plete equipment of our schools and the thoroughness with which the basic doctrines are instilled into the life blood of the students. It is said of Benjamin Franklin that he could not take a walk nor go on a journey without seeing all about him unsolved problems and new illustrations of universal laws; and with Franklin to see a problem was almost the same as to solve it.

MANUAL TRAINING.

I can not close this rambling address without referring to a recent improvement in secondary education which is likely to affect favorably engineering education, and through that education promote the future of engineering itself. I refer to the introduction into high schools and academies of the study of tools, materials and the mechanical processes. At the age of fifteen the expanding boy feels the thrill of increasing strength, and a natural hunger and thirst for contact with material things. The instinct to handle things, to do things, requires guidance or it becomes belligerent and destructive. The material universe is to be solved by every one for himself; if in no better way, it will be by pulling things to pieces to see how they are put together; by breaking things to see how strong they are; and by making new things if he only know how.

Then and there are the time and place for manual training; not for a trade or a profession, nor even for fun and pleasure; but for culture and a conscious mastery of tools and materials, and of the arts of construction. During the secondary stage of education the student should find himself and get an intelligent insight into the world of mind and matter around him. Both inborn aptitude and external opportunity should justify the coming engineer. The new educational feature goes far to develop the one and to discover the other. The fruit of well-organized and logical manual training is clear thinking, strong, vivid concepts, a world of knowledge gained first-hand, a power and habit of mental analysis of concrete problems—all of which admirably prepare the boy to take up, as a man, the study and practise of engineering. We have all seen something of this rich fruit, and have tested its value. In my judgment, it bodes well for engineering. Like Franklin, these young men (and they are swarming through our manual training schools and knocking in increasing numbers at the doors of our technical schools and colleges) will see things, and solve things, and make things move. The promise of the future is glorious; splendid is the era now dawning; fortunate in their opportunity are the young engineers with clear heads and skilled hands who are coming to the front; and happy are we who, to the best of our ability, are helping on the higher civilization which good engineering makes possible.

Calvin Milton Woodward.

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*PROBLEMS IN HUMAN ANATOMY.**

For the solution of the problems presented to him, the anatomist is by no means limited in his technique to the scalpel or the microscope, but justly claims the right to use every aid to research which other departments of science are able to furnish. His position, therefore, in the scientific field is determined by the standpoint which he occupies and from which he regards animal structures, rather than by any special means and methods employed for their study.

By common consent, anatomical material includes not only structures which may be easily dissected and studied with the unaided eye, but also those which tax the best

* Address prepared for the Section of Human Anatomy at the International Congress of Arts and Science, at St. Louis. Owing to the unavoidable absence of the writer, this addr ss was not delivered.

powers of the microscope for their solution. But even within such wide limits the material that ordinarily comes to hand leaves much to be desired, and in elucidating this or that feature in the structures under examination, it is often found necessary to modify the physiological conditions under which these structures have been working, in the hopes that their appearance may be altered thereby, and so be more readily understood.

Taken in a broad way, this is the reason why the data of pathology and experimental morphology are so important for the development of anatomical thought, helping as they do in the solution of the problems connected with the finer structure of the animal body, just as embryology and teratology illuminate the gross morphological relations in the adult.

I am quite aware that in making the foregoing statements I have suggested more modes of investigation than are at present used in connection with man. But the anatomy of the human body in adult life forms in itself so limited a field that no investigator can possibly confine himself to this portion alone, and there is every reason for here treating the subject in the larger way. As we see from the history of human anatomy, it was brought into the medical curriculum in response to the demands both of physiology and surgery, but gradually became most closely associated with the latter. For a long time its relative significance as a medical discipline was very great, because it represented the only real laboratory work which appeared in the training of the medical student. Indeed, a generation ago the exactness of anatomical methods was so lauded in comparison with the methods then commonly used in medicine, that anatomists came to scoff at the vagueness of their colleagues, while to-day, if we may be persuaded by some of our physiological friends, they have remained only to prey on the time of students who might be better employed. Although such a thrust may be readily parried, it is, nevertheless, necessary to admit that times are changed, and that as a laboratory exercise human anatomy is today outranked by several of the subjects in which the laboratory work permits a more precise formulation of problems and their more rapid and definite solution. However, it still retains, rightly enough, much of its former eminence.

Among the problems in human anatomy, there is, perhaps, none more important than the way in which it is to be presented to the five young gentlemen ranged around a subject in the somewhat trying atmosphere of the dissecting room. Just what they may be expected to learn from such an experience would require some time to state. Certain it is that these beginning anatomists are almost all of them intending to become physicians, and some of them to become surgeons, and to this end they are building up a picture of the human body which will be useful to them in their profession. They are doing this by the aid of the best pedagogical means at their command, namely, the reinforcement of the ocular impressions by the contact and muscular sensations that come from the actual performance of the dissection itself. If previously they have had some experience in the dissection of the lower mammals, they will note at once the differences shown in the case of man, and if their embryology is at their command, it will be easy for them on suggestion or on their own initiative to appreciate how some of the peculiar relations between parts of the human body have been developed. Beyond this the information obtained is of the same order as that of the vocabulary of a language. The student gets a certain number of discrete pictures of the different parts of the body more or less clearly impressed upon his mind, and when he has occasion later to deal with these same parts, he has the advantage of finding himself in the presence of familiar structures. How far in this first experience the special groups of facts which are sometimes set apart under the head of surgical anatomy should be introduced, is a more or less open question. The present weight of opinion demands that they should still be kept by themselves. Nevertheless, while the anatomical experience of the average medical student should rest on a broad scientific background, he should at the same time have a distinct appreciation of the eminently practical value of the information he is expected to acquire.

The question at once arises how the monotony of long-continued dissection can be relieved, and the student maintained in a condition of sufficient receptivity to make the work really worth while; for the acquisition of vocabularies has never been counted as one of the greater pleasures of life. There are several legitimate devices. In the first place, if it is possible for the student to have near at hand a microscope which may now and then be used for the examination of the different tissues as they appear in the cadaver. This cross reference between the gross and microscopic appearance will serve to bring into close connection with one another two classes of facts which are often separated to their disadvantage, and to revive the histological pictures which should be incorporated in gross structures, but which in most cases remain forever apart from them. On the other hand, a search for anomalies or variations serves to give both a reality and purposefulness to the work and to make a student feel that in return for the large amount of time necessarily required for his anatomical training, he is, in some small measure at least, contributing to the science. It is unavoidable, this expenditure of time, and absolutely necessary, that the student should do these things with his own hands in order to obtain the three-dimensional impression of the structure with which he deals.

In this connection just a word as to the way in which the beginner may be aided in the comprehension of his work. The excellent diagrams and pictures which are now used to illustrate the best anatomical text-books carry us as far as that means of assistance can probably go. Pedagogical experience points strongly, however, to the superior value of the three-dimensional model, and although such models are more difficult to collect, harder to care for, and require more space and caution in their use, they are so far superior to any other device, except an illustrative dissection itself, that the collection of them in connection with anatomical work becomes a moral obligation.

If we turn now to the wider uses which may be made of anatomical material as it usually appears in the dissecting room, we find that a number of directors of laboratories have been utilizing this material for the accumulation of data in such a form that it may be later treated by statistical methods. Thus they have weighed and measured in different ways various parts of the cadaver, and in some cases determined the correlations between the organs or parts examined. It can not be too strongly emphasized that the results thus obtained are to be used only with the full appreciation of the fact that the material ordinarily available for examination in the dissecting room belongs in all countries to a social group which contains the highest percentage of poorly developed and atypical individuals. The conclusions, therefore, that can be drawn from the investigations of this material must always be weighted by its peculiar nature. To illustrate what is here meant by the peculiar character of this material, we may take as an instance the bearing of the results obtained from material of this sort on the problem of the brain weight in the community at large. It must be admitted that the figures which we have at our command for this measurement are, with the exception of one short list, derived from the study of individuals belonging to the least fortunate class in the community, and it is not fair, therefore, to carry over these data and apply them directly to the average citizen who is of the normal type and moderately successful in the general struggle for existence. From what has been said, it is plain that much of the work now being carried on in the dissecting room comes very close to the lines which have been followed for years by the physical anthropologists, yet because these have for the most part concerned themselves with the study of the skeleton, have limited their comparisons to the various races of men and have developed no interest in surgery, they have for a long time stood apart, and only recently joined forces with the professional anatomists. This step has certainly been to the advantage of anatomy, and as one result of it, anatomical material not previously utilized will now be treated by statistical methods. But all the work to which reference has here been made is on the body after death. So manifest are the disadvantages arising from the conditions which are thus imposed, that the necessity is felt on all sides of extending our observation as far as possible to the living individual. As an example of such an extension, we have the determination of the cranial capacity and brain weight in the living subject which has resulted from the labor of Karl Pearson and his collaborators.* The methods which have been employed for this purpose are capable of giving as accurate results as are ordinarily obtained from post-mortem examinations, and, moreover, have the advantage of being applicable at any time to any group in the community which it is desired to investigate.

To redetermine, as far as possible, from studies, on the living, all the relations which have been made out, post-mortem becomes a very immediate and important line of work.

But even under the general limitations which apply to the dissecting room material, it is desirable to refine our knowledge of the human body by classifying the subjects according to race, and thereby bringing into relief the slight anatomical differences that exist between the well-marked races of Europe and the races of other parts of the world. The history of anatomical differences due to sex lacks several chapters, and it is possible also to show the modifications of structure which come from the lifelong pursuit of certain handicrafts which call for peculiar positions of the body or for the unusual exercise of certain muscles; as, for example, the anatomy of a shoemaker.*

Such results as the one last mentioned have a direct bearing on the modifications of the human form which may be introduced by peculiarities of daily life and work, and bring anatomy into connection with the problems of sociology; while, on the other hand, both lines of work are contributory to the broader questions of zoological relationship and susceptibility to modification.

Yet when we have gained all the information which the scalpel can give, there still remains the whole field of finer anatomy, the extent of which it is so difficult to appreciate.

While recognizing that the human body

* Pearson and collaborators, *Phil. Trans. Roy. Soc.*, 1901.

* Lane, W. A., *Journ. of Anatomy and Physiology*, Vols. XXI. and XXII., 1887 and 1888.

may be regarded as a composite, formed by the fitting together of the series of systems, and while in some instances we have more or less accurate notion of the way such a system appears—as, for instance, in the case of the skeleton—yet a much better understanding of the relation of the soft parts would follow an attempt to extend this method of presentation, and to construct phantoms of the body in the terms of its several systems in some way which would show us the system in question as an opaque structure in a body otherwise transparent. This is, of course, the final aim of the various corrosion methods, or those which depend on injection or differential coloration of structures which may be viewed in three dimensions.

When the vascular, lymphatic, nervous and glandular systems can be thus exhibited for the entire body, or for the larger divisions of it, it will be possible to see the human form transparently, and to see it whole; a feat difficult to accomplish, but worthy of earnest endeavor. The development of such phantoms should serve to make more impressive the familiar fact that in many organs and systems the total structure is built up by a more or less simple repetition of unit complexes, as, for example, the liver by the hepatic lobule, the bones by Haversian systems, and the spinal cord by the neural segments.

If we pass now from the consideration of the systems of tissues to that of their structural elements, we enter the domain of histology and cytology. Starting with the differentiation of the tissues by means of empirical staining methods, investigators have gradually come to appreciate the chemical processes which underlie the various color reactions, and as we know now, there already exist methods for determining in the tissues several of the chemical elements, such as iron, phosphorus, etc., to say nothing of the more or less satisfactory identification of complex organic bodies by means of definite reactions. This being the case, it is possible to imagine representations of the body built up on the basis of these micro-chemical reactions, representations which would show it in the terms of iron or in the terms of phosphorus, thus yielding us an image which might be compared with that obtained by aid of the spectroscope when the picture of the object is taken by means of one out of the several wave-lengths of light which come from it.

The contemplation of the multitudinous opportunities for investigation and comparison which appear within this field, lead us to pause and inquire what is properly the purpose of all this anatomical work; for without a strong guiding idea we are liable to repeat the errors of earlier generations, and merely accumulate observations, the bearing of which is so remote from the actual course of scientific progress that the investigations are mainly useful as a mental exercise for the individuals who conduct them. Anatomical results begin to have a real meaning only when correlated with physiology, and when we learn that a tissue with a certain structure is capable of performing given functions, we feel that we are really bringing our anatomy into touch with the life processes. It is to aid in the accomplishment of this end that men devote their lives to anatomical work. With the variation that we find everywhere in organic structures, it should be and is possible to discover by comparison what variations in the structure of a tissue or a cell are accompanied by the best physiological responses. It is along this line that we must necessarily work in order to reach human life either through medical practise or through other avenues of approach, for in the end the object and purpose of all science is to ameliorate the unfavorable conditions which surround man, and in turn to produce a human individual more capable of resistance to disturbing influences, and better suited for the enjoyment of the world in which he lives.

Considering anatomical work with this thought in mind, the problems which it presents can be grouped according to their relative value and importance. The approach may be made from two sides. On the one hand it is, for example, extremely worth while to direct years of labor to the determination of the finer structure of living substance, because the more closely we approximate to a correct view of that structure, the more readily will our anatomy and physiology run together, and the clearer will be the conception of the sort of structure which it will be most desirable to increase for the attainment of our final purpose. On the other hand, if we follow the path from the grosser to the finer anatomy, we are led to inquire whether there is any one part or system of the human body which at the present moment is specially worthy of attention. When we say that the nervous system is such a part, I think that even those who are not engaged in the study of it will admit that there are some grounds for the statement. The peculiar feature which sets the nervous system apart is the fact that its enlargement, both in the animal series and during the development of the individual, is in a very special way accompanied by changes in its physiological and psychological reactions. To be sure, we think of it as built up fundamentally by the union of a series of segments, but the relationship established between these segments becomes ultimately so much more important than the constituent units that in the end we find ourselves working with a single system of enormous complexity rather than a series of discrete units, a state of affairs which is not paralleled in any other tissue. In addition to this, the nervous system as a whole is par excellence the master system of the body, and as such, the reactions of the organism are very largely an expression of its complexity. Indeed, within the different classes of vertebrates, the various species may be regarded as compound bodies composed of four fundamental tissues and a species could well be defined by the quantitative relations found to exist between the nervous, muscular, connective and epithelial constituents. Working from this standpoint, Dubois,* the Dutch anatomist, stimulated by the work of Snell,† has brought forward evidence for the view that when, within the same order, several species of mammals similar in form, but differing in size, are compared with one another, the weight of the brain is found to be closely correlated with the extension of the body surface, and by inference with the development of the afferent system of neurones. This view would seem to imply that in these cases there is the same density of innervation of each unit-area of skin; but the correctness of this inference can only be determined by the careful numerical study of the afferent system of the animals compared. It will appear, however, that under the conditions imposed, the relative weight of the brain depends upon the fact that each unit-area of skin, represented by the nerves which supply it, calls for a correlated addition of elements to the central system, and thus the increase in one part is followed by a corresponding increase in the other. When, however, the large and small individuals within the same species are compared, it is found that the increase in the brain weight follows quite another law, and that in this latter case it is relatively much less marked than in the former. This

* Dubois, *Archiv f. Anthropologie*, 1898.

† Snell, *Archiv f. Psychiatrie u. Nervenkrankheiten*, 1892.

result at once suggests that the mechanism of the increase is dissimilar in the two cases. For the solution of the problems that are raised by such investigations as those just cited, we need to employ quantitative methods, and on this topic a word is here in place.

Microscopic anatomy and histology, like all the sciences, have passed through a series of phases which are as necessarily a part of their history, as birth, growth and maturity are a part of the life history of a mammal. The microscope in its early days enabled Schwann to propound the fruitful theory that the tissues were composed of cells. A preliminary survey showed that these cells were different in their form and arrangement in the different parts of the body, and a still more careful examination with the aid of various dyes or solutions altering the tissues in the differential way gave the basis for yet finer distinctions. This phase in the development of the science, however, may be fairly compared with qualitative work in chemistry, where the object is to determine how many different substances are presented in the sample examined. Naturally, the next step is the introduction of quantitative methods, and we are, therefore, now using the methods of weighing, measuring and counting for the purpose of rendering our notions more precise, and thereby facilitating accurate comparisons. When emphasizing this point, we do not, however, forget that hand in hand with this quantitative work the qualitative tests have been marvelously refined, and that these necessarily form the foundation for quantitative work, since all such work must deal with the elements or groups of elements which can be sharply defined, and the basis for their definition is given through qualitative studies. As progress is made along these lines, we appreciate more and more that it is of importance for us to know not only how much brain and how much spinal cord by weight normally belong to a given species of animal, but also the *quantitative relations* of the different groups and classes of elements which compose these parts. We are continually asking ourselves how far the range in gross weight of the central nervous system may be dependent on changes in the number of elements in the different divisions or localities, and how far dependent on the mere increase in the bulk of the individual units without any change either in their absolute number or relative size. Work along this line rests, as we know, on the neurone theory, that epoch-making generalization concerning the structure of the nervous system which was put forward by our honored colleague, Professor Waldeyer.* Most of us are aware that, at the moment, this theory is the subject of lively and voluminous discussion, and that Nissl,† for example, urges the inadequacy of the conception on the ground that it does not account for the gray substance in the strict sense.

No one can fail to appreciate the very great importance of the satisfactory conclusion of the present dispute, and earnestly desire that we may obtain conclusive evidence on points involved; but however the question of the gray matter may be settled, the enormous importance of the neurone conception, and the value of it for the purposes of the microscopic analysis of the nervous system, will remain untouched, while our quantitative determinations applied to the neurone as we now understand it, will still have a permanent value.

Returning to the questions which are raised by the previously mentioned investigations of Dubois, we require in the first instance to determine the number of neu-

* Waldeyer, *Deutsche medicinische Wochenschrift*, 1891.

† Nissl, 'Die Neuronenlehre und ihre Anhänger,' 1903.

rones connecting the skin with the central nervous system, and to see how this number varies in the different species of mammals similar in form but unlike in size. There is only one animal, the white rat, on which as yet such studies have been made, so that the whole field lies practically open. Should we be able to get good numerical evidence in favor of the view that under the conditions named above, the afferent system could be taken as an index of the size of the brain, it would show us at once that in the laying down of the nervous system certain proportions were rather rigidly observed, and bring us to the next step, namely, the determination of the influences which control those proportions and the possibility of effecting an alteration in them. In the meantime, there is every reason to prepare for the application of these results to man, and although the program here is simple enough to state, it will involve great labor to carry it through.

So far as the numerical relations in man are concerned, we have, through the work of Dr. Helen Thompson,* an excellent estimate of the number of nerve cell bodies in the human cortex, and through that of Dr. Ingbert,† a reliable count of the number of medullated nerve fibers in the dorsal and ventral roots of the thirty-one pairs of spinal nerves of a man at maturity. It is easy to see, however, that we must get some notion of the amount of individual variation to which these relations are subject within the limits of one race and one sex before it is desirable to attempt to learn whether the difference in race or sex here plays an important rôle. It is to be anticipated, however, that the differences dependent upon race and sex will be comparatively slight, and especially so when contrasted with the differences which we may anticipate as existing between the adult and the child at birth. This aspect of the problem illustrates, in a concrete form, the sort of question which is raised by the anatomical study of the body during the period of growth. The embryologists have worked out the formation and early developmental history of the various organs and parts of the human body, but the study of the later fœtal stages have been blocked by the scarcity of material, and the inconvenience of dealing with it. On the individual at birth, we have again more extensive observations, but for the period comprised between the first two years of life and the age of twenty our information is again scanty. The lower death rate during this part of the life cycle, as well as social influences, combine to keep material between these ages out of the dissecting room. Here is an important part in the life history of man which needs to be investigated along many lines, and during which it is most desirable to have a record of the changes in the nervous system expressed in quantitative terms. In the general problem which is here under discussion, our next step would be to enumerate in man at birth the medullated nerve fibers in the roots of the spinal nerves. Such an enumeration will probably show us between birth and maturity a very large addition to the number of these fibers, but we still have to determine at what portion of the period, and according to what laws, this addition takes place. At this point our observations on animals will assist us, and we should certainly look for the occurrence of greatest addition during the earlier part of the growing period.

Let us assume then that we have obtained results which show us the normal development of this portion of the nervous system between birth and maturity. These observations could be used as a standard. Once possessed of such a standard, we are

* Thompson, *Journ. of Comp. Neurol.*, 1899.

† Ingbert, *Journ. of Comp. Neurol.*, 1903 and 1904.

prepared to determine variations in the nature of excesses or deficiencies, and in this instance the question of deficiencies is the one most easy to handle.

The studies of Dr. Hatai* on the partial starvation of white rats during the growing period show that very definite changes can be brought about in the nervous system when these animals are deprived of proteid food for several weeks. As a result of such treatment, the total weight of the nervous system is reduced much below that of the normal rat. Such a result, however, leaves two points still undetermined; (1) the general nature of the changes bringing about a diminution in weight, and (2) the parts of the system in which changes occur. In testing our animal material by quantitative methods, we should in the first instance direct attention to a possible decrease or arrest of growth in the afferent system of sensory nerves, and seek to determine whether the unfavorable conditions have not retarded the growth process in this division of the nervous system. If the results of such observations are positive, we may expect to find a corresponding modification in man, when the human body during the period of growth is subjected to unfavorable conditions of a similar nature. As a matter of fact, such unfavorable conditions do exist in the crowded quarters of our larger cities, and it seems highly probable that we have there in progress examples of partial starvation quite comparable with the experiments conducted in the laboratory. Under these circumstances, it is important to discover in the case of our animals how far a subsequent return to normal food conditions will modify the anatomy of a nervous system which has been subjected to proteid starvation for some weeks. At present there are no observations which indicate whether or no recovery in the nervous system will take place, and it will probably require some time to reach a definite conclusion. The work necessary for a determination of the anatomical changes exhibited by the animals alone constitutes by no means a light task, since in order to obtain reliable results and to eliminate the factor of individual variation a series of individuals must be examined, and it requires a very definitely sustained interest to carry through the long line of enumerations necessary for such an investigation. The examination of the growth of the nervous system in animals subjected to definitely unfavorable conditions, is, however, only one part of the work.

It will be necessary to contrast the changes there found with the effects of special feeding, care and exercise in other groups, in order to see how far above the ordinary form the nervous system can be anatomically improved by any such treatment, and experiments in this direction are already being conducted by Dr. Slonaker. Of course the results which have been obtained and may be obtained on the animals studied in this way should not be directly applied to the case of man, because it seems quite evident that the higher organization of man is responsible for his ability to resist to a remarkable degree the disturbing effects of an unfavorable environment. The impression is abroad that the reverse is the case, and that it is man who is more responsive to unfavorable surroundings. I believe, however, that this current view will prove to be incorrect, for the lower mammals at least, and that when we place such animals where the conditions for them are abnormal, their limited powers of adaptability lead them to be more seriously affected than are animals which are more complexly organized. If such is the case, variations of the same amount should not be expected to appear in man, but there is every reason to assume that the variations

* Hatai, *American Journal of Physiology*, 1904.

which do appear will be of the same general character and that we might look for them in the human nervous system where we find them in that of the rat. When it is possible to see how the anatomy of the nervous system may be altered during the post-natal growth period, we shall be prepared to take up the problem of how it may be improved during embryonic and fœtal life, and how the actual number of potential neurones is determined, and their relative distribution controlled, and this should lead ultimately to the attempt to breed animals with improved nervous systems in which we shall know the nature of the improvement in considerable detail.

It may be urged that putting the problems in this way indicates a greater interest in the application to physiology of the anatomical results than in the results themselves. But I take it that the interest of a machinist in building a machine is to make the parts for one that will go, and that no less honor is due him for his painstaking care in determining the construction of the different parts and their right relations, because at the end of the operation he has devised something capable of doing work. Similarly, it is possible that a man's interest from day to day shall be absorbed in the technique of anatomical science, and yet it is nevertheless distinctly advantageous, if his anatomical observations bear on the performances of the living animal, and a final result is obtained which is the synthesis of research in two associated fields.

In drawing up the preceding outline, no one is more aware than the writer of the fact that problems connected with the nervous system have alone been considered. Without doubt those more interested in the other systems of the human body could duplicate for these the problems which have been suggested in connection with the nervous system, so that the account given above may be taken simply as an illustration of the sort of thing that seems worth doing. In presenting these illustrations it has been my purpose to indicate a standpoint from which the anatomical problems can be profitably regarded, and to draw attention to the use of quantitative methods in the study of anatomy, and especially as applied to the body during the period of active growth.

Yet perhaps the largest of our problems and certainly one which appeals to all of us, is the ways and means for the solid advancement of our science. Alongside of the question of how we shall hand down to successive generations of students the facts already established, lies the still more fundamental problem of the best method of building up the body of anatomical knowledge.

It is not my purpose to advocate as a means to this end the sharp separation of teaching from investigation. It is a rare man who can stand the strain of such a division, whether he chooses one or the other, and there is, moreover, much to be said for such an arrangement as will bring the average student into a laboratory where he can himself see how research work is conducted. Yet it would be possible to name institutions in which the relative amount of time required for teaching as compared with that left free for investigation might with advantage be readjusted, and almost all of our educational institutions at the same time admittedly lack the funds, and not often the educational purpose, which would justify them in attempting to meet the various difficulties connected with anatomical investigations on a large scale. Yet no one questions the importance of striving for a more rapid advance. A response to this feeling finds its expression in the several research funds which are now available in this country and abroad for the endowment of investigation, and in the plan presented to the International Association of Academies, and, it should be added, largely due to the initiative of Professor Waldeyer, for the establishment in various countries, of special institutes for the furtherance of research in embryology and neurology.

These two subjects were first selected owing to the peculiar difficulties of obtaining the needed material, and the great labor necessary to prepare the complete series of sections which are required in many cases. These conditions make it imperative that if we would avoid large loss of labor and much vexation of spirit, the work in these lines should be coordinated, standards adopted and the material of the laboratory, like the books of a library or the specimens in a museum, be available for the use of other investigators. Nothing, I believe, is further from the minds of those engaged in this plan than an attempt to produce anatomical results on a manufacturing scale. But the questions calling for solution in the fields here designated are so numerous, that such an arrangement will merely mean a subdivision of labor in which each institute will take one of the larger problems and direct its main energies to the study of this, so conducting the work that it shall be correlated with that in progress elsewhere. The director of such an institute will be justified in extending his work through assistants just as far as he can carry the details of the different researches in progress, and thus knit them into one piece for the education of himself and his colleagues. When we pass beyond this limit, admittedly subject to wide individual variation, there is little to be gained, but the evils of excessive production, should they arise, carry within themselves the means of their own correction.

This step, which is assuredly about to be taken, should enable us in the future to do things in anatomy not heretofore possible, and when, some years hence, there is another gathering of scientific men, with an aim and purpose similar to that of the present one, it is easy to predict that we shall be able to listen to a report on the important advances in anatomy arising from coordinated and cooperative work.

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SCIENTIFIC BOOKS.

Ideals of Science and Faith. Essays by Various Authors. Edited by the Rev. J. E. Hand, editor of 'Good Citizenship.' New York, Longmans, Green & Co. 1904.

Were this book not remarkable in itself, its motive would render it remarkable in any case. We readers of Science devoted, most of us, to absorbing technical subjects, may well peruse it to our great advantage, and realize a few tendencies of the day, unfamiliar to us maybe, and assuredly not clear in their main outlines.

The plan of the work is novel, even daring, and conjures up piquant expectancy. It consists of ten essays, each from a different hand, and divided into two groups. The first group, of six, under the general title 'Approaches through Science and Education,' deals with the possible contemporary relations between science and religion (relations of an irenical nature) from the standpoint of the lay expert. The subjects, and the authors who speak for them, are as follows: 'Physics,' Sir Oliver Lodge; 'Biology,' Professor Arthur Thomson, of Aberdeen University; 'Psychology,' Professor Muirhead, of the University of Birmingham; 'Sociology,' Mr. Victor V. Branford, secretary of the Sociological Society of London; 'Ethics,' the Hon. Bertrand Russell, fellow of Trinity, Cambridge; 'General and Technical Education,' Professor Patrick Geddes, University Hall, Edinburgh. The second group, of four essays, entitled 'Approaches through Faith,' presents the clerical standpoint in its various phases as follows: 'A Presbyterian Approach,' the Rev. John Kelman, of Edinburgh; 'A Church of England Approach,' the Rev. Ronald Bayne; the Rev.