Professor of Zoölogy in the Johns Hopkins University.

Joseph Leidy[2] was born in Philadelphia, there he passed his three-score years and ten, and there he died. For forty-five years he was an officer of the Philadelphia Academy of Natural Science, and a professor in the University of Pennsylvania for forty years. His character was simple and earnest, and he had such a modest opinion of his talents and of his work that the honors and rewards that began to come to him in his younger days, from learned societies in all parts of the world, and continued to come for the rest of his life, were an unfailing surprise to him.

His knowledge of anatomy, zoölogy, and botany, and mineralogy was extensive and accurate and at his ready command. Farmers and horticulturists came to him and learned how to check the ravages of destructive insects; physicians sent rare or new human parasites and were told their nature and habits and the best means of prevention; jewelers brought rare gems and learned their value. His comments, at the Academy, on the recent additions to its collections, gave a most impressive illustration of his ready command of his vast store of natural knowledge.

Leidy wrote no books, in the popular meaning of the word. He undertook the solution of no fundamental problem of biology. There are few among his six hundred publications that would attract unscientific readers or afford a paragraph for a newspaper. They are simple and lucid and

[1] An address delivered on the occasion of the unveiling of ten busts of American men of science at the American Museum of Natural History, New York, December 29, 1906.

[2] That anatomists recognized the value of Leidy's work in the field of anatomy, as well as the high character of his influence on the active investigators of his time, is illustrated by his election to the first presidency of the Association of American Anatomists in 1888. He took an active part in the organization and work of the society until his death in 1891.—Editor.

to the point. Most of them are short, although he wrote several more exhaustive monographs. They cover a wide field, but most of them fall into a few groups. Many deal with the parasites of mammals—among them, one in which his discovery of trichina in pork is recorded.

Two hundred and sixteen, or about a third, of his publications are on the extinct vertebrates of North America. His first paper on palæontology was published in 1846, and his last in 1888, as the subject occupied him for more than forty years. He laid, with the hand of a master, the foundation for the palæontology of the reptiles and mammals of North America, and we know what a wonderful and instructive and world-renowned superstructure his successors have reared upon his foundation. It was this work that established his fame and brought him honors and rewards. They who hold it to be his best title to be enrolled among the pioneers of science in America, are in the right in so far as the founder of a great department of knowledge is most deserving of commemoration; but I do not believe it was his most characteristic work.

I can mention but one of the results of his study in American fossils. He showed, in 1846, that this continent is the ancestral home of the horse, and he sketched, soon after, the outline of the story of its evolution which later workers have made so familiar.

More than half his papers are on a subject which seems to me to contain the lesson of his life. Like Gilbert White, he was a home-naturalist, devoted to the study of the natural objects that he found within walking distance of his home, but he penetrated far deeper into the secrets of the living world about him than White did, finding new wonders in the simplest living being. In the intestine of the cockroach, and in that of the white ant, he found wonderful forests of microscopic plants that were new to science, inhabited by minute animals of many new and strange forms. His beautifully illustrated memoir on *A Flora and Fauna Within Living Animals* is one of the most remarkable works in the whole field of biological literature. Another memoir gives the results of his study of the anatomy of snails and slugs. The inhabitants of the streams and ponds in the vicinity of his home furnished an unfailing supply of material for research and discovery, and many of his publications are on aquatic animals. He finally became so much interested in the fresh-water rhizopods that he abandoned all other scientific work in order to devote all his attention to these animals. His results were published in the memoir on *The Fresh-water Rhizopods of North America.* This is the most widely known of his works. It is, and must long be, the standard and classic upon its subject. I have no time to dwell upon his work as the naturalist of the home—his best and most characteristic work. Its lesson to later generations of naturalists seems to me to be that one may be useful to his fellowmen, and enjoy the keen pleasure of discovery, and come to honor and distinction, without visiting strange countries in search of rarities, without biological stations and marine laboratories, without the latest technical methods, without grants of money, and, above all, without undertaking to solve the riddles of the universe or resolving biology into physics and chemistry.

If one have the simple responsive mind of a child or of Leidy, he may, like Leidy, " Find tongues in trees, books in running brooks, sermons in stones, and good in everything."

INVESTIGATIONS.

A Preliminary Note Upon Some Characteristics of the Venous System of Tragulus Meminna and Allied Genera, by Frank E. Beddard, M. A., Oxon., F. R. S., *Prosector of the Zoölogical Society of London.*

I have recently seen, through the kindness of the author, an account by Prof. McClure of the post caval vein of the Indian Chevrotain, *Tragulus meminna.*[1] It appears from that gentleman's notes that *Tragulus* presents a condition of the postrenal region of the postcaval vein which is only paralleled elsewhere among the Mammalia by the genus *Dasypus,* by the majority of the Marsupials, and by both *Echidna* and *Ornitho rhynchus.* This is particularly interesting in view of the admittedly low position which Tragulus occupies in relation to other Artiodactyles. In the animals in fact referred to the postcaval vein behind the entrance of the renal veins lies ventrally to, and accurately covering, the aorta, instead of lying to the right side and dorsal to that artery. This position of the postcava is associated, as Prof. McClure's researches[2] into the development of *Didelphys* inform us, with a different origin of the postrenal section of the postcava. Prof. Hochstetter has noted[3] and described the same state of affairs as an abnormality in an example of the common cat, and Prof. McClure, therefore, was unable to assert

[1] The Postcava of an Adult Indian Chevrotain (*Tragulus meminna,* Erxleben), Anat. Anz., Bd. XXIX, 1906, p. 375.

[2] A Contribution to the Anatomy and Development of the Venous System of *Didelphys marsupialis* (L.), Am. Journ. Anat., 5, 1906.

[3] Beiträge zur Entwickelungsgeschichte der Amnioten III. Saügethier-Morph. Jahrb. XV, 1893.

that the conditions which he described in *Tragulus meminna* were not also an abnormality. Upon this question he writes as follows: "As only one specimen of *Tragulus* was examined one cannot be certain that the postcava in this particular case represents the normal conditions; whether it be normal or abnormal, however, the type of postcava presented by the single specimen is certainly unusual for Ruminants, and, so far as is known to the writer, has not been hitherto recorded as occurring in the same." It is evident, therefore, that the settlement of the question of normality or abnormality in the conditions of this vein is of some little importance. I find from an examination of three examples of *Tragulus meminna* that Prof. McClure has made a contribution to Mammalian anatomy and has not merely recorded an abnormality. Two of these examples were adults, the one a male and the other a female. The third individual was a young male, nearly if not quite ready for birth, which was extracted from the uterus of the mother after death. In all three specimens the relations of the veins and arteries concerned were precisely as figured by McClure, so much so that I have not thought it worth while to introduce a figure of my own. I may take this opportunity of remarking that the resemblance which the postcava of the Armadillos bears to *Tragulus* and the other types mentioned above is not limited to the genus *Dasypus* in which the facts have been recorded by Hyrtl and Hochstetter. I have lately dissected *Tatusia kappleri* and find precisely the same arrangement. There is another matter concerning the blood vessels of *Tragulus* which is not specially described, but is figured, by McClure. The right kidney receives two veins from the postcava, while on the left side of the body there is but a single renal vein. This is not absolutely a characteristic of the Chevrotain. But in two of the three examples which I have just referred to the veins in question were as figured by McClure. In the third, which happened to be the female, though I lay no stress upon this fact, there was but a single renal vein on each side. *Tragulus* is also remarkable among the Artiodactyle Ungulates by reason of the structure of the azygos vein. Hochstetter in remarking that probably all of these Ungulates were characterized by the possession of a permanent left azygos connected directly with the coronary sinus and not opening independently into the precava doubtless represents current opinion on the matter, and from the same point of view Max Weber in his recent account of the mammalia [4] utilized correctly this condition of the azygos as a feature of the order. I have had the opportunity of dissecting a

[4] Die Saügethiere, Jena, 1904.

considerable number of genera of Aritodactyles, both Ruminants and Pigs, and find that, broadly speaking, the generalization of the two observers mentioned are correct. But *Tragulus* happens to be an exception. In this animal the azygos is only developed upon the right side of the body, the merest traces representing the otherwise missing left azygos. Here again we have an identity in the disposition of the veins in all of the three examples dissected, and indeed they agree in the very tiniest details. That this represents the normal is as certain, I imagine, as can be. In view of the fact that among the Primates and Carnivora and American Edentates (I know nothing of the African and Oriental genera) as well as many Marsupials the right azygos is the only azygos vein properly developed in the adult or at least (Marsupials) is frequently the prevalent azygos vein when there are two, it is not improbable that this persistence of the azygos is the characteristic one among the Eutheria. Nevertheless it is at least equally possible that the retention of the right azygos only may have been independently arrived at more than once. However, so far as regards the Aritodactyles, it is to be remarked that as a general rule, subject it is true to many exceptions, the left azygos opening directly into the heart through the coronary sinus is not the only azygos vein present. For in many Antelopes there is a not inconsiderable right azygos drawing blood from four or five intercostal spaces.

One might expect that the Pig tribe would throw some light upon this matter, but they do not as far as my own knowledge goes. For in the genera *Potamochœrus* and *Phacochœrus* the azygos veins, right and left, are quite typically Artiodactyle. On the other hand the deer tribe have to some extent preserved the conditions characteristic of *Tragulus*. For in *Cervus sika* (but not in *Cervus aristotelis,* which is typically Artiodactyle) the right azygos alone is present and with the relations of that vein in *Tragulus.* It is remarkable that the nearest ally of *Tragulus,* viz., *Dorcatherium,* has azygos veins which conform to the general Artiodactyle plan in that the left is the stronger vein and enters the heart directly. It is not without interest to observe that in this group, Tragulina, which are undoubtedly the most ancient among the Selenodontia, we find in the azygos vein both types which are found in the other more specialized members of the order. The same "prophetic" phase of the azygos is shown in a more striking way in the Subungulate type *Hyrax.* I have examined four individuals of *Hyrax capensis* and find that two of them agreed [5] in the presence of a large azygos on the right side and the

[5] And with two described by George (Ann. Sci. Nat. (6), I, 1874).

absence of anything but traces of a left azygos. In the existence of a right azygos only these individuals resemble the Perissodactyles, at any rate the horse, zebra, and, according to Sir Richard Owen, the Indian Rhinoceros. In a third specimen, and I think in the fourth, a left azygos was also present, opening into the postcava just where that vein enters the heart. In this instance is an obvious approximation to the Artiodactyle. Recent developmental studies upon the azygos (by Hochstetter, Parker & Tozier, McClure) have shown that the azygos is a derivative, as was shown long ago by Rathke, of the postcardinals; but the actual share which the postcardinal takes in the production of the azygos of its side of the body varies in different Mammalia. While in the Rabbit the persistent (right) azygos is formed out of the postcardinal down to the eighth thoracic segment and thereafter is a new structure, the azygos (left) of *Didelphys* is only formed out of the postcardinal at its very commencement. In these cases the rest of the postcardinal disappears in the adult animal, so far that is as concerns the thoracic portion of the same. In all of the four newly-born examples of the Rodent *Myopotamus coypu* the intercostal veins showed some interesting facts which have a bearing upon the origin and nature of the azygos. It is remarkable in the first place that the conditions were identical in all four specimens. There was no variation whatever. In all of them there were three longitudinal veins draining the musculature of the back in the thoracic region. On each side was a vein, much larger on the right side than on the left, which entered the precava and passed to that vein along the junction of the ribs with the centra of the successive vertebræ. Just before entering the precava the right hand vein received an equally strong vein which passed closer to the median dorsal line of the body and was connected by cross anastomoses with the vein already mentioned. In the adult *Myopotamus coypu* only the innermost of the two right hand longitudinal veins remains as the azygos, but there are traces of the outermost right hand vein in the shape of anastomoses between two or three of the successive intercostal branches. In some other Rodents allied to *Myopotamus* there are more extensive traces of the same, amounting in fact to a retention of the two longitudinal veins of the right side. It seems to me to be difficult to avoid coming to the conclusion that we have in the young *Myopotamus* two postcardinals persisting for an unusually long time and an azygos derived from the upper end only of the postcardinal so far as that vein is concerned, and, furthermore, the conclusion seems inevitable that in this animal and probably in certain other Rodents the thoracic intercostal system of veins of the adult is partly formed of the postcardinal and partly of the azygos, which both persist as parallel longitudinal vessels. Though an unborn example of *Tragulus* showed no trace of any second longitudinal trunk on the right side I have found in *Cervus sika* considerable traces of the same and in other animals also.

THE NASAL SKELETON OF AMBLYSTOMA PUNCTATUM (Linn.), with four plates. By Robert J. Terry. Transactions of the Academy of Science of St. Louis, Vol. XVI, No. 5, December 1, 1906.

The results obtained by Professor Terry may be summarized as follows: The early stages in the development of the nasal skeleton of Amblystoma are like those of Rana and Necturus; the study of the later stages makes it possible to compare the divergent nasal skeletons of the adults. The ethmoidal column is to be regarded as the beginning of the proper nasal skeleton. The other parts, such as the trabecula, trabecular crest, and antorbital process are related from the outset to neighboring structures, as well as to the nasal organs. The ethmoidal column in the animals named, and probably in all Amphibians, grows in adaptation to the olfactory organs, namely, the bulb, nerve, and nasal sac. In connection with it there are formed the greater part of the nasal capsule, the olfactory portion of the lateral wall of the cranium, part of the boundaries of the foramen for the olfactory nerve, and the anterior wall of the cranium, which is in front of the olfactory bulbs. The floor of the nasal capsule of Amblystoma is formed in large part by the trabecular horn, the lateral end of which appears to have a primary relation to Jacobson's organ. In Rana, a highly developed Jacobson's organ is supported by a floor for the capsule; in Siren the organ and floor are probably rudimentary, and in Necturus both structures are absent. The ethmoidal column in Rana develops in connection with the trabecular skeleton, whereas in Amblystoma and Necturus it arises independently. In Amblystoma the column unites secondarily with the trabecula and so enters into the wall of the brain-case, but in Necturus it remains separate from the trabecula and enters only into the formation of the nasal capsule. The independent origin of the ethmoidal column in Amblystoma and Necturus is regarded as evidence of reduction of the chondrocranium; the adaptation of this column to the nasal sac alone, in Necturus, results in its partial re-formation.

OBSERVATIONS ON THE LIVING DEVELOPING NERVE FIBER.[1]

BY

Ross G. Harrison.

The immediate object of the following experiments was to obtain a method by which the end of a growing nerve could be brought under direct observation while alive, in order that a correct conception might be had regarding what takes place as the fiber extends during embryonic development from the nerve center out to the periphery.

The method employed was to isolate pieces of embryonic tissue, known to give rise to nerve fibers, as for example, the whole or fragments of the medullary tube, or ectoderm from the branchial region, and to observe their further development. The pieces were taken from frog embryos about 3 mm. long at which stage, *i. e.,* shortly after the closure of the medullary folds, there is no visible differentiation of the nerve elements. After carefully dissecting it out, the piece of tissue is removed by a fine pipette to a cover slip upon which is a drop of lymph freshly drawn from one of the lymph-sacs of an adult frog. The lymph clots very quickly, holding the tissue in a fixed position. The cover slip is then inverted over a hollow slide and the rim sealed with paraffine. When reasonable aseptic precautions are taken, tissues will live under these conditions for a week and in some cases specimens have been kept alive for nearly four weeks. Such specimens may be readily observed from day to day under highly magnifying powers.

While the cell aggregates, which make up the different organs and organ complexes of the embryo, do not undergo normal transformation in form, owing, no doubt, in part, to the abnormal conditions of mechanical tension to which they are subjected; nevertheless, the individual tissue elements do differentiate characteristically. Groups of epidermis cells round themselves off into little spheres or stretch out into long bands, their cilia remain active for a week or more and a typical cuticular border develops. Masses of cells taken from the myotomes differentiate into muscle fibers showing fibrillæ with typical striations. When portions of myotomes are left attached to a piece of the medullary cord the muscle fibers which develop will, after two or three days, exhibit frequent contractions. In pieces of nervous tissue numerous fibers are formed, though, owing to the fact that they are developed largely within the mass

[1] Read before the Society for Experimental Biology and Medicine at the 23d meeting, New York, May 22, 1907.

of transplanted tissue itself, their mode of development cannot always be followed. However, in a large number of cases fibers were observed which left the mass of nerve tissue and extended out into the surrounding lymph-clot. It is these structures which concern us at the present time.

In the majority of cases the fibers were not observed until they had almost completed their development, having been found usually two, occasionally three, and once or twice four days after isolation of the tissue. They consist of an almost hyaline protoplasm, entirely devoid of the yolk granules, with which the cell-bodies are gorged. Within this protoplasm there is no definiteness of structure; though a faint fibrillation may sometimes be observed and faintly-defined granules are discernible. The fibers are about 1.5-3 μ thick and their contours show here and there irregular varicosities. The most remarkable feature of the fiber is its enlarged end, from which extend numerous fine simple or branched filaments. The end swelling bears a resemblance to certain rhizopods and close observation reveals a continual change in form, especially as regards the origin and branching of the filaments. In fact, the changes are so rapid that it is difficult to draw the details accurately. It is clear we have before us a mass of protoplasm undergoing amœboid movements. If we examine sections of young normal embryos shortly after the first nerves have developed, we find exactly similar structures at the end of the developing nerve fibers. This is especially so in the case of the fibers which are connected with the giant cells described by Rohon and Beard.

Still more instructive are the cases in which the fiber is brought under observation before it has completed its growth. Then it is found that the end is very active and that its movement results in the drawing out and lengthening of the fiber to which it is attached. One fiber was observed to lengthen almost 20 μ in 25 minutes, another over 25 μ in 50 minutes. The longest fibers observed were 0.2 mm. in length.

When the placodal thickenings of the branchial region are isolated, similar fibers are formed and in several of these cases they have been seen to arise from individual cells. On the other hand, other tissues of the embryo, such as myotomes, yolk endoderm, notochord, and indifferent ectoderm form the abdominal region do not give rise to structures of this kind. There can, therefore, be no doubt that we are dealing with a specific characteristic of nervous tissue.

It has not as yet been found possible to make permanent specimens which show the isolated nerve fibers completely intact. The structures are so delicate that the mere immersion in the preserving fluid is sufficient to cause violent tearing and this very frequently results in the tearing away of the tissue in its entirety from the clot. Nevertheless, sections have been cut of some of the specimens and nerves have been traced from the walls of the medullary tube but they were in all cases broken off short.

In view of this difficulty an effort, which resulted successfully, was made to obtain permanent specimens in a somewhat different way. A piece of medullary cord about four or five segments long was excised from an embryo and this was replaced by a cylindrical clot of proper length and caliber which was obtained by allowing blood or lymph of an adult frog to clot in a capillary tube. No difficulty was experienced in healing the clot into the embryo in proper position. After two, three, or four days the specimens were preserved and examined in serial sections. It was found that the funicular fibers form the brain and anterior part of the cord, consisting of naked axones without sheath cells, had grown for a considerable distance into the clot.

These observations show beyond question that the nerve fiber develops by the outflowing of protoplasm from the central cells. This protoplasm retains its amœboid activity at its distal end, the result being that it is drawn out into a long thread which becomes the axis cylinder. No other cells or living structures take part in this process.

The development of the nerve fiber is thus brought about by means of one of the very primitive properties of living protoplasm, amœboid movement, which, though probably common to some extent to all the cells of the embryo, is especially accentuated in the nerve cells at this period of development.

The possibility becomes apparent of applying the above method to the study of the influences which act upon a growing nerve. While at present it seems certain that the mere outgrowth of the fibers is largely independent of external stimuli, it is, of course, probable that in the body of the embryo there are many influences which guide the moving end and bring about contact with the proper end structure. The method here employed may be of value in analyzing these factors.

APPOINTMENTS.

Dr. Harold D. Senior, of the Wistar Institute of Anatomy, has accepted the position of Associate Professor of Anatomy at Syracuse University and will take up the duties of his new position in September. During the past winter Dr. Senior has been filling the chair of anatomy at Washington University, St. Louis, carrying on the work of Dr. R. J. Terry, who is at Harvard University on leave of absence.

REPORTS.

CONCERNING THE WISTAR INSTITUTE OF ANATOMY.

On Monday, March 4, the Board of Managers of the Wistar Institute of Anatomy held its annual meeting to consider the work of the year just closed and to approve plans for the year 1907.

As the principal aim of the Institute is to serve the science of anatomy it may be of interest to present here a brief excerpt from the Director's report, which reviewed the essential points of the year's activities, gave a full statement of the Institute's finances and suggested plans for the future.

The general plan of the Institute, outlined early in 1905, was to organize an Advisory Board of Anatomists, which should be representative of the active research anatomists of the country, and by the assistance of such a Board to determine from time to time the details of a plan which would enable the Wistar Institute, with is modest but steadily increasing endowment, to render the greatest aid to the science of anatomy. The plan further contemplated the organization of a local scientific staff, the assembling of such laboratory equipment as would be required, not only in the ordinary research work of the Institute, but also from time to time in extraordinary researches originating here or elsewhere, and the constant addition to the museum of materials of actual scientific value.

The plan met with the approval of those anatomists who were consulted.

The Advisory Board at its first meeting prepared definite suggestions for the establishment of a local research staff and for placing the Institute in the proper relation to research anatomy.

The following committees were appointed:

On Neurology and the Establishment of Relations with the International Association of Academies: Dr H. H. Donaldson, Chairman; Dr. L. F. Barker, Dr. F. P. Mall, Dr. J. P. McMurrich, Dr. C. S. Minot.

On the relations of the Wistar Institute to American Anatomists: Prof. S. H. Gage, Chairman; Dr. G. Carl Huber, Dr. G. A. Piersol.

On Comparative Anatomy and Embryology: Dr. G. S. Huntington, Chairman; Dr. E. G. Conklin, Dr. F. P. Mall.

Aside from the routine duties in connection with a public museum almost the entire year 1905 was spent in developing the plans suggested.

At the beginning of 1906, the records of which we have just officially closed, the Institute secured as its research chief in neurology Dr. Henry H. Donaldson and the real work was begun. Later in the year the scientific staff was augumented by the election of Dr. George L. Streeter and Dr. S. Hatai as Associates in Neurology, making a total of seven on the staff.

The internal readjustment of the affairs of the Institute and the equipment of the laboratories have progressed steadily during the year.

In April, 1906, the second meeting of the Advisory Board was called, and the results of their discussion are briefly set forth in the following suggestions:

1. That the Institute initiate a study of racial anatomy of the brain and cooperate with foreign institutes to secures brains of other races.

2. That the Neurological Committee be requested to consider means for the further organization of neurological workers in this country.

3. That it be recommended to develop a staff of expert laboratory assistants, such as draughtsmen, modelers. and technicians, to facilitate the mechanical work of research.

4. That investigators be admitted from time to time by the Director to the full advantages of the laboratories as guests for such periods as may be determined upon.

5. That whenever opportunity offers of obtaining specially desirable material for the study of comparative anatomy and embryology this should be secured and preserved for future use.

Of suggestion No. 1 our report will show an addition to our collection of 77 human brains, representing the racial anatomy of this organ. Nine of these specimens are worthy of special mention, but for obvious reasons their identity must be withheld. This is an important part of our work, and the large number collected during the year is due primarily to our relations with other institutions. The collection of human brains representing race types is perhaps one of our most important and immediate duties as a museum, for this will be impossible in the not very distant future.

Concerning recommendation No. 2, it may be said that the Neurological Committee has made progress. Its work is not yet completed and cannot be reported in full. An effort is being made to connect our Institute with other institutions which will furnish opportunities for clinical work and the collection of another class of material.

Recommendation No. 3 is perhaps one of the most important for the success of our laboratory and can be carried out when our income is augmented or when we are able to economize in some other direction.

To make our facilities complete and satisfactory we must have laboratory assistants, draughtsmen, modelers, and technicians as recommended.

It is just here that most laboratories are weak and are unable to furnish the investigator with that perfection of apparatus and technical assistance which will enable him to complete his researches. This part of our force will be developed as rapidly as possible. It must be said, however, that such equipment should come slowly as the work demands it, otherwise there will be a useless waste of energy and funds.

Investigators are admitted to our laboratories as proposed in recommendation No. 4. A number have availed themselves of the opportunity during the year.

Concerning recommendation No. 5 it may be said that we have collected and stored material for comparative anatomy whenever the opportunity presented itself. The museum is especially rich in certain lines and some of this material has been sent to investigators in other laboratories.

As a result of our effort to create here a Central Anatomical Institute and of our decision to follow neurology for the present as our major subject we received, in February, from the Central Commission for Brain Investigation, through the Imperial Academy of Sciences at Vienna, a formal recognition of the Wistar Institute as an international central institute for brain research in America. Hereafter all work in America in cooperation with the Central Brain Commission may be communicated through the Wistar Institute.

In May a meeting of this Commission was held in Vienna. Professor Donaldson, as a member and the Director of the Institute, by special invitation, attended this meeting. The actions of this Commission, soon to be published by Professor Waldeyer, will be of interest to neurologists.

Naturally our museum growth has been greatest in neurological material, and while not great in numbers every specimen is significant. In the museum catalogue during the year 148 entries have been made, comprising 27 series of neurological preparations containing 2568 slides; 23 series of shad embryos, 6 reconstructions of the developing shad's heart, 2 models of embryo shad (the series of embryos, reconstructions and models all belonging to one research), and 77 human brains of special value and interest, the remaining entries consist of a variety of anatomical material. Of the human brains received 63 were negro brains presented by Professor Franklin P. Mall, of Johns Hopkins University. They represent a series which has been carefully studied for certain race characteristics (American Journal of Anatomy, Vol. V, No. 4,) and are now held for future investigations on the brain of this race. Nine brains of special individual interest have been received during the year. In addition to these the museum has acquired a number of special preparations presenting normal human anatomy, which add to the attractiveness of this part of the museum, though they are not of special research significance.

The equipment of the laboratories has required no small amount of attention. Such apparatus as may be purchased in the markets has been supplied. The best forms of Zeiss microscopes, photographic lenses, the newest types of microtomes, and the many other appliances which go to make up a laboratory equipment have been furnished.

Among the special devices which have been built in our own shop may be mentioned the projection and photomicrographic apparatus. This instrument is designed to meet the requirements of the anatomical laboratory where drawing or photographs from sections or other objects may be required and obtained with the least possible effort and minimum amount of time, or where the object may be studied directly and measurements made by means of this apparatus without the photographic processes. The apparatus is always in working order, no rearrangement of cumbersome pieces being necessary to operate it. The apparatus is mounted in a dark room, with a developing room adjoining, directly in one of our main laboratories so that the work of preserving, preparing, and photographing or drawing a specimen may be done on the same floor within a radius of a few feet.

Although we now have two large microtomes the reconstruction of a new brain-cutting microtome for much finer and better work is underway. This will add to our facilities for producing valuable series of brain sections.

As anatomy has been studied by the various mechanical means of analyses there now remains the chemical means of attack. For this purpose the Institute has recently equipped a bio-chemic laboratory supplied with all the necessary apparatus, much of which was constructed in our own shop. I mention in some detail these bits of special equipment to emphasize the fact that our shop facilities make it possible to supply any apparatus which cannot be purchased in the market but which may be demanded for special research work.

Concerning library facilities it is not necessary for me to say that Philadelphia is unequaled in this respect, the magnificent library of the Academy of Natural Sciences, of the American Philosophical Society, of the College of Physicians, and of the University of Pennsylvania, not to mention a number of other large libraries are all accessible to the members of our laboratory. Of the Institute's library it may be said that here are to be found all the principal journals and reference books required in anatomical work. This year 46 new volumes were added to our library, making a total to date of 1486 bound volumes. We have received 41 periodicals and 14 books issued in parts, 55 in all. The reprints have all been carefully catalogued under both author and subject.

One of our most important accessions is, perhaps, a complete set of the bibliography cards relating to microscopy, physiology, and anatomy, issued by the Concilium Bibliographicum. They are divided as follows: Microscopy, 3230 cards; physiology, 16,098 cards, and anatomy, 28,056 cards, making a total of 47,384 cards correctly filed and accessible. These cards represent bibliographical data in the three subjects named from 1898 to date, excepting in physiology, in which branch the publication was discontinued from 1899 to 1904, but was resumed in 1905. This set of cards of the Concilium Bibliographicum is, I believe ,the only set in Philadelphia, and is, of course, open to anyone who may desire to use it.

While every book has been accessioned, I regret to say that on account of lack of time we have been unable to complete our card catalogue of the library. This will be taken up during the summer months when there are less demands from other directions upon the time of the librarian.

The neurological library belonging to Professor H. H. Donaldson has been placed in the Institute for the use of investigators in the laboratories. The library consists of more than 1000 bound volumes and 4000 reprints and subscribes to 14 scientific journals. It forms a most valuable acquisition to our working equipment.

In this connection I must also mention the very valuable library, consisting of some 4000 volumes, largely scientific, willed to the Institute by General Wistar and which has been placed in dust-proof cases in a specially prepared room at the Institute.

It is with pardonable pride that I record the results of our efforts to establish research in our laboratories and make our museum subservient thereto. Investigations for the present are directed to neurology, and the chief resources of the Institute are being expended to develop research in this department; there is no desire, however, or effort made to limit researches to this field, should any investigator desire to pursue in our laboratories investigations in any other field. In neurology, under the direction of Professor Donaldson, some fourteen pieces of research are underway in our own laboratory while a number of others are being prosecuted elsewhere, also under Professor Donaldson's direction.

In pursuing researches in neurology it is essential to have an abundant supply of fresh material, and a single type of animal tends to increase the accuracy of deductions. It is for this reason that we have established a colony of Albino rats which are bred to a standard of weight and size and furnish material of the proper kind. This colony comprises several hundred animals. In addition to this we have established also a colony of opossums (*Didelphys virginiana*) the only representative of its family in America and presenting an extremely interesting anatomy from the neurological and embryological standpoint. These two forms will furnish abundant material of its kind for laboratory use.

Every effort will be made to strengthen our relations with other laboratories and to assist in every possible way in promoting researches in anatomy. To this end we have attempted to take the most liberal view in all matters relating to the privileges offered by the Institute, a policy which I believe will tend to knit together in the closest bonds the men who are so unselfishly devoting their lives to the development of our science.

A number of men have availed themselves of the laboratory privileges during the year and we are glad to say that there is always room and the necessary supplies for the man who has a problem to solve and knows how to solve it.

At their recent meeting the Board of Managers of the Institute took a number of important steps for the promotion of our work. They authorized the Director to dispose of such materials of the museum as have only taxonomic interest and secure in lieu thereof materials related more properly to the problem of the Institute; they also authorized the support of a research room at the Woods Hole Laboratory, and a subvention to the American Journal of Anatomy. The Director was also authorized to make such arrangements with the Graduate School of the University of Pennsylvania for the promotion of research work in anatomy as will be mutually beneficial, and the same arrangements and privileges are to be extended to other universities which may desire to cooperate. The details of such arrangements will be considered by the Advisory Board.

M. J. Greenman.

REVIEWS.

"Papers from the Anatomical Laboratory of St. Louis University," by A. C. Eycleshymer. Volumes I-III, 1904-6.

Since Professor Mark set the example in numbering and distributing the publications from his laboratory in a systematic form, we have become accustomed to volumes of collected papers from other laboratories,[1] which in a true way show their activity. Professor Mark holds the first endowed chair of anatomy in America, the incumbents having contributed their full share in developing the science of anatomy and zoölogy with us. Professor Eycleshymer is at the head of the newly established anatomical department of St. Louis University, and these three volumes of studies show what will result when anatomy is placed in charge of an able specialist who is supported by a strong staff.

The Papers, comprising wholly reprints from foreign and American journals and from university publications, cover a wide range of subjects, such as embryology, neurology, topographical anatomy, anomalies, and general topics. Physicians and surgeons will be interested especially in the exhaustive study of the topography of the viscera by Potter, which is also published as a monograph by the University of Missouri. Those who doubt the practical value of scientific work in medicine are referred to Potter's excellent study.

I cannot fail to express my strong approval of a department of anatomy which renders so good an account of itself, for it is through departments like Professor Eycleshymer's that our standing as anatomists will finally be established. Medical schools that place anatomy upon a scientific foundation, as has been done by the St. Louis University, are certainly

[1] I have at hand the following list of collected papers which are arranged in chorological order:

(1) Contributions from the Zoölogical Laboratory of Harvard University, 1884-1906, 183 numbers.

(2) Studies from the Pathological Laboratory, Columbian University, 1890-1905, 10 volumes, 132 numbers.

(3) Papers from the Anatomical Laboratory, Johns Hopkins University, 1893-1906, 11 volumes, 198 numbers.

(4) Contributions from the Anatomical Laboratory of Brown University, 1898-1905, 4 volumes, 65 numbers.

(5) Contributions from the Biological Laboratory of Bryn Mawr College, 1904-1905, 5 volumes, 70 numbers.

(6) Studies from the Rockefeller Institute for Medical Research, 1902-1906, 5 volumes, 115 numbers.

(7) Papers from the Department of Anatomy, University of California, 1903-1905, 2 volumes, 24 numbers.

(8) Contributions from the Anatomical Laboratory of the University of Wisconsin, 1904-1906, Vol. 2, 32 numbers.

(9) Papers from the Anatomical Laboratory of St. Louis University, 1904-1906, 3 volumes, 19 numbers.

doing their duty to the medical profession, for students who have the good fortune to come under the broadening influence of scientists make the best physicians.

Franklin P. Mall.

"ANATOMICAL TERMINOLOGY: WITH SPECIAL REFERENCE TO THE [BNA]," by Lewellys F. Barker, M. D., Professor of Medicine, Johns Hopkins University; formerly Professor of Anatomy in Rush Medical College, University of Chicago. With vocabularies in Latin and English. Two colored and several other illustrations. Price, $1.00. P. Blakiston's Son & Co., Philadelphia, 1907.

This is the latest addition to the valuable series of books written by Professor Barker in the interests of anatomical science. The primary object of the present work is to present the origin, nature, and aims of the Basle Anatomical Nomenclature [BNA], and to promote its adoption in the English-speaking countries.

Many of the objections and difficulties that have arisen in connection with the use of the BNA are met by Professor Barker with clear and convincing arguments. One misconception in particular which has retarded the acceptance of this nomenclature is the idea that the terms of the BNA are intended to be used unmodified in everyday speech. It is pointed out that this is not the case. Even the distinguished authors of the BNA do not adhere to it strictly in their lectures. The primary purpose of the BNA is rather to serve as a standard for use in written works, especially in those intended for international use. It was expected that each nation, in spoken language, would in the case of many of the terms prefer the equivalent term in the native tongue to the Latin form. This procedure has in the present work been facilitated for English-speaking students of anatomy by placing in parallel columns the BNA and the literal English equivalents. The English equivalents are not necessarily preferable, however, even for use in speaking; and there is a tendency, which most teachers using the system have probably noticed, for the students to adopt the Latin terms as English. But the Literal English equivalents will in any event serve as convenient stepping-stones, where the Latin terms are not already familiar.

An additional help to those unfamiliar with the BNA is provided by placing in parenthesis the common English synonym, where this is not practically identical with the BNA. About 650 "old terms" are thus introduced, but the corresponding BNA are by no means all new terms.

In the majority of these cases the BNA is already familiar in English, or is so slightly different as to be readily recognized.

As a matter of fact, as is pointed out, it is really incorrect to designate the BNA as a "new nomenclature." Probably less than 5 per cent of its 5000 terms are actually new to English-speaking anatomists. And it must be conceded that the great majority of these new terms are decided improvements. The few inappropriate and undesirable terms will doubtless be corrected in future revisions of the BNA.

Two colored figures are included, representing the surface regions according to the BNA. Incidentally it may be noted that an authoritative statement of the precise boundaries of the various regions would be useful to clinicians and others interested in the surface form of the body.

In addition to anatomists this work will doubtless be of much service to zoölogists, physiologists, pathologists, and clinicians who desire to familiarize themselves with the revised anatomical nomenclature, which may now be fairly considered as well-established in this country.

C. M. Jackson.

COURSES IN ANATOMY, HISTOLOGY, AND EMBRYOLOGY AT THE UNIVERSITY OF MICHIGAN, 1906-7.

ANATOMICAL STAFF.

J. Playfair McMurrich, A. M., Ph. D., Professor of Anatomy.
Simon M. Yutzy, M. D., Demonstrator of Anatomy.
Robert Bennett Bean, B. S., M. D., Instructor in Anatomy.
Henry W. Stiles, M. D., Assistant Demonstrator.
Joseph D. Heitger, A. B., Assistant Demonstrator.
Mark Marshall, B. S., A. B., Assistant Demonstrator.
Grace D. Peele, B. S., Assistant Demonstrator.
Cyrenus G. Darling, M. D., Clinical Professor of Surgery, Lecturer in Surgical Anatomy.

I. Osteology. Laboratory work and recitations. Two hours daily, for nine weeks. Drs. McMurrich, Yutzy, Bean, and Stiles.

II. Practical Anatomy. Four hours daily for twenty-four weeks, accompanied with lectures on the morphology of the human body, twice daily. Drs. McMurrich, Yutzy, Bean, and Stiles.

III. Anatomy of the Central Nervous System. Lectures and demonstrations. Two hours weekly for eighteen weeks. Laboratory work one hour daily for three weeks. Dr. McMurrich.

IV. Anatomy of the Central Nervous System. Laboratory course. Optional. Dr. McMurrich. Hours arranged with instructor.

V. Anatomy of the Lymphatic System. Lectures ten hours. Dr. McMurrich.

VI. Topographic Anatomy of the Ear. Lectures and demonstrations, six hours. Dr. McMurrich.

VII. Topographic Anatomy of the Air Passages. Lectures and Demonstrations, six hours. Dr. Yutzy.

VIII. Topographic Anatomy of the Abdominal and Thoracic Viscera. Lectures and demonstrations, eight hours. Dr. Bean.

IX. Topographic Anatomy Studied on Sections Optional. Dr. Bean. Hours arranged with instructor.

X. Surgical Anatomy. Lectures and demonstrations, twenty-seven hours. Dr. Darling.

XI. Special Problems in Anatomy. Optional. Dr. McMurrich. Hours arranged with instructor.

XII. Practical Anatomy for Dental Students. Laboratory work, three hours daily, for nine weeks. Dr. Stiles.

HISTOLOGY AND EMBRYOLOGY.

G. Carl Huber, Professor.
Lydia M. DeWitt, B. S., M. D., Instructor.
Herbert N. F. Nichols, A. B., Technical Assistant.

I. Embryology, Histogenesis, and Histology. Lectures, recitations, and demonstrations, three hours weekly, for thirty-two weeks. Dr. Huber.

II. Laboratory Work in Histology and Histogenesis. Sections of about fifty students working four hours daily for nine weeks. (Two to three sections a year.) Drs. Huber and DeWitt.

III. Lectures, Recitations, and Laboratory Work in Histology. Arranged for dental students. Three hours daily for twelve weeks. Drs. Huber and DeWitt.

IV. Laboratory Work in Vertebrate Embryology. Optional. Dr. Huber.

V. Technical Methods in Vertebrate Histology and Embryology. Drs. Huber and DeWitt.

VI. Research Work in Vertebrate Histology and Embryology. Dr. Huber.

THE ANATOMICAL RECORD.

No. 6. AUGUST 1, 1907.

ON MEASURING HUMAN EMBRYOS.

BY

FRANKLIN P. MALL.

WITH 4 FIGURES.

In looking over the literature on human embryology I find that it is not always easy to determine the size and the degree of development of embryos, under consideration, partly on account of the lack of uniformity in measuring specimens and partly because it is not always stated how the measurements were taken. Obstetricians uniformly give as the standard measurement the greatest length of the fœtus after it has been straightened more or less, and this measurement is a most useful one for it can be compared directly with the standing height after birth. This standard measurement is used quite frequently by embryologists, Toldt being one of the most recent who has employed it, but on account of the difficulty in making it upon young specimens without injuring them, Arnold and many others, including His, measured young embryos from the top of the head to the breech. This gave us the well known vertex-breech measurement, which corresponds with the sitting height after birth. To these two measurements His has added a third, which he makes from the projection on top of the neck (over the medulla) to the breech, the neck-breech or *Nackenlinie,* which is a very useful measurement for embryos of the first and second months; in general it measures the length of the spinal column. However, from my own experience, as well as from that of others, this measurement is difficult to make accurately and therefore it has not proved to be of general value.

During the past few years I have remeasured all of the human embryos in my possession, as well as the profile illustrations of embryos which have been published during the last 100 years and I have found that very often the measurements published by various authors do not correspond with their illustrations. The one marked exception to this statement is made by His, whose measurement always correspond with the pictures of the embryos which he has published. Other writers are often inexact, not

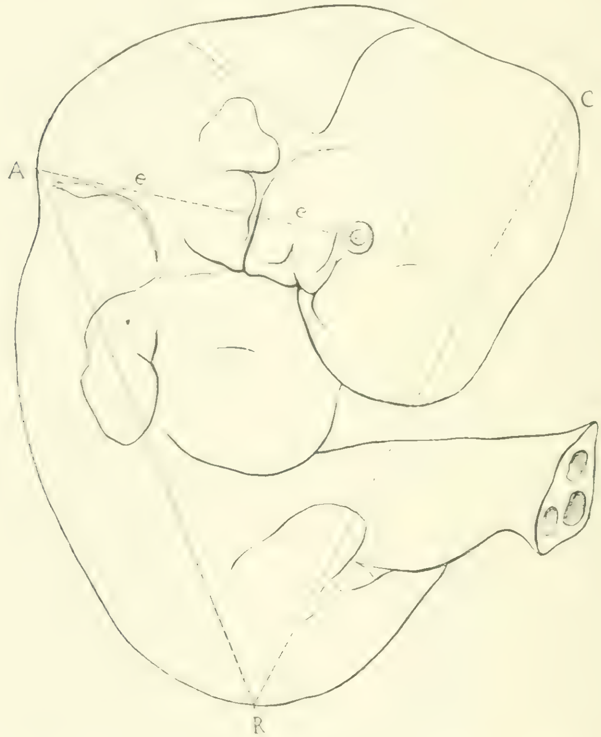

FIG. 1. Embryo No. 163, × 10 diameters. *C*, crown immediately over the mid-brain; *R*, rump; *A*, point between the occipital bone and the first vertebra; *ee*, eye-ear line.

stating from what part of the top of the head they measured, and in case they give His' *Nackenlinie* they usually place its upper end too low down, sometimes as low as the shoulder. The same criticism of this measurement may be made of the records of embryos found in my own note-book. When I began to collect embryos in 1890 the *Nackenlinie* was properly taken, as defined by His, but as the specimens increased in number I now find that I gradually placed the upper point from above to measure lower and lower until it finally became fixed at a point between the head and the shoulders. It had really become the "neck-breech" measurement.

In measuring my own specimens, as well as all of those I have found suitably pictured in the literature, my attention was called to the neck-

FIG. 2. Embryo No. 144, × 7 diameters. Letters as in Fig. 1. *H*, heel; *h*, hip joint; *K*, knee joint; *x*, point in leg which equals the distance from *h* to *R*. By adding *xH* to *CR* the standing height of the embryo is obtained.

breech measurement and its meaning. As it is usually taken it is of value from the time the embryo is well-curled upon itself until the neck is fairly well developed, that is, from the second to the sixth week. During this period this measurement is the longest, or is as long as any other that can be made upon the embryo without stretching the legs. In later stages it equals practically the length of the vertebral column.

The object of this note is to suggest three measurements for all human embryos which can be compared with those usually made by anthropologists on infants and on adults. The outlines of embryos, which I give, will enable others to criticise the measurements and will also aid those

Fig. 3. Embryo No. 22, × 5 diameters.

who are willing to send me data, to make them upon embryos in their possession. In addition to such measurements I desire also menstrual histories of specimens, which are determined by subtracting the date of the beginning of the last menstrual period from that of the abortion. It will be impossible for me to construct a satisfactory curve of the age and size of embryos until a much larger number of menstrual ages and measurements of embryos are obtained than I now possess. Up to the present time I have collected the measurements of over 600 embryos of which only 200 are accompanied with menstrual histories.

In order to make satisfactory measurements upon the bodies of young embryos it is necessary to measure them from more fixed points than is usually done. According to the position of the head the upper end

FIG. 4. Embryo No. 131, natural size. Length of "vertebral column," 68 mm.; sitting height (crown-rump or vortex-breech length), 90 mm.; standing height (90 + 21 + 23), 134 mm.

of the longest measurement of an embryo may fall over any portion of the brain, and from a study of numerous specimens I find that the middle of the mid-brain is usually just below the highest point of the head, but whenever this is not the case, as it is found to be in young embryos, I think the measurement should still be taken from a point immediately over the mid-brain as is shown in Fig. 1, *C*. The other point, which I suggest as a desirable one to measure from, lies in the mid-dorsal region just above the first cervical nerve, as shown in Figs. 1 and 2, which have the outlines of this nerve drawn in. In Figs. 3 and 4 this point is marked by passing a straight line from the middle of the lens through the external auditory meatus to the back of the head. In both of these specimens this line passes between the atlas and the occipital bone. This gives an upper point, between the skull and the vertebral column, which is below the one from which His drew his *Nackenlinie* and above the depression in the neck from which a number of embryologists make their neck-breech measurements.

I have found from numerous measurements of embryos, fœtuses, infants, and adults that a line drawn from the middle of the eye through the middle of the ear and extended to the back of the neck, always passes just below the foramen magnum, or slightly higher. For practical purposes it cuts the skull from the body, and according to our knowledge of the position of the eye and ear this should be the case. This line which I shall term the *oculo-auricular* or eye-ear line, is of fundamental importance in measuring the length of the spinal column in embryos. Anthropologists obtain the same point between the skull and vertebral column by extending the plane between the two rows of teeth to the back of the head; while artistic anatomists determine it by projecting a horizontal line through the nasal spine, just below the nares, to the back of the head; in both cases the skull is cut off. All three of the lines meet in the adult at the foramen magnum, but in the embryo only the eye-ear line is of practical use for it can be determined early and with certainty. The height of the skull, which forms the submodulus in the Fritsch-Schmidt canon, can be obtained in any embryo by measuring the distance at right angles from the above-mentioned horizontal line through the nasal spine, to the crown, *C*, that is, the point immediately over the mid-brain.

The two upper points from which to measure being fixed just above the atlas, and just over the mid-brain, it is necessary to have a lower point in order to measure the length of the head and trunk. All embryologists agree that it be placed at the lowest point of the breech. The line *AR* approximates the length of the spinal column and the line *CR* equals the sitting height of the embryo. These two lines mark respectively the atalanto-sacral and the mesencephalo-sacral measurements. In Figs. 1 and 2 the point *R* is exactly below the sacrum, but as the embryo grows longer (Figs. 3 and 4) the ischium gradually recedes; at birth it is considerably below the level of the sacrum. For practical purposes, therefore, the line from the foramen magnum to the rump, *AR*, equals the length of the spinal column. In the adult the tip of the sacrum is at the level of the middle of the acetabulum, and this latter point is naturally chosen by Fritsch in the construction of the canon. On account of the high position of the ilium in both the embryo and the fœtus, and an account of the close relation between the lower end of the sacrum and the rump in them I believe it most desirable to measure to the rump and not to the acetabulum. Furthermore, it makes one of the measurements, *AR*, equal the length of the spinal column, and the other, *CR*, the sitting height of the embryo.

A comparison of these two lines upon all four figures shows that in all cases they are the longest lines that can be drawn from the mid-brain and atlas to the rump in each case. Furthermore, as the embryos increase in size the angles they form at the rump becomes more and more acute. In Fig. 1 the crown rump line falls far in front of the eye; in Fig. 2 it is just in front, and in Fig. 3 just behind the eye; in Fig. 4 it nearly strikes the ear.

The entire length of the body, the mesencephalo-calcanean line, or the standing height of the embryo, is really the best single measurement of the embryo, for it is the one usually made by obstetricians as well as by anthropologists. It has been said that the standing height of the embryos and fœtuses is an unsatisfactory measurement on account of its uncertainty, but my experience obtained from the measurement of 600 embryos shows that it is no more variable, probably less so, than either the sitting height or that of the spinal column. In Fig. 1 the sitting and the standing heights still equal each other for, as is easily seen, the leg bud cannot be stretched beyond the rump. The other figures show that by extending the legs the standing height becomes greater than the sitting. In each of the figures the hip and knee joints and heel are indicated by letters. If a circle is described, as has been done in the figures, the portion of the length of the leg to be added to the sitting height in order to obtain the standing height is easily ascertained. In Figs. 2 and 3 this amount is only a portion of the leg, while in Fig. 4 it includes most of the thigh and all of the leg. A number of fresh embryos were measured in this way, the legs were then straightened and specimens were again measured from crown to heel and it was found that the two measurements agreed exactly. By this method, then, the standing height of an embryo can be determined without stretching a fresh specimen or injuring a valuable one after it has been hardened.

By making a large number of measurements of the human body, Pfitzner[1] has demonstrated that the most constant ratio of any is obtained by dividing the breadth of the head by its length. The mean index for individuals of every year, from birth to old age, is 83 in males and 82 in females. I gather from the figures of embryos and fœtuses, published by Retzius[2] that in all months of uterine life the index is the same as after birth, for in the individual cases given it ranges between 80 and 85. Were it possible to apply these measurements to all fœtuses I think either the length or the breadth of the head would prove the best standard, and all other measurements could be adjusted to it as the artistic anatomists has adjusted all proportions to the submodulus. That other measurements are required of the body of the embryo than those that are usually made, including that of entire length of the body, is indicated by various writers, including His,[3] who was the first to use the *Nackenlänge.* More recently he employed a new measurement which he calls *Kopftiefe,*[4] and which he says corresponds about to the height of the head, measured from the chin to the crown. The *Kopflänge* is the length of the head, a measurement which can easily be obtained if this part of the embryo is not distorted. The point between the occipital bone and atlas having been determined, as is done by the eye-ear line, a second line may be introduced connecting the spine of the nose with it. The longest line within the head of the embryo parallel with this measures the length of the head and a line at right angles to it extending to the crown measures the height of the head. Thus it is seen that it is possible to make some of the ordinary head measurements of the adult upon the head of the embryo. It may be that the submodulus of Fritsch-Schmidt[5] may yet prove to be the standard measurement in human embryology, comparing all of the other measurements of the body with it, as is the case in the Fritsch-Schmidt canon of the adult. However, this possibility appears to be remote.

It seems to me, that for the present we must continue to employ the sitting height or the crown rump measurement as the standard. Next in importance is the standing height, and judging by the form of a curve made by abscissas and ordinates to determine the means by the graphic

[1] Pfitzner, Zeit. f. Morph. u. Anthropol., I, 1899.

[2] Retzius, Biol. Untersuch., XI, 1904.

[3] His, Anat. Mensch. Embryonen.

[4] His, Entwikl. d. Mensch. Gehirns, 1904.

[5] Fritsch, Die Gestalt des Menschen, 1899.

method, I do not find that one is more variable than the other. The sitting height is the measurement most easily, and, therefore, the one usually made upon young specimens, and the standing height upon older ones. These two measurements can be compared directly with the two standard measurements made after birth. By means of the eye-ear line the point between the head and neck can be marked and from it the length of the head, and of the skull, may be obtained. That the standing height is just as good a measurement as the sitting height is further found by the experience of Pfitzner,[6] who was at first opposed to it, but after having made many more measurements he selected it as the best standard measurement with which to compare all others. This last statement is based upon the careful measurements of 5000 cadavers.

The measurement from the foramen magnum to the lower part of the body, the rump, does not include all of the spinal column in young embryos, equals it in length in embryos up to the eighteenth week, and exceeds it somewhat from the eighteenth week to birth. This point is well illustrated by Merkel[8] in a series of sagittal sections of the fœtus. In relation to the transverse section of the body the lower end of the sacrum falls considerably below the pubis at birth, but in the adult it is on a level with the top of the symphysis. So the measurement from the atlas to the rump includes more or less of the spinal column according to the age of the embryo. To include in this measurement the hump on the back of the head, that is, part of the occipital region, as is the case in His' *Nackenlänge,* seems to me to be enough to exclude this measurement altogether. If it were possible to find the lower end of the sacrum in each case I would prefer to measure to it rather than to the rump, but this seems to be out of the question at the present time. The acetabulum is not quite so difficult to locate, but on account of its wandering during development the objections to it as a fixed point are as great or greater than those to the rump. A measurement to the perineum has less objections to it than any other, and this point was selected by Pfitzner rather than the tuberosity of the ischium, and therefore his measurement of the head and trunk are a little shorter than the sitting height and considerably longer than the combined height of the skull

[6] Pfitzner, l. c., I.

[7] Pfitzner, l. c., VI.

[8] Merkel, Mensch. Embryonen, etc., Abhandl. d. k. Gesell. d. Wiss., Göttingen, XL, 1894.

and length of the spinal column. Beyer[9] has found that the sitting height is but 3 cm. greater than the distance from the crown to the perineum by measuring over 4500 cadets from 15 to 23 years of age. It seems to me that the advantages to the rump as a point to measure to are so decided and the objections to it are so small—embryologists and anthropologists have been compelled to accept it—that we should not try to establish a new point as Fritsch and Pfitzner have done.

The preliminary list of proportions I have made is based upon the measurement of 140 embryos less than 20 mm. long, 200 between 20 and 100 mm. long, and a large number of older fœtuses. Many of the measurements were obtained from illustrations to scale, found in the literature; some of them, like those of Retzius, have been published by others, and a large number of them were obtained from specimens in my own collection. In each case the sitting height was obtained by direct measurement from the crown to the rump, and the standing height by direct measurement of the specimen after it had been straightened or by the method indicated in the figures. The length of the spinal column was obtained by extending the eye-ear line to the dorsal midline behind the foramen magnum, and from its intersection with the skin a line was drawn to the rump, that is, to a point immediately over the tuberosity of the ischium. The individual measurements were then tabulated, using those of the sitting height as abscissas and those of the standing height, and those of the spinal column, as ordinates. Thus, two curves of a series of dots, representing the specimens, were obtained. By dividing each of the rows into fourths the two middle fourths containing half of the cases gave the probable deviation, and a line midway between them gave the probable mean. In the near future, when more records have been obtained, I shall publish these records in the form of charts, and from the means thus obtained I shall construct a curve, giving the probable age of embryos based upon actual histories of the specimens. The mean measurements of embryos less than 20 mm. based upon 140 specimens are as follows. The figures are in millimeters:

Vertebral Column	1.3	2.3	3.5	4.5	5.5	7	8	9	9.5	9.8
Sitting Height	2	3	4	5	6	7	8	9	10	11
Standing Height	2	3	4	5	6	7	8	9	10	11

Vertebral Column	10	10.5	11	11.3	12	12.5	13	14	15
Sitting Height	12	13	14	15	16	17	18	19	20
Standing Height	12	13	14	15	16.5	18	20	21.5	23

[9] Beyer, Proceed. of U. S. N. Inst., XXI, 1895.

It is seen that the length of the legs is added to that of the body in embryos over 15 mm. long. From now on the measurements are given for every 5 mm. of sitting height until the embryos are 50 mm. long and then for every 10 mm. until birth.

Vertebral Column	15	18	22	26	30	34	38	45	51	58
Sitting Height	20	25	30	35	40	45	50	60	70	80
Standing Height	23	30	39	47	54	62	69	84	98	114
Vertebral Column		65	71	78	83	90	98	107	115	120
Sitting Height		90	100	110	120	130	140	150	160	170
Standing Height		130	145	162	175	187	200	214	240	255
Vertebral Column		128	135	142	150	157	165	172	180	188
Sitting Height		180	190	200	210	220	230	240	250	260
Standing Height		267	282	300	315	332	347	360	375	392
Vertebral Column		195	202	208	215	224	234	243	250	259
Sitting Height		270	280	290	300	310	320	330	340	350
Standing Height		410	425	440	455	475	490	510	530	550

It may be seen by looking over this table that the spinal column increases 7 mm. in length, and the standing height 15½ mm., every time the sitting height increases 10 mm., in embryos over 20 mm. in length. This continues until the sitting height has reached 300 mm. As the fœtuses become larger and larger the growth of the legs is slightly more marked than before, and during the last month or six weeks of pregnancy the standing height increases 20 mm., while the sitting height increases 10 mm. The statement may therefore be made for embryos and fœtuses from the end of the second month to the end of the eighth month, that the spinal column increases 7 mm. and the sitting height 10 mm., while the standing height increases 15½ mm. This reduced to a formula reads as follows:

$$\frac{\text{Spinal Column} - 15}{7} = \frac{\text{Sitting Height} - 20}{10} = \frac{\text{Standing Height} - 23}{15\frac{1}{2}}$$

The figures I have given make it possible to convert the standing height into the sitting height, an obstacle which has been difficult to overcome in estimating the age of embryos. When the figures are converted into curves it is readily seen that Toldt in making his estimate has confused these two measurements, for in embryos under four and one-half months old he has used the sitting height and in those over six months the standing height, connecting the two during the fifth month. Hecker's curve is much more nearly the correct one, but it begins only with the tenth week. At the present time I do not wish to add another curve to Hecker's because my data are accumulating rapidly and I prefer to withhold it until the number of records is large enough to give the curve a final form.

ON THE ORIGIN AND DIFFERENTIATION OF THE OTIC VESICLE IN AMPHIBIAN EMBRYOS.

BY

WARREN HARMON LEWIS.

From the studies of Le Cron[1] and Lewis[2] on the origin and differentiation of the lens it would seem quite evident that this organ is dependent not only for its initial origin from the ectoderm on the contact influence of the optic vesicle but that its continued differentiation for a while at least is dependent on the continued influence of the eye. In marked contrast to the lens is the behavior of the optic vesicle. This organ is self-differentiating from a very early period, even before the eye spot can be recognized on the early medullary plate. The notocord, muscle, and the central nervous system are likewise self-differentiating from a very early time, at a stage even when the blastopore is still wide open or earlier perhaps. The cornea like the lens is dependent for its origin and differentiation on the influence of the eye.

What factors are concerned in the origin and differentiation of the various other organs of the embryo is almost entirely unknown, for embryologists have concerned themselves for the most part with descriptive studies of the origin and differentiation of the various organs and tissues of the body, and the causal relations in development have so far received but little attention. Experimentation is the only means of obtaining an accurate conception of the causal factors, and as a method of work offers much greater difficulties in a technical way than the ordinary descriptive methods.

In the following series of experiments the embryos were killed in Zenker's fluid, embedded in paraffin, cut into serial sections 10 micro mm. in thickness and stained in hæmatoxylin and congo red.

In considering the factors concerned with the origin and differentiation of the otic vesicle my experiments were begun on embryos of an age shortly after fusion of the neural folds. At this stage there is a

[1] Am. Jour. of Anat., Vol. VI, 1907.

[2] Am. Jour. of Anat., Vol. III, 1904; Vol. VI, 1907.

thickening of the inner layer of the ectoderm into the otic plate but no sign of invagination. Thinking perhaps there might be a very delicate correlation, between the structures beneath the otic plate and the otic plate itself, which if interfered with might, as is the case with the lens, result in a lack of differentiation of the otic plate, ten experiments were performed on embryos of rana palustris and rana sylvatica; a skin flap with the thickening of the otic plate was loosened and turned away from the side of the head either as a dorsal or a ventral flap and then after a few seconds replaced in its original position. All the connections, if there were any, between the otic plate and the structures beneath were broken by the operation, yet there was no interference with the formation or differentiation of the otic vesicle.

That correlations may have been reestablished between the otic plate and structures beneath was of course possible, and in order to determine if any structures in the region of the otic vesicle are necessary for its differentiation, several series of experiments were made. In one series of 15 embryos a skin flap including the otic plate was turned back from over the ganglionic masses of the fifth to the tenth nerves. They were carefully removed and the side of the brain scraped. The skin flap was then replaced and soon healed in its original position. In all of these experiments the invagination, growth, and differentiation of the otic vesicle proceeded in a perfectly normal manner, at least during the period the embryos were allowed to live, namely, 2 to 16 days.

The ganglionic masses always regenerate though they are usually smaller than the normal ones on the other side of the head. This regeneration nullifies to a certain extent the value of these experiments.

In another series of 12 experiments a similar skin flap was made and the lateral one-half of the brain of the otic region removed either with or without the ganglionic masses. The embryos were killed from 2 to 6 days after the operation and there was apparently no interference with the invagination and differentiation of the otic vesicle. There is more or less regeneration of the brain but this half is smaller than normal, and often so small as to exclude the idea of any direct influence on the differentiation of the otic vesicle.

It seemed very probable from these experiments that neither the ganglionic masses nor the brain were causal factors in the invagination or differentiation of the otic vesicle, nor are these structures capable of stimulating the formation of an otic vesicle from strange ectoderm.

In four experiments a small piece of ectoderm, including the otic plate, was cut away entirely. The surrounding ectoderm soon covered the wound but there was no regeneration of the otic plate or otic vesicle from this new ectoderm even 10 days after the operation. In two other experiments there was a small regenerated otic vesicle but its origin is probably due to the failure to cut out in the original operation all of the otic plate and the part left on the embryo developed into a small otic vesicle. In doing the operation I was not at first exactly sure of the limits of the otic plate and could easily have cut away only part of it instead of all. This explanation is born out by the fact that the otic vesicles arising from the transplanted otic plates were smaller in the last two than in the preceeding mentioned experiments.

The small pieces of ectoderm with the otic plate which were cut away in the preceding experiments on rana sylvatica were transplanted in several of the experiments into somewhat older embryos of amblystoma in the region between the eye and ear. These transplanted pieces were buried in the mesenchyme, yet from the otic plate there was formed an otic vesicle which continued to differentiate. The older ones show the ductus endolymphaticus and a more or less irregular arrangement of the semi-circular canals. The above embryos were killed from 2 to 15 days after the transplanting. There is during this period no sign of histolysis, which might be expected between tissues of such widely separated species. In still older examples it would probably occur as is the case when the eye is transplanted from rana to amblystoma. These experiments show the great power of self-differentiation possessed by the otic plate and its independence of any especial environment.

But the most remarkable feature is the formation about the otic vesicle, in one of the experiments in which the otic plate of rana sylvatica was transplanted into amblystoma of a cartilaginous capsule. The embryo was killed 15 days after the transplantation. The cartilage is of amblystomal origin and not of rana sylvatica origin, as can be readily seen from a comparison of cartilage in the two animals. The transplanted otic vesicle of rana sylvatica in this experiment lies buried in the mesenchyme between the eye and the normal otic vesicle. Owing to the position of this transplanted vesicle its cartilaginous capsule, which it has forced to form about itself, is continuous with the skull cartilage at one place and at its caudal end with the cartilage surrounding the normal otic vesicle. This cartilaginous capsule has all the appearance of having arisen *de novo* from the mesenchyme about the otic vesicle rather than as an extension of the cartilage either of the skull or the otic vesicle.

Correlated with this new formation of the cartilaginous capsule about the transplanted otic vesicle is the absence of the formation of a capsule in those embryos where the otic plate is entirely removed and regeneration of the otic vesicle fails to take place. This, of course, is what would be expected if the cartilaginous capsule is dependent for its origin on the influence of the otic vesicle. In one experiment where a small otic vesicle regenerated owing to its partial removal, there is forming about it a small otic capsule of cartilage corresponding in size and shape with the otic vesicle. Such a condition is what one would expect if the cartilaginous otic capsule were dependent for its origin on the influence of the otic vesicle on the mesenchyme.

The formation of the anterior endothelial layer over the anterior chamber of the transplanted eye is another example of this influence of organs on the formation of structures from the mesenchyme. This endothelial layer forms over the pupil of a transplanted optic vesicle no matter whether such an eye has a lens or not or whether it was transplanted from one frog embryo into another of the same or another species, or from frog into amblystoma.

I have made but a few preliminary experiments with the idea of determining at how early an age the otic vesicle is self-differentiating and find that in rana sylvatica, even before the neural folds are closed, when the medullary plate is still wide open that ectoderm from the otic region, when transplanted into an older embryo, will continue to differentiate into an otic vesicle with the sensory thickenings and ductus endolymphaticus. In one embryo which was killed 10 days after the operation the transplanted otic vesicle lies partly in the Wolffian body, and in this region a cartilaginous capsule is beginning to form about the vesicle. At how early a period the otic vesicle is self-differentiating can only be determined by further experimentation.

In two experiments on amblystoma where the otic vesicles, shortly after their invagination and separation from the ectoderm, were transplanted into older embryos of the same species they continued to grow and differentiate with the formation of the semi-circular canals, etc. About each one is a cartilaginous capsule, continuous, however, with the cartilaginous capsule of the normal ear. It is thus here not possible to decide whether the new capsule is an extension of the old or a formation from the mesenchyme surrounding the transplanted vesicle which has taken place under the influence of the latter.

With a more detailed study of the above experiments and more new ones on embryos of various ages I hope to trace back still farther the age at which the otic vesicle first becomes self-differentiating, and by the transplantation of the otic plate into such a position where the cartilage forming about it will have no contact with the skull or normal otic cartilage, to show conclusively whether the otic vesicle has the power of stimulating the formation of the cartilaginous capsule about itself.

The transplantation from frog into amblystoma offers certain advantages over transplanting from frog into frog in that when the cartilage develops about the transplanted otic vesicle one is easily able to distinguish between cartilage of amblystomal and cartilage of frog origin. When of amblystomal origin we are certain that the otic cartilaginous capsule was not derived from precartilage cells of the frog that were transplanted with the otic plate.

If the cartilaginous capsule about the otic vesicle is dependent upon the influence of the latter for its origin it will probably be found the cartilage in other regions of the embryo is likewise dependent on certain influences of the neighboring structures for its origin from the mesenchyme. The influence of the otic vesicle can scarcely be a specific one in that the cartilage forming in other regions can not owe its origin to the otic vesicle. But we must look for some factor or factors common to a variety of positions in the embryo. A piece of transplanted brain or a transplanted eye, for example, even when close to the cartilage forming about the otic vesicle or central nervous system does not stimulate the formation or growth of cartilage about itself.

JOHN BRUCE MacCALLUM.

In the premature death of John Bruce MacCallum, late Assistant Professor of Physiology in the University of California, scientific medicine in America has met with a deplorable loss. The subject has, in this country, had but few men of his age of such brilliant promise or of such significant achievement.

Born in Dunnville, Ontario, in 1876, interested early in natural history by his father, MacCallum received his general education in the Canadian schools, graduating in the Natural Science Course at the University of Toronto in 1896. During his course in Toronto he came under the stimulating influence of Professor Ramsay Wright in biology and Professor A. B. Macallum in physiology, and through them the love of nature study, implanted by his father, was fostered and developed. He decided to study medicine in Baltimore, entering the Johns Hopkins Medical School soon after that college was opened. Finding there but a small number of students, all of them college-bred, and in intimate contact with a group of young and enthusiastic teachers and investigators, MacCallum felt at home at once. Research was in the air, and in his very first year this eager student undertook, in the anatomical laboratory, in addition to the regular work of the course, a special investigation bearing upon the finer structure and development of the muscle cells in the heart. In this study he had the constant support and sympathy of Professor Mall, whom MacCallum gladly recognized as the source of the greatest impetus to his scientific development during the early years spent in Baltimore. His findings in histology made it easy for him to make certain contributions to the knowledge of the pathology of the heart muscle, especially the phenomena of fragmentation and segmentation of the heart-muscle cells in disease; abundant material for the study was made available to him by Professors Welch and Flexner in the laboratory of pathology.

On graduation in 1900 MacCallum decided to give his life to teaching and investigation in the fundamental medical branches, and began his post-graduate career as Assistant in Anatomy in the Johns Hopkins University. He took hold of the work with ardor, and spent all his spare time in original inquiries in histogenesis, resulting in the publication of his papers on (1) the development of the pig's intestine, (2) the Wolffian body of higher mammals, and (3) the muscular architecture and growth of the ventricle of the heart.

In 1901 he worked for a short time in the laboratory of anatomy in Leipsic under Professor Wilhelm His.

As early as in 1899 MacCallum had become cognizant of symptoms which were doubtless the indications of the beginning of the malady which was to handicap him in his work and to cut short his life. While in Leipsic definite signs of apical tuberculosis developed, and it became necessary for him to interrupt his studies. He spent a winter in Jamaica for the sake of his health; but even during this period of climatic treatment he kept at work, translating Szymonowicz's text-book of histology into English.

In the autumn of 1902 he decided, on account of the precarious state of his health, to settle in Denver, where he began to teach anatomy in the medical school and to engage in private practice. His heart, however, was in scientific investigation, and when Professor Loeb, who had just been appointed to the professorship of physiology in the University of California, offered him a position in that institution, he accepted with joy, hoping that he might be able in the California climate to continue experimental work without detriment to his chances in the struggle against his infection. At Berkeley during the next three years he did a large amount of experimental work bearing upon the action of cathartics and leading to the publication of more than a dozen different papers on the subject. These researches were carefully planned and systematically carried out and led to results of great value both for physiology and for the practice of medicine. The relations between the Professor of Physiology and the assistant Professor became very intimate; Professor Loeb found in MacCallum a discoverer of rare ability, and the latter received from the former the companionship and the inspiration which he prized most highly.

It is difficult to estimate the contributions to science which MacCallum would have made had twenty years more of life been granted to him. Science, and particularly American scientists, must mourn sincerely the loss of one who was so full of promise and who by his character and personality had endeared himself to all who knew him.

Lewellys F. Barker.

REVIEWS.

J. Kollmann: Handatlas der Entwickelungsgeschichte des Menschen. 2 volumes, 769 figures, Jena, 1907.

The foundation of an objective human embryology can be ascribed to His in much the same sense that the foundation of modern systemic gross human anatomy is ascribed to Vesalius. Vesalius had a greater accumulation of knowledge to draw from and an easier subject to describe and illustrate. It is not strange, therefore, that he could bring his work nearer completion. His, perforce, left far wider gaps for others to fill but, nevertheless, as surely pointed out the way which those must follow who would make substantial contributions.

Kollmann's Handatlas, although it embodies much which was furnished by His, is of special interest because it illustrates concisely the great progress in human embryology which has been made since the publication of His' Anatomie menschlicher Embryonen in 1880. His showed the value of objective description and of illustration by means of magnified reconstruction of minute complex structures seen in serial sections. Progress along these lines has been due in large part to the utilization of the wax-plate reconstruction method of Born in the laboratories of Keibel, Kollmann, Mall, and many other workers. The figures in the Atlas are based chiefly on reconstructions by this method, although some are drawn or photographed directly from specimens or sections of specimens and some schematic diagrams are given. A considerable number of the figures illustrate conditions found in quadrupeds and lower vertebrates. While comparative embryology is indispensable for any real understanding of human embryology, we, however, think that in an atlas of this kind, where text and space are limited, it would be better to follow the example of His and keep more strictly to objective human embryology, utilizing the space thus gained for illustrations of human development.

Kollmann takes the subject up in the following order: Vol. I, progenesis, blastogenesis, membranes, external form, bones, muscles; Vol. II, alimentary canal, respiratory and urogenital organs, heart and blood-vessels, nervous system, skin and organs of special sense, subject index and author index (with titles of publications utilized).

In the section on Progenesis there are an excellent series of illustrations of human sex glands and sex cells. American work is represented by Broedel's figures from Clark's monograph on the ovary. In the section on blastogenesis Bonnet's beautiful figures on canine embryology are utilized to illustrate differentiation of the embryonic shield. This can, however, be well illustrated by human material. Neither Peter's embryo nor von Spee's embryo v. H. are figured in this section. Kollmann has made a somewhat serious mistake in attributing Figs. 65 and 66 to an embryonic shield of the stage of Fig. 64 and in making it possible to draw false deductions from the text as to the origin of the chorda plate and mesoderm.

The sections on embryonic membranes and appendages and on the decidua and placenta are very satisfactory. They are illustrated largely from specimens belonging to Kollmann's fine collection at Basel. The sections on embryos of the first and second month and on fœtuses are likewise well illustrated. A considerable proportion of the figures are original, although good use is made of illustrations of embryos of Eternod, von Spee, His, Mall, Rabl, and others. We should like to see the No. 12 embryo of the Mall collection included among the younger embryos and less prominence given to embryos with deep dorsal flexure.

The development of the skull is much more satisfactorily treated than that of other parts of the skeleton. In another edition more space may well be given to the earlier stages in the development of the skeleton, of the trunk and limbs, and to the development of the joints. On the other hand, it is to be hoped that there will be adequate material for illustrating much more fully in another edition the development of the musculature of the head. The illustrations of the development of the musculature of the trunk and limbs in man are based chiefly on the work of Lewis and of Bardeen and Lewis.

Owing largely to the contributions and stimulating example of His the sections devoted to the development of the viscera are among the best in the Atlas. A few additions may, however, be suggested. While Hammar's illustrations of the development of the pharynx and its appendages are most satisfactory Sudler's illustrations of the position of the developing pharynx in transparent embryos might well be added to these. More of Röse's models of the developing teeth should be pictured. More of Mall's models might have been used with advantage to illustrate the development of the diaphragm and of the intestines. In another edition Huber's work on the development of the kidney will doubtless be included. Attention should be called to the apparent situs transversus in Fig. 348, due to reversing a figure for the sake of making a diagram. As in all parts of the Atlas in these sections Kollmann has introduced many original figures of great interest and value.

The development of the blood-vessels is well illustrated, owing largely to the well-known work of His, Hochstetter, and Mall. In Fig. 557 the metanephros is mislabeled "mesonephros." The development of the lymphatics is illustrated by Sabin's studies on the pig and by an original figure of the lymphatics in the inguinal region of a human fœtús.

The earliest stages in the development of the central nervous system are illustrated by figures of Eternod and von Spee; the later stages by figures from His and by original figures. The work of Retzius might have been further utilized to advantage. The figures by Streeter make a welcome addition to the older figures utilized to illustrate the development of the peripheral nervous system. Streeter's work on the development of the ear may well be added in the next edition. On the whole the sections on the development of the skin and organs of special sense illustrate adequately the present knowledge of these subjects.

The Atlas is conveniently arranged. Sheets of heavy glazed paper for the figures alternate with sheets of thinner paper for the legends. Each sheet is printed on both sides. The legends lie opposite the figures they describe. Most of the borrowed figures have been redrawn. The method of illustration most frequently used is a drawing in bold lines upon which colors are superimposed so as to bring different structures out sharply.

Taken as a whole the Atlas is a most useful contribution. The author is to be congratulated on the high standards which he has been able to maintain. All students of embryology owe a debt of gratitude to both author and publisher for bringing out so extensive and excellent an Atlas at a price which puts it within reach of all.

C. R. Bardeen.

HISTOLOGICAL STUDIES ON THE LOCALIZATION OF CEREBRAL FUNCTION. BY ALFRED W. CAMPBELL, M. D., Pathologist to the Asylums Board of the County of Lancaster. University Press, Cambridge, 1905. 360 pages, quarto, 29 full page plates, and 23 figures in the text. Price, 18 s. net. The Macmillan Company, New York. Price, $6 net.

This publication of a research upon the histology of the cerebral cortex presented to the Royal Society of London and published by aid of a subsidy from that Society is a work of the greatest importance. It was a colossal undertaking to make a complete microscopic examination of the cortex of a considerable number of cerebral hemispheres; three "completely examined for both nerve cells and nerve fibers, three for fibers only, and two partially examined for nerve fibers and nerve cells." In addition to this the report covers the examination of three hemispheres of the anthropoid ape, "two brains from cases of Amyotrophic Lateral Sclerosis, seven from cases of amputation of one or other extremity, three from cases of Tabes Dorsalis, and one from an old-standing case of capsular lesion; and the occipital lobe was completely examined in two cases of old-standing blindness." Furthermore, in an addendum of some thirty pages the structure of the cortex of three domestic animals—the cat, the dog, and the pig—is carefully described and compared with that of man.

The author finds different cortical areas characterized by structural differences, both in cells and fibers, and by means of the comparison of carefully made drawings he is able to map out divisions of the cortex, which, to a certain extent, agree with the generally accepted ideas of localization. His *pre-central* or motor area, characterized by the presence of Betz cells, corresponds quite closely to the area found to be excitable by Sherrington and Grünbaum in their recent experiments. That this area is characteristically and peculiarly motor is confirmed by his demonstration of pathological changes in cases of amputation of the extremities. Anterior to this he finds a larger area, which he calls the *intermediate* *pre-central,* differing but little from the pre-central, except in the absence of Betz cells. This area, he thinks, has a "physiological kinship" to the pre-central and endeavors to bring this observation into accord with Hughling's-Jackson's hypothesis of the "three levels." It is interesting to observe that this area embraces the convolution of Broca.

While he finds the structure of the remainder of the frontal lobe "approximately uniform in character it is nevertheless possible to split it up into two fields," the *frontal* and the *pre-frontal,* the latter confined practically to the frontal pole and the cortex immediately surrounding it. The special characteristic of these areas is a gradual diminution, from the intermediate pre-central area forward, in the size of the cells, especially of the large pyramidal, as well as of the caliber of the cortical fibers. The diminution in fiber wealth and the inferior cell development induces him to look upon the pre-frontal as of "low functional importance compared with the frontal."

The base of the central fissure forms the dividing line between two distinctly different types of cortex; the *pre-central* and the *post-central.* The latter is confined to the posterior wall of the central fissure and the anterior half of the crest of the post-central convolution and a correspondingly slight extension upon the mesial surface. It shows a marked difference in structure from the pre-central, both in fiber and cell. A well-sustained argument, supported by interesting observations of changes in cases of Tabes Dorsalis, points to this area as the cortical representation of common sensation, while the posterior half of the post-central convolution—*the intermediate post-central* area—though differing in structure is probably closely related to it in function. "This separate localization of the various components combining to produce common sensation is beset with difficulties. However, the view is promulgated here that the post-central area, like better known sensory realms, is divisible into a purely sensory part, to which all impressions primarily pass, and an investing psychic part. The former occupies the post-central area proper and, in accordance with my thesis, its destruction should lead to abolition of psychic, as well as impairment of fundamental sensory components; the latter covers the intermediate post-central field and may extend further back in the parietal direction; its destruction should lead to isolated disturbance of psychic sensory attributes."

He also, on similar grounds, divides the auditory and visual areas into sensory and surrounding psychic areas marked by slight, though distinct, differences in structure. The *audito-sensory* area is confined to the "transverse temporal gyri of Heschl" lying within the fissure of Sylvius and connecting the superior temporal convolution with the island of Reil. This area is, not only microscopically but macroscopically, distinct from the surrounding cortex, being of distinctly darker coloration. A portion of the cortex of the superior temporal convolution surrounding this area "possesses a special structure resembling but not identical with that of the audito-sensory cortex, and one which makes it readily distinguishable from that of more outlying parts" and is marked out as the *audito-psychic.*

The division of the calcarine cortex into a *visuo-sensory* and a surrounding *visuo-psychic* is equally interesting and will repay careful study. This, indeed, may be said of the whole work, which gives evidence throughout of careful, conscientious work by a competent investigator. The drawings are particularly interesting and present the views of the writer in a remarkably clear and distinct way. The mechanical part of the work is also worthy of high praise and the bibliography accompanying each chapter fairly complete.

It must be a matter of regret, however, that such an enormous amount of labor, of such an important character should not have been carried out upon material more absolutely normal. It is, above all, in the cerebral cortex that pathological changes take place in abnormal mental conditions. Of the eight cerebral hemispheres which Dr. Campbell classes as "normal human material," "six were taken from persons who died while of unsound mind in Rainhill Asylum; two only, came from a sane individual." Notwithstanding the opinion of so experienced a pathologist, that the objections to the use of such material are "based more on sentiment than reality" we would rather have our histology based upon a a foundation unassailable even by "sentiment."

But the work is certainly to be reckoned among the classics and should be within the reach of every student of cerebral localization.

"Stöhr's Histology Arranged upon an Embryological Basis." By Frederick T. Lewis. 450 illustrations, 434 pages. Blakiston's Son & Co.

"The need of a text-book of histology arranged upon an embryological basis has long been felt." In a number of American laboratories, it has been customary for some time to treat histology from the basis of embryology and histogenesis, and teachers have found it necessary to supplement the current text-book accounts of the structure of tissues and organs by class-room expositions of the developmental history of the structures considered or to recommend the use of a good text-book of embryology in conjunction with that of histology. However, students have, as a rule, found it difficult to co-ordinate their embryological knowledge with that gained by the study of adult tissues and organs; the later stages of the development and differentiation of tissues and organs, those leading to the adult conditions, being as a rule not described with sufficient fullness to enable the student to pass from the more detailed accounts of their anlage and early developmental stages to the structures presented in full development. The Lewis edition of Stöhr, in many respects, meets in a very satisfactory manner this modern trend of histologic teaching.

The subject-matter is treated under three general heads: (1) Cytology; (2) general histology; (3) special histology, followed by a very brief account of the methods of preparation and examination of microscopical specimens.

The section on cytology covers relatively few pages and might with profit be extended somewhat, especially the part dealing with the important phenomena of maturation and fertilization of the sex-cells. Cytomorphosis, a term used to indicate "the structural modification which cells or successive generations of cells may undergo from their origin to their final destruction" is, we believe, for the first time given due consideration in a text-book of histology.

The section of general histology is introduced by a brief but adequate account of segmentation and the formation of the germ layers, including a table giving the origin of the tissues from the germ layers. This is followed by a discussion of the fundamental tissues under which head are considered the epithelia, mesenchymal, muscular, nervous and vascular tissues, about 125 pages being devoted to their consideration. This section was perhaps subjected to greater alteration than other sections, receiving additions both to text and figures, and of the latter many are original. In connection with the epithelia, there is given a preliminary description of gland cells and glands with a new and very good tabular classification of glands, based on their origin from the respective germ layers, their function, and to some extent their morphology. In the consideration given to each of the fundamental tissues, stress is laid on its embryology and developmental history. This section deserves, on the whole, much commendation. Viewpoints of editors and writers must of necessity differ as to certain minor details of structure and it is not the function of a review to emphasize such differences. The following general statement may, however, be permitted as a suggestion to which consideration may be given in a future edition. It would seem that a somewhat fuller treatment of the histogenesis of the fundamental tissues would be helpful to both students and teachers. For example, if in considering the development of the central nervous system, there would be added to the concise and well-formulated statement of the morphologic embryology of this tissue a somewhat fuller and more connected statement of the developmental history of a motor, spinal ganglion, and sympathetic neurone, beginning with the undifferentiated cell and tracing it through its several stages of development, including the development and relation of the sheath cells, the ultimate sketch would enable the student to form a more comprehensive picture of the different neurones thus considered. The addition of a few typical figures illustrative of appearances presented by growing and differentiating neuraxones would be helpful. Attention might also be drawn to the excellent experimental work which has been done in America to substantiate the outgrowth theory of the neuraxone.

Under special histology, to which some 250 pages are devoted, are considered the blood-forming and blood-destroying organs, the entodermal tract (mouth and pharynx, tongue, branchial epithelium derivatives, salivary glands, intestines, liver, pancreas, lung), the urogenital organs, skin, suprarenal, brain, and sense organs. This very important section has been greatly improved by adding to it a fuller treatment of the embryology of the structures considered, these additions being accompanied by a goodly number of new figures. The embryology added deals to a large extent with the morphologic development of the organs treated, which is adequately and well presented. As the science develops, there may well be added, as occasion permits, a more detailed account of the structural differentiation of the respective tissues which go to make up an organ. This can now be done for only a few organs and presents a fruitful field for further research. In connection with the consideration given to the female genital organs, there is found a brief but good and well illustrated account of the structural changes during menstruation and of the development of the decidual membranes, a useful addition to a text-book of histology.

Throughout the work the BNA nomenclature has been adopted and consistently used.

G. C. Huber.

COURSES IN ANATOMY AT THE UNIVERSITY OF CHICAGO.

STAFF.

ROBERT RUSSELL BENSLEY, A. B., M. B., Professor of Anatomy.
CHARLES JUDSON HERRICK, S. M., Ph. D., Professor of Neurology.
JOHN GORDON WILSON, A. M., M. B., Assistant Professor of Anatomy.
GEORGE ELMER SHAMBAUGH, M. D., Instructor in Anatomy of the Ear, Nose, and Throat.
BASIL COLEMAN HYATT HARVEY, A. B., M. B., Instructor in Anatomy.
DANIEL GRAISBERRY REVELL, A. B., M. B., Instructor in Anatomy.
ELIZABETH HOPKINS DUNN, A. M., M. D., Associate in Anatomy.
EDWIN GARVEY KIRK, S. B., Associate in Anatomy.
EMIL GOETTSCH, S. B., Ph. D., Associate in Anatomy.
JOHN SUNDWALL, S. B., Ph. D., Assistant in Anatomy.
FRANK ST. SURE, S. B., Assistant in Anatomy.

The courses in anatomy at the University of Chicago are divided into two groups, college courses and graduate courses. The former are designed to give the student of medicine an adequate preparation for his subsequent studies and at the same time to enable medical and other college students to lay a broad foundation from which they may proceed to the more special work of the graduate courses and finally to individual investigation. The work in human anatomy is largely laboratory work in dissection of the human body, for which purpose an abundant supply of good material is available. Students are encouraged to work independently, using atlases as guides. Lectures are given for the purpose of elucidating the comparative morphological aspects of the work. The courses in histology, splanchnology, and neurology are lecture and laboratory courses dealing with the structure of the tissues, and with the gross and microscopic anatomy of the organs of the body, including the central nervous system. These courses are prerequisites to the graduate courses in these fields. Special opportunities are offered during the Summer Quarter to physicians and advanced students preparing for special practice to perfect themselves in the knowledge of the anatomy of the regions in which they are especially interested.

The graduate courses are more restricted in their scope, each such course dealing with some special field of anatomy. They consist of lectures, conferences, and laboratory work, in which the newer aspects of the subject are studied and a critical examination of the literature and current lines of progress made. These courses are primarily intended for students proceeding to higher degrees, with anatomy as a principal or secondary subject; but they are also available for medical students who are adequately prepared and who have the time and inclination to do advanced work in anatomy. On account of the close relation that exists between the anatomical laboratory and other scientific laboratories of the University the opportunities for correlated work in anatomy and other related fields are unusually good. Of especial interest in this connection are the facilities afforded to students of psychology and of physical anthropology to acquire the necessary training in neurology and in human anatomy. In the departments of zoölogy and of vertebrate paleontology, also, facilities for advanced work and research in embryology and comparative anatomy of vertebrates may be found.

General biological problems and current progress in research are discussed in Seminar courses, to which suitably prepared graduate students may be admitted. Facilities for research in all branches of anatomical work are offered.

COURSES OF INSTRUCTION (1907-08).

Primarily for the Senior Colleges. Assistant Professor Wilson, Drs. Harvey, Goettsch, Sundwall, and others.

1. Dissection of Arm (Human). Mj. Autumn Quarter. Repeated in Winter and Spring Quarters. Laboratory: Monday, Friday, 2.00-5.00 (*with similar arrangements for Courses 2-6*).

2. Dissection of Leg (Human). Mj. Autumn Quarter. Repeated in Winter and Spring Quarters.

3. Dissection of Head, Neck, and Spinal Column (Human). Mj. Autumn Quarter. Repeated in Winter and Spring Quarters.

4. Dissection of Thorax and Abdomen (Human). Mj. Autumn, Winter, and Spring Quarters. *Prerequisite: Courses 1, 2, and 3.*

5. Dissection of Abdomen (Human). Mj. Autumn, Winter, and Spring Quarters. *Prerequisite: Courses 1, 2, and 3.*

6. Human Osteology. Dr. Revell and Mr. Kirk. ½ Mj. Autumn and Summer Quarters. Lecture: Tuesday, 8.30. Laboratory: Tuesday, 9.30-1.00.

7. Topographical Anatomy. Assistant Professor Wilson. Mj. Summer Quarter. Repeated in Winter Quarter, 1908. *Prerequisite: Courses 1, 2, 3, and 4.*

10. Splanchnology, Histology, and Cytology. Dr. Revell, Mr. Kirk, and others. Mj. Autumn Quarter. Lectures: Monday, Friday, 9.30. Laboratory: Monday, Friday, 10.30-1.00; Thursday, 11.00-1.00.

16. Elementary Neurology. Dr. Dunn. An elementary course on

the structure of the central nervous system. Mj. Autumn Quarter. Two lectures. Seven hours laboratory work. *Prerequisite: Course 10.*

17. Gross and Microscopic Anatomy of the Human Central Nervous System and Sense Organs. This is a required course for medical students. Professor Herrick, Dr. Dunn, and assistants. Mj. Spring Quarter. Lectures: Monday, Tuesday, 8.30. Recitation: Wednesday, 8.30. Laboratory: Monday, Tuesday, and Wednesday, 11.00-1.00. *Prerequisite: Microscopic Anatomy.*

20. Anatomy of the Ear, Nose, and Throat. Special anatomy for practicing physicians. Dr. Shambaugh. DM. First Term, Summer Quarter. Lectures and Laboratory: Monday, Thursday, 1.30-4.30.

23. Anatomy of the Pharynx and Larynx. Assistant Professor Wilson. DM. First Term, Summer Quarter. Lectures and Laboratory Work: Monday, Tuesday, Wednesday, Thursday, 2.00-5.00.

Primarily for the Graduate School.

25. Comparative Neurology. Professor Herrick and Dr. Dunn. Mj. Autumn Quarter. Two lectures. Six hours laboratory work. *Prerequisite: Courses 16 or 17.*

26. Mammalian Neurology. Professor Herrick and Dr. Dunn. With special reference to the structure of the human brain. Mj. Winter Quarter. Two lectures. Six hours laboratory work. *Prerequisite: Course 25.*

28. Neurological Research. Professor Herrick. 3 Mjs. Autumn, Winter, and Spring Quarters.

29. Neurological Seminar. Professor Herrick. 3 Mjs. Autumn, Winter, and Spring Quarters. Thursday, 4.00-6.00.

30. Comparative Anatomy, Histology, and Histogenesis of the Organs of Secretion and Absorption. Professor Bensley. 3 Mjs. Autumn, Winter, and Spring Quarters. Lectures and Laboratory Work: Monday, Friday, 2.00-4.00. *Prerequisite: Human or Comparative Anatomy and Histology.*

31. Gross and Microscopic Structure of the Organs of Special Sense. Assistant Professor Wilson. 2 Mjs. Autumn and Winter Quarters. Lectures and Laboratory Work: Monday, Thursday, 11.00-1.00. *Prerequisite: Same as for Course 30.*

32. Organs of Internal Secretion. Dr. Harvey. Mj. Winter Quarter. Lectures and Laboratory Work: Monday, Thursday, 8.30-10.30. *Prerequisite: Same as for Course 30.*

33. Morphology of the Blood and Blood-Forming Organs. Dr. Sundwall. Mj. Spring Quarter. Lectures and Laboratory Work: Tuesday, Friday, 8.30-10.30. *Prerequisite: Same as for Course 30.*

34. Cytology and Histology. Dr. Revell. 2 Mjs. Autumn and Spring Quarters. Two lectures. Six hours laboratory work. *Prerequisite: Same as for Course 30.*

41. Research Work. Professor Bensley. The laboratory is equipped for the original investigation of anatomical problems. Suitably trained and endowed students who have the time to do such work, will be encouraged to undertake it. 2-4 Mj.

42. Seminar. Professor Bensley. A limited number of students can, by special arrangement, be admitted to a seminar, in which subjects of current interest in Gross or Microscopic Anatomy will be discussed. 1-2 Mj. Autumn and Winter Quarters. Friday, 4.00.

NOTES AND APPOINTMENTS.

It is a matter of gratification to anatomists in this country to learn of the appointment of Dr. R. R. Bensley to the professorship of anatomy in the University of Chicago and Rush Medical College. Dr. Bensley's career has been a steadily progressive one in both teaching and investigation. Trained under Professors Ramsay Wright and A. B. Macallum in Toronto, especially along the lines of biology, comparative anatomy, histology, and physiology, Dr. Bensley taught in the University of Toronto for several years. His success there led to his appointment as assistant professor in the University of Chicago, where for several years he has had charge of the microscopic work of the department of anatomy and has also taught gross anatomy. Dr. Bensley's research has consisted chiefly of histological work. His studies upon the histology of secretion are valued by investigators in Europe as well as in America. His studies of the histology and physiology of the cardiac and other gastric glands and of the glands of Brunner have been particularly important, and his investigations of the chemistry of the mucins are full of promise. Dr. Bensley's contributions to technique have also been valuable, and as a result of their introduction, especially of the method for the demonstration of iron in the tissues and the methods of demonstrating secretion products, have given rise to a number of researches which would otherwise have been impossible. While Dr. Bensley is much interested in comparative anatomy and teaches also gross human anatomy, it is interesting that a university in the Middle West has been ready to appoint as its professor of anatomy a man whose chief contributions have been histological and histo-chemical. This broadening of the conceptions of the functions of anatomists in medical schools is to be welcomed. The practice of appointing research workers to the chairs of anatomy in our medical schools and the practice of regarding histological work as a part of the anatomical department seems now to be fairly well established in America.

At the Eighty-second Annual Commencement of the Jefferson Medical College of Philadelphia, held on June 3, 1907, the honorary degree of Doctor of Laws was conferred upon George Sumner Huntington, M. D., Sc. D., Professor of Anatomy, Columbia University.

THE ANATOMICAL RECORD.

No. 7. NOVEMBER 10, 1907.

EFFECTS OF EARLY REMOVAL OF THE HEART AND ARREST OF THE CIRCULATION ON THE DEVELOPMENT OF FROG EMBRYOS.[1]

BY

H. McE. KNOWER.

The Anatomical Laboratory, Johns Hopkins University.

This study was first undertaken to test the action of solutions of acetone-chloroform, a specific heart poison, in suppressing the circulation from the earliest possible stage of frog embryos, especially with eggs of R. Palustris and R. Sylvatica. Loeb made some similar experiments in 1893 with solutions of potassium chloride (KCl) acting on the eggs of a fish (Fundulus), but based his conclusions on living embryos only, without comparing them with preserved material and sections.

In order to eliminate any possible direct action of a drug on cells other than those of the heart, and yet to examine the effects of an arrest of the circulation on the development of other structures, it seemed best to simply cut out and remove the heart rudiment at a stage as early as possible. Cuts were made so as to carry the heart rudiment away in a wedge-shaped piece, injuring neighboring structures as little as possible. The embryo was now placed in 0.2 per cent sodium chloride solution in tap water for a few days, and then into plain tap water, in which development continued for as long as fourteen days. The method of operating was varied, in efforts to limit the amount of tissues taken away, or to insure complete removal of the heart and the large vessels immediately attached.

The development of embryos operated upon in this way proceeds actively, the wound closing in the first day, where the cuts have not exposed too great a surface of yolk. By the fourth day the abnormal

[1] This paper was presented to the *Seventh International Zoological Congress*, before the section of Embryology and Experimental Zoology. *Boston, Mass., August 22, 1907.*

(6 mm. to 7 mm.) are readily distinguished from the normal (7 mm. to 8 mm.) larvæ, both by size and form.

On the fifth day (8-9 mm.) it is possible to observe the pulsations of the anterior lymph hearts, at an earlier stage and more clearly than by any other method. Often the lymph hearts may be identified earlier; but from this stage the increasing œdema distends the skin and spreads the connective tissue and pigment cells apart, until the attachments to surrounding cells, the action of the valves, and the course of blood corpuscles can be studied with ease. Indeed this is the best method of demonstrating the embryonic lymph hearts and the pronephros, as I pointed out in 1903. Fluid now continues to accumulate in the cavities of the body which soon become swollen, while the walls become transparent. The internal organs are then seen with exceptional clearness in living specimens or in cedar oil.

By the tenth day the larva has assumed a most abnormal form, due to the œdema. In extreme cases, the distension of the abdomen is so great as to give the appearance of a fish embryo lying on its yolk sac; while from above the swellings of the pronephric and head sinuses make a very odd picture. These specimens move around awkwardly. They do not seem to grow much or differentiate after the ninth day, and are now on the tenth day, hardly half as large as their controls.

Between the tenth and thirteenth days the tail usually begins to shrivel, and the abdominal walls are apt to burst from excessive œdema. In any event the operated larvæ die about this time.

A study of operated larvæ, in sections and as entire specimens in cedar oil, helps us to form a more accurate idea of the effects of the arrest of the circulation on the development of regions not immediately injured by the operation. In the first place two periods in the development of these embryos are plainly emphasized. The earlier stages, up to about the fifth day, are occupied with the primary differentiation of tissues and organs, in the typical manner. After this, though the embryo may continue to live for more than twice this period, further differentiation is arrested. Increase in size (or growth) is now due, in part only to the multiplication of cells, mostly to the great distension of cavities and spaces from the œdema. There appear to be fewer cells in the older operated specimens than in normal ones of the same age. The period of primary differentiation and establishment of the typical forms of organs is not followed by the usual further elaboration of relations characteristic of older larvæ.

The arrest in the development of organs may be observed most readily in unstained and partially dissected specimens studied in cedar oil. The digestive tract exhibits one of the most striking abnormalities. It is limited to a single coil. It represents the intestine of about the stage of a normal four day embryo. The liver and pancreas are arrested, if present. Injury to the early rudiments persists, their being no regeneration.

The mesentery becomes much distorted; being transformed into a great bag, in which many corpuscles accumulate, and into which the aorta generally opens freely. The pronephric sinus may also open into the mesentery, and fluid or corpuscles propelled through the anterior lymph hearts soon reach this great sac.

When these larvæ are viewed from above and compared with the normal of the same age in cedar oil, the central nervous system of operated specimens is seen to be much smaller, while the subdivisions of the brain have failed to acquire their specific size and shape. This is most evident in the forebrain, where the vesicles open widely backward and have not enlarged normally. The eyes cling abnormally close to the brain. They are less than one-half as large as normal, and in ten days, hardly developed beyond normal five day eyes. (This is especially well shown by the lens). The walls of the optic cup cling closely around the little rudimentary lens, leaving almost no cavity within. The ear vesicles are less than one-half the normal size.

The musculature is underdeveloped, and after five or six days much vacuolated. The connective tissue develops normally during the first four days, until the œdema begins to be extensive. After this the cells do not multiply so vigorously, nor do they form a characteristic network. Fluid accumulates so freely between them as to stretch their processes and give the whole an attenuated appearance in place of the rather dense mesh of the usual ten day embryo.

The posterior cardinal vein on each side, and the sinus communicating with it and surrounding the pronephric tubules have become so greatly distended in these stages that the outer wall of the pronephros covers about one-third of the side of the embryo. A spacious chamber is formed in which the tubules occupy a novel position, the nephrostimal tubules being much enlarged and stretched outward to the collecting ducts and reservoir, which lie dorsally and near the outer surface. The whole system is thus readily studied in total mounts. The common duct exhibits only a few simple bends, as it runs back through the great sinus-like vein. The lumina of the tubules are enlarged, the cells vacuolated and irregular. The glomerulus is usually transformed into a hardly recognizable sinus. Though much distorted, the pronephros finally reaches a stage which may be compared to that of a normal embryo between four and five days.

In examining the tails of a series of these larvæ the normal character of the early stages of outgrowth is striking. The tail appears to pass through the typical changes, except in larvæ which have suffered excessive injuries anteriorly, in which case the tail fin is decidedly less expanded and shrivels early. The musculature has been described above. The connective tissue cells are relatively few, more scattered, and less organized than in a five day normal embryo.

The effect of these experiments on the development of the vascular system is interesting. The heart does not regenerate; (nor do other structures whose rudiments have been removed in these operations). Remnants of its chambers developing from uninjured portions of the rudiment, beat rythmically. Even after most extensive operation, involving much of the neighboring tissues, before the heart is clearly differentiated, the aorta the large veins and the segmental vessels are laid down. It has not been possible to inhibit their formation, which therefore apparently takes place in situ. The anterior lymph hearts are constantly formed, though distorted. Both arteries and veins are very abnormal and have a few well defined smaller branches. All vessels become much distended, and follow very irregular courses. The aorta and pronephric sinuses open into the mesentery. The glomeruli are dilated sacs. A study of the tail shows that the aorta and veins are there also much distended. In most cases the first pre-capillary loops are represented by enlarged sinuses, but there is a notable absence of capillaries in the fin. These smaller vessels do not push out nor form characteristic plexuses. Their development is inhibited. The weaker the heart beat, in fact, the less does the blood flow outward from the larger vessels and pre-capillary loops. Corpuscles are relatively few, and collected mostly in the mesentric bag; also in the aorta, post cardinal veins, pronephric sinuses, and the anterior lymph hearts.

There is no circulation through the gills after successful operations, and the gills fail to develop beyond rudimentary buds. There cannot be said to be a definite circulation in a true sense, where the systemic heart has been eliminated; though it is true that the corpuscles and fluids are kept moving through some of the larger vessels and the mesenteric sac, by the pulsations of the anterior lymph hearts. Even when a remnant of the heart beats, there is this imperfection.

Attention should be here called to the similarity between these larvæ and those with weak circulation produced from eggs developed in certain poisons, or after exposure to the X-rays. Late in the season abnormal bunches of eggs are often found, many of which develop into similar arrested and distended larvæ with weak circulation.

On the whole it would be difficult to find a better example, to illustrate the influence of a complete and efficiently functioning vascular system on the later elaboration of structure and form. The primary formative forces are well exhibited here, acting in the earlier stages to establish the characteristic tissues and organs and arrangement of the entire body structure; but, with this, the impetus to continued differentiation becomes limited, and in the absence of elaborate special capillary systems further development is arrested and growth rendered abnormal. In tadpoles this remains true, in spite of the extra provision of the cells with yolk, and the activity of the anterior lymph hearts.

THE METHOD OF MAKING MODELS FROM SHEETS OF BLOTTING PAPER.

BY

SUSANNA PHELPS GAGE.

Ithaca, New York.

The Born Method of reconstructing models from wax plates is in use in all the larger laboratories of Anatomy and Embryology. Various modifications of that method have been introduced, notably at Johns Hopkins University. For smaller laboratories and isolated investigators the wax plates are difficult to prepare or to obtain already made. Moreover, in the larger laboratories the preparation of the plates is a much dreaded piece of drudgery to be done in the basement. The apparatus is cumbersome and if at all accurate, expensive. Like any other apparatus it requires some skill to use it with success. Any one who has either cast or rolled wax plates will not need a statement of the inconveniences.

In 1905, it occurred to me that sheets of blotting paper might serve instead of wax plates. A small model was at once made which showed its feasibility. Models made of this material were demonstrated at the Association of American Anatomists in December, 1905, (Amer. Jour. Anat. V., 1905-06, p. XXIII) and the method was further demonstrated at the International Zoological Congress held in Boston, August, 1907. It has also been used successfully in the embryologic and anatomic laboratories of Cornell University and the University of West Virginia.

Blotting paper models were demonstrated by Dr. J. H. Hathaway and by Dr. J. B. Johnston at the Association of American Anatomists held in New York, 1906 (*Proc. Assoc. Amer. Anatomists,* Anat. Record, April 1, 1907).

Usually with the Born method the wax plates are 1, 2, or 3 mm. in thickness and the sections of the specimen are 10μ or some other multiple of 5, thus making the magnification at which the drawing of the sections should be made, a simple problem in proportion.

It has been objected that it is difficult to obtain blotting paper of a given thickness. This is indeed true. In Ithaca, at a wholesale paper dealer's one package was bought in which the paper was of the desirable thickness of one millimeter. The thickness since obtainable is 0.5 mm., 0.77 mm. and 0.9 mm.

The following steps give a general outline of the method used:

1. For testing the thickness, a pile of 40 pieces of the same size cut from different sheets of the blotting paper is held closely together by a rubber band. One end of the block so formed is dipped in hot paraffin and compressed with the fingers. The measurement of the paraffined end divided by the number of pieces gives the working thickness of the paper.

2. Size of model and thickness of plates.—Suppose a model is to be made of a specimen cut into a 10μ series and the blotting paper available has a thickness of 0.9 mm. or 900μ. Each sheet is 900μ divided by $10\mu = 90$ times as thick as the sections. The simplest case would be for a model 90 times as large as the object. Then each section is drawn at a magnification of 90 and a plate of the blotting paper is used for each section.

Suppose it were desirable to use a magnification of 120. Each section is drawn of the proper size, and must be represented by a thickness on the model of $120 \times 10\mu = 1200\mu$ or 1.2 mm. One plate is 0.9 mm. thick, that is 0.3 mm. less than it should be. In every three plates there is a loss of 0.9 mm., a loss which is made good by using two sheets of blotting paper for every third section, that is, for every group of three sections four pieces of blotting paper would be used.

Suppose a magnification of 60 were desired, then each section if drawn at a magnification of 60 should be represented on the model by $60 \times 10\mu = 600\mu$ or 0.6 mm. As the thickness of the paper is 0.9 mm., one plate is 0.3 mm. too thick and three plates would be 0.9 mm. too thick. Hence if every third plate is omitted the correct thickness is secured. In practice the drawing of every third section is omitted.

Other problems are easily met as occasion demands by adding plates or omitting the drawing of certain sections. The slight inaccuracy thus produced is negligible.

3. Thickness of paper, size of model and magnification having been determined, the drawings of sections are made upon the blotting paper by the aid of a camera lucida, or more satisfactorily with a projection microscope.

One or more duplicate drawings may be easily secured by using carbon paper and thin sheets over the blotting paper.

4. The difficulty of cutting wax plates is considerable. This difficulty has been met by Dr. E. L. Mark by using a sewing-machine with an electrically heated wire as cutting edge. (Demonstrated at the Asso-

ciation of American Anatomists, December, 1906. Method published in the American Acad. Arts and Sciences, March, 1907. See also Science, XXV, 1907, Anat. Record, Apr., 1907.)

With the blotting paper, if the drawings are small the cutting is easily done with scissors or a knife. When the drawings are large and especially when the model is to be made by representing each section by two to four thicknesses of blotting paper it has been found that an ordinary sewing-machine can be used to do the cutting. By setting the regulator for the shortest stitch an almost continuous cut is made and the parts are easily separated. If a large sewing-machine needle is sharpened in the form of a chisel, the cut becomes considerably smoother. It has been found advantageous when long continued or heavy work is to be done to attach to the machine an electric sewing-machine motor. Skill in guiding the work is soon acquired. There are some details of a complicated drawing which are more easily cut by the scissors or a knife after the main lines have been cut by the machine.

5. It is a great advantage in any working model to have sections at regular intervals in marked contrast with the body of the material. Blotting paper of a large variety of colors (black, red, blue, pink) is easily obtained in the market. In the models made every tenth plate was a bright or light color and every 100dth was black, rendering rapid numeration easy.

6. When the paper sections are thus prepared they are piled and repiled as is usual until the shape conforms to an outline predetermined from photographs, drawings, or measurements made before the specimen was cut.

It has been found that an easily prepared support and guide for the model in process of setting up, is made by cutting the outline to be followed from a block of four or five sheets of blotting paper, marking upon it the lines of direction for every tenth or twentieth section. The colored numerating plates must of course conform to the spacing and direction of these lines.

7. The preliminary shaping having been accomplished more exact modeling is undertaken. The paper sections slide very easily upon one another. The most satisfactory means of fastening them together is by the use of ribbon pins, ordinary pins, or wire nails of various sizes, depending upon the size of the model. No kind of paste or glue was found suitable for this purpose.

8. When the model is well formed, inequalities are best removed by rubbing with the edge of a dull knife and smoothing with sand paper.

Any dissections of the model for showing internal structures should be planned for at this stage for it is now more easily separated than later. It is also at this time that superfluous "bridges," which have been left in place to support detached parts, would better be removed.

9. To finish the model it is held together firmly and coated with hot paraffin either by a camel's hair brush or by dipping in paraffin and removing the superfluous coating by a hot instrument. On a very large model Dr. Hathaway used a thermo-cautery for this purpose.

The paraffin renders the model almost of the toughness of wood without destroying the lightness of the paper.

10. For coloring the surface of the model, it was found most desirable to use Japanese bibulous paper (the lens paper of the microscope dealers) which had been dipped in water color and dried. Any of the laboratory dyes or inks can be used, such as eosin, picric acid, methylene green, black ink, etc. The colored lens paper molds over the surface with ease and is held in place by painting with hot paraffin. All color and enumeration lines and fine modeling show through the transparent paper.

When the model ceases to be a working model it can be covered with oil paints mixed with hot paraffin and rubbed to any degree of finish desired.

11. One can dissect the model by a hot knife run along the planes of cleavage or cut across them by a saw.

The advantages claimed for blotting paper models are the ease and cleanliness of their production and the lightness and durability of the product. The models are broken with difficulty, are easily packed or transported, and when they cleave apart are easily repaired, thus contrast-with the weight and fragility of wax models and their deformation by heat.

By this process are secured for the original model reconstructed from microscopic sections, the same qualities which have made the Auzoux models molded from papier-maché such useful and lasting additions to laboratory equipment; and in the hands of Dr. Dwight and Mr. Emerton, of Harvard University, have aided so much in the demonstration of structure and form of special anatomic preparations.

A NEW LABORATORY PROJECTION APPARATUS.

BY

M. J. GREENMAN.

The Wistar Institute of Anatomy, Philadelphia.

WITH 10 FIGURES.

The projection apparatus was designed to meet the requirements of the anatomical laboratory of the Wistar Institute where, in nearly every research, photographic processes, outline drawings from the projected objects or Born's method of reconstructing microscopic objects are employed. It is essentially a fixed apparatus and not designed for lecture

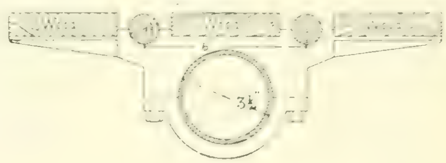

FIG. 1.

purposes. Its parts are all heavy to avoid vibration and that they may remain in place without fastenings. The base or optical bench differs from other forms of projection apparatus in consisting of one piece. Other differences are found in the mechanical stage, in the cooling cells, in the focusing apparatus, in the lantern, and in some other minor points. The camera presents a number of new features, but as it is not yet completed no further mention will be made of it at this time, except to say that it is to be applied to the same optical bench and the same lantern, condensers, mechanical stage, and focusing device are to be used.

The apparatus is a result of a series of experiments with crudely constructed apparatus to ascertain the exact requirements. I am indebted to Dr. H. D. Senior and Dr. G. L. Streeter for their assistance in developing the plans and to Mr. S. Noble, the Institute's mechanician, for the skillful mechanical work.

The Optical Bench consists of an iron frame approximately ten feet long. It is made up of a central steel tube $3\frac{1}{2}''$ in diameter bearing eight saddles or transverse castings placed equidistant upon this tube. The tube furnishes rigid support for the transverse bars which in turn bear two parallel round steel shafts or ways each $1\frac{1}{8}''$ in diameter and 10′ long and set 6″ from centre to centre. Between the two steel ways and on both outer sides are strips of wood $4'' \times \frac{7}{8}''$ secured to the saddles forming a flat table surface. The central strip bears a T slot which may be used to secure apparatus to the bench. See Fig. 1.

Accurate alignment of all the optical parts is secured by turning and grinding to a perfectly true cylinder the supporting $3\frac{1}{2}''$ tube; milling all the saddles on a jig so that they are exactly alike and using turned and ground shafting for the ways.

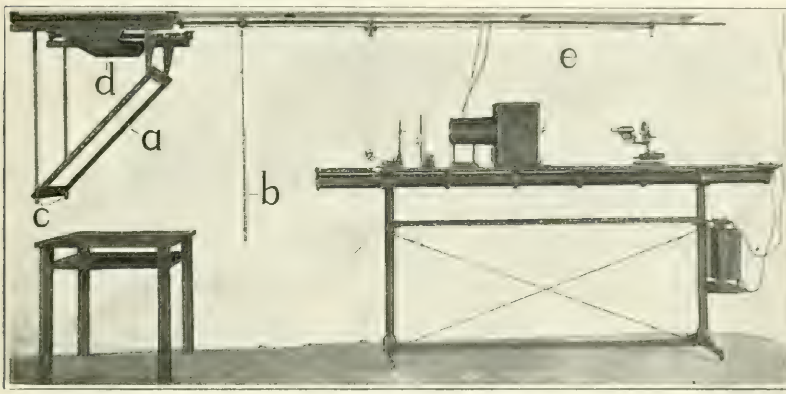

FIG. 2.

The optical bench is borne upon two upright tubes or standards $2\frac{1}{4}''$ in diameter mounted in cast iron feet and of the proper length to bring the top of the bench 48″ from the floor. This frame is made rigid by a $1\frac{1}{2}''$ channel from foot to foot and two diagonal tie rods with turnbuckles. Just beneath the optical bench is a shelf 10″ wide. Upon a bracket on one standard is mounted the Rheostat (10 to 25 amperes). Upon the two steel ways the lantern, condensing system, mechanical stage, microscope, and other accessories are movable from end to end of the bench.

At the proper distance from this apparatus is placed the mirror and drawing table. The mirror $24'' \times 36''$ (Fig. 2 a) is suspended at an angle of 45° from a wooden framework by strips of steel, one pair of which has binding screws and slots at the lower ends (c) in order that the miror may be accurately adjusted at 45°. The wooden framework carrying the mirror is 36″ x 33″; the central cross bar (d) is blocked down at each end in order to pass beneath the apparatus secured to the ceiling. This frame is suspended from the ceiling of the projection room by means of a steel track such as is used for sliding doors in house construction. This makes it possible to move the mirror nearer to or farther from the projection apparatus according to the magnification desired. The drawing table is of ordinary construction with a shelf just beneath the top to carry paper or wax plates. Suspended by a universal joint

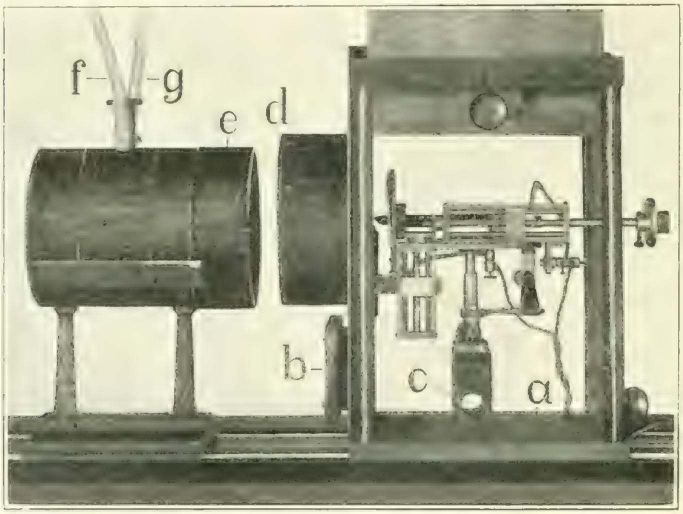

FIG. 3.

conveniently near the drawing table is the focusing rod (b) which is also movable from end to end of the projection room. Secured to the ceiling by brackets are two parallel steel rods (e) $\frac{1}{2}$″ in diameter and $2\frac{1}{2}$″ apart. These rods extend from end to end of the projection room directly above the apparatus. They carry the pulleys of the focusing apparatus and make it possible to have the microscope at any point of the optical bench and focus it while working at any other point in the room. Projecting from the ceiling, at convenient intervals over the optical bench are three pairs of water supply ($\frac{3}{8}$″) and waste pipes ($\frac{1}{2}$″) (not shown in the figure) to furnish water circulation for the cooling cell.

Each piece of apparatus to be used on the bench has a cast iron base, the bottom of which has a V-shaped groove on one side and a flat surface on the other side. The V-groove fits over one way or shaft of the optical bench and keeps the apparatus in line while the flat surface rests on the other shaft giving the necessary support.

The lantern consists of a cast iron base (Fig. 3a) 10¾" x 8". The corner supports are ⅞" turned rods into which grooves are sawn 1/16" wide by 3/16" deep. In these grooves the sides of the lantern slide. Any side may be drawn out as shown in Fig. 3. The top of the lantern is open, yet made light proof by a series of Z-shaped sheets of metal. Through the base at (b) and at (c) are air inlets. At (d) is a double tube or light lock secured to the front of the lantern into which an extension of the condensing system (e) fits loosely so that the distance from the arc to the condensing lens may be varied without allowing light to escape. The lamp which we use is a Thompson Hand Feed Lamp. The screws for adjusting the carbons extend through the rear of the lantern

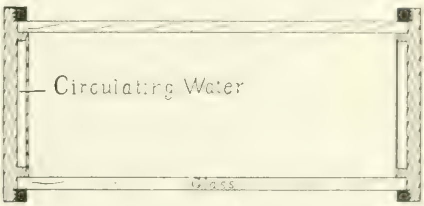

FIG. 4.

and by means of a strip of steel held in grooves in the rear plate render the adjustment of the lamp easy and without the escape of light. The electric wires enter the lantern through two small holes extending 3" into the base and then turning upward into the lantern. The optic axis is fixed at 9" from the top of the ways of the bench.

The condensing system consists of two 6" plano-convex lenses in extra heavy brass mountings with a cooling cell fitted snugly between to absorb the maximum amount of heat. The cooling cell differs from other forms known to me in having a hollow or jacketed wall through which cold water, from any source, keeps the temperature down. The water does not enter the cell itself. The water flows into one opening (f) passes almost entirely around the cell and out another opening (g). The construction is shown by the section Fig. 4. Water connections are made with the before mentioned outlets in the ceiling of the projection room by means of rubber or flexible metal tubes with screw fittings. This device keeps the lens mountings cool and renders the rays practically free from heat. In cases where extra light is needed or where objects must be kept cold a second cell is attached to the stage. For this improvement I am indebted to Professor Simon H. Gage, of Cornell University, who discovered that when a microscope slide under an intense light, bearing heat rays, was placed upon a cold surface the heat was more rapidly conducted out of the slide than it was absorbed from the rays by merely passing through a cold fluid. The glass surface of the cooling cell is therefore the stage proper. Behind the cell is a brass plate carrying an iris dia-

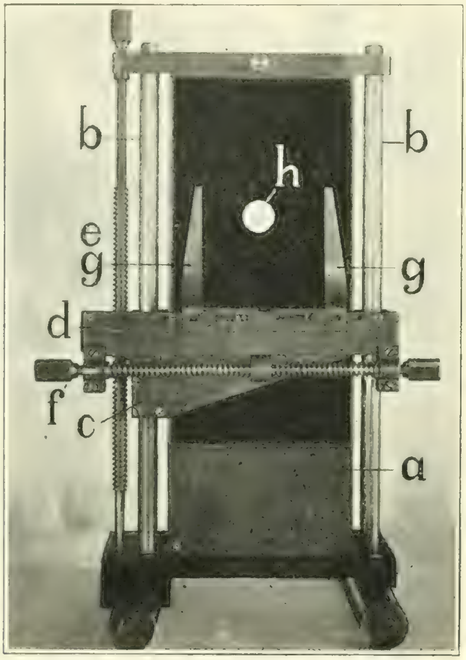

Fig. 5.

phragm. When the cooling cell is not needed the brass plate is brought forward to serve as the stage proper. The cooling cell is 4½″ wide, 9″ high, and 1½″ thick.

The mechanical stage differs from others in its capacity. An ordinary 1″ x 3″ or a 7½ x 5½″ slide are equally easily manipulated. The screws, especially made for the apparatus, give a moderately rapid movement of the carrier in either direction. Referring to Fig. 5, (a) is a heavy cast block to give stability without the necessity of fastening it to the bench.

Two ⅝" steel rods (b b) carry the movable parts (c-d). The vertical movement is accomplished by the screw (e) while the bar (d) is moved horizontally upon (c) by the screw (f). Two adjustable clips (g g) hold by means of beveled edges the glass slides against the stage. These clips may be moved to accommodate any length of slide up to 7½". At (h) is the iris diaphragm, which is placed on the radiant side of the cooling cell. The device carrying the objective consists of a heavy cast iron base (Fig. 6) (a) carrying a sliding top (b); secured to this sliding top by stud bolt (c) is the objective carrier (d) resting upon three adjusting screws (e e e) The objective carrier consists of a large brass disc to which a bellows or other apparatus may be secured. This disc is bored and threaded for our

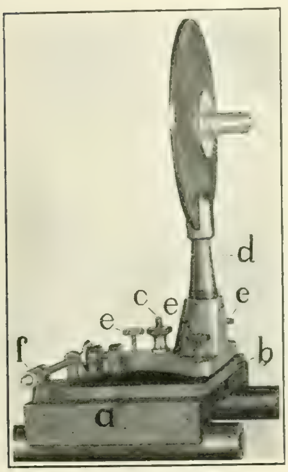

FIG. 6.

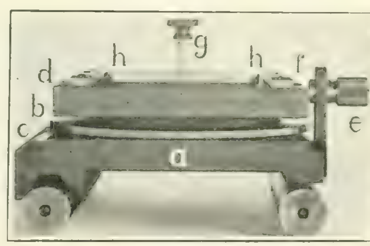

FIG. 7.

largest photographic lens and has a series of bushings for other lenses down to the society screw for microscopic objectives.

The fine adjustment is accomplished by the milled head (f) which actuates, through a bevel gear, the sliding plate (b). This simple stand is used for all low powers. When high power objectives are to be used the compound microscope is substituted and mounted on an adjustable table shown in Fig. 7. This table consists of a base (a) through which a 5" hole admits the threaded extension of the table proper (b). The large brass nut (c) projecting slightly on each side is turned to raise or lower the table. The upper portion of the table (d) slides between two beveled guides secured to the lower portion of the table and the lateral adjustment of the miscroscope is thus accomplished by the milled nut (e) which fits into a groove in the upright (f). The microscope is held in place by the clamp and screw (g) between the guides (h).

The focusing device is shown in position in Fig. 2. The focusing rod (b) hangs from the ceiling and is easily moved from one end of the room to the other, likewise the wheel and jointed arm which actuates the fine adjustment of the microscope may be placed at any point on the optical bench. For the details of the focusing device, Fig. 8 shows a clamp (a) which may be secured to any point along the optical bench by the screw (b); this clamp carries the rod (c) which is adjustable vertically and transversely to the bench by means of the screw (d). At (e) another thumb screw permits the pulley (f) to be adjusted at any

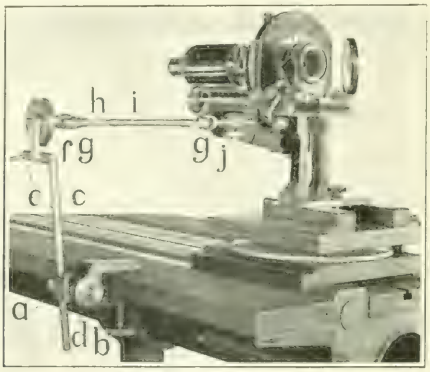

FIG. 8.

angle to the rod (c). At the points (g g) are universal joints, while between them is a shaft (h) carrying a loose sleeve (i). The shaft is grooved on one side and the sleeve carries a key which fits the groove. Thus the arm is freely extensible without clamping screws. The thimble (j) is lined with soft leather and slips over the fine adjustment of the microscope with sufficient grip to turn it. This device is sufficiently flexible in its adjustments and movements as not to bind or jar the microscope while focusing high powers. The pulley (f) is operated by an oiled silk cord or common fishing line coming from the apparatus attached to the ceiling. The details of other parts secured to the ceiling are shown in Fig. 9. Two $\frac{1}{2}''$ steel parallel rods $2\frac{1}{2}''$ apart (a a) are secured to the ceiling above the apparatus by brackets screwed to the rods at the sides (b b) (brackets not shown) so that the clamps (c c) may pass without interference. Each pair of clamps (c c) are grooved to fit the rods and clamped together by the screw (j); screwed to the lower halves of these clamps are the pulleys. Pulleys (f) and (g) are idlers, one is placed at each end of the projection room. They are to keep the cord taut over the other pulleys. The axis of pulley (e) extends

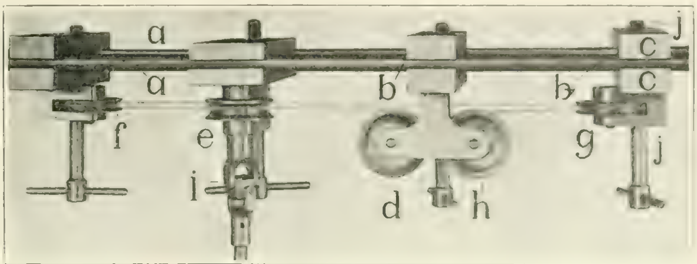

FIG. 9.

downward and carries a universal joint (i) from which the focusing rod is suspended. The cord from the pulley (f) Fig. 8, attached to the optical bench passes over pulley (d) Fig. 9, then to pulley (e) making one complete turn around this pulley, then around pulley (f) and from this point directly to pulley (g) and from (g) over pulley (h) and down to the optical bench again. From the universal joint (i) hangs a wooden

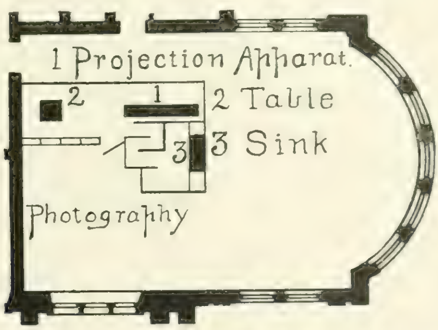

FIG. 10.

rod $\frac{3}{4}''$ in diameter. This rod has been spoken of as the focusing rod and it will readily be seen that a turn of this rod in either direction pro-produces a corresponding movement in the fine adjustment of the microscope. The movement of the focusing apparatus is easy and without jar, so that while drawing at one end of the projection room, the microscope at the opposite end is easily focused. The same focusing device may be used with the photomicrographic camera.

The projection room together with a dark room of light panel work construction is located in one of the large laboratories so that the investigator may turn from his table to the projection apparatus without leaving the laboratory. The ceiling of the projection room is seven feet high. Good ventilation is maintained by means of a small fan and two 24″ light tight openings in the ceiling and one in the side wall.

Fig. 10 is a floor plan of the laboratory which contains the dark room and projection room and shows the location of the apparatus.

THE RELATION OF TEACHER AND PUBLISHER.

BY

S. H. GAGE.

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Both teacher and publisher have the same purpose in view; viz, the best text-books; one from the standpoint of the user, the other from that of the producer. It is desirable, furthermore, that there should be relations of friendliness and respect between the two groups.

It is so obviously to the advantage of all concerned to devise some means whereby teachers could examine, and by personal inspection judge of the excellence of new text-books as they appeared, that there naturally grew up the custom of sending early copies for examination. Probably there are few teachers of experience who have not thus been able to employ a new edition or a better text a year earlier by this courtesy on the part of publishers.

Unfortunately, during the last few years there has arisen a practice on the part of some publishers in Philadelphia, New York, and Chicago, of treating the matter in a purely business fashion; and there seems to be a feeling on the part of such publishers that the complimentary copy is in a sense still their property, and that it should be followed up to make sure that the money thus invested in advertising should not miss its purpose. To this end there arrives, in addition to the letter accompanying the complimentary copy, each spring and autumn something like the following: "We think you would find this a very satisfactory book for use in your classes, and trust that you have been able to recommend it to them. Should you have done so, will you kindly see that it appears in your catalogue for the coming session? We do not, however, wish you to feel under any obligation to recommend the work by reason of our having sent you a complimentary copy."

Again in September: "Undoubtedly you are giving thought at this time to the question of text-books that you will recommend to your students when you begin your course of lectures for the coming college session. We are inclined to think that you would like to have before you a list of our books on the subjects in which you are interested, copies of which have been sent to you from time to time with our compliments, and which are listed below. We wish, however, to emphasize the fact that in sending you complimentary copies we have no desire to place you under any obligation to recommend the books."

The above were from Philadelphia. Here is one from New York: "We trust you were favorably impressed with the book, and that you will decide to use it in your classes the coming fall term, and be good enough to list it in your spring catalogue, which you are doubtless preparing at this time."

Chicago sends this: "We trust the examination of Volume I and of Volume II, just sent to you, will enable you to recommend them to your students as a class text-book. The acceptance, however, of the complimentary copy places you under no obligation to do so."

Another Chicago press with the best connections sends a certain text-book accompanied by a letter stating that the work is presented to the teacher free in case of a recommendation to his classes.

Philadelphia and Chicago try to soften the assumption of their ownership of the complimentary copy and apparently also of the teacher accepting it, but New York goes right to the point, and does not put on an emollient at the end.

Still the publishers who send out these letters to the teachers of the country bring out many excellent books, and some of them have done so for more than a generation. Is it possible that the teachers of the country have so degenerated that they can be bought by a complimentary copy, and are ready twice a year to acknowledge the bill of sale? The writer does not think so meanly of his colleagues as that. Furthermore, his acquaintance with the men carrying the responsibility of great publishing houses leads him to believe most firmly that this method, recently adopted by some of them, is an error and as galling to the high-minded business man as to the high-minded teacher. It certainly does not lead to friendliness and mutual respect, and these two elements are at the foundation of all permanent success.

Any teacher worthy of the name wishes to give his students the very best instruction, and the very best text-books obtainable. The publisher who sends a text-book of superior excellence to such men can feel sure that it will be welcomed and as quickly as possible given to the students. The publisher does not need continually to remind the teacher of the complimentary copy and urge the desirability of its announcement in the college catalogue.

The complimentary copy problem is certainly very much before the teachers of the country. Shall they be accepted, and also with meekness, the inevitable frequent reminder of the gift with the veiled or unveiled implication of obligation for its receipt, or shall the teacher refuse such gifts?

If the spring and autumn letters following up the compliments were certain to be received from all publishers it would probably not take long for teachers to devise an adequate remedy, but fortunately the feelings of friendliness and mutual respect still obtain. Some of the publishers have clung to the good, old, high-minded traditions of the true relations of teacher and publisher.

DOCUMENT I OF THE REPORT OF THE PRESIDENT OF THE BRAIN COMMISSION (Br. C.).

In the spring of 1906, the Imperial Academy of Sciences at Vienna, issued to the Associated Academies, a report on the condition of the inter-academic institutes for brain study. This report appeared in two documents (A) and (B), the former of which (A) contained the earlier correspondence relating to the institutes for brain study, the names of those at that time members of the Central Commission for brain study, and the provisional order of business and program proposed for the meeting of the Brain Commission (Br. C.) to be held in Vienna at the end of May, 1906.

Document (B) gave a brief historical review of the progress thus far made in the establishment of Interacademic Institutes for brain study.

I now add a report on the further course of affairs and especially on the first session of the Brain Commission, together with a report of the meeting of the Committee of the Associated Academies.

The meeting, called conjointly by the undersigned and the President of the Vienna Academy, took place on the 27th and 28th day of May at Vienna. All the members of the Brain Commission were invited. There were present besides the undersigned, the Messrs. Donaldson (Wistar Institute, Philadelphia), Ehlers (Göttingen), Flechsig (Leipzig), Langley (Cambridge, England), v. Monakow (Zürich), Hermann Munk (Berlin), Obersteiner (Vienna), and G. Retzius (Stockholm), Golgi (Pavia), Dr. Greenman, Director of the Wistar Institute, was present at the deliberations. Detailed minutes of the proceedings were taken by Dr. Marburg, of Vienna. These are in the possession of the President of the Central Commission for brain study. (The President at that time, and until 1909 inclusive, being Dr. Waldeyer, Berlin, N. W. 6, 56 Luisenstrasse, Anatomisches Institut.) These minutes are, however, open to inspection by the several academies, as well as by the institutes for brain study and the members of the Commission.

At these sessions there was drafted a constitution, together with an order of business, and later this was revised for publication by the undersigned, with the approval of the Executive Committee. This appears as Document II of the present report, and in its revised form, must be presented for final acceptance and ratification at the next meeting of the Brain Commission (Br. C.), which will occur in the spring of 1909, previous to the next session of the Committee of the Associated Academies. Moreover, the paragraphs in this document which regulate the relations of the Brain Commission to the Association of Academies, must also be ratified at the regular meeting of the Association of Academies at Vienna in the spring of 1907. In the meantime, the undersigned President with the co-operation of the Executive Committee, will conduct the business in accordance with the provisional constitution, as given in Document II.

The accompanying Document III contains information concerning the relation of the Brain Commission to the Association of Academies.

By vote of the members, the Central Commission was enlarged. It consists at present of the following members:

Egypt	Elliot Smith	Cairo.
Belgium	Van Gehuchten	Louvain.
Denmark	F. C. C. Hansen	Copenhagen.
Germany	1. Edinger	Frankfurt a. M.
	2. Ehlers	Göttingen.
	3. Flechsig	Leipzig.
	4. H. Munk	Berlin.
	5. Waldeyer	Berlin.
England	1. Langley	Cambridge.
	2. Sherrington	Liverpool.
	3. V. Horsley	London.
France	1. Dejerine	Paris.
	2. Raymond	Paris.
Japan	Shuzo Kure	Tokio.
Italy	1. Golgi	Pavia.
	2. Luciani	Rome.
	3. Romiti	Pisa.
Holland	Winkler	Amsterdam.
Norway	Guldberg	Christiania.
Austria-Hungary	1. S. Exner	Vienna.
	2. Obersteiner	Vienna.
	3. v. Lenhossék	Budapest.
Russia	1. Bechterew	St. Petersburg.
	2. A. Dogiel	St. Petersburg.
Sweden	1. Henschen	Stockholm.
	2. G. Retzius	Stockholm.
Switzerland	v. Monakow	Zürich.
Spain	S. Ramon y Cajal	Madrid.
U. S. of North Am.	1. F. P. Mall	Baltimore, Md.
	2. C. S. Minot	Boston, Mass.
	3. H. H. Donaldson	Philadelphia, Pa.

Thirty-one members in all.

At the suggestion of the members assembled in Vienna, the undersigned will put himself in communication with Australia, with the purpose of selecting a member of the Commission to be elected from that country. (A letter has been sent to Dr. Wilson in Sydney).

The large number of members, and their selection from different countries and nations, will serve only to advance the cause. Besides this a large membership is necessary in order that at the triennial meeting of the Brain Commission, the desired number of members may be present. It may be remarked that only 8 of the 18 members were able to be present at the last meeting. The same conditions may be looked for in the future. Suggestions as to further elections particularly from countries not yet represented, will be gladly received. These may may be forwarded to the present President.

The proposals, especially those concerning the Executive Committee, made by the President in the previously mentioned Document (A), were accepted.

The Executive Committee is composed for the present of the following gentlemen:

1. W. Waldeyer, Berlin, President of the Br. C.
2. H. Obersteiner, Vienna, Vice-President.
3. E. Ehlers,
4. P. Flechsig, } Members.
5. H. Munk,

The reason why the members of the Executive Committee have been chosen thus far solely from Germany and Austria, is merely to facilitate communication with the present President whose home is in Berlin, but this arrangement must not be regarded as establishing a precedent.

Owing to vacancies caused by death, certain changes became necessary in the special commissions established in London in 1904 for the several departments of brain research. These changes were made at the meeting in Vienna in May, 1906, and are as follows:

Retzius was made President of the Commission on Embryology, and Donaldson was named on this commission in the place of Schaper, deceased. On the Commission on the Pathology of the brain, Mingazzini was named in place of Weigert, deceased.

At present the seven special commissions are constituted as follows:

I. Commission on descriptive Anatomy. Waldeyer (President), Cunningham, Mall, Manouvrier, Zuckerkandl.

II. Commission on comparative Anatomy. Ehlers (President), Edinger, Giard, Guldberg, Elliot Smith.

III. Commission on histological Anatomy. Golgi (President), Ramon y Cajal, Dogiel, van Gehuchten, Lugaro.

IV. Commission on Embryology. Retzius (President), Bechterew, Donaldson, v. Lenhossék, C. S. Minot.

V. Commission on Physiology. H. Munk (President), V. Horsley, Luciani, Mosso, Sherrington.

VI. Commission on pathological Anatomy and Physiology. Obersteiner (President), Dejerine, v. Monakow, Langley, Mingazzini.

VII. Commission on clinical Neurology. Flechsig (President), Henschen, Ferrier, Lannalongue, Raymond.

The following were recognized as interacademic Institutes for brain study.

1. The Neurological Institute of the Madrid University conducted by Ramon y Cajal.

2. The Neurological Institute of the Leipzig University, conducted by P. Flechsig.

3. The Neurological Institute of the Vienna University, conducted by H. Obersteiner.

4. The Neurological Institute of the Zürich University, conducted by v. Monakow.

5. The neurological department of the The Wistar Institute, Phila., U. S. A., conducted by H. H. Donaldson; M. J. Greenman, Director of of the Institute.

6. The Neurological Institute in Frankfort a. M., conducted by von Edinger.

In addition to the Institutes already recognized, the Wistar Institute in its neurological department was accepted as a Central Institute for brain study, and consequently will be regarded by the Brain Commission as the Central Institute for brain study in the United States of North America.

The Messrs. v. Monakow and Obersteiner proposed that the Central Commission should request the proper authorities in the countries mentioned below, to recognize the Neurological Institute at Zürich, as the Central Institute for Switzerland, and the Neurological Institute at Vienna, as the Central Institute for Austria. This request will be made at an early date.

In addition, reports were made on the Neurobiological Institute of the Berlin University, under the direction of O. Vogt, and on the condition of affairs in Norway, Sweden, Holland, England, Italy, and Hungary.

In Sweden, Professor Lenmalm is ready to undertake work of this sort.

In Norway, Professor Guldberg is prepared to utilize his Institute for the same purpose.

In Holland, Professor Winkler has taken steps to organize there an Institute for brain study. Assent has also come from Italy and Hungary. The Imperial Academy at St. Petersburg has also reported to the undersigned that the proposition for the establishment of an Institute for brain study will be favorably considered there. Finally, Messrs. Bechterew and A. Dogiel in St. Petersburg, and Messrs. Darkschewitsch in Kasan, and Roth in Moscow, have announced their willingness to place their laboratories or clinics at the service of this cause.

The question whether or not a Central Imperial Institute should be organized in Germany, was considered at the session of the Associated Academies in Göttingen in October, 1906. For various reasons such a Central Institute for the united German Empire was rejected by the authorities, who much preferred to leave the organization of the Institutes for brain study to the individual states. This, however, does not prevent the larger states from establishing Central Institutes as well as local Institutes. As previously stated, the Institutes under the direction of Flechsig and of Edinger, have been already recognized as Interacademic Institutes for brain study.

The Institute in Berlin, directed by O. Vogt, has not yet become connected with the Brain Commission.

As regards the recognition as Interacademic Institutes for brain study, see Section XVII of the constitution. In regard to the Central Institutes and their recognition and arrangement, see Section XXI.

It is not to be expected that immediately upon their inception the proposed organizations shall at once exhibit a complete activity, but by degrees, a closer union of the separate Institutes will develop, and through experience, that form of organization will be found which will make possible effective co-operation.

In accordance with Professor Langley's proposal, made at the meeting of the Central Commission, one of the first steps taken will be towards the further revision of the nomenclature, with the purpose of obtaining international uniformity.

Moreover, we beg the Academies still to lend their powerful support to this undertaking which has developed through their initiative, for without such support we shall find it hardly possible to induce the several governments, in view of the many demands made upon them, to grant with the desired promptness, the means necessary for the establishment of specially planned and suitably arranged Institutes for brain study.

Finally, we beg the above mentioned Institutes, in accordance with the constitution, to furnish the Central Commission with the necessary reports as to their condition and activities, and at the same time, to assist one another through an interchange of material and publications.

By this means, in the course of time, the Institutes may hope to attain the desired completeness in the matter of collections and reference libraries.

Signed, *Waldeyer,*
President of the Brain Commission.

ANNOUNCEMENTS.

The Director of the Wistar Institute hands us the following: "Plans have just been completed for the re-establishment of the *Journal of Morphology* on a secure financial basis, and the publication of the journal will be resumed immediately. This announcement has been made possible by the generosity of Dr. Horace Jayne, a friend and former Director of the Wistar Institute of Anatomy and Biology. The journal will be published hereafter under the auspices of the Institute, which assumes all financial responsibility; it will be edited by a board representing different institutions. The board consists of the following:

E. P. Allis, Jr., Milwaukee.
E. G. Conklin, University of Pennsylvania.
H. H. Donaldson, Wistar Institute.
M. J. Greenman, Wistar Institute.
R. G. Harrsion, Yale University.
G. C. Huber, University of Michigan.
Horace Jayne, Wistar Institute.
F. R. Lillie, University of Chicago.
F. P. Mall, Johns Hopkins University.
C. S. Minot, Harvard Medical School.
T. H. Morgan, Columbia University.
G. H. Parker, Harvard University.
E. B. Wilson, Columbia University.
C. O. Whitman, University of Chicago.

"The *Journal of Morphology* was founded in 1887 by C. O. Whitman and E. P. Allis, Jr., and it established a reputation for scientific merit and excellence of printing and illustration which was unsurpassed by any similar journal in the world. After the appearance of seventeen volumes the journal was compelled, in 1902, to temporarily suspend publication, owing to insufficient financial support."

"In the meantime the *American Journal of Anatomy* and the *Journal of Experimental Zoology* have been established and have taken high rank in their respective fields, but the general field of animal morphology has had no organ of publication in this country. During the past five years it has been necessary to send to European journals many contributions within this field, and it has been a source of much anxiety and humiliation to American morphologists that in this great country, where so much research work is being done and where such great sums have been given for the advancement of science, no means existed for the adequate publication of morphological contributions and monographs. This great need will be met in large part by the reorganized *Journal of Morphology,* which will be conducted on the same broad and high plane which has always distinguished it.

In general, articles too long for the *American Journal of Anatomy* will be referred to the *Journal of Morphology;* for it is planned to have these two journals, as well as the *Journal of Experimental Zoology,* cooperate in every respect.

After the current year the *Journal of Anatomy and Physiology* will be issued in two independent parts. In one will be published articles on anatomical, histological, morphological, and embryological subjects, and this will be designated the *Anatomical Part;* the other will contain papers on subjects of physiological interest (including physiological chemistry), and will be termed the *Physiological Part.*

The acting editor of the *Anatomical Part* will be Professor D. J. Cunningham (Edinburgh), with whom will be associated Sir William Turner, K.C.B. (one of the original founders of the journal), Professor Alex. Macalister (Cambridge), and Professor G. S. Huntington (New York).

The acting editor of the *Physiological Part* will be Professor E. A. Schäfer (Edinburgh), with whom will be associated Professor F. Gotch (Oxford), Professor W. D. Halliburton (London), Professor C. S. Sherrington (Liverpool), ond Professor E. H. Starling (London).

It has already been announced in *Science* that Princeton University has received a gift of $600,000 to build a new laboratory and museum.

We are informed that besides furnishing modern accommodations for the department of Geology and Paleontology, this building will contain very complete laboratories for the department of Biology; there will be an annex for a vivarium and aquaria for fresh and salt water. We are told that the plans for the building are practically finished and that the foundations will be laid next spring.

Professor G. F. W. McClure holds the chair of comparative anatomy, and at the present time controls the biological work at Princeton.

The reconstruction model of the human medulla, which was prepared by Dr. Florence R. Sabin a number of years ago, has been duplicated in a satisfactory form by *Herr Friedrich Zieglar, Atelier für Wissenschaftliche Plastik, Freiburg, I. B., Germany;* and can now be purchased. The original single model has been reproduced as five models, each representing a special portion or dissection of this region of the brain. The original model was described and pictured in the Johns Hopkins Hospital Reports, Vol. 9, and in An Atlas of the Medulla and Midbrain, by F. R. Sabin, published by The Lord Baltimore Press, of Baltimore, Md. Its reproductions are described in the Anatomischer Anzeiger, Vol. XXII, 1902.

The price of the set of five models is about $125.

REVIEWS.

"The Essentials of Histology, Descriptive and Practical, by E. A. Schäfer. Seventh edition. Lea Brothers & Co., Philadelphia and New York, 1907. 507 pages, 553 figures, of which 139 are colored. Price, $3.00.

The seventh edition of Professor Schäfer's excellent book on the Essentials of Histology has just appeared, 1907, and will be welcomed in the laboratory. The book is the outcome of successful teaching and the note in the preface that " only those methods are recommended upon which experience has proved that full dependence can be placed " is exactly true. The work does give the essentials, and in such form as to be feasible and practical to the student.

The book has been enlarged, for it has 553 pages as compared with 355 in the fifth edition; but by the use of thinner paper the bulk has not been increased. The proportion of figures to pages, 553 to 507, shows that illustrations are abundant. A new feature of this edition is the introduction of colored plates, 139 out of the total number having one or two colors. The figures are, for the most part, clear, definite, and characteristic, and in many of them the colors are used effectively; for example, in the figures of the blood cells, the sections of developing bone, the nerve endings, and in sections like those of the gastric mucosa, Fig. 354, p. 291, where the use of two colors brings out the differences between the parietal and chief cells.

The essential changes are the introduction of references to the newer work and a considerable addition to the chapters on the nervous system. The references to new work, even though they are brief, are exceedingly valuable, especially where the names of scientists are added; for example, in a few words Metchnikoff is mentioned in connection with phagocytoses, and Wright in connection with opsonins, p. 50. Later on Ranvier, Nussbaum, and Sozili are mentioned as having shown that in certain places smooth muscle may be derived from epithelium, page 127. References of this type are valuable to the student from two points of view; first, to make him realize that microscopic anatomy based on biology is a growing subject and that this growth is essential to the development of medicine; second, to introduce him to scientific literature.

We believe it the greatest possible advantage to the student to be led to read original articles, and we doubt whether the references in the Schäfer are adequate to stimulate reading. To do this enough of the subject must be given to interest the student to read further, and references must be given so that he may find the articles. A book like Schäfer's Histology assumes that this is the function of the leader in a course, and the text book is to give simply the foundation of the subject. This is a legitimate standpoint, and it is not just to criticise a book for not being something it does not aim to be. Nevertheless, our experience has been that the best students demand a more elaborate and extensive text than is given in the Schäfer.

The chapter on glands has one figure of a model of a tubulo-racemose gland which is a type of illustration especially valuable because it introduces the student to the third dimension and breaks away from the simple microscopic section. Many more illustrations of the same type would be an advantage to bridge over the gap between the gross and the microscopic. The chapter on connective tissue could be improved by including some of Maximow's work on the cells and by having reticulum more adequately illustrated. Fig. 84, of the lymphoid tissue is poor.

The chapter on bone is excellent and is beautifully illustrated. The figures are especially good of the development of bone both from cartilage and from membranes. The chapter on striated muscle has been made more interesting by the introduction of new matter in regard to the contraction wave.

The sections on nerve cells and on the nervous system have been most changed. There is a variety of new illustrations bringing out the work on the neurofibrils, the pericellular net, the Nissl bodies and the effects on the nerve cells of cutting their fibers. Nerve endings are well illustrated. The chapter on the nervous system gives a good, brief account of the subject; it gives first an outline of the main tracts and then the characteristics of each region, and this we think the most interesting way of presentation. A number of the figures of Weigert sections of the medulla, taken from photographs, seem to be inadequate. The book closes with good chapters on the special senses.

F. R. Sabin.

"Atlas und Grundriss der Embryologie der Wirbeltiere und des Menschen," by Dr. Alexander Gurwitsch, St. Petersburg. With 340 pages and 143 colored figures on 59 plates and 186 text figures. Published by J. F. Lehmann, Munich, Germany, Volume XXXV of Lehmann's Handatlasses, 1907. Price $3.00 (i. e., 12 marks).

This little book contains an excellent, concise resumé of the comparative aspects of mammalian embryology. The author exhibits ready command of this wide and complex field, together with a very pleasing style. It appears evident to the reader that the recently issued and extensive "Handbook of Comparative and Experimental Embryology of Vertebrates," edited by Professor O. Hertwig, has been a great aid to the author, indeed he acknowledges this obligation in the preface.

For a number of years the discussion of the germ layers has been a stumbling block to writers of elementary text-books of vertebrate embryology, and no satisfactory comparative account has appeared in such text-books since the earlier editions of O. Hertwig's "Lehrbuch," now about 15 years old. In the meanwhile much work has been done in this field and there has been pressing need for a new and modern presentation of the subject. O. Hertwig's "Handbook" gives this with full details. In his revised and rewritten "Lehrbuch," he gives the same more concisely. Gurwitsch has assimilated this great mass of matter well and has written the gist of it in a very concise and quite satisfactory statement, considering the space allotted. Such topics as the origin and maturation of the germ cells, fertilization, and segmentation cover a very broad field, knowledge of which has been advanced with exceptional industry and success. It seems to us that Gurwitsch has made a very happy selection here and has touched on the essentials with much skill, giving in a wonderfully condensed form a reasonably true glimpse of the modern standpoint and interpretation. The chapter on body form, as developed from germ layers, is good, though a beginner would desire more frequent references to the beautiful pictures as details are described; attention to this would improve the descriptive text throughout the book. The remarks on embryonic membranes, Bauchstiel, placenta, etc., are interesting, but this chapter is one of the weakest we think. Additional figures and a series of diagrams are much needed here to give an adequate idea of these difficult relations and processes.

The remaining half of the book, about 200 pages, is devoted to the development of special systems of organs; naturally the treatment is in the nature of epitome. It is also rather uneven, some topics receiving unexpected attention and others seemingly more important being dismissed with a word. The derivatives of the pharynx, the para-thyroids, and thymus require more space. To illustrate the development of the cœlom, other figures than sections should be used. The muscle system, limbs, and skeleton are interestingly worked out; and this is especially true of the skull, which is treated in exceptional detail. The fundamental relations and chief changes of the heart and vascular system are described sufficiently to bring out the main facts of the history of these organs in vertebrates. In the urogenital system there is a chance to dwell on comparative relations and interesting metamorphoses; but though this is done ably with the aid of sections, it leaves us wishing for a figure or two from Keibel's models. The chapter on the nervous system is quite full with many excellent figures and plates; it is especially strong on the side of histogenesis. The organs of special sense receive 40 pages illustrated by sections for the most part.

We regret the lack of historical references, so ably given in Hertwig's Lehrbuch; and the absence of at least some references to the literature of embryology is a serious omission.

On the whole we feel this little book worthy of considerable commendation; it is original, modern, beautifully illustrated and printed, and exceptionally well written. It will be valuable to students in college courses who are studying vertebrate embryos. The comparative aspects of embryology are viewed from a somewhat different standpoint than that of Hertwig's "Lehrbuch." All through are found interesting and suggestive summaries of the facts and changes which are under discussion. We believe the medical student should have met such facts and views in the college laboratory, before entering the medical school, and we think that teachers in these laboratories will welcome Gurwitsch's Grundriss. Kollmann's "Lehrbuch," though now in much need of revision, is, in the opinion of the writer, better adapted to the requirements of medical students who have already had courses in general biology and comparative anatomy, than any text-book of about its size yet examined by him. Of course Kollmann's Atlas is a great addition to his "Lehrbuch." This opinion should not discount in any way the equally able and fascinating "Lehrbuch" of O. Hertwig; but Kollmann has exhibited a very special aptitude in selection of illustrations as well as point of view to make the embryological relations of human embryos especially prominent. Gurwitsch's Grundriss will serve as a valuable supplement to the more extensive texts which give more comprehensive and detailed accounts, because of its skillful emphasis upon comparative and histogenetic relations. Much detailed information is given not commonly found in works of its size.

H. McE. Knower.

NOTES AND APPOINTMENTS.

An appointment of great importance is that of Professor J. P. McMurrich, to the chair of anatomy in the University of Toronto, Canada. This announcement will counteract the impression, which some have formed, that scientifically-trained anatomists of wide experience in biology find better opportunity outside of the medical faculty, or that medical faculties are blind to the advantages of securing such men to manage their anatomical work.

The history of Dr. McMurrich's lengthy and varied experience in zoology, as well as his administration of the anatomical department at the University of Michigan for a number of years, is too familiar to require recapitulation here.

His long list of valuable papers on zoological topics; his numerous special anatomical studies, on the musculature, etc.; his considerable work of supplying students with several well-known text-books, atlases, etc.; and his recent addresses and work on important committees (as in the Wistar Institute); explain the flattering call which has been extended to him.

The chair of anatomy, which he held at Ann Arbor, left little to be desired, one would suppose; its high character and favorable conditions and opportunities being known generally. Hence his change of station can only be looked on as another indication of the growth of a realization on the part of the universities, of the importance of experienced scientists to the development of their medical departments. A friendly competition has thus arisen among medical schools which are adopting a modern type of anatomical organization, and the careers of those anatomists who shall have been likewise markedly successful in their positions promise to be greatly extended in future, as the work of such men becomes known.

Dr. George L. Streeter, Associate Professor of Neurology, Wistar Institute of Anatomy, Philadelphia, has been appointed professor of anatomy at the University of Michigan to succeed Professor McMurrich. Dr. Streeter graduated in arts at Union College and in medicine at Columbia University. After graduation he studied anatomy under the direction of Professor Edinger at Frankfort, Professor Hertwig at Berlin, and the late Professor His at Leipzig. During the years 1903-06 he served successively as assistant and instructor in anatomy at the Johns Hopkins University. Dr. Streeter's investigations upon the structure and development of the central nervous system of man and of the ostrich, and also upon the development of the internal ear of man are familiar to readers of the *American Journal of Anatomy.* He has also published experimental studies on the development of the ear of the frog, in the Journal of Experimental Zoology. These contributions have already gained recognition from the writers of several text-books upon anatomy and embryology, in which illustrations have been borrowed. The Wistar Institute has thus indicated another way in which it will aid the growth of anatomy in this country. While its own staff will feel the loss of Dr. Streeter's special capacity in technique and organization, and his stimulating influence in research, a valuable point is gained for the Institute when educational institutions of high standing seek professors from among its investigators.

The appointment of Dr. Ross G. Harrison, to the Bronson professorship of comparative anatomy in Yale University, will be noted with interest by American anatomists. When it is remembered that the incumbent of this chair is placed at the head of the biological work of the University, it will be realized that the fact that a man is selected from the anatomical department of a medical faculty, rather than from a biological or zoological laboratory for a place in the philosophical faculty, marks a very great change in attitude and conditions from those presented only twenty years back. There were at that time extremely few (perhaps two or three) anatomists to be found in our medical schools, with sufficient breadth of training in the fundamental aspects of biological science to hold such a position. The then new school of biologists had little or no sympathy or familiarity with the problems of medical education; and an anatomist was conceived to be a specialist of an almost exclusively technical training, interested in the more practical applied side of morphology. The broader biological aspects of the subject would have been very difficult to acquire in this country outside of a zoological laboratory.

A glance at the career of Professor Harrison gives us a vivid conception of our development and change of attitude in all this, and of some of the influences exerted by such men to bring it about. On completing his undergraduate studies at the Johns Hopkins University, Dr. Harrison elected advanced work in animal morphology. The degree of Ph. D. was conferred upon him and he was appointed lecturer on biology at Bryn Mawr College for the year 1889. From that time until 1896, he devoted his time to study and research, at Bonn and Naples. He was made instructor in anatomy in the Johns Hopkins University in 1896.

He now undertook to apply Born's method of grafting to the solution of various anatomical problems. For this purpose frog embryos were selected, and the results have been valuable in clearing up fundamental problems in the development of the peripheral nervous system. His latest studies on the histogenesis of living, isolated elements of tissues open up a new and fascinating field. This series of contributions to experimental embryology is marked by a remarkably thoughtful and skillful method; and an exceptionally judicial and finished treatment.

In 1899 Dr. Harrison took the degree of M. D. in the University of Bonn, Germany. He was then advanced to an associate professorship in anatomy.

He has been managing editor of the Journal of Experimental Zoology since its foundation, and recently he has been made a member of the editorial board of the Journal of Morphology.

His teaching and affiliations have been strongly affected by a deep interest in the development of medical education. It will then be a surprise to many anatomists to learn of his acceptance of a chair only indirectly related to the medical faculty. Some will certainly regret this, and feel it to be a loss that his influence will bear less directly on the problems of medical education.

However, modern anatomy and modern medicine have been developed most by just this type of investigators and teachers, who are becoming more numerous. They have encouraged others to equip themselves early, before studying medicine, with a knowledge of the biological sciences, in one of the numerous modern zoological laboratories which now offer excellent facilities for a thorough ground work. They have insisted upon a new and broader conception of anatomy. Their laboratories reflect their ideals; and even departments which formerly looked elsewhere than to anatomists for scientific method, now turn to them for guidance.

Dr. C. Judson Herrick, Professor of Zoology in Denison University since 1898, has accepted the chair of neurology at the University of Chicago, formerly occupied by Professor Donaldson. Professor Herrick received his college education at Denison University and at the University of Cincinnati; and his university education at Columbia, where the degree of Ph.D., was conferred upon him in 1900.

Before he graduated at Denison his interest was drawn towards his brother's neurological work, and in his baccalaureate thesis he wrote up the topography of the brain of the porcupine, and a little later he made a contribution to the gross anatomy of the catfish brain. He then worked independently on the morphology of lower brains; but his labors were not altogether productive, until he worked out the complete peripheral nervous system of one type thoroughly. His contribution on the brain of Menidia, which was done under Dr. Oliver Strong's direction, laid the foundation on which all of his subsequent work has been done; not only upon the peripheral nerves, but on the brain as well. The feature of his work that is most distinctive is the selection of several low types for comparative study, beginning first with the species in which the brain attains its maximal rather than its lowest development. Here everything connected with a functional system is exaggerated, while other functional systems may suffer a corresponding reduction or at any rate no increase. This may be illustrated for instance by the comparative study of the visual paths in a type like the cod with very large eyes, on the one hand, and blind cave fish, on the other. In connection with this work, Dr. Herrick undertook the management of the *Journal of Comparative Neurology,* which he has edited for a number of years.

The transfer of Dr. Herrick to an institution of first rank will increase his usefulness, for it places him in the very best position to continue his scientific work as well as to exert his influence upon a larger number of well-trained medical and graduate students.

Dr. ARTHUR W. MEYER, Instructor in Anatomy at the Johns Hopkins University, has accepted a call to an Assistant Professorship of Anatomy at the University of Minnesota. Dr. Meyer is a graduate of the University of Wisconsin and of the Johns Hopkins University.

The removal of Dr. J. B. JOHNSTON from the chair of Zoology in the University of West Virginia, to the Associate Professorship of Anatomy in the University of Minnesota, again emphasizes the influence of research on the career of a teacher who might otherwise have been lost sight of in an isolated position. Dr. Johnson took his Ph.D. at Michigan, in 1899. He held an instructorship in that institution for six years and was appointed professor of zoology in West Virginia University, in 1900. While teaching in this position he continued, very actively, reasearch work on a number of topics; especially on the nervous system of the lower forms of vertebrates. His publications of the results of this work have advanced the subject notably. His text-book on the Central Nervous System of Vertebrates, recently issued, has attracted much attention. Indeed, it has been so well received as to be spoken of as "epoch-making," in one of a number of flattering reviews. One of these reviews was published in the second number of the *Anatomical Record.*

The University of West Virginia is to be congratulated on the impetus to further scientific activity given her preparatory medical departments by the influence of this teacher and investigator in organizing the zoological work on a modern basis.

Dr. JOSEPH MARSHALL FLINT, Professor of Anatomy at the University of California since 1901, has accepted the chair of Surgery at Yale University. Dr. Flint graduated in science at the University of Chicago in 1895 and in medicine at the Johns Hopkins University in 1900. He also received an honorary degree from Princeton University in 1900. Before his appointment at the University of California he was associate in anatomy at the University of Chicago. During the past two years he has been abroad, on leave, studying surgery at Munich, Vienna, Bonn, and Leipzig. He is a co-editor of the *American Journal of Anatomy.*

Dr. Albert M. Reese, formerly Associate Professor of Histology and Embryology, Syracuse University, has accepted the professorship of zoology in the University of West Virginia. Professor Reese is known from his studies on Petromyzom, Cryptobranchus, and the Alligator.

Dr. Eben C. Hill, A.B. and M.D., of the Johns Hopkins University, has been appointed Assistant in Anatomy in that institution.

Dr. Eliot R. Clark, A.B., Yale, and M.D., Johns Hopkins University, has accepted an Assistantship in Anatomy in the Johns Hopkins University.

An encouraging sign of the progress of anatomical science in this country is afforded by the organization from time to time on a scientific basis of the departments of anatomy in our State universities. In this connection anatomists will be interested in the recent appointment of Dr. John Sundwall, of the University of Chicago, to the professorship of anatomy in the University of Utah. Dr. Sundwall received his anatomical training at the University of Chicago, where he has been a graduate student in anatomy and pathology since 1902. He received the degree of Doctor of Philosophy in these subjects in December, 1906, and since that time has been Assistant in Anatomy.

Mr. Ralph Edward Sheldon has been appointed Assistant in Anatomy at the University of Chicago.

Dr. Daniel Graisberry Revell has resigned his instructorship in anatomy at the University of Chicago to accept the directorship of the biological laboratories of the Provincial Board of Health, Edmonton, Alberta.

Professor WILHELM HIS, JR., son of the eminent anatomist, has accepted the chair of Medicine in the University of Berlin in succession to Professor von Leyden. Professor His is well known for his anatomical studies upon the ear vesicle, the smypathetic nervous system and upon the musculature of the heart. It was he who discovered the bundle of muscle connecting the auricle with the ventricle.

Dr. AUGUSTUS G. POHLMAN, late Associate Professor of Anatomy in the University of Indiana, has been advanced to a junior professorship.

The chair of anatomy in the new university at Manila has been accepted by Dr. ROBERT BENNETT BEAN, who receives the title of associate professor. Dr. Bean is a graduate of Johns Hopkins University and has been an instructor in anatomy at that university and at the University of Michigan.

During the past two years Dr. N. W. INGALLS has been studying under the direction of Professor Keibel at Freiburg, and Professor Rabl at Leipzig. He has resumed his work as Instructor in Anatomy at Western Reserve University, Cleveland.

Dr. ROBERT RETZER, Instructor in Anatomy at the Johns Hopkins, was granted leave of absence for the summer semester to continue his studies on the heart muscle under the direction of Professors Wiedersheim and Keibel at the University of Freiberg.

At a recent meeting of the National Academy, Dr. FRANKLIN P. MALL was elected a member.

Through the generosity of Messrs. Alfred F., Charles C., and John S. Pillsbury, of Minneapolis, Dr. Thomas G. Lee has secured for the Department of Histology and Embryology, University of Minnesota, the working library of the late Prof. William His, of Leipzig. This collection comprises over 8400 monographs and separats contributed by over 2500 different authors.

Professor J. P. McMurrich, of Toronto, and Sir William Turner, members of the Association of American Anatomists, have been elected members of the American Philosophical Society.

ANNOUNCEMENT OF THE TWENTY-THIRD SESSION OF THE ASSOCIATION OF AMERICAN ANATOMISTS.

The Twenty-third Session of the Association of American Anatomists will be held in the Hull Laboratory of Anatomy at the University of Chicago, and in affiliation with the American Association for the Advancement of Science and other Scientific Societies, during convocation week, January 1, 2, and 3, 1908. The large number of Societies meeting at this time and place will insure the usual railroad rates. Details concerning transportation, headquarters, smoker, etc., will be given in the preliminary program which will be sent to the members sometime in advance of the meeting.

Members of this Association desiring to present papers or give demonstrations, are requested to notify the Secretary at a date as early as possible. It is desired to send out the preliminary program about ten days before this meeting. Titles of papers and demonstrations should, therefore, be in the hands of the Secreary by December 15. Special attention is again called to the desirability of making demonstrations an especial feature of the meeting. Members who have attended the more recent meetings of this Association have expressed their approval of emphasizing the importance of demonstration. If members desiring to avail themselves of the opportunity of presenting demonstrations will communicate this fact to the Secretary in due time, an attempt will be made to assign definite hours to demonstrations, so that members having demonstrations to make may have time and opportunity to profit by those made by others. Those desiring microscopes or other apparatus for purposes of demonstration may address Professor Bensley (University of Chicago), or communicate with the Secretary.

The limited time at the disposal of the Association for the reading of papers, and the fullness of the program, judging from the past meetings, make it very desirable that these be abridged as much as possible. Members are urged to bear this in mind in preparing communications.

The business meeting will be held on the second afternoon of the session, and the reading of papers will begin promptly after the first meeting is called to order.

It is hoped that a general discussion on the development of the lymphatic system may be arranged for.

Members are requested to propose for membership in this Association persons eligible thereto. The necessary information concerning eligibility and the manner of proposing members is contained in Article V of the constitution, which reads: "Candidates for membership must be persons engaged in the investigation of anatomical or cognate sciences and shall be propsed in writing to the Executive Committee by two members, who shall accompany the recommendation by a list of the candidates publications, together with the references. The election shall take place in open meeting, a two-thirds vote being necessary." Application blanks may be obtained from the Secretary and when filled out may be sent to the President or Secretary, who will present the same to the Executive Committee for consideration.

The attention of members with dues in arrears is called to the fact that the annual dues for 1907 became due January last. In view of the fact that the AMERICAN JOURNAL OF ANATOMY is sent to members on payment of the annual dues to the Treasurer of this Association, it is eminently desirable that members in arrears pay their dues at an early date, so that the accounts of the Association with the AMERICAN JOURNAL OF ANATOMY for the present fiscal year, may be closed. The numbers of Vol. VI and VII of the AMERICAN JOURNAL OF ANATOMY not yet sent to members with dues in arrears will be forwarded them on payment of dues.

Members are requested to consult the list of members with titles and addresses found on pages 96 to 107 of the ANATOMICAL RECORD of THE AMERICAN JOURNAL OF ANATOMY, VI, No. 4, to see whether their name, title, and address is correctly given. If not the Secretary requests that he be communicated with and the necessary correction indicated. The Secretary requests that such corrections be forwarded him at an early date.

G. Carl Huber, Secretary-treasurer,
1330 Hill St., Ann Arbor, Mich.

THE ATTENTION OF MEMBERS OF THE ASSOCIATION OF AMERICAN ANATOMISTS IS CALLED TO THE ABOVE ANNOUNCEMENT.

THE ANATOMICAL RECORD.[1]

No. 8. FEBRUARY 29, 1908.

PROCEEDINGS OF THE ASSOCIATION OF AMERICAN ANATOMISTS

TWENTY-THIRD SESSION

In the Hull Laboratory of Anatomy, University of Chicago, January 1, 2, and 3, 1908.

Wednesday, January 1, 9.30 to 12.30. The meeting was called to order by the president, Dr. Franklin P. Mall, who appointed the following committees:

Committee on Nominations: Dr. Henry H. Donaldson, Chairman; Dr. Warren H. Lewis, Dr. Clarence M. Jackson.

Auditing Committee: Dr. Robert R. Bensley, Chairman; Dr. Abram T. Kerr.

The following papers were presented:[2]

SYMPOSIUM ON THE DEVELOPMENT AND STRUCTURE OF THE LYMPHATIC SYSTEM

GEORGE S. HUNTINGTON, *Columbia University*, and C. F. W. McCLURE, *Princeton University*. THE ANATOMY AND DEVELOPMENT OF THE JUGULAR LYMPH SACS IN THE CAT.

GEORGE S. HUNTINGTON. GENETIC INTERPRETATION OF THE DEVELOPMENT OF THE LYMPHATIC SYSTEM IN THE CAT.

FLORENCE R. SABIN, *Johns Hopkins University*. SOME FURTHER EVIDENCE ON THE ORIGIN OF THE LYMPHATIC SYSTEM FROM THE VEINS.

[1] Attention is called to the notice in this number in regard to new arrangements for Vol. II of THE ANATOMICAL RECORD.

[2] Full abstracts of papers the titles of which are given here will be published in early numbers of Volume II of THE ANATOMICAL RECORD.

Walter A. Baetjer, *Johns Hopkins University.* ON THE ORIGIN OF THE MESENTERIC SAC AND ITS RELATION TO THE THORACIC DUCT.

Presented by Florence R. Sabin.

George J. Heuer, *Johns Hopkins University.* THE DEVELOPMENT OF THE LYMPHATICS OF THE INTESTINE.

Presented by Florence R. Sabin.

Henry McE. Knower, *Johns Hopkins University.* THE ORIGIN AND DEVELOPMENT OF THE ANTERIOR LYMPH HEARTS AND THE SUBCUTANEOUS LYMPH SACS IN THE FROG.

Arthur W. Meyer, *University of Minnesota.* (a) THE HEMOLYMPH GLANDS OF THE SHEEP; (b) THE SUBCUTANEOUS HEMOLYMPH GLANDS.

William F. Allen, *Pacific Grove, California.* THE DISTRIBUTION OF THE SUBCUTANEOUS VESSELS IN THE TAIL REGION OF LEPISOSTEUS.

Presented in Abstract by G. Carl Huber.

THIS SESSION CLOSED WITH THE READING OF THE FOLLOWING GENERAL PAPERS:

Clarence M. Jackson, *University of Missouri.* ON THE GROWTH OF THE HUMAN EMBRYO.

Charles R. Bardeen, *University of Wisconsin.* NOTES ON THE DEVELOPMENT OF THE SPINAL COLUMN AND SKULL.

Robert R. Bensley, *University of Chicago.* OBSERVATIONS ON THE SALIVARY GLANDS OF MAMMALS.

Arthur E. Hertzler, *University Medical College, Kansas City, Mo.* THE ILIO-TROCHANTERIC LIGAMENT.

Wednesday, January 1, 2.00 to 5.00. Demonstrations as follows:

Walter A. Baetjer, *Johns Hopkins University.* SPECIMENS SHOWING THE DEVELOPMENT OF MESENTERIC LYMPH SAC OF LEWIS.

Presented by Florence R. Sabin.

ROBERT R. BENSLEY, *University of Chicago.* PREPARATIONS SHOWING THE STAINING REACTIONS OF THE SALIVARY GLANDS.

EUGENE R. CORSON, *Savannah, Georgia.* X-RAY PICTURES OF THE CARPAL BONES IN THE NEGRO: (a) NORMAL CARPUS; (b) CARPUS IN WHICH THE SEMILUNAR AND CUNEIFORM BONES ARE FUSED.

LYDIA M. DEWITT, *University of Michigan.* RECONSTRUCTIONS AND PREPARATIONS OF THE AURICULO-VENTRICULAR BUNDLE.

HERBERT M. EVANS, *Johns Hopkins University.* SECTIONS AND ENTIRE MOUNTS OF INJECTED PIG EMBRYOS ILLUSTRATING THE DEVELOPMENT OF THE VASCULAR SYSTEM IN MAMMALIAN EMBRYOS.

Presented by Florence R. Sabin.

SIMON H. GAGE, *Cornell University.* (a) GLYCOGEN IN THE ENDYMAL CELLS OF THE PARAPLEXUS (PLEXUS CHOROIDEUS VENTRICULI LATERALIS) OF A 19 CM. HUMAN EMBRYO; (b) GLYCOGEN IN THE NEURAL PLATE OF AMBLYSTOMA.

SIMON H. GAGE (for E. A. Read), *Cornell University.* DEMONSTRATION OF THE OLFACTORY NERVES OF MAN AND DOG, AND OF THE VOMERO-NASAL (JACOBSON'S) ORGAN IN THE CAT.

GEORGE J. HEUER, *Johns Hopkins University.* SPECIMENS SHOWING THE DEVELOPMENT OF THE LYMPHATICS OF THE INTESTINE.

Presented by Florence R. Sabin.

G. CARL HUBER, *University of Michigan.* BLASTODERMIC VESICLE OF DOG, SHOWING INNER CELL MASS.

GEORGE S. HUNTINGTON, *Columbia University*, and C. F. W. MCCLURE, *Princeton University.* DEMONSTRATION OF RECONSTRUCTIONS, CHARTS AND LANTERN SLIDES SHOWING THE ANATOMY AND DEVELOPMENT OF THE JUGULAR LYMPH SACS IN THE CAT.

JOHN B. JOHNSTON, *University of Minnesota.* SECTIONS AND MODELS ILLUSTRATING THE SENSORY ROOT OF THE TRIGEMINUS TO THE MESENCEPHALON IN A HUMAN EMBRYO.

ABRAM T. KERR, *Cornell University.* (a) STOMACHS FROM HARDENED DISSECTING ROOM BODIES, ILLUSTRATING VARIATIONS IN SHAPE; (b) FIVE SPECIMENS OF DOUBLE URETERS.

EDWIN G. KIRK, *University of Chicago.* PREPARATIONS SHOWING THE HISTOGENESIS OF THE GASTRIC GLANDS.

CAROLINE MCGILL, *University of Missouri.* (a) PREPARATIONS SHOWING THE STRUCTURAL CHANGES DURING CONTRACTION OF SMOOTH MUSCLE; (b) FIBROGLIA FIBRILS IN THE INTESTINAL MUCOSA OF NECTURUS.

Arthur W. Meyer, *University of Minnesota.* (a) PREPARATIONS OF THE HEMOLYMPH GLANDS OF THE SHEEP; (b) SUBCUTANEOUS HEMOLYMPH GLANDS.

William S. Miller, *University of Wisconsin.* LYMPHATICS IN THE HUMAN LUNG.

August G. Pohlman, *Indiana University.* EXTENSOR BREVIS DIGITORUM MANUS; (b) FLEXOR CARPI RADIALIS BREVIS; (c) APPENDIX FORMING A DUODENAL-CÆCAL CANAL.

Robert Retzer, *Johns Hopkins University.* PREPARATIONS OF MAMMALIAN HEARTS.

Florence R. Sabin, *Johns Hopkins University.* (a) SPECIMENS SHOWING THE CERVICAL SAC AND ITS RELATION TO THE VEINS; (b) INJECTED EMBRYOS ILLUSTRATING THE RELATIONS OF THE LYMPHATICS TO THE VEINS.

H. D. Senior, *Syracuse University.* WAX-PLATE RECONSTRUCTIONS ILLUSTRATING THE DEVELOPMENT OF THE HEART IN SHAD.

George L. Streeter, *University of Michigan.* WAX-PLATE RECONSTRUCTION OF THE BRAIN AND CRANIAL NERVES OF A 10 MM. HUMAN EMBRYO.

Mervin T. Sudler, *University of Kansas.* DEMONSTRATION OF MATERIAL USED IN TEACHING THE ANATOMY OF THE CENTRAL NERVOUS SYSTEM.

Robert J. Terry, *Washington University, St. Louis.* CRANIUM OF A CAT EMBRYO OF 23.1 MM.

Thursday January 2, 9.00 to 12.30, Session for the Reading of Papers, the president, Dr. Franklin P. Mall and the first vice-president, Dr. George A. Piersol, presiding.

Abram T. Kerr, *Cornell University.* THE SUBSCAPULAR NERVES IN MAN. A STATISTICAL STUDY.

Simon H. Gage (for E. A. Read), *Cornell University.* THE TRUE RELATION OF THE OLFACTORY NERVES OF MAN, DOG, AND CAT.

C. Judson Herrick, *University of Chicago.* ON THE MORPHOLOGICAL SUBDIVISION OF THE BRAIN.

Read by Title.

R. E. Sheldon, *University of Chicago.* AN ANALYSIS OF THE OLFACTORY PATHS AND CENTERS IN FISHES. (By invitation.)

JOHN B. JOHNSTON, *University of Minnesota.* THE MESENCEPHALIC ROOT OF THE TRIGEMINUS IN MAN AND MAMMALS.

Read by Title.

HENRY H. DONALDSON, *Wistar Institute, Philadelphia.* THE NERVOUS SYSTEM OF THE AMERICAN LEOPARD FROG, RANA PIPIENS, COMPARED WITH THE EUROPEAN FORMS, RANA ESCULENTA AND RANA TEMPORARIA. ILLUSTRATED BY LANTERN SLIDES.

ELIZABETH H. DUNN, *University of Chicago.* A STUDY OF THE GAIN IN WEIGHT FOR THE LIGHT AND HEAVY INDIVIDUALS OF A SINGLE GROUP OF ALBINO RATS.

Thursday, January 2, 3.00 p. m. BUSINESS MEETING.

The minutes of the Secretary as printed in the ANATOMICAL RECORD (*American Journal of Anatomy,* Vol. VI, No. 3) pages 1 and 2, were on motion approved.

The treasurer made the following report for the year 1907:

Total receipts for the year 1907	$1165.15	
Balance on hand December 24, 1906	145.96	
Total	$1311.11	$1311.11

EXPENDITURES FOR 1907.

To the *American Journal of Anatomy* for 237 subscriptions and two supplements	$1068.50	
For expenses of secretary to New York and Madison meetings	54.69	
Smoker, New York meeting	31.15	
Postage	24.00	
Printing	24.25	
Total	$1202.59	$1202.59
Balance on hand December 29, 1907, deposited in Farmers' and Mechanics' Bank, Ann Arbor, Mich.		$108.52

The chairman of the auditing committee reported for that committee: "We have examined the treasurer's accounts for 1907 and found them correct."

On motion the report of the auditing committee was accepted and adopted.

The chairman of the committee on nominations made the following report for that committee:

For President, James Playfair McMurrich, Toronto University.

For First Vice-President, William S. Miller, University of Wisconsin

For Second Vice-President, Florence R. Sabin, Johns Hopkins University.

For Secretary-Treasurer, G. Carl Huber, University of Michigan.

For Executive Committee, term expiring in 1910, Thomas G. Lee, University of Minnesota; term expiring in 1912, Robert R. Bensley, University of Chicago.

On motion, the secretary was instructed to cast a ballot for the officers named.

The following were recommended by the executive committee for election to membership in the Association:*

William J. Baumgartner, A. M., Assistant Professor of Histology and Zoology, University of Kansas.

Eliot R. Clark, M. D., Assistant in Anatomy, Johns Hopkins Medical School.

Walter E. Dandy, A. B., Research Student in Anatomy, Johns Hopkins Medical School.

Earl R. Hare, A. B., M. D., Instructor in Anatomy, University of Minnesota.

Howard Hill, M. D., Professor of Anatomy, University Medical College, *Kansas City, Mo.*

C. F. Hodge, Ph. D., Professor of Biology, Clark University.

N. William Ingalls, M. D., Instructor in Anatomy, Medical Department, Western Reserve University.

Harvey E. Jordan, Ph. D., Adjunct Professor of Anatomy, University of Virginia.

Francis L. Landacre, A. B., Associate Professor of Zoology, Ohio State University.

Michael A. Lane, A. B., Research Assistant, Department Physiology and Histology, University of Minnesota.

George G. Lempe, A. B., M. D., Lecturer on Anatomy, Albany Medical College.

Archibald L. McDonald, A. B., M. D., Professor of Anatomy, University of North Dakota.

Ralph H. Major, A. B., Research Student in Anatomy, Johns Hopkins Medical School.

James B. Murphy, A. B., Research Student in Anatomy, Johns Hopkins Medical School.

James Patterson, B. S., Assistant in Anatomy, University of Chicago.

Edward L. Rice, Ph. D., Professor of Zoology, Ohio Wesleyan University.

Richard E. Scammon, A. B., Austin Teaching Fellow in Histology and Embryology, Harvard Medical School.

Ralph E. Sheldon, A. M., M. B., Assistant in Anatomy, University of Chicago.

Septimus Sisson, B. S., V. G., Professor of Comparative Anatomy, Ohio State University.

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* A full list of members will appear in Vol. II of The Anatomical Record. *(See No. 4 of this volume (Vol. I), May, 1907, for the last list.)*

CHARLES R. STOCKARD, Ph. D., Assistant in Embryology and Histology, Cornell Medical College, *New York City.*

OLIVER E. STRONG, Ph. D., Instructor in Histology and Embryology, Columbia University, *New York.*

On motion, the secretary was instructed to cast a ballot for election to membership in the Association of American Anatomists of applicants recommended by the executive committee.

The executive committee recommended that Professor A. Nicolas, Professor of Anatomy École de Médecine, Paris, France, be elected an honorary member of the Association.

On motion of Dr. James Playfair McMurrich, the secretary was instructed to cast a ballot electing Professor A. Nicolas an honorary member of this Association.

The executive committee recommended that a committee be appointed to consider the revision of the constitution.

Dr. George S. Huntington moved that such a committee be appointed. Passed. The president appointed as such committee: Dr. G. Carl Huber, chairman; Dr. Henry H. Donaldson, and Dr. Robert R. Bensley.

Dr. Donaldson moved that this Association express its thanks and appreciation to the members of the Anatomical Staff of the University of Chicago and to other members of the local committee for the very successful arrangements made for the meeting and for the many courtesies shown to members of this Association. Carried. On motion the business meeting was adjourned.

After the business, the members attended the demonstrations.

Friday, January 3, 9.30 to 12.30, SESSION FOR THE READING OF PAPERS, the secretary presiding.

GEORGE L. STREETER, *University of Michigan.* THE CRANIAL NERVE ORIGINS IN THE 10 MM. HUMAN EMBRYO.

WESLEY M. BALDWIN, *Cornell University.* THE RELATION OF THE SPINOUS PROCESSES OF THE VERTEBRAE TO THE SUPERFICIAL ORIGINS OF THE SPINAL NERVES FROM THE SPINAL CORD AND TO THEIR DISTRIBUTION IN THE SKIN OF THE BACK.

Presented by Abram T. Kerr.

ABRAM T. KERR, *Cornell University.* (a) THE SHAPE OF THE STOMACH AS FOUND IN HARDENED DISSECTING ROOM BODIES; (b) DUPLICATION OF THE URETER IN MAN AS ILLUSTRATED BY FIVE CASES FROM THE DISSECTING ROOM.

EUGENE R. CORSON, *Savannah, Ga.* FUSION OF THE SEMILUNAR AND CUNEIFORM (O. LUNATUM AND O. TRIQUETUM) ON BOTH SIDES IN MALE NEGRO, WITH X-RAY PICTURES.

Presented by Simon H. Gage.

CAROLINE MCGILL, *University of Missouri.* (a) THE STRUCTURAL CHANGES DURING CONTRACTION OF SMOOTH MUSCLE; (b) THE FIBROGLIA FIBRILS IN THE INTESTINAL MUCOSA OF NECTURUS.

THOS. G. LEE, *University of Minnesota.* ON THE IMPLANTATION OF THE OVUM IN DIPODOMYS.

FREDERIC T. LEWIS, *Harvard University.* THE REGULAR OCCURRENCE OF INTESTINAL DIVERTICULA IN EMBRYOS OF PIG, RABBIT, AND MAN.

Presented by Robert J. Terry.

EDWIN G. KIRK, *University of Chicago.* THE HISTOGENESIS OF THE GASTRIC GLANDS.

GEORGE E. COGHILL, *Denison University.* THE DEVELOPMENT OF THE SWIMMING MOVEMENT IN AMPHIBIAN EMBRYOS.

AUGUST G. POHLMAN, *Indiana University.* THE COURSE OF THE BLOOD THROUGH THE FETAL MAMMALIAN HEART.

ROBERT RETZER, *Johns Hopkins University.* SOME RESULTS OF RECENT INVESTIGATIONS ON THE MAMMALIAN HEART.

Read by Title.

HERBERT M. EVANS, *Johns Hopkins University.* (a) A STATISTICAL STUDY OF THE HUMAN SUPERIOR MESENTERIC ARTERY; (b) THE BLOOD-VESSELS OF THE SMALL INTESTINE IN MAN.

Read by Title.

HENRY MCE. KNOWER, *Johns Hopkins University.* THE DEMONSTRATION OF THE INTERVENTRICULAR MUSCLE BANDS OF THE ADULT HUMAN HEART.

Read by Title.

H. W. SCHULTE, *Columbia University, New York.* A FURTHER COMMUNICATION UPON THE VENOUS SYSTEM OF MARSUPIALS.

Read by Title.

J. P. MUNSON, *Washington State Normal School, Ellensburg, Wash.* NUCLEAR ACTIVITY IN GROWING CELLS.

Read by Title.

Abstracts of papers presented and announced will appear in forthcoming numbers of the Anatomical Record.

G. Carl Huber, Secretary.

REGENERATION OF PERIPHERAL NERVES.[1]

BY

ROSS G. HARRISON,

Yale University, New Haven, Conn.

The nerves of one side of the tail of larvæ of Rana sylvatica, 2-2.5 cm. long, were cut with fine scissors just beyond the point of emergence from between the myotomes. The processes of degeneration and regeneration were then observed from day to day in one and the same nerve in the living specimen. The degenerative processes take place very rapidly. In less than 24 hours the medullary sheath is completely disintegrated beyond the lesion and for a very short distance central to it. In the axis-cylinder of both the medullated and the non-medullated nerves the signs of degeneration are less marked, though unmistakable, and are noticeable in even the finest and most remote twigs. The Schwann cells become less regularly spindle-shaped, with a somewhat humpy surface, and do not adhere so closely to the axis-cylinder. They are also found to contain a few granules. After one or two days it is found that the two cut ends of many of the nerves have united together by a protoplasmic bridge, and in such cases the degeneration of the peripheral part of the axis-cylinder is immediately arrested, indicating that in these larvæ a primary healing of nerve fibers is possible. The medullary sheath is not rehabilitated immediately and the process of re-formation of this structure resembles that of its initial development. When the peripheral portion of a nerve fails to unite with a central stump, degeneration continues and ultimately the nerve disappears, the finer twigs disintegrating first. When a central stump fails to unite with a peripheral end, regeneration by a comparatively slow process, in a centrifugal direction, takes place. There is no indication whatever of any power of "auto-regeneration" in the nerves whose connection with the central end remains severed.

[1] Abstract of a paper read before the American Society of Zoölogists, at the meeting held at New Haven, December 28, 1907.

THE METHODS OF FUNCTIONAL NEUROLOGY.

BY

J. B. JOHNSTON,

University of Minnesota, Minneapolis, Minn.

In a review of my book on the Nervous System of Vertebrates in the American Naturalist for November, 1907, occur some statements which require correction. Professor Parker says: "The eye and its nervous connections are put in the somatic afferent division, not because they are concerned with touch or any of the derived senses, but because in certain of the lower vertebrates the spinal nerve terminals are stimulated apparently [1] by light. The olfactory apparatus is classed under the visceral sensory division because it is concerned with the acquisition of food. The weakness of this classification is apparent from the fact that the reasoning by which the author is led to assign the olfactory apparatus to the visceral sensory division, if applied to the optic apparatus, would bring these organs under that head instead of under the somatic sensory. In a similar way the organs of taste ought not to be classed as visceral sensory organs, but as a somatic sensory mechanism, for the reason that the cutaneous sensory nerves of lower vertebrates are stimulated by sour and salt substances much as our organs of taste are." He follows these statements with severe condemnation of the book and censure of the group of neurologists which it represents, because they are following a wrong method which is bound to lead to false conclusions. Professor Parker would of course not say this if he did not believe it and think that he was doing a service to science. For this reason it is proper to make the following correction as to facts.

The reasons for the classification of the visual apparatus with the

[1] Why does Professor Parker use this word? I have simply accepted and followed his own positive statements in this matter. Professor Parker's second paper on this subject is interesting. It appeared November 1, 1905, and I was able to insert its results only in the proof sheets of the book. One of his conclusions there reads: "This sensitiveness of the vertebrate skin to light is probably a remnant of that primitive condition from which the lateral retinas were derived, etc." This is in entire accord with the extended argument contained in my paper in the Journal of Comparative Neurology and Psychology for May, 1905 (see p. 233).

somatic afferent division are very different from the one which he states. The optic centers were assigned to the somatic sensory division in 1902 before Professor Parker's first paper on the stimulation of cutaneous nerves by light was published (1903) and before I knew anything of this physiological fact. The reasons for the classification stated in the book are:

1. The primary optic centers form a part of the dorso-lateral column of the brain (p. 24).

2. These centers are at the same time centers for both primary and secondary fibers of touch (p. 150). Primary touch fibers reach the same region in all vertebrates including man (p. 115-116 and later work).

3. The optic tract is morphologically comparable—homologous—with the secondary tract of touch, the medial lemniscus (p. 150).

4. The retina itself is derived from the dorso-lateral zone of the embryonic brain (p. 44-45, 150).

5. The animal *responds to* light stimulation on the eye and on the spinal nerve terminals *by the same characteristic movements* (as shown by Parker) (p. 150). Throughout the book the mode of response to various types of stimulation is considered in determining functional and morphological relationships. This Professor Parker has overlooked.

Professor Parker's next statement requires correction as follows: "The olfactory apparatus is classed under the visceral sensory division because it is" primarily and chiefly "concerned with the acquisition of food," *and equally* because it has centers in the brain in common with those of taste. Does Professor Parker mean to say, as he implies, that vertebrates use their eyes primarily and chiefly "in the acquisition of food"? In fact, they use the eyes primarily and chiefly to *see their way about.* Those forms (*e. g.,* teleosts, birds) which depend chiefly on their eyes for finding food at a distance also use their eyes primarily to see their way, to avoid obstacles and enemies, etc. Furthermore, they depend upon the somatic motor mechanism for catching food as well as for locomotion. The mode of response to visual stimuli is somatic. Again, the stimulation of cutaneous nerves by sour and salt substances would *not* be ground for classing taste organs with them or for any classification at all. The mode of response must be taken into account as well as the *normal* mode of stimulation to which the structures are adapted.

Professor Parker's statements show that he has failed to understand the method of functional neurology which he condemns. Nothing is more desired on the part of functional neurologists than thoughtful criticism of their work. The author has been very much gratified by the way this book has been received among anatomists and biologists. Of all the numerous reviews both in this country and abroad, only this one has been adverse. All the neurologists who have reviewed it have expressed their appreciation of the attempt to seek the meaning of the nervous system by unifying the results obtained from the structural, functional, and phylogenetic modes of study. Many have offered in published reviews or by letter very helpful suggestions and criticisms. It has been my purpose here only to point out the errors in Professor Parker's statements. At the proper time and place I shall endeavor to explain in a more clear and simple manner than heretofore the principles involved in the functional analysis of the nervous system.

STUDIES OF THE INTERSTITIAL CELLS OF LEYDIG.
No. 3. Histology.

BY

R. H. WHITEHEAD, M. D.

From the Anatomical Laboratory, University of Virginia.

With 8 Text-Figures.

In two previous numbers of this journal the writer (1 and 2) has given the results of a study of the development, embryonic and post-embryonic, of the interstitial cells of the testis as seen in the pig. The present study is devoted to the histology of these cells in various adult mammals, the methods of investigation employed being, in large part, newer ones not used by previous students of the subject.

I shall not attempt here to take up in detail the rather extensive bibliography, as in my first article I have reviewed the principal reports made during the last century; and a full account of the literature is contained in the article of v. Bardeleben (3) and in the more recent one of Ganfini (4).

As a result of the studies of Leydig and Koelliker it was definitely established that the interstitial cells are a constant constituent of the mammalian testis. Friedmann (5) and Ganfini find that they are present also in some amphibians, reptiles, and birds, while absent in others; but the evidence adduced for their presence in forms lower than mammals is not fully convincing. I regret that I have not been able to investigate this point. It is a matter of some importance, seeing that one of the hypotheses put forward as to the function of these cells ascribes to them the general biological property of establishing and maintaining the secondary sexual characters of male animals through the medium of an internal secretion.

A question much debated by the earlier writers was the origin of the interstitial cells. Their conclusions were mainly deductions from adult conditions; and no one seems to have studied the question by a thorough examination of embryonic material until Ganfini, Allen (6), and the writer, working independently, and each with fairly complete series of embryos at his disposal, arrived at essentially the same conclusion, namely, that the interstitial cells are derived from the mesothelium of the genital ridge, although the authors differed as to the details of the process.

A review of the literature shows that as yet no agreement has been reached as regards the finer histology of the individual cells, their arrangement, and their relation to the blood-vessels. It is with these three points that the present article is chiefly concerned. The material used was obtained from the rat, gray squirrel, rabbit, opossum, dog, cat, bull, sheep, pig, and man. The opossum material, unfortunately, was so poorly fixed that it could not be used for a study of finer details. In the case of the human material, one of the specimens, which I owed to the kindness of Prof. R. R. Bensley, was removed from an executed criminal immediately after death, and was quite favorable for study; the other was obtained from a man dead of pernicious anæmia a few hours post mortem, and was in a fair state of preservation.

It will be unnecessary to give a detailed description of the appearances noted in each animal, as it is possible to draw a general picture, the differences in detail being pointed out here and there.

THE ARRANGEMENT AND STROMA OF THE INTERSTITIAL CELLS.

As seen in sections of the testes of the usual laboratory animals, the interstitial cells appear as more or less isolated collections of cells lying in the intervals between the sections of three or more seminal tubules—the *carrefours* of French authors. In general, these collections are molded to the shape of the spaces in which they lie, being triangular, quadrangular, or some modification thereof as the case may be. Frequently, a narrow band projects from each of two neighboring collections to almost meet each other, but are prevented from doing so by the close approximation of the walls of two tubules. In some animals, however, (cat, pig, opossum) serial sections show that the collections are frequently continuous with one another, though the narrow bands connecting them may almost be pinched in two in the cracks between tubules. In rodents the collections of cells are relatively few and small, and entirely isolated; and the same is practically true of the dog. The interstitial cells are not confined to the intertubular spaces, but are also found between the tubuli recti, along the interlobular septa, and beneath the albuginea. In the latter situation, they usually fill the triangular intervals between the albuginea and the diverging bases of the seminal tubules; but in some animals, as the dog and opossum, they form a lining for the inner surface of the albuginea, arranged in a row, or perhaps in several rows, of small cubical cells. Many of the cells give evidence in their shape of subjection to pressure. In the testis of cryptorchid pigs the interstitial cells usually appear as a large continuous mass in which the seminal tubules are imbedded; and I have pointed out elsewhere (1) that this condition—a continuous mass of cells in which the seminal tubules are imbedded as in a matrix—is characteristic of the later stages of the embryo pig's testis. The study of the development of the interstitial cells also showed that they are subject to periods of atrophy coincident with periods of rapid growth of the seminal tubules with a resulting diminution in the size of the individual cells and their segregation into groups. I conclude, therefore, that the isolation of the collections of cells, or their continuity with one another, is simply a variable feature of the histological picture dependent upon the amount of cells originally present and upon the pressure to which they are subjected by the growing tubules, which tend to separate an originally continuous mass of cells into separate groups.

As to the arrangement of the cells within the collections, quite diverse views have been expressed. v. Bardeleben, who regarded the cells as purely epithelial in structure and arrangement, reported that they contained no formed intercellular substance. Hansemann (7), on the other hand, using Van Gieson's stain, describes a fibrous intercellular substance. Plato (8), who believed that the interstitial cells were formed by direct transformation from the ordinary connective tissue cell, agrees with Hansemann, Nussbaum (9) describes the interstitial cells as arranged in isolated nests and strands, each such collection being surrounded by a membrane similar to the wall of the seminal tubules. Finally Ganfini, who devoted considerable study to the question, reached the conclusion that the interstitial cells are arranged typically in columns, each surrounded by an endothelial sheath; and that, according as the section is made transverse to, or parallel with, the long axes of these columns, their sections will appear as disks or longitudinal rows. For investigating the stroma of the intertubular spaces I have employed digestion methods and the stain for connective tissue devised by Mallory, which are doubtless the best methods now at our command for studying connective-tissue frameworks and their relations. In digesting tissues I have relied chiefly upon Flint's modification, in which a small block of tissue is first digested en masse, and afterwards sectioned and stained. Where haste is not required this is a very satisfactory method. The reults are equally as good as those obtained by digesting sections on the slide; and, moreover, one does not run the risk of losing his sections.

The accompanying figures, together with a few words of explanation will suffice to make the findings clear.

Figures 1, 2, and 3 are low power drawings of digested testis of a young man, a bull, and a cat respectively; while Fig. 4 is a drawing under much greater magnification of an intertubular space in a cat. The cells, both tubular and interstitial, have been removed, leaving only the bare framework of the organ. It is seen that, while the stroma of the intertubular spaces differs in detail in the different animals, it is in each essentially a fibrous meshwork, the empty spaces of which were previously occupied by the interstitial cells. High magnification shows that the

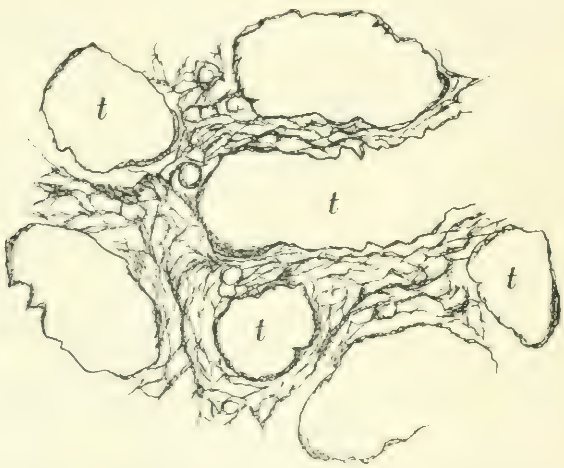

FIG. 1. Section of digested testis of a young man. All cells have been removed, leaving only the walls of the tubules (t) and the intertubular connective-tissue framework. $\times$ about 80.

fibers are composed of wavy fibrils. In the sections shown in the figures the amount of stroma is greatest in the man and least in the cat. The size of the meshes varies all the way from that just sufficient to accommodate one interstitial cell to those capable of lodging a number of them. In the case of the cat the larger bundles of fibrils often run parallel for a considerable distance, suggesting an arrangement of the cells in rows; but even here there are occasional exchanges of cross-fibrils between the larger bundles. The Mallory preparations give results which are quite confirmatory of the digestion methods, and supplement them, often showing the cross-fibrils between the cells distinctly. Thus, Fig. 5 illustrates a portion of a cat's testis in which with ordinary methods there might

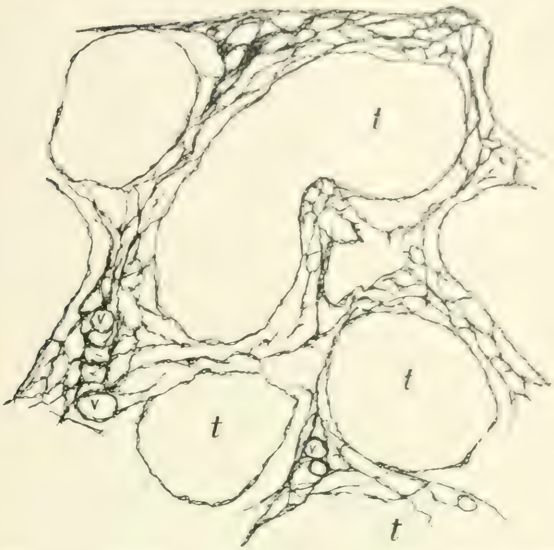

FIG. 2. Section of digested testis of a bull. The intertubular spaces are occupied by a connective-tissue meshwork which is not so dense or tightly woven as in the preceding figure. Some blood-vessels (v) are seen in cross section. × about 80.

FIG. 3. Section of digested testis of a cat. Here the connective-tissue meshwork is much more loosely woven than in either of the preceding figures. × about 80.

appear to be a typical arrangement in parallel rows without intercellular substance; but the Mallory stain shows fine blue fibrils here and there between the cells. These findings seem to make it certain that v. Bardeleben was mistaken in his view that the interstitial cells have a typical epithelial arrangement without formed intercellular substance. They

Fig. 4. A single intertubular space from a digested cat's testis highly magnified. The scantiness of the connective tissue and the large size of the meshes for the interstitial cells are shown. × about 500.

are also quite contradictory of Nussbaum's opinion. Nor does an arrangement in columns of cells, each column invested in an endothelial sheath as maintained by Ganfini, seem typical. It is true that such may seem to be the arrangement, particularly in the cat and the pig, unless such methods as the digestion and Mallory's be employed. In these animals the interstitial cells are large and numerous, and the stroma is quite scanty; and a collection of Leydig's cells subjected to pressure by three or more converging tubules will commonly have its cells forced into a row-like order, the rows converging to a center. But even here the Mallory stain will disclose occasional intercellular fibrils between cells in the same row. In the cat's testis, however, I have found interstitial cells among the tubuli recti which undoubtedly were disposed in columns. Fig. 6 illustrates such a group. In still other animals, as the squirrel, the stroma is exceedingly scanty, and consists of a fine reticulum running at irregular intervals between the cells (Fig. 7). The very small amount of stroma here makes the use of digestion methods unprofitable.

FIG. 5. A single collection of interstitial cells in the cat, stained by Mallory's method. The connective-tissue reticulum is shown dividing the cells into short columns and irregular masses. A capillary is seen entering on the left to bifurcate about the center of the collection. × about 500.

A correct general statement would seem to be that the interstitial cells are imbedded in a meshwork of fibrous reticulum, and that this meshwork is abundant and tightly woven in some animals, scanty and loose in others.

THE RELATIONS OF THE INTERSTITIAL CELLS TO BLOOD-VESSELS.

Some of the earlier authors, as Boll (10), supposed that the interstitial cells formed the walls of capillaries; and this view has been maintained recently by Senat (11). Waldeyer's (12) theory that they are perithelial in character seems to have been abandoned. But, while there may be no longer reason to think that there is any organic connection between the cells and the vessels, it is certain that the cells have a very generous blood-supply and a close spatial relation to the arterioles of the seminal tubules. Since the small branches of the spermatic artery, entering from the albuginea and the interlobular septa, must traverse the intertubular spaces which are largely occupied by the interstitial cells, it is clear that the collections of these cells will be pierced by the arterioles on their way to the tubules. Such vessels, however, are usually well separated from the cells by the accompanying connective tissue, and have no particular relation to the cells except that of space. They give off capillaries, however, which do come into very intimate relation with the cells. Fig. 5 shows such a capillary. The capillaries, after entering the collections of cells, often divide, usually dichot-

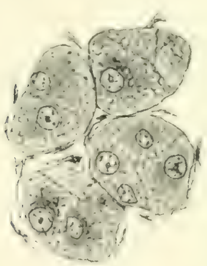

Fig. 6

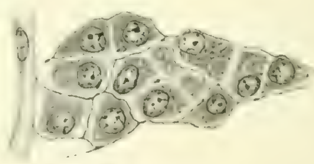

Fig. 7

Fig. 6. Collections of interstitial cells from among the tubuli recti of the cat's testis. × about 500.

Fig. 7. A group of interstitial cells from the squirrel's testis. The connective tissue is reduced to a fine reticulum running among the cells at irregular intervals. The group rests upon a capillary. × about 500.

omously, to form a capillary network, and are separated from the cells only by the framework of the latter. The clear spaces around the capillaries are possibly the beginnings of lymphatics. Many of the capillaries do not terminate among the interstitial cells, but proceed through them to join the vascular network on the walls of the tubules.

THE HISTOLOGY OF THE INDIVIDUAL CELLS.

It is probable that there is a fairly typical conformation of Leydig's cells in all mammals. It seems to have been noted first by Plato in the cat, and was also found by v. Lenhossék in man; while the writer observed it through all the later stages of the development of the pig's testis. Ganfini, in his extensive study of mammalian material, found it constantly present, and this has also been my experience in the various mammals that I have studied. Figs. 5 and 8 represent this form in the cat, in which animal it reaches its acme. It will be noted that there is a more or less eccentrically placed mass of condensed granular cytoplasm containing the nucleus, while the peripheral portion of the cell is extensively vacuolated. So marked is this arrangement that v. Lenhossék has used in connection with it the terms commonly applied to amœbæ, and speaks of endoplasm and ectoplasm. By no means all of the cells have this typical structure, but all gradations are found from cells whose bodies are composed entirely of "endoplasm," to those in which it is reduced to a remnant in the immediate vicinity of the nucleus. Plato regards these vacuolated forms as old cells, the opposite extreme being youthful forms; while Ganfini thinks that this appearance is a secretory phenomenon connected with the production of fat. The analogy with what has been

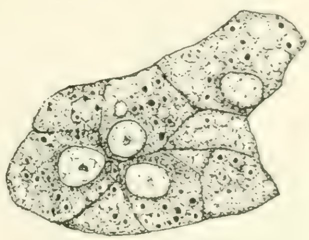

FIG. 8. A small group of interstitial cells from the cat's testis showing granules. Preparation stained with neutral gentian. × about 800.

observed in various gland cells is certainly very suggestive of secretory function; but, for reasons which will appear later, I fell sure that the activity of the cells is not limited to the formation of fat. It should be stated that the vacuoles are not always so smooth and regularly circular as those shown in the illustration; frequently they are large, irregularly-shaped cavities with more or less ragged margins, doubtless the result of the breaking down of the partitions between adjacent vacuoles. It is hardly necessary to add that the demonstration of the structure of the interstita cells requires fresh tissue and good fixation.

The nucleus is relatively large, and contains much nuclear sap with a large nucleolus. It is almost always eccentric in position. Plato and Ganfini state that the nuclei of the non-vacuolated cells stain intensely and homogeneously; but as I have not been able to find such nuclei except in preparations stained with iron hæmatoxylin, I am inclined to believe that the appearance is due to imperfect differentiation of the stain.

Reinke's (15) finding of mitotic figures in the interstitial cells has not been confirmed except by v. Lenhossék. These investigators report finding a very few mitotic figures in material derived from executed criminals. My experience, like that of most others, is entirely negative, and I have never seen any evidence of karyokinesis in these cells except in the early stages of their embryonic development. It is possible that they multiply by direct division, as was taught by v. Bardeleben; but, with the exception of the occasional presence of two nuclei in a cell, I have seen no evidence of this process.

Cell Contents. 1. Fat. As so much importance has been attached by various authors to the existence of fat in these cells, I have made a special study of it in several animals by microchemical methods. Frozen sections, either of fresh material or of tissue fixed in formalin, were stained with osmic acid and with Sudan III. The results obtained were as follows: In the dog's testis fat was found in considerable amount both in the interstitial cells and in the epithelium of the seminal tubules. In the former it was present in the form of small grains and also as large mulberry-like masses. In the case of the cat, fat was found in large amount in the interstitial cells, chiefly as small drops near the periphery, though oftentimes the cells were practically filled with it. A comparatively small amount was present in the seminal epithelium. In the testis of a young man the fat was present in about equal amounts within the tubules and in the interstitial cells. In the latter situation it existed mostly as small grains. In all three of these animals fat was also detected in the lymphatics of the testis, particularly large clumps lying in those of the albuginea, as has been described by Ganfini.

I come now to two animals in which the tests were negative, the opossum and the pig. In both cases fat was practically absent from the interstitial cells, though abundant in the seminal epithelium. The opossum material was not well fixed; spermatogenesis, however, was in progress, and, as said, fat was abundant in the seminal tubules. It is possible that the lack of fat in the interstitial cells was due to the season of the year (winter) at which the animal was killed, but this explanation can hardly account for the findings in the pig. I have repeatedly examined the testis of this animal for fat at all ages both before and after birth, and have never been able to demonstrate fat in the interstitial cells except in very minute amounts, though that substance is constantly present in the seminal epithelium after a very early stage (4 cm.) of embryonic life. In the wild boar Plato could detect but very little fat, while Ganfini's pig material had been fixed in alcohol and so could not be used for the study of fat. I am forced, therefore, to the conclusion that the interstitial cells of the pig, and probably also of the opossum, do not contain fat in any appreciable amount.

The arrangement of the fat in the cells is interesting. It is deposited as small globules which, however, may fuse into larger mulberry-like masses; but they do not run together into a large sphere, as is the case with the typical adipose cell, flattening the nucleus out against the cell-wall. Rather the arrangement is such as is found in developing fat cells, and in the so-called brown fat-glands of rodents. This characteristic has led some to doubt if the fat is "ordinary fat"—notably Ganfini, who founds upon this doubt his theory as to the function of the cells. The globules are dissolved by ether, absolute alcohol, xylol, etc., and are stained by both osmic acid and Sudan III—in short, give the usual microchemical reactions employed for the demonstration of fat in other tissues; so that the burden of proof is upon those who would deny that they are ordinary fat.

2. *Pigment.*—This was not present in any of my material, and accordingly is not a constant content of the interstitial cells. Sehrt (14), who has made the latest study of its nature, finds that it is fatty, staining well with Sudan III in frozen sections and faintly even in material that has been treated with alcohol. He considers it a waste pigment.

3. *Crystalloids.*—The discovery by Reinke in 1896 of crystalloids in the interstitial cells of an executed criminal aroused considerable interest at first, and his findings were confirmed by v. Lenhossék and others. It soon became evident, however, that their presence is restricted to a very few animals, if, indeed, it is not limited to man; they were found by Ganfini and by me only in man. I shall content myself with simply noting their inconstancy.

4. *Specific Granules.*—Almost all who have written concerning these cells have mentioned the granular character of their cytoplasm, but the only reference to specific granules which I have been able to find is by Regaud (16). He describes certain secretory vesicles and granules in the rat's testis fixed in Tellyesniczky's fluid (equal parts of 3 per cent solution of potassium bichromate and 5 per cent acetic acid) which are so obviously different from the granules about to be described that I need not review the article here. I[1] find that certain definite granules are quite constantly present in the mammalian testis, including that of man.

[1] A preliminary note on these granules was published in Amer. Jour. Anat., Vol. VI, No. 3, Anat. Record, Vol. I, No. 3.

To demonstrate them the tissue must be well preserved, and the fixing fluid is of prime importance. Thus, they are quite sensitive to certain acids, fluids containing much acetic acid or potassium bichromate, such as Zenker's, Tellyesniczky's, or Kopsch's, giving negative results; occasionally a few may be seen in material fixed with Fleming's solution. Absolute alcohol and 10 per cent formalin give very satisfactory fixation. With Mann's methyl blue-eosin they stain red; they are brought out well by iron hæmatoxylin; but the most distinctive picture is furnished by staining with Reinke's neutral gentian, as modified by Bensley. With this stain the cytoplasm is colored orange, while chromatin and the granules are stained violet; so that an excellent contrast is obtained between the granules and the cytoplasm in which they are imbedded. In such preparations (Fig. 8) the majority of the interstitial cells contain definite granules one or two mikrons in diameter, often in clusters. They lie, for the most part, in the peripheral portions of the cells, but may be found anywhere in the cytoplasm. Each granule is contained in a distinct vacuole, as is evident in thin sections two or three mikrons thick. It is interesting to note that in the case of cells which contain many fat globules, they and these granules must lie in the same vacuoles. The only animal in my series in which the granules could not be demonstrated was the opossum; but, as in this case the material was imperfectly fixed, this negative result may be excluded. They were comparatively few in the rodents, fairly numerous in the dog and sheep, and abundant in the cat, pig, and man. To determine the time at which they appear I made use of a series of pig embryos, and found them first in a pig 23 cm. long, after which time they are regularly present. In the undescended testis of a cryptorchid pig, they were very numerous. Hence they are probably not related to spermatogenesis, since in such testes the seminal epithelium is undeveloped or atrophied.

The staining reactions of these granules and their sensitiveness to acetic acid call to mind the zymogen granules of the pancreas. On the other hand, the reaction for prozymogen, which usually can be had in cells which produce zymogen, could not be obtained. Our knowledge of the zymogens is so imperfect that it does not seem safe either to affirm or to deny the zymogenic nature of the granules; but, without any reference to their chemical nature, we may regard them as an internal secretion of the interstitial cells.

DISCUSSION OF RESULTS.

In attempting to apply the results of this histological study to the various theories which have been proposed concerning the function of the interstitial cells, we come first to the original view of Leydig and of Koelliker, according to which they are a modified form of connective tissue which supports the tubules. While, no doubt, they do serve as an admirable supporting matrix for the tubules and their blood-vessels, the great majority of those who have studied these cells have felt that they must have some more specialized function than this.

Von Bardeleben (3) thought that they were youthful forms of Sertoli cells, and that they were capable of passing through the walls of the seminal tubules there to become full-fledged Sertoli cells. This theory has found no supporters, and only the great reputation of its author has kept it alive.

Plato (8) held that it was their function to act as nurse-cells, passing their fat and pigment through minute canals in the walls of the tubules to be received by the Sertoli cells and there used as pabulum in the formation of spermatozoa. Plato's theory has been supported in some measure by Friedmann and v. Lenhossék, but no one has been able to confirm his statements as to the existence of canals in the walls of the tubules and the passage of fat through them. Indeed, the presence of fat in the lymphatics of the testicle would indicate that the flow of fat is away from the tubules. Moreover, the study of the development of the interstitial cells in different animals has shown us that frequently fat is present in the tubular epithelium before it appears in the interstitial cells; and that, in the pig, it is never present in any but the minutest amount. Finally, as Ganfini has pointed out, in undescended testes, where the Leydig's cells are usually typically developed and numerous, the seminal epithelium is undeveloped or atrophied, and consequently there are no spermatozoa being formed. So that Plato's theory is without good foundation.

Reinke (15) seems to have been the first definitely to suggest an internal secretion in connection with his crystalloids. Their inconstancy, however, they being practically limited to man, is sufficient to prevent any theory of general applicability to mammals from being based upon these structures.

Ganfini (4) has advanced an attractive theory, according to which the fat itself is the internal secretion of the interstitial cells, and is poured into the general circulation through the lymphatics. He bases this opinion upon the fact that fat is found in the lymphatics leaving the testis; and that the fat in the interstitial cells is in the form of more or less discreet droplets rather than in one large drop, as in the ordinary adipose cell, and that consequently it is not ordinary fat. The defects in this theory are obvious. In the first place, in one mammal (the pig), at least, there is practically no fat in the interstitial cells. Again, the presence of fat in the lymphatics coming from a tissue rich in that material is nothing unusual. And, finally, the assumption that a substance which gives the reactions for fat is not ordinary fat, because it is arranged in discreet droplets, is too frail a foundation upon which to erect a hypothesis.

About the same time that Ganfini's article appeared, Loisel (17) published a paper on spermatogenesis in the sparrow, in which he advanced the theory that the interstitial cells manufacture an internal secretion out of their fat, and that this secretion produces the secondary sexual characters of the male.

Finally, Ancel and Bouin (18) have adopted Loisel's theory, so far as the function of the supposed secretion is concerned, and as a result of a few experiments and considerable observations on cryptorchid animals, announce that the interstitial cells constitute a gland which, by means of an internal secretion, establishes and maintains the secondary sexual characters of male animals—that the effects upon the general economy which have been attributed to the testicle as a whole, are due to the interstitial cells alone. It is clear that this latter hypothesis enters upon a very wide biological field, and that the question cannot be settled by histological studies of normal conditions. Such studies are useful, however, in so far as they tend to show that the interstitial cells are or are not glandular in nature.

CONCLUSIONS.

1. The framework of the interstitial cells of the testis consists of a reticulum of fibrous tissue, abundant and fine-meshed in some animals, scanty and loosely woven in others. The cells lie within the meshes and, according to the character of the meshwork, are arranged singly, in small groups, or even in rows or columns, so that there is in the latter case an indistinct lobulation.

2. The collections of cells have a rich blood supply through capillaries given off by vessels en route to the tubules.

3. Fat is not present in the interstitial cells in sufficient amount to justify the conclusion that they are simply adipose cells; and in some animals they contain little or no fat.

4. No evidence exists to show that the fat, when present, differs from ordinary fat.

5. The interstitial cells constantly contain granules whose chemical and tinctorial reactions are similar to those found in various gland cells.

6. The histogenesis and arrangement of these cells, their blood-supply, conformation, and content of specific granules strongly support the view that they are glandular in nature.

In conclusion I wish to express my obligations to Dr. R. R. Bensley for helpful suggestions.

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REVIEWS.

"Skeletal Remains Suggesting or Attributed to Early Man in North America," by Ales Hrdlicka. Smithsonian Institution, Bureau of American Ethnology, Bulletin 33. Washington, 1907.

The Chief of the Bureau of Ethnology tells us in the prefatory note that a paper by Dr. Hrdlicka on all the human bones discovered in North America, for which a high antiquity had been claimed, was about to be published when the discovery of crania and other bones of the so-called "loess man" in Nebraska was announced. The publication was suspended and Dr. Hrdlicka was sent to examine the new specimens. The present bulletin contains the result of his researches added to those detailed in his till now unpublished paper. It is, therefore, both comprehensive and important. Before leaving the prefatory note by W. H. Holmes, we must quote from it the statement of the position adopted by the Bureau: "In the earlier years of the investigation there existed a rather marked tendency on the part of students, and especially on the part of amateurs and the general public, hastily to accept any testimony that seemed to favor antiquity, and the conservative attitude of the Bureau was emphasized by a desire to counteract and correct this tendency. Evidence of the great antiquity of man in the Old World is abundant and convincing, and the assumption that like conditions exist in America seemed reasonable and was perhaps justifiable, although it led to the general acceptance of much that was without satisfactory verification." These remarks are scientifically sound and decidedly called for, but it is perhaps a little unfortunate that they seem to foreshadow the result of the investigation.

We shall first consider Hrdlicka's study of the early finds, reserving till later that of the Nebraska specimens. The earlier specimens came from all quarters, as far south as New Orleans and Florida, as far north as Quebec, and from the Atlantic to the Pacific. Specimens found in New Orleans in or about 1844, on the strength of which it was said that the human race existed in the delta more than fifty-seven thousand years ago, are dismissed very briefly. The Quebec skeleton (now not to be found) said to have been dug out of the solid schist-rock, is an absurdity. The Natchez pelvic bone, concerning which there was much discussion, is found not to differ from modern bones, except in being fossilized. Some might think the exception an important one; but, as is shown later, this feature is by no means necessarily a proof of great antiquity. The bone was examined by prominent anatomists and geologists. The question clearly lies in the domain of the latter, and opinions are divided. Skipping a couple of unimportant items, we come to the celebrated Calaveras skull found in California in 1866. This very imperfect skull showed nothing of anatomical interest. The whole question centers on the fossilization and—far more—on its origin. It was found in a shaft in a hill some 130 feet below the surface in one of many layers of gravel alternating with layers of lava. The one in which it was found dates from about the middle Tertiary period. But it is not impossible that this hill was entered by caves in the sides and, in fact, the skull resembles closely those from caves in the same county. The author considers the fossilization of little import. He believes that not enough attention has been given to the calcareous coating, and asks: "How could such a coating have been formed, and formed with such uniformity, over the surface of a skull packed in sand or mud and gravel of an ancient river?" In short, he inclines to the cave origin. The Rock Bluff skull from near the Illinois river is a very interesting one, as it presents anatomical points worthy of consideration. It is a low skull, the lowness of the forehead being emphasized in profile by the prominence of the supra-orbital ridges. These, however, are not like those of anthropoids or of the Neanderthal skull, inasmuch as their excessive development is confined to the inner three-fifths. They are not excessive at the outer angle of the orbit. The author gives the photographs of two skulls from mounds, which show the same characteristics and appear if anything rather lower than that from Rock Bluff. The geological question is of great importance in this case. The skull has been said to belong to the Champlain or even the glacial epoch. Hrdlicka again considers evidence of great antiquity unsatisfactory, and certainly the photographs just mentioned seem to confirm his view that it is to be classed with other skulls from the Illinois mounds. Again in the case of the "man of Peñon," found more or less fossilized in limestone in Mexico, while authorities differ about the age the author sees nothing to distinguish these from other Indian bones.

Among the most interesting anatomically are the crania from Trenton, N. J. Many implements, which are thought to antedate the Indians, were found with them. While some bones may safely be called Indian, others certainly are not. Among the latter are the Burlington County skull and the Riverview skull. These resemble each other in being low skulls in the sense of having a short vertical diameter, in being broad at the back of the cranium, narrow in front, and in having a narrow face. The forehead, though low owing to the want of height of the skull, is not a retreating one. Some animal matter seemed to persist in the Burlington skull. Here now is a pretty problem: Two skulls much alike and not Indian, what are they? A search of the literature convinced the author that these were specimens of the *chamæcephalic* type which had been found in northwestern Germany and in some Zuyder Zee islands. Hrdlicka believes that these skulls also are relatively modern, and again does not accept the geoglogical argument for great antiquity. Records show that there were natives of Holland among the settlers of New Jersey. Although holding it more prudent to believe these skulls modern, the author remarks that "a type of so pronounced a character is probably very old, and may be very ancient," and hints that it is not impossible that the American representatives of the race may be older than the European, and that in prehistoric times the Atlantic may have been traversed. This, however, is a flight of fancy which is evidently not meant to be taken very seriously, for Hrdlicka goes on to remark that the probabilities are against the ancient origin of the crania. Both the Trenton femur, Professor Putnam's report on which has not yet appeared. and the Lansing (Kansas) skeleton can claim great age on geological evidence only.

There is a very interesting account of certain fossilized bones in Florida, chiefly from near the west coast. Anatomically there is no reason to doubt that they are Indian; and the fossilization is of little significance, as the water in this region is heavily charged with minerals and, in trickling through sand, readily fossilizes what it touches.

So far there is very little to be said for the theory of great antiquity for the remains scattered throughout the country. The evidence for the most part is geological and is found at best inconclusive. We are entirely with the author that in so far as the question can be determined by morphology, there is no skull which may not be modern. Let us now take up the most recent finds.

The first specimen, a skull of the so-called "loess man," was found as long ago as 1894, in a mound on the top of a hill in Nebraska, less than five feet from the surface and beneath a layer of earth hardened by fire. according to a practice followed in some Indian burials, presumably to protect the remains from animals. This skull was a very fine specimen of the Neanderthal type, but not having come into scientific hands, it lay in a garret for 12 years till interest was awakened by Mr. Gilder's explorations, when it was given to the University of Nebraska and is now known as skull No. 8 of the Gilder collection. In 1906 Mr. Gilder explored this mound and found several other skulls, some complete bones of the extremities, and many fragments.

Skull No. 8 is certainly a very remarkable one, approaching the original Neanderthal specimen. No. 6, though less striking, is of the same nature. Some of the other skulls may be called "low," and others are not remarkable. None of them is fossilized. At least one is mentioned as apparently quite recent.

Five entire humeri and many fragments were unearthed. The supratrochlear perforation was frequent, as is the case in Indians, and there was a flattening of the shaft having the same significance. Two of the bones show what we imagine to be rudimentary supracondyloid processes. Hrdlicka calls them the ridges in the location of the process. The femora are as a rule like those of Indians. Two pairs show an abnormal curvature forward. The tibiæ are said to approximate the Indian type. They are but moderately bent backward at the head and do not show the excessive flattening met with in Indians of some parts of the country and (we believe we may add) to be expected in ancient bones.

These were the subjects of Dr. Hrdlicka's latest studies. His examination of the mound was made under disadvantages, the ground being partially frozen. The loess began some 10 inches under the surface soil. "The signs of fire are most noticeable toward the center of the mound, where they extend to a depth of nearly 3 feet. An effort was made to ascertain whether there is a bed of baked earth beneath the superficial layer . . . . but without success, on account of the frozen condition of the ground. It was plain, however, that at no point had the baking progressed so far as to render the earth impervious to water. No definite line of separation between the superior and the inferior levels in the mound was observed, and there is no perceptible difference in the density or structure of the loess at different levels." The following passage is from Hrdlicka's summing up. "Within a depth of five feet or less, the Gilder mound contained the remains of apparently about a dozen bodies. There were male and female skeletons, ranging in age from the infant to the senile subject. . . . . Two or three of the skulls, with some accompanying bones, lay within 2½ feet or less of the surface. Below this, according to the explicit statements of Mr. Gilder, was a layer of clay of undetermined area, hardened by fire. . . . . Beneath this cover of hardened earth lay in some promiscuity, but in numerous instances in partial association, the skeletal remains of eight or nine bodies. At still lower levels, down to the depth of 11½ feet, were found here and there pieces of human bones. Instances of anatomical association extended to the depth of 6 or 6½ feet. Below this everything was disconnected and fragmentary." Hrdlicka points out that the color, markings, and general features of the bones are much the same at all the levels. He lays great weight on the total absence of fossilization, which he thinks would be hard to explain in bones dating from the original loess deposit. A point of great importance is the occurrence of knife marks observed chiefly in the long bones and in the skulls. In the latter they are found behind the foramen magnum. Now these scratchings are the same in the bones from all levels. In short, our author does not feel that there is any evidence of great antiquity to be gathered from the mound and says, indeed, that probably the question would never have been raised had it not been from the low character of some of the skulls. This brings us at once into the heart of the matter. What is the real significance of a Neanderthaloid skull? He points out that in Indians (and perhaps also in whites) there are occasional examples of very low skulls, some of them showing the excessive development of the superciliary arches together with a retreating forehead, which are the characteristics of this type.

Hrdlicka regards these low-browed skulls as individual peculiarities. "Their special features, which are really exaggerations of definite sexual characters, may indicate degeneration or may possibly be reversions." He adds that it will readily be understood that several instances of such a peculiarity should be found together. He then points out that skulls of this type most certainly occur among Indians and, indeed, especially in mounds in the region whence these skulls came. He insists that this region extends over parts of Illinois, Iowa, and Wisconsin, and that the burial places from which the specimens come have no claim to geological antiquity. He gives photographs of several skulls from the National Museum which are unmistakably of the same type. An appendix is devoted to recent Indian skulls of a low type in that institution.

The reviewer does not profess to be a judge of the geological arguments for or against; but the morphological question is here very interesting. When we consider what extraordinary shapes of heads we meet with in white men of the day, the occurrence of a single very low head is of little importance. But here we have several and, as just pointed out, in a region abounding in them. Thus it seems that it is hardly possible to dispose of these as instances of individual variation. Much more it seems that we must admit that in the Indian population there is, or has been, a very considerable Neanderthaloid element. But it does not follow at all that such an element is either a reversion or an arrest of ascent. As our author intimates, it may very well be a degeneration. It may presumably affect a whole family or a whole tribe or a nation, as well as it may an individual. It is begging the question to predicate antiquity from morphology alone, especially in the absence of conclusive geological evidence.

Thomas Dwight.

"DARWINISM TO-DAY," by Vernon L. Kellogg. Henry Holt & Co., 1907, pp. xxii + 403. $2.00.

With the increased activity within late years among biologists in the study of heredity and variation, many facts have been gathered together which throw considerable light upon the method by which organic evolution is accomplished. The result of these advances is that Darwin's method of natural selection of favorable chance variations has been found to a certain extent to be inadequate to account for all the phenomena encountered, so that it is necessary for the biologist to orient himself anew in his evolutionary thinking. "Darwinism To-day" furnishes the biologist and general reader an impartial account of the different theories of species-formation so that the reader is enabled to choose his own position with reference to these theories from the data presented in this work. As an aid to the more advanced student who wishes to refer to original sources, there is throughout the text a large number of exact references to original papers, and many more or less extended quotations from them, bearing upon the subject under discussion.

The first two chapters are introductory and serve to make clear the distinction, which is frequently ignored, between evolution and Darwinism, and to explain briefly the relation between evolution on the one hand and theology, philosophy, pedagogy, and sociology on the other.

In the remaining chapters the author presents the numerous weaknesses of Darwinism and the answers to these objections which the Darwinians have proposed in their defense. In addition to the attack on and defense of Darwinism, there are outlined clearly and critically the various theories which have been advanced to take the place of or to supplement the Darwinian theory.

In Chapters III to V, inclusive, the attack on Darwinism is outlined quite fully. It will be possible at this time to mention only the more important of these criticisms which have been raised. The greatest weakness of the theory of natural selection lies in the fact that it depends primarily upon the pre-existence of variations and at the same time exerts no influence on the origin or control of these variations except in so far as it may determine what individuals shall be permitted to give birth to other individuals. Another criticism is that even in the severest competition it is difficult to suppose that an infinitesimal advantage in one competing individual may not be exactly counterbalanced by an infinitesimal advantage in another direction in the second competitor so that a real life-and-death-determining advantage lies with neither individual; for example, the favorable increase of strength on the part of one individual may possibly be balanced by a favorable increase in agility in the other so that natural selection can pick out neither form as the better fitted to survive. The extinguishing of favorable variations by interbreeding and the needed coincidence of several variations at one time are discussed as well as the development of countless structures of great utility to their possessors, but which can be of use only in their highly perfected state. Finally the fatal overdevelopment of certain characters, such as the antlers of the great Irish elk and the enormous size of the Dinosaurs, is discussed among the objections to Darwinism.

The fifth chapter includes a rather satisfactory discussion of the theory of sexual selection and presents fairly the various objections which have been raised against it by Morgan and by Mayer in his experiments with Promethea. The general untenability of the theory is emphasized, although the author mentions particularly the value of Darwin's presentation of the theory in that it directed thought toward the wonderful phenomena of secondary sexual characters.

At the outset of Chapters VI and VII, entitled "Darwinism Defended," attention is called to the fact that the burden of attack rests upon the anti-Darwinians and that against them is the presumption of right. The positions of the Weismannians, Neo-Darwinians, and Neo-Lamarckians are outlined as well as the answers to the various objections presented in the previous chapters. In brief, it may be said that the answers of the Darwinians are not always entirely satisfactory, and that even the strictest selectionists must call to their aid some other factors of isolation or segregation.

A discussion of "Other Theories of Species-Forming and Descent: Theories Auxiliary to Selection" makes up Chapters VIII and IX. The theories presented are those of Panmixia and Germinal Selection of Weismann, of Intra-selection or the battle of the parts, proposed by Roux, of organic selection or orthoplasy of Baldwin, Osborn, and Lloyd Morgan (the theory that the survival of the individual does not depend solely on congenital variation but on ontogenetically acquired adaptations as well). The various isolation theories are fully discussed in the ninth chapter.

"Theories Alternative to Selection," which are presented in the two following chapters are: Lamarckism, Orthogenesis of Nägeli, Eimer, and Cope, and the theory of metakinesis of Jaeckel (that while genera and families may show continuous phyletic series, species appear sporadically, suddenly, and without special reference to the phyletic series). The experiments and observations of Devries upon which the mutation theory is based are satisfactorily described and the relation of the mutation theory to Darwin's theory is carefully explained. Several alternative theories to explain secondary sexual characters complete the chapters under consideration. In general it may be said that these other theories of species-formation are weak in that they are based on very insufficient evidence.

The present standing of Darwinism, according to the author, may be conveyed best by his own words in the closing chapter of the book. "Darwinism, then, as the natural selection of the fit, the final arbiter in descent control, stands unscathed, clear and high above obscuring cloud of battle. At least, so it seems to me. But Darwinism, as the all-sufficient or even most important causo-mechanical factor in species-forming, and hence as the sufficient explanation of descent, is discredited and cast down. At least, again, so it seems to me. But Darwin himself claimed no *Allmacht* for selection. Darwin may well cry to be saved from his friends!"

The style of the author is not above criticism in that there are some evident signs of haste and lack of finish. The German habit of compounding words and of inserting all-modifying clauses between the article and noun has firm hold on the author. Among the examples of this may be mentioned: "Fact-bodies," "extreme-charactered," "food-zeal," "cell-sorts," and "the already referred to action."

On the whole the work is very satisfactory and is valuable to all who would have a thoroughly modern knowledge of the true standing of the principle of natural selection and the origin of species as held by the leading biologists. *B. W. Kunkel.*

"Evolution and Animal Life," by David Starr Jordan and Vernon Lyman Kellogg. D. Appleton & Co., 1907, pp. xi + 489. $2.50.

The volume under consideration presents an elementary account of the processes of evolution as they are so far understood, and is made up primarily of the substance of a university course of elementary lectures delivered jointly by the authors to students representing all lines of college work.

The material of the book has been rather well chosen and the general plan is admirable, although one or two changes in the order of the chapters might be suggested; for instance, the chapters on natural and artificial selection might be transposed to advantage so that the reader could appreciate the transmutations of races by the agency of man, before being introduced to the infinitely more complex relations of natural selection; again, the chapters on generation, sex, and ontogeny might precede those on heredity which include a discussion of such varied subjects as sex determination, homologous and rudimentary structures, Mendel's law, and the inheritance of acquired characters.

After several chapters in which evolution is defined and the fundamental properties of living matter and the meaning of species are discussed, the authors pass on to the factors and mechanism of evolution which includes such subjects as variation, heredity, selection, isolation, mutation, orthogenesis, and Lamarckism. Natural selection, artificial selection, the various theories of species-forming and descent control, and geographic isolation are then taken up in greater detail; and variation and mutation, heredity, ontogeny, paleontology, and geographical distribution each receives treatment in a separate chapter. Then are discussed adaptations, parasitism, mutual aid and communal life among animals, animal coloration; while by way of introduction to the closing chapter of the book on man's place in nature, there is a single chapter on reflexes, instinct, and reason. The last six chapters of the book are rather more carefully written than the preceding ones and contain a very large number of interesting facts of natural history relating largely to the insects, with which group the junior author is especially familiar. From such a brief outline of the contents of the book it will be seen that the scope of the work is exceedingly broad and of necessity rather superficial in character. Still the book should serve to arouse the interest of the elementary student for the biological sciences; and to give him a general knowledge of some of the more important principles underlying biological phenomena, so far as such principles can be acquired from a textbook.

There is an inexcusably large number of typographical errors in the text and in the descriptions of the figures. Fig. 84 is incorrectly labelled and Fig. 106 is upside down. Many of the figures are extremely roughly drawn and the three colored plates are rather unsatisfactory. On page 193 there is an error which is slightly confusing; the especially tall peas which result from a cross of a short pea 1 foot in height with a tall pea

6 feet in height are given as a specific example of "blended inheritance." Again, on page 334, the lancelet is referred to as a fish; and on page 373 from a comparison of the text with the accompanying figure which is referred to, the reader might be led to suppose that the colony of Podocoryne growing on the shell of a hermit crab is a sea anemone.

An appendix contains references to general accounts of the subjects treated in this book, arranged according to chapters. The references are confined to publications in English and are therefore mostly to manuals and textbooks rather than to the original sources, and are intended for the assistance of the general reader and elementary student.

B. W. Kunkel.

"Contributions from the Anatomical Laboratory of Brown University." Vol. V, Providence, R. I., 1907.

This volume contains 14 papers which have appeared recently in various scientific journals, the 36th annual report of the commissioners of inland fisheries of Rhode Island, etc., the American Journal of Physiology, the Biological Bulletin, as well as from other journals. Most of the contributions are of a biological nature, none being distinctly anatomical. It is interesting to note that this anatomical laboratory contributes mainly to the science of zoology, as must be the case when an anatomical department is not connected with a medical school. In the latter instance the obligation of the teacher to medical students keeps gross and microscopic anatomy, as well as embryology, in the foreground, and this naturally compels him to contribute to these subjects.

F. P. Mall.

"The Development of the Human Body," by J. Playfair McMurrich. Third edition. P. Blakiston's Son & Co., Philadelphia, 1907. X + 528 pages, 277 figures. $3.00

McMurrich's "Development of the Human Body" is the best brief didactic American text-book of embryology. In its third edition it has been thoroughly revised, but is no larger than before. The Basle nomenclature has been introduced, but here and there are found such rejected terms as *lymph follicles, discus proligerus,* and *uterus masculinus.* The word *anlage* does not occur. In English we may say that "an organ arises (or begins) as an outgrowth" rather than "the anlage of the organ is an outgrowth"; and that "the liver at first is a diverticulum" rather than "the anlage of the liver is a diverticulum." Apparently no new terms have been proposed.

The following changes and additions are of interest. In man the number of chromosomes is 24 (Duesberg) instead of 16. The studies of Heape on menstruation in lower mammals, of Marshall on the internal secretion of the ovaries, of Kirkham and of Gerlach showing that the mouse has a second polar body overlooked by Sobotta, and of several authors in favor of the epithelial origin of lutein cells have been added. Hubrecht's term *trophoblast,* corresponding with epiblast and hypoblast, is replaced by Minot's *trophoderm,* corresponding with ectoderm, etc.; it is described as a modified ectoderm adapted for implantation rather than as a distinct germ layer. The description of implantation has been modified with reference to Rejsek's study of Spermophilus and Doria's account of a young human embryo. Assheton's and Peebles' experimental studies of growth in the chick's blastoderm have been substituted for the concrescence theory, which is not mentioned in the third edition. The existence of a primary chordal canal opening at Hensen's knot is now admitted (p. 60); in view of this change the secondary chordal canal (p. 100) should be more sharply defined.

In connection with the development of the skeleton, a new figure is introduced illustrating the relation of vertebræ to segments; Mall's work on the ossification centers of the interparietal and maxilla, and Fawcett's on the pterygoid process have been cited.

Red blood corpuscles are described as discs. Since photographs of the cup-shaped form have not yet been published, two are inserted in this review. They represent a few corpuscles of the form in question among a large number of shadows from which the hæmoglobin has disappeared. It is improbable that Retterer is correct in regarding the cup as being only apparent and due to the distribution of hæmoglobin. Such cup-shaped appearances as are shown in the photograph are characteristic of circulating and of well-preserved blood. They appear in embryos when the nuclei of the erythroblasts are eliminated.

Of the origin of blood plates it is said that "the most plausible suggestion is that they are the fragmented nuclei of broken-down leucocytes." The fine investigation of James H. Wright is not mentioned.

There are many changes in the chapter on blood-vessels. A new diagram shows the questionable fifth aortic arch as equivalent to the other five. Six aortic arches require the presence of five pharyngeal pouches, yet according to McMurrich, there are but four. The fifth arch is, however, said to be "rudimentary." Mall's important work on the cerebral veins in man replaces Selzer's description of these veins in the guinea-pig, but the complex story of development is rendered confusing by a misplacement of figures, Fig. 151 *B* (p. 271) being younger than Fig. 151 *A*. The *supracardinal veins* of Huntington and McClure are described and figured. These include the dorsal limbs of the loop formed by the cardinal veins around the ureter, and other more anterior vessels of a different origin; the anterior portion is shown in the figures of the cat, but not of the rabbit. The loop around the ureter is well known from the studies of Hochstetter. His diagrams (Hertwig's *Handbuch*, Vol. 3, p. 142) show the extent of the loop more accurately than McMur-

Photographs of human red blood corpuscles within a blood vessel. Fixing reagent unknown. Weigert's stain. Those retaining their hæmoglobin are cup-shaped. *A*, × 315 diams. *B*, × 630 diams.

rich's figure, and correctly indicate the relation of the genital veins to its ventral limb (compare also Anat. Anz., Vol. 25, p. 271). If the term *supracardinal vein* could be restricted in its application, so as to be synonymous with *dorsal limb of the ureteric loop*, it would be more readily adopted. The veins of the limbs are described at greater length than in the previous edition, but without the necessary figures.

In the account of the lymphatic vessels interpretations rather than observations are considered, and thus the "discordant" element is emphasized. A figure of a section through the jugular lymph sac, such as Professor Sabin has published, is much needed, and reconstructions are better than diagrams. Sabin's studies of lymph glands and Mall's work on the spleen have been incorporated. The spleen has been transferred from the chapter on mesenteries to that on the circulatory system, and as a result of Stoerk's investigations, the coccygeal gland is placed with the lymphoid organs.

The description of the entodermal tract now includes Flint's conclusion that the lung in the pig grows by lateral branching, and that the suppression of the left eparterial bronchus and the development of the right infracardiac bronchus are correlated with the position of the aortic arch and heart respectively.

Tandler's record of the pronephros in human embryos up to 20 mm. is noted, and the development of the ovary and testis have been rewritten with reference to Allen's work. Presumably McMurrich hesitates to accept the determination of the large cells appearing in the entoderm and supposedly migrating into the sexual glands, as germ cells; he does not refer to them.

The suprarenal glands have been redescribed, with a figure and references to Wiesel's studies. They are placed in a chapter with the carotid glands and Zuckerkandl's organs.

Under the nervous system the bearing of Harrison's experiments on the interpretation of sheath cells and on the neurone theory is recorded. Streeter's reconstruction of the otocyst of a 20-mm. human embryo replaces that of His of a similar stage. Fuch's observation in the rabbit that the stapes is at first separate from the second branchial cartilage is regarded as an ontogenetic condition and not of general significance.

The large number of changes in this edition of McMurrich's book reflect the progress of embryology during the last three years. Students will like the small size of the volume, and teachers will appreciate Professor McMurrich's estimate of the value of recent researches.

Frederic T. Lewis.

"A Text-book of Clinical Anatomy," by Daniel N. Eisendrath, A. B., M. D. Second edition, Saunders, Philadelphia, 1907.

This work on clinical anatomy, now in its second edition aims to assist the student of descriptive anatomy to apply the great mass of facts that he has accumulated in the dissecting room in the more thorough and rational understanding of the clinical cases that later come under his notice. It is designed to make his anatomical knowledge of the greatest practical value to him. The value of such a book to a student of medicine, particularly in conjunction with his clinical work, can scarcely be overestimated.

The average medical student, in his acquainting himself with long and wearisome descriptions of signs and symptoms and lines of treatment, is altogether too prone to lose sight of the anatomical and physiological groundwork involved in any given case, as he is of the results most obviously occasioned by any disturbance or interference to which they may be subjected. For such this volume is intended as it is for the busy practitioner whose stock of anatomical knowledge may have shrunken somewhat since his leaving the dissecting room.

The work is essentially anatomical in character and from a purely anatomical standpoint we have found in it not a little to criticise. Although one may not demand of the clinician any profound knowledge of anatomy, the number and character of the errors to be found in the book seem to us quite inexcusable. The author refers, for example, to the chorda tympani as one of the motor nerves of the tongue; in two lines devoted to the vena cava inferior he states that "two-thirds of its length lies inside of the pericardial cavity"; he speaks of the cystic artery as entering the gall-bladder and declares that the inguinal canal "is a potential canal like the urethra." Reference to "meningeal branches of the circle of Willis" is well calculated to lead to confusion, as are repeated statements regarding the "infraorbital notch" (the position of the infraorbital nerve being almost regularly misplaced in his illustrations). Not only the text but the illustrations leave much to be desired. Figures 50 and 53, for example, and other similar ones are very instructive, but in these the thickness of the body walls, particularly in the thoracic region, has not been taken into account. Figures 79 and 100 are woefully at fault and we see no occasion, from any point of view, for the insertion of such figures as 144 and 145.

These lapses from anatomical accuracy not only detract from the value of the work, but must shake severely the reader's confidence in the writer. His phraseology is too often indefinite and unscientific (aorta in relation with the upper dorsal vertebra) and his statements couched at times in words that savor more of excerpts from a popular medical treatise than a book intended for scientific workers. ("The pericardium is a closed sack in which the heart and great blood-vessels have been placed.")

The treatment of the subject matter is throughout concise, the arrangement good. Many subjects have been, however, in our opinion treated too briefly and a few extra lines of explanation would have added to the value of many passages. On the whole, the work may well fulfill the purpose of its author. Nevertheless, greater concern for the accuracy of anatomical details coupled with a clearer and more extended exposition would enhance greatly the value of a subsequent edition.

N. W. Ingalls.

"Die Grosshirnrinde des Menschen in ihren Massen und in ihrem Fasergehalt. Ein gehirnanatomischer Atlas, mit erlauterndem Text und schematischer Zeichnung, *16 Tabellen, 15 Kurven und 79 farbigen Tafeln* (*Folio*), von Prosektor Dr. Theodor Kaes, in Hamburg. Erster Teil: Kurven und Tafeln. Zweiter Teil: Text. —Jena, Verlag von Gustav Fischer, 1907.

This quarto by Dr. Theodor Kaes, of Hamburg, comprises the records of years of detailed work. The book is divided into two main parts. The first part contains the drawing of a transverse section through a gyrus, used to illustrate the nomenclature employed by the author, 15 charts (Curven) based on the measurements of the entire human cortex and its layers, and 79 colored plates showing variations in its fiber content.

These plates, the publication of which has been made possible by a grant from the Royal Society of Göttingen, are printed in pairs. They illustrate the arrangement of the fibers in 12 localities from each cerebral hemisphere of a given brain. Sections from 39 brains are thus given (Plates 1-78), each pair of plates being accompanied by the corresponding table of measurements. Plate 79 illustrates a few pathological appearances which were incidentally observed. The last sheet of this part gives the bibliography of the author from 1891 to date.

Part II contains Table 1, showing the weights of the 41 brains examined, and also 48 pages of text together with 15 tables of measurements. It will be seen from this outline, that the unique feature of the book is the series of colored plates; the text, tables, and curves being merely subsidiary to them. The book, therefore, should be considered as an atlas intended to support the interpretations made by the author, and also to furnish standards for comparison by other investigators, and it is from this point of view that our criticisms will be made.

To determine how far these conditions are fulfilled, let us begin with an analysis of the fundamental Table 1, containing the records for the 41 brains on which the measurements have been made.

In each case there is given either the fresh weight of the encephalon, or both the fresh weight and the weight after preservation in Müller's fluid. Then follow two columns, one headed "Hemispheres," and the other "Cerebellum," but these terms are loosely used, since the combined weights of the parts thus designated are made to equal the total weight of the encephalon. In this table also the weight in Müller's fluid for the brain of "Spanier, 3¾ years," should be 1450 grams instead of 1350 grams, as printed, while in nine other cases, there are slight discrepancies between the weight of the encephalon and the sum of the weights of its parts. In some cases the discrepancies are due to misprints, while in others, they probably depend on the loss of fluid following division of the fresh encephalon.

According to my calculations from Kaes' data, the gain in weight due to the absorption of water by the brains while in Müller's fluid, is on the average 16 per cent of the fresh weight, but this in turn is largely lost by the subsequent shrinkage after alcohol, so that the cortex after being thus hardened probably has nearly its initial thickness.

On comparing the fresh weight of the normal brains in Kaes' series with those in the other standard series of brain weights, Kaes' records show nothing unusual in this character. It must be noted, however, that with the exception of two or three instances, these brains are from persons of very moderate intelligence.

How far the final histological procedure (Weigert-Wolters' stain) modifies the thickness of the cortex, is not known. There exists, therefore, a gap in our information concerning the relation of the thickness of the fresh cortex to the cortex as described and measured by Kaes.

Continuing the analysis of the 41 cases entered in the table, we find that there are 28 males and 13 females. In all the curves and discussions, Kaes treats the two sexes together. This is theoretically objectionable, but an examination of the curves shows that the modifications introduced by combining the records for the sexes are not significant, although detectable.

Far more important is the question of the number of records to be removed from this table in order that it shall represent only approximately normal individuals of the same race.

Kaes himself removes from among the males, one microcephalic, one negro and one criminal (decapitated), and from among the females, two microcephalics, but uses the remaining 36 cases as a basis for his study of growth and medullation.

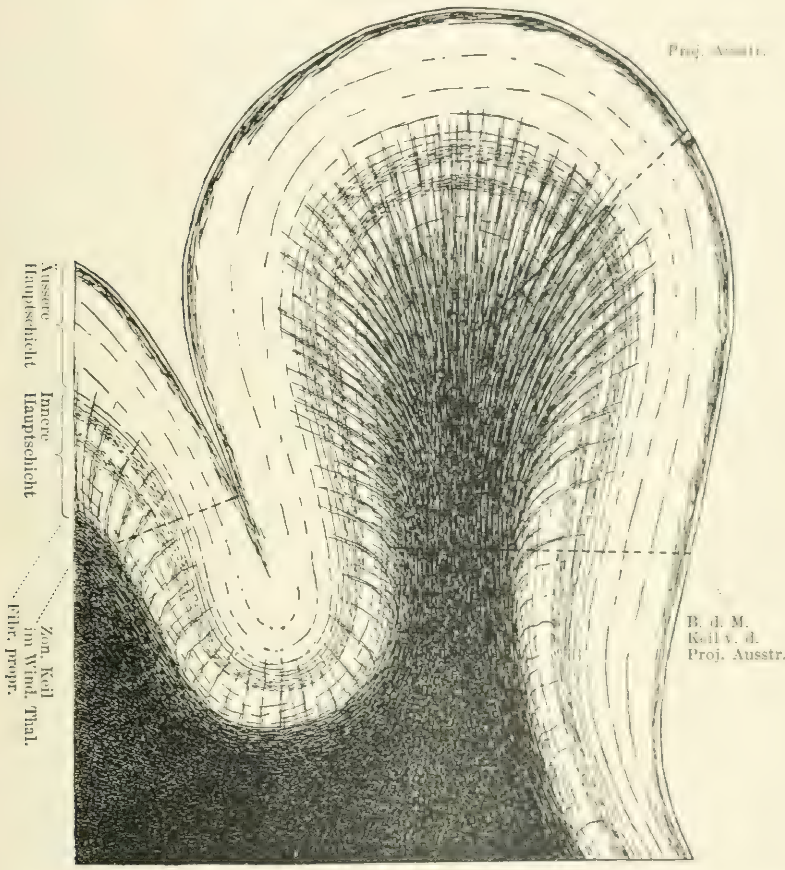
This is too uncritical a treatment of the material, for it still leaves among the males the brains of one epileptic, four criminals and two non-Europeans, as well as two brains (Witt and Fries) with excessively thick cortices—these being omitted from the Plates—and among the brains of the females, one criminal (decapitated) and three mental defectives—all of which are material quite unsuitable for the study of normal growth. Kaes' table, as he uses it, therefore, is only very inadequately purged of its abnormal and suspicious specimens, and it must be remembered that the 13 cases above indicated, which we believe should be classed with the five cases that he himself excludes, appear in all the curves and tables of averages that he gives.

I took the time to redraw the curves for the thickness of the entire cortex, omitting the measurements made on the 18 brains above designated as objectionable, and as a consequence found the curves to be almost entirely relieved of the wide fluctuations which appear in Kaes' presentation.

When we examine the curves in Chart I as thus redrawn, it appears that the thickness of the entire cortex diminishes rather rapidly from the first entry (three months) to the entry for the seventh year, after which the thickness remains nearly the same up to the entry for the 65th year, which is as far as Kaes' material should be used. Of course variations occur after the entry for the seventh year, but so far as these are not due to the technique, they represent merely individual deviations, and are no more to be interpreted as growth changes than are the deviations in the absolute weight of the brains to which the sections belonged. Yet in the face of this apparently self-evident fact, Kaes (Part II, page 11) describes the variations in the thickness of the cortex shown in the curves drawn by him as representing growth processes, and speaks of a decrease in cortical thickness up to the 23d year, followed by an increase up to the 45th year, where it is to be noted the thickness attained is even *greater* than that at birth.

After this phenomenal increase in cortical thickness at 45 years, he speaks of a subsequent thinning, going on to old age, though apparently quite undisturbed by the fact that the next entry, at 45½ years, shows a cortex which has suddenly decreased about one millimeter in thickness. It is perhaps worth repeating that the two 45-year brains (Witt and Fries), the cortices of which mark Kaes' maximum at maturity, are not represented in the series of plates illustrating the fiber systems of the cortex, although no reason is given for omitting them. These interpretations by Kaes of his curve after the seventh year are quite unwarranted by the material, and lead to confusion only.

On the same page of the text where this description is given, Kaes repeats a conclusion which he has previously published, namely, that the more developed and rich in fibers a cortical locality is, the narrower the cortex. This very interesting conclusion is in general correct when applied to the growth changes in a given locality. The narrowing comes about in this way. Kaes measures the thickness of the cortex from the ectal border of the fiber-free layer to the ectal border of the fibrae propriae (portion included by both brackets in the accompanying Schema). From



Schematic representation of a section through the cortex showing the layers of medullated fibers. Weigert-Wolters' fiber stain. (After Kaes. Only a portion of the designations for the layers are given.)

Äussere Hauptschicht = Outer main layer.

Innere Hauptschicht = Inner main layer.

Fibr. propr. = Fibrae propriae.

Zon. Keil im Wind. Thal. = Zonal wedge at bottom of sulcus.

Proj. Ausstr. = Radiating projection-fiber bundles.

B. d. M. Keil v. d. Proj. Ausstr. = Width of column formed by radiating bundles of projection-fibers.

the age of three months to the seventh year, the layer formed by the fibrae propriae thickens rapidly, its ectal border being built out towards the surface of the cortex. With the advance of this border, which always forms the ental limit of a measurement, the total thickness of the cortex naturally diminishes. Kaes' schema of a cross section through a gyrus with a portion of his nomenclature, is here repeated to facilitate the description of his results.

After the seventh year it is hard to tell from the revised curve whether the process of thinning still goes on, but more complete records might show it to continue through the remaining years. This same idea is of course applicable to brains in which through arrest of growth, the formation of fibers in the cortex has been hindered or stopped. Kaes, however, is not content with applying this idea to the growing cortex alone, but since at maturity the cortex is thinnest at the bottom of the sulci, intermediate at the sides, and thickest at the summit of the gyri, he extends this notion by stating that the cortex is therefore least developed in the last locality, and most developed in the first.

In order to test his view, we may examine the data contained in his Table 2, which gives the averages for the thickness of the cortex on the convex surface of each hemisphere. During the interval between the entry at three months (his youngest record) and that at seven years, when the greater part of the thinning of the cortex has been accomplished, the loss in thickness, presumptively due to growth, is .57 mm. at the bottom of the sulci, .80 mm. at the sides and .81 mm. at the summit of the gyri. This means that the fibrae propriae have increased in thickness most at the summit and sides. As the amount of this change is a measure of development, it follows that the cortex in the latter localities has undergone more development than at the bottom of the sulci. The measurements, therefore, are exactly opposed to Kaes' statement.

Kaes has also given attention to the changes which occur in the thickness of the two main layers ("Äussere Hauptschicht" and "Innere Hauptschicht") into which he divides the cortex, but as this presentation is open to exactly the same criticisms as are here offered in connection with his study on the growth in the thickness of the entire cortex, nothing will be gained by examining his descriptions in detail.

Yet before leaving this part of the book, it is desirable to make some additional statements which have a general application to the remaining tables and curves. In the tables of measurements (Table 2-Table 16) there is in each a column designated "II u. III Schicht." The measurements given under this heading are those for the entire outer main layer.

although the part designated by the heading is but a fraction of that layer. Similarly, under "Äussere Meynert-Associationschicht" are given the measurements for the entire inner layer, although again the part designated is only a fraction of that layer (See Schema). No mention of this arrangement in the tables appears in the text.

By inspection, and not by anything found in either the text or the tables, we learn that the measurement of the main layers applies to the cortex at the summit of the gyri only.

As the schema shows, the sum of the thicknesses of the two layers in question should equal the thickness of the entire cortex. When the tables are tested on this point, the result is very unsatisfactory. Out of the 41 records in Table 2, only three occur in which the sum of the two layers is equal to the entire thickness of the cortex at the summit. Of the remaining 38 cases, 19 show a plus or minus deviation up to one per cent, and the remaining 19 show a plus or minus deviation which averages over 4 per cent. The most extreme instance (Noelzel, 30 years) gives a sum of the layers 14 per cent less than the thickness of the entire cortex. On the cause of these discrepancies, the text is silent. It should be stated, however, that such discrepancies are less marked in the special tables which accompany the plates.

In connection with both the tables and the charts, it is of the greatest importance to determine how Kaes deals with the five cases which he considers pathological. For this Tables 2-16, inclusive, are to be examined. In Tables 3-15, inclusive, the measurements on the pathological specimens are indicated by heavy type, so that here they may be picked out easily. They should be indicated in the same way also in Table 2, but this has not been done. Table 16 gives the grand averages for the thickness of the cortex in the entire series of localities examined, and it is important to note that according to the text, the measurements on the abnormal brains are here included. Hence the averages in Table 16, which might have had a sort of value if based upon the normal brains alone, are not only worthless, but what is more important, quite misleading.

The treatment of the pathological records in the curves (I-V) is also very unsatisfactory. In each curve, the 41 cases of the original table are entered. Where the measurements on the pathological specimens are markedly different from those on either side of it, the value is sometimes indicated by a vertical, starting from the curve itself. This would be satisfactory if it were pursued as a uniform plan, but such is not the case. There is not one of the charts on which all of the records from the pathological brains are so distinguished. When the measurements from the pathological brains do not, in the judgment of Kaes, seriously disturb the record, he incorporates them in the curve without special designation. Thus in Charts I and II, the indications for the measurements from these pathological brains are incomplete, and in Charts III-V they do not occur at all. At the same time, it is exactly these entries which most disturb the form of the curves.

Moreover, the drawing of the curves has been done with but slight feeling for accuracy. Neglecting trifling displacements, which are numerous, this statement is justified by the fact that out of the 1066 entries in the five charts (I-V) 43, or 4 per cent, are one square or *more* out of place. In one instance, the displacement amounts to seven squares. The squares measure about three millimeters on the side. In some cases this quite alters the appearance of the curve, but the chief importance of it lies in the fact that it gives rise to a feeling of distrust, which makes it necessary to verify every record.

We turn next to the plates. Here we have in color the depiction of the medullated fiber content of the cortex at 12 localities in each hemisphere of 39 out of the 41 brains. The brains of Witt and Fries, each 45 years old, and both of which according to the tables gave a very thick cortex, are omitted from the plates without comment.

At first glance, one is struck by the clearness of the illustrations. They suggest excellent preparations; but the further one studies these illustrations, the less satisfactory they appear.

The thickness of the sections is not stated, and so far as Kaes has given technical details, they are mainly to be found in his papers of 1891, 1893, and 1896. In these accounts he speaks of marking the localities from which specimens were taken, on a schema of the brain surface, but in the present instance, he is content to use such general designations as anterior frontal (Vordere Stirne), visual cortex (Sehrinde) etc., omitting the schema entirely. It is evident that the portions of the cortex to which these terms apply are always extensive and sometimes ill-defined, so that the value of the illustrations as standards, is much lessened by the impossibility of locating the sections with any degree of exactness.

In the illustrations the sections from all the different brains are pictured in nearly the same size, about 100 mm. by 33 mm. This obscures the fact that abnormal often differ from normal brains in the thickness of their cortex and also that in normal brains this character not only changes with age, but varies according to locality. Kaes' first plate (Tafel 1) serves to illustrate this last point. The six illustrations which form the top row in this plate, represent as many different localities. They are from sections which, according to the table of measurements accompanying this plate, range from 4.80 mm. to 5.95 mm., yet the six illustrations are to all intents and purposes the same size. It is, therefore, evident that by this method of presentation important differences are obscured. To obtain illustrations of the same size, the larger sections must have been reduced, or the smaller ones enlarged, and if this were done by any mechanical process, it would follow that the relations of the main layers would not be modified by this treatment.

When the illustrations are tested with this point in mind, some astonishing results are obtained. For example, and it is merely an example, if we run our eye along the top row of illustrations in Plate 60, it appears that in the six illustrations the ectal edge of the outer stripe of Baillarger stands at very nearly the same level. This edge marks the boundary between the two main layers of the cortex. (See the junction point of the two brackets in the Schema.) As the total length of the illustration is nearly the same in all these instances, it follows that if they had been proportionately reduced, the relative thickness of the two main layers as measured should be similar in all of them. Let us compare this conclusion with the measurements in the table.

The following extract from the accompanying table, shows that the measurements for the thickness of the entire cortex, as well as for the main layers, differ rather widely.

FROM KAES' TABLE FOR PLATE 60; RIGHT HEMISPHERE; HINDU, 40 YEARS.

Locality.	Thickness of cortex in mm. Summit of gyrus.	Outer main layer.	Inner main layer.
1. Anterior frontal	5.7	2.5	3.3
2. Posterior "	5.16	2.1	2.9
3. Anterior central	4.9	2.2	2.8
4. Posterior "	3.9	1.4	2.5
5. Operculum	5.3	2.0	3.3
6. Insula	5.7	3.1	2.6

This table shows variations in the total thickness of the cortex from 3.9-5.7 mm. and a relation between the inner main layers which is indicated by 2.0 to 3.3 mm. in the operculum, and 3.1 to 2.6 mm. in the insula, while the stripe of Baillarger, as depicted in the illustrations, stands at almost the same level in both. It follows from this that the several sections have not been proportionally reduced, and that these illustrations have not been made in a way really to represent the sections.

Probably, therefore, they are based on drawings which are skillful after a manner, but not at all accurate. This conclusion is supported by two other observations. In his tables Kaes gives the number of bundles of radiating fibers found in strips of cortex 1 mm. wide. With the enlargement used, the illustrations correspond to original strips approximately 1.5 to 2.2 mm. wide. There should then always be shown in the illustrations more radiating bundles than were found in 1 mm., which is the standard width used in the table. The fact is quite the reverse. In 72 cases examined, the number of bundles shown in the illustrations is never more than that given in the tables, and for the most part is from $\frac{4}{5}$ to $\frac{2}{3}$ that number. Moreover, the numbers shown in successive illustrations do not bear any regular relation to the numbers given in the tables.

In many of the illustrations, very thick fibers are represented. When these are reduced to the size which they would have in the cortex before enlargement, it appears that they must represent fibers 25μ-50μ in diameter, quite an impossible caliber. Finally, no sections of blood-vessels appear. All these facts taken together justify us in stating that the illustrations in the plates do not in any proper sense represent the appearances or relations of the medullated fibers in the human cortex. At best and in a general way, they give a notion of the local abundance of these fibers, and show whether they are coarse or fine, so that to present and discuss Kaes' ideas of the changes in medullation with age, would hardly be satisfactory in view of the condition of his data.

To many of the observations recorded in this book we have made no allusion, but it is not necessary to go further, for the plates which we expected to find the important and fundamental feature, turn out to be nearly worthless either as evidence for the author's views or as standards for comparison.

We began the examination of this book with high hopes; we leave it depressed. At every point where it could be tested, it has failed to stand the test, and it is fair to assume that the tables, which we cannot test, are no better than the rest of it.

These things are unpleasant to write and disagreeable to read, but it was necessary to warn and caution those who might be over-impressed by this array of tables, charts, and plates against an uncritical use of them, for such use can bring confusion only as a consequence.

Yet, by his studies, Kaes has emphasized a very important method for the investigation of the cortex, and recognizing this, it is with genuine regret that we give this reception to a book on which a colleague has spent so much time and labor, and which he must perforce, cherish as his magnum opus.

Henry H. Donaldson.

NOTES AND APPOINTMENTS.

We are informed officially of the appointment of Professor B. F. KINGSBURY to be Professor of Histology and Embryology in Cornell University, on the retirement of Professor Simon H. Gage, which will take place at the end of the present term. Suitable notice of this announcement will be published at another time.

Anatomists are glad to learn that Professor CATTELL will continue the publication of the *American Naturalist.* This magazine, though somewhat popular in its scope, has made a distinct contribution to the development of the sciences which it aims to represent. It is sure to prove in the future, as hitherto, a useful repository for articles of the general character which its name indicates as appropriate. The American Society of Naturalists has here a journal which is well adapted to interest and hold together its somewhat diverse membership through the publication of articles and discussions bearing on the educational and scientific problems which are important to such a society.

The consolidation of the interests of the Bausch & Lomb Optical Company; Bausch, Lomb, Saegmuller Company; and the Carl Zeiss Optical Works of Jena, Germany, is noted with pleasure. The relations of the Company of Messrs. Bausch & Lomb with our investigators and teachers have made possible many instruments and pieces of apparatus which would not have been readily produced otherwise. Like some other of our progressive firms in the same line, they have placed before our students a very good series of microscopes, lenses, etc., at most reasonable prices. Their enterprise has simplified the equipment of our laboratories, and their spirit of co-operation has contributed no little aid to the solution of many of our technical problems. There are certain traditions in the manufacture of optical instruments and other apparatus which we associate with the name Zeiss, and which assures us that the American company will gain much by the closer association of interests with a firm relying on such scientific methods as does that of Carl Zeiss.

SOME INFLUENCES FAVORING THE DEVELOPMENT OF THE AMERICAN JOURNAL OF ANATOMY AND THE ANATOMICAL RECORD.

BY

H. McE. KNOWER.

The establishment of The Anatomical Record has naturally resulted from the conditions which produced and continue to foster the growth of the *American Journal of Anatomy.* A brief resumé of some perhaps quite familiar facts may still be of interest in connection with the history of these journals.

The biological sciences have made such remarkable progress in America in the last thirty years, that it now seems trite to point out that our zoologists, physiologists and botanists have won a position of respect and influence, not only among their fellow scientists the world over, but in the educational system of this country. Their problems and results are appreciated, and their influence in the universities, colleges and schools is welcomed, as is shown by the introduction of many essential modifications of the curricula, which they have brought about.

During the same period medicine has been profoundly modified through these developments and through the rise of modern pathology, bacteriology and experimental medicine. These changes have given medical education a new and far wider meaning.

In the meantime anatomy has also been most actively cultivated, but, until very recently, for the most part under obscure and perhaps confusing circumstances. (See Dr. Mall's address on "Some Points of Importance to Anatomists, The Anatomical Record, No. 3, April, 1907.)

Some peculiarities of the development of medical education in this country explain this. Anatomical teaching in medical schools had become too largely a discipline, and it was considered important chiefly as furnishing information which could be shown to have a practical value. The teaching was, as a rule, entrusted to the surgeon; who has incidentally made many valuable contributions to anatomy and has done much to develop those special aspects of the science with which he has a daily familiarity, and which, indeed, he should teach in a special course of applied anatomy to advanced students. As a professor of anatomy, however, he was evidently not in a position, nor had he the time, to correlate his teaching with the very rapid advances of the biological sciences—and his research problems lay in another direction. Hence in place of the modern anatomical laboratory was found merely a dissecting room and a hall for didactic lectures. Naturally those interested in working out the problems of anatomy were found elsewhere.

The scope of research in anatomy is so wide in dealing with the human body in all its relations to other organisms, and her problems are so fundamental in seeking to explain the evolution and adaptations of this highly specialized structure, that the field had been invaded and extended by investigators working in many special departments of biological science. The term anatomist had, as has been said, acquired a very technical and restricted meaning; but the results of many of these biologists entitle them in reality to be called anatomists, though they were identified as morphologists, zoologists, cytologists, neurologists, etc. An examination of the files of a variety of biological journals, whether observational or experimental, discovers the interesting fact that many important papers from American workers are to be recognized as contributions to anatomy without any undue extension of the term. (We may cite, for example, Howell's work on the blood; Conklin, Lillie and Wilson, etc., on germ-cells, cell-division, and fundamental problems of development; Locy, Platt, etc., on the morphology of the head; Herrick, O. Strong and Johnston on the nervous system; Kingsley, Osborn and their students on comparative anatomy and palaeontology; Harrison, Morgan and many others on experimental embryology and regeneration, etc.)

It was the influence of the University Medical Schools that brought order out of this confusion. Here were professional anatomists who devoted all of their energies to research in, as well as to the teaching of this science. Their work finally secured recognition and proper facilities.

Histology, embryology, neurology and comparative anatomy were, for the most part, removed from the zoological or other laboratories to their proper place under anatomy. This process is not yet completely carried out everywhere, but the progress made in so short a period is really astonishing.

The result was to attract investigators interested in anatomical research to an environment created to make it possible for them to work to better advantage than elsewhere. Researches which formerly would have issued from laboratories of various types now began to appear uniformly from anatomical laboratories. There was, however, no suitable medium of publication for the results of these activities, hence the numerous papers were scattered through many different journals at home and abroad, and, consequently, left a very inadequate impression of anatomy as a science.

The founders of the *American Journal of Anatomy* hoped to remedy this state of affairs, and not only to gather together this valuable material but to make of it an exhibit of what is being accomplished for this subject in America, as well as to teach the methods, aims and scope of scientific anatomical research. The enterprise has proven to be well worth while. An abundance of good material is constantly supplied from all parts of the country. The subjects of investigation are selected from a representative range of topics, and already a number of papers have been quoted as important contributions. American anatomists have become a more definite group.

In one respect, especially, the experience of this journal has been quite noteworthy. It has furnished a remarkable example of co-operation in science. An acknowledgment has already been made in the first volume of the Journal of Anatomy for the generous response which was received from many quarters from those who must be regarded as the founders of the Journal, since their co-operation made its establishment possible—a special circular, in which a list of these founders is published, may be had on application to the Journal. The editorial board adopted from the first as liberal a policy as possible towards papers, illustrations, subscriptions, everything, and the management has been allowed the greatest latitude in order to secure a result which might be worthy of a national journal. All doubtful questions have been settled without dispute by simple submission to several editors, who invariably made a solution easy. Authors have aided the Journal in many ways, especially in regard to adapting their illustrations to less expensive methods, or in helping to defray excessive expense when requested. Several laboratories have also furnished aid towards this object. The steady support of so technical a journal given by many busy practitioners has discovered a widespread and encouraging interest in the problems of modern medical education; and, lastly, the co-operation of the Association of American Anatomists has been of the greatest assistance, not only in aiding the Journal to pay its own way, which it has managed to do, but also in assuring to it a circulation among the most desirable class of readers.

Probably few even of those who, as investigators in anatomy, are vitally interested in the standard maintained and in the success of the Journal realize how great and constant effort must be expended in such a campaign as this journal has undertaken in their behalf and in the cause it represents. It is absolutely necessary that every anatomist should feel a personal responsibility for the extension of the Journal's influence, whether on the board of editors or not. There is need of steady and enterprising loyalty to secure a worthy and national development for the science.

Perhaps, after all, the best method of attaining this object would be simply to continue the publication of carefully selected scientific research of respectable quality in the *American Journal of Anatomy,* until the impression made by the accumulation of these results shall produce an adequate effect on scientific medicine and education. Without doubt this must be relied upon as the most efficient agency in advancing the cause; but there are many subordinate, yet important aids to this end which it would be a mistake to neglect.

THE ANATOMICAL RECORD represents an effort to make use of these additional forces. It should furnish anatomists and others a reliable and ready means of keeping in touch with, and bringing opinion to bear upon, the whole range of problems involved in the organization and teaching of anatomy in America. Since it was begun in 1906 there has been a steady growth of interest in its work. Many of our representative anatomists have expressed an earnest desire that the RECORD be continued along the lines originally planned, and have indicated an intention of co-operating actively in making it a success. A strong feeling is expressed that there is really need for it, and for its publication at more frequent intervals than hitherto. Indeed, so great has been the enthusiasm displayed that the editorial board of the *American Journal of Anatomy* has thought it best to entrust the future management of the RECORD to an entirely new and independent board of editors, composed of those who have exhibited the greatest interest in its development.

Just at this juncture the WISTAR INSTITUTE, with Dr. Horace Jayne, has generously come forward and made it possible for the Record to be issued separately from the Journal of Anatomy, at the same time finally providing adequate office facilities for both journals, as well as for some other related journals, at the Institute. This is a very important step. It is more; it is a distinct and valuable contribution to science. It should be clearly understood, however, that the Wistar Institute does not undertake to furnish the entire support of the journals. These journals have become self-supporting, and there seems every reason to expect that they will continue to be so. The most careful management has been required, however, to accomplish this result, and it is a great satisfaction to feel that the financial affairs will be henceforth under such expert control. While, therefore, the business management of the office will continue much the same, the transfer makes possible many economies in routine: permanent and well-trained assistance can give much better and prompter service;

there are opportunities to improve illustration; much more can now be done to develop advertising and promoting features, reviews, bibliographies of anatomy, etc.; and foreigners will hear of and secure the Journals much more readily.

This change will, of course, relieve the editorial boards of the various journals of much work and administrative cares, which can be carried better by a permanent, central office; but the Wistar Institute has shown great foresight and sagacity in insisting that each journal retain its peculiar organization, and that each board of editors shall still continue its scientific responsibilities and activities as hitherto. There is, then, no less demand for active promoting and loyalty in support from collaborators and subscribers to the *Journal* and to the RECORD. In order to secure a distribution to libraries and to all who can use the results and data published, which after all is the most important function of such journals, a very considerable degree of enterprise will be required, and past experience has demonstrated that progress in this direction is made chiefly by personal solicitation. If the members of the Association of American Anatomists will continue to do their part, there is little doubt that a brilliant future awaits both journals, as well as great usefulness to the further development of modern scientific and medical education.

INDEX TO VOL. I.

(See also *Contents of the Record* for titles, personal references and authors' names)

Reference to all articles which have appeared in THE ANATOMICAL RECORD are included in this index.

(See page 255 of this volume for a notice of the transfer of the Record and the Journal of Anatomy to the Wistar Institute, Philadelphia, Penna.)