physical characters, though it is not possible in the space allotted me to do full justice to the theme.

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*THE DESIRABILITY AND THE FEASIBILITY OF THE ACQUISITION OF SOME REAL AND ACCURATE KNOWLEDGE OF THE BRAIN BY PRE-COLLEGIATE SCHOLARS.**

Never before has the need of information as to the structure and function of the nervous system been so keenly felt by experts in various branches of knowledge and by practitioners of various specialties.

Never before, likewise, has there been so general and so earnest a desire for such information among the laity. For the first time has it been claimed by a prominent educator that neurology is a prime constituent of a liberal education. Among the branches of knowledge essential to a liberally educated man President Gilman names (*Educational Review*, III., 105–119, February, 1892), "first, the knowledge of his own physical nature, especially of his thinking apparatus, of the brain and the nervous system, by which his intellectual life is carried forward."

Under prevailing conditions, however, any approximation to a real and accurate knowledge of the brain is gained by but few, and at a late educational stage. Hence the public are ignorant or misinformed,* and the time that specialists might devote to research and advanced instruction is consumed in acquiring and im-

* This article is based upon a paper presented at the meeting of the American Society of Naturalists in Boston, December 29, 1896; it is an extension of the views expressed by that Society in 1891, 1892 and 1893 regarding a science requirement for admission to college and the introduction of natural history studies into the lowest grades of schools. It also embodies the substance of published or unpublished remarks upon the subject made by the writer on the following occasions:

1889.—In the article 'Anatomical Terminology,' Reference Handbook of the Medical Sciences (VIII., p. 532, § 82), occurs the following passage: "Aside from prejudice and lack of practical direction as to removing, preserving and examining the organ, there is but one valid reason why every child of ten years should not have an accurate and somewhat extended personal acquaintance with the gross anatomy of the mammalian brain; that obstacle is the enormous and unmanageable accumulation of objectionable names under which the parts are literally buried."

The foregoing paragraph is reproduced in a footnote upon p. 335 of my paper, 'Neural Terms, International and National,' *Jour. Comp. Neurology*, VI., 216–352, December, 1896 (issued February, 1897).

1896, a.—An address before the Home Congress, in Boston, October 13, 1896, was entitled 'Brains for the young: the desirability and the feasibility of the acquisition of some real knowledge of the brain by precollegiate scholars.' Through misapprehension a report of the address was printed in the *Arena* for March, 1897, pp. 575–583. Although unauthorized and containing some errors, it fairly represents what was said.

1896, b.—At the meeting of the New York State Science Teachers' Association in Buffalo, December 31, 1896, in the discussion on Biology in the Schools, the main points of the article above named were briefly stated; they were correctly reported in Science, April 2, 1897, p. 537.

1897.—A paper on 'The practical study of the brain in a primary school' was read before the University Convocation, June 29, 1897.

*Among the anxious parents and teachers to whom they are addressed how many are able to profit by the information contained in, for example, Donaldson's 'The growth of the brain' and Halleck's 'The education of the central nervous system?' How many persons recognize as erroneous the statements so frequently made as to the supreme absolute or relative size of the human brain? May not high school pupils describe the rivers of Africa and even the 'canals' of Mars and yet be so little familiar with the topography of the cerebrum as to accept without question the alleged representations thereof in most text-books, misrepresentations that might serve equally well for a heap of sausages? A large part of the community is at the mercy of charlatans, and squanders time and money upon that peculiarly American humbug, phrenology as practised. In a recent issue of a popular magazine, whose editor is sincerely interested in education, is an article containing not merely the phrenologic misstatements and vapidities, but a diagram of the 'convolutions of the brain' which has no basis of fact.

parting the neurologic alphabet. Indeed, so numerous are the parts of the central nervous system,* so heterogeneous and unfamiliar are their appellations,† so complex are their connections, so subtle and interdependent are their operations, so multifarious and difficult are histologic and physiologic manipulations, so diverse are the interpretations of nervous phenomena, and so voluminous is the literature of neurology,‡ that by the time existing knowledge is fairly mastered the would-be investigator has too often passed the period of greatest energy, enthusiasm and opportunity.

Were the practical study of the brain commenced in the primary schools two results might be anticipated, viz.:

First, the more general and thorough comprehension of the references to the structure, functions, disorders and injuries of the brain that occur with increasing frequency in lay as well as professional publications.

Secondly, among the many thus early and systematically trained in the fundamentals of neurologic fact, theory, method and literature, such as were fitted by nature and nurture to increase knowledge would be several years in advance of investigators as now prepared.

My general proposition is that *a certain amount of study of the vertebrate brain constitutes an indispensable element of every course at every educational stage; that this study be objective; that dissections and drawings*§ *be imperatively required; and that the forms and methods employed, and the ideas and generalizations inculcated and elucidated, be adapted to the average mental condition at the several epochs.*

The following remarks and quotations may serve to introduce an outline of neurologic study and to avert some possible objections.

The human brain is commonly the ultimate object of inquiry, but it is so difficult to obtain, preserve, manipulate and comprehend that animal brains are more conveniently employed at first. *Fiat experimentum in corpore vili.*

Descriptions, pictures and models may serve to convey additional information to such as are already fairly well informed; but there should first be laid a concrete foundation composed of direct personal impressions of the object, manual as well as visual.

Other things being equal, the acquisition of advanced knowledge is rapid and perfect in direct ratio with the earliness and thoroughness of appropriate preliminary training.*

The higher a material superstructure, the deeper are laid its foundations. If, therefore, as stated by Minot, the human brain is the most complex organ known, and if the human intellect is destined to be long baffled by the mysteries of its own agent, so much the rather should the fundamental facts and ideas of neurology be firmly fixed in the vacant and receptive depths of the youthful mind.

Because the elaborations of a science tax the mental powers of the philosopher is no reason for postponing its rudiments un-

* Including the meninges and blood-vessels, there are between five and six hundred; see the lists compiled by the committee of the Anatomische Gesellschaft and by the writer; 'Neural Terms,' etc., 1896.

† In 1888 the total in all languages was 10,500; see 'Neural Terms,' etc., pp. 230–231.

‡ The card-catalogue prepared in the neurologic laboratory of Cornell University refers mainly to vertebrates and includes between five and six thousand titles.

§ In a recent discussion of 'Physiology in the Schools' (University Convocation Report, 1896, p. 74) I have declared my belief that "children should be taught to draw before they write."

* In a very different connection it has been declared by Professor W. W. Goodwin (*The Nation*, October 24, 1895, 'School English') that "whatever study is to be pursued with effect must have its foundations laid before the age of fifteen."

til old age. At one extreme of astronomy are problems of the universe; but at the other is the recognition of the more conspicuous stars.

Mere memorizing becomes more and more irksome and difficult with age, while the youthful mind has been well characterized as 'wax to receive and adamant to retain.' Hence the desirability of the early acquisition of the main facts and terms of neurology.

Children have no prejudices against words of classical origin. *Hippocampus*, *rhinencephalon*, *hypophysis*, *fornix* and *callosum* would be accepted quite as readily as *hippopotamus*, *rhinoceros*, *hypotheneuse*, *appendix* and *chrysanthemum*.

Other things being equal, the readiness with which a new term is assimilated is in direct ratio with the completeness of the impression associated therewith. The pupils who succeed in remembering the names of mountains (*e. g.*, Himalayas) which few can anticipate visiting, and of ancient warriors (*e. g.*, Agamemnon) whose features are unknown to them, will promptly accept and firmly retain the designations of parts of their own bodies, especially when those same parts, obtained from animals, are not merely seen by them, but handled and dissected.

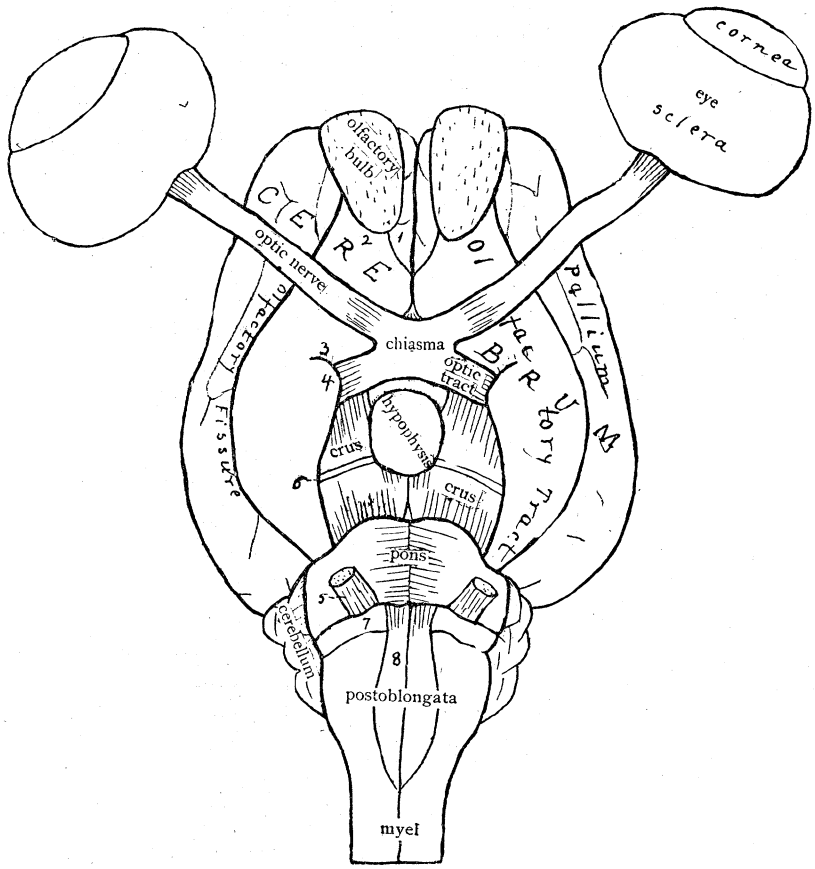

Fig. 1. Base or ventral aspect of the sheep's brain with the eyes attached; slightly enlarged. From the writer's 'Physiology Practicums,' second edition, 1895.

Children are spontaneously interested in natural objects. Like the terror of dogs, the squeamishness that would induce reluctance to handle a 'specimen' is commonly an artificial condition induced by the ignorant or thoughtless interference of parents or teachers. Left to itself the healthy child sucks in knowledge through its finger-tips.

Paradoxical as it may at first appear, notwithstanding the extreme complexity of its ultimate structure, as a gross object the brain is the easiest of all the viscera for the beginner. It is symmetric, and the main divisions are clearly outlined; moreover its colors are attractive, it retains little blood, the natural odor is not offensive, and it has no unpleasant associations.

If it be legitimate to slaughter animals for food, it is even more so to kill them humanely (as with chloroform) in order to gain information. This is particularly true of the superfluous cats and dogs that lead miserable lives in most cities. Children should be taught that the greatest kindness toward such is a speedy and painless death.

The two following sentences, from an artist and a philosopher, respectively, embody profound truths as to physical and metaphysical methods in any branch of study. According to Philip Gilbert Hamerton, "Personal familiarity alone makes knowledge alive." Joseph Henry declares that "In the order of nature, doing comes before thinking, art before science."

Huxley and Wm. North Rice have emphatically condemned the maxim, "A little knowledge is a dangerous thing." Ignorance alone is perilous, and in proportion to its density.

The practical study of the brain in educational institutions below the college may conveniently form three stages, corresponding with the primary school, the grammar and intermediate schools and the high school. At all three stages actual specimens are to be used and drawings are to be made.

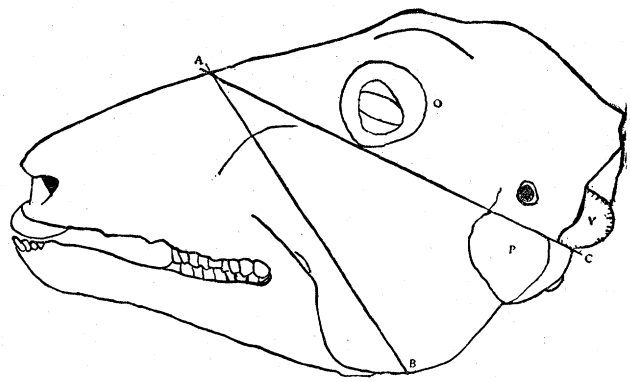

FIG. 2. Head of sheep skinned. Along the line *A–B* the butcher may cut so as to remove most of the face; the line *A–C* indicates the plane of section with a saw for removing the cranium.

In the primary stage there is to be mainly *observation* with the unaided eye, and simple manipulation. A sheep's brain* is to be examined by each pupil; but there should be shown also preparations exhibiting the location of the brain in the head, its continuity with the myel (spinal cord), and its connection with the eyes and larger cranial nerves; also preparations, models or charts of corresponding aspects of the human brain. Few terms need be employed, but the parts should become familiar as the features of the face. For further details see the description of an application of the plan in the latter part of this article.

* In most localities where neurology is likely to be considered the heads of sheep may be had in abundance, at a trifling cost, and without involving the killing of the animals for the purpose. In varying degrees the same may be said of calves, pigs and oxen. Sometimes the butchers can be employed to extract the brain after a rough fashion as if for food; but it is removed most safely and easily according to the method devised by P. A. Fish, described by me before the American Society of Naturalists, in 1890, and indicated upon Figures 2 and 3.

In the grammar* school observation is to be extended to *comparison*; with the sheep's brain as a standard the brains of cats and dogs and rabbits are to be examined, drawn and dissected in the same way. All the cranial nerves may be identified. The general nature of cerebral fissures may be considered, and certain special points elaborated, *e. g.*, the distinction between the

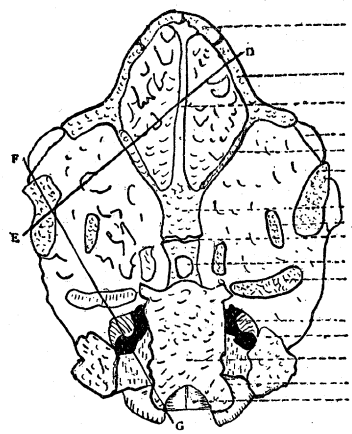

FIG. 3. Ventral aspect of the cranium after removal along the line *A–C*. If the parts outside the line *D–E* and *F–G* are sawn off the brain may be exposed with nippers.

fissures of the cat and of the dog; the difference between the right and the left; the extent of individual variations. Pigs, kittens and puppies† at various ages, before and after birth, may illustrate changes in the form and proportions of parts. A lens may be required for some purposes. The fibrous nature of the white portions may be demonstrated upon hardened specimens.

* In his admirable address, 'Science Teaching in the Public Schools,' (*Amer. Soc. Naturalists*, 1897; *American Naturalist*, September, 1888; also with Appendices, D. C. Heath & Co., 1889), Wm. North Rice assigns the nervous system to the fifth of the nine grades recognized in the primary and grammar schools; but there is also an implication that the study of the brain as an object is to begin in the high school.

† Fetal pigs may usually be obtained at any large slaughter-house.

In the high school, with further observation and comparison should be associated *reflection*. The pupil should be led to recognize the segmental constitution of the brain, and the modifications of the several segments. For this purpose, after a trial of several forms, I believe the brain of the large Green turtle (*Chelone mydas*) of the Atlantic is most available.* The severed heads may be obtained from city hotels, and the brain readily exposed by sawing off the larger part of one side. Afterwards may be studied the brains of other turtles, of salamanders, of lizards and of small mammals, and finally those of frogs and birds. The compound microscope should now be employed for the demonstration of cell-clusters and fiber-tracts in certain regions. In every high school there should be at least one well preserved adult human brain; also that of a monkey. The main resemblances and peculiarities of the former may then be illustrated. Each pupil should have an opportunity of studying the topography of the human cerebrum, and the general arrangement of the fissures should be as familiar as the river systems of his native country. The order of formation of the fissures should be shown upon a series of fetal brains, or models or diagrams thereof.

The foregoing outline is not assumed to be complete or perfect, and the experienced teacher will of course modify the details in accordance with the circumstances.

An opportunity for a partial test of its validity was afforded last spring with a class of forty boys and girls between seven

*Even were the commonly employed brain of the frog not too small, the insignificance of the cerebellum and the secondary fusion of the olfactory bulbs are apt to occasion misconceptions. Indeed, so aberrant is the structure of the frog in most respects that the ease and safety with which it may be obtained, kept alive and experimented upon, constitute a real and considerable bar to the formation and diffusion of sound morphologic ideas.

and eleven years old in the second grade of a primary school. Among the fathers of these children half a dozen are day-laborers and as many more teachers or clergymen, the majority being mechanics or tradesmen.

With the approval of Superintendent H. W. Foster, of the Ithaca Schools, and the cordial cooperation of the teacher, Mrs. H. A. Surface, but with absolutely no advance intimation to the pupils themselves, on the 26th of April there was placed before each of the forty a hardened sheep's brain. During one-third of the half-hour exercise the pupils made drawings of the dorsal aspect of the brain. The rest of the time was spent in discussing the form and naming the main features by the aid of the blackboard. At a second exercise the base was drawn (Fig. 3). At a third each brain had been transected at two levels, *viz.*, between the cerebrum and the cerebellum, and through the frontal part of the cerebrum. After considering the contours and colors of the regions thus exposed, the middle piece was held under water, and air blown into the single orifice in the mesencephal; its escape through the two cerebral orifices demonstrated the continuity of the cavities.

Most of the pupils manifested an eager interest, and only one or two a slight disinclination to handle the specimens.

Twenty names were introduced, nearly in the following order: *cerebrum, cerebellum, olfactory bulb, oblongata, spinal cord,** *arachnoid, pons, chiasma, optic nerve, hypophysis, crus, alba, cinerea, cortex, cavity, endyma, fissure, gyre, pia* and *callosum.* After an interval of nearly two months, at an unannounced examination, most of the pupils were able to recall the main features and their names.

Lest it be hastily inferred that I advocate the introduction of the study of the brain as an isolated branch of biology, let me state, first, that the laws of New York prescribe instruction in physiology for all grades; secondly, that the three lessons above mentioned were merely the last of a series of thirty given by me to the same class, all illustrated by specimens and simple experiments. For the encouragement of others who may desire to further the establishment of objective science teaching in the public schools, it may be added that evidence as to the acceptability of this contribution was received from all parties concerned, *viz.*, the superintendent, the teacher, expert visitors, parents and, by no means least significant, the pupils themselves in the form of spontaneous letters. Two indirect results deserve special mention. The pupils discussed the lessons with their parents (some of whom, by the way, had themselves been my university students); so far from interfering with other work, the interest aroused by the object lessons in physiology was reflected upon totally different branches of study, a point worth considering by those who apprehend that there is no room for science teaching in the public schools.

Appendix: Some educators are concerned as to what shall replace the classics in the curriculums where they are no longer required.* Why not neurology? It is certainly difficult enough, and for most persons —beyond a certain point—it would be quite as attractive and useful. Incidentally, too, there would be learned a by no means insignificant amount of Latin and Greek. This proposition should form the subject of a separate article, but in passing I desire to record publicly the conviction that has been frequently expressed to my colleagues during my twenty-nine years of service, viz., that a certain minimum of both Latin and Greek should constitute a part of the intel-

* Under all the circumstances it seemed best to waive my personal preference for *myel.*

*See, for example, the article, 'After Latin and Greek, what?' in (Boston) *Journal of Education,* XLV., p. 196, March 25, 1897.

lectual equipment of every college graduate; not as entitling him to the name of classical scholar, but as enabling him to comprehend his mother tongue and use it to better advantage, and as facilitating the acquisition of scientific terminology.* That minimum should certainly not be less than what, at my suggestion, has long been required for admission to the two years' course preparatory to the study of medicine at Cornell University, *viz.*, the equivalent of four books of Cæsar's 'Gallic War' and of Goodell's 'The Greek in English.'

BURT G. WILDER.

THE NATIVE DAHLIAS OF MEXICO.

THE *Dahlia*, botanically speaking, is purely an American genus confined to Mexico. When the Spaniards first visited Mexico they found a people who had advanced considerably out of the state of barbarism. Not only did these people have well-governed towns, but they were agriculturists and horticulturists. They cultivated fruits and vegetables, and in their gardens were many handsome flowers transplanted from the native soil. The Dahlia seems to have been one of these plants. So struck was he by the beauty of this flower that Hernandez, who visited Mexico in 1615, in his History of Mexico, published in 1651, makes mention of two species, one with pale red flowers which grew in the mountains of Quanhuahuac, and was called by the natives *acoctli*. A little over a century later, M. Thierry Menonville, a well-known French botanist of his time, was sent to Mexico by his government to steal the cochineal insect from the Spaniards. While on his dangerous mission Menonville saw the Dahlia on several occasions, and on his return to France, in 1787, published a book of his adventures, in which he spoke of the beauty of the strange flower which he had seen.

About 1788 some seeds of the Dahlia must have been sent to Madrid, for it is recorded that plants flowered for the first time in the botanic gardens of that city in October, 1789. A few of these seeds were secured by Lord Bute and sent to England, where they flowered in 1790. The plants, however, were soon lost, owing to the mistaken idea that they required stove treatment. About this time this species received the name of *Dahlia coccinea*, the generic name being given by Cavanilles, a Spanish priest and one of the most eminent botanists of his day, who was at that time the head of the Royal Gardens at Madrid. The genus was named in 1791 in the Icones Plantarum by Cavanilles in honor of Andreas Dahl, a Swede, a student and disciple of the great botanist Linnæus. Later, Carl Wildenow, objecting to the name *Dahlia*, on account of its similarity to *Dalea*, renamed the plant *Georgina* after Georgi, a Russian scientist and traveller. According to Salisbury, a second species, *Dahlia variabilis*, was introduced into England in 1804 by Lady Holland, who sent the seeds from Madrid. Its behavior under cultivation is described by Salisbury in his paper read before the Horticultural Society in 1808 and printed in the first volume of the Transactions.

The most successful early cultivator of the Dahlia appears to have been Count Lilieur at St. Cloud. He had four distinct varieties to work on in 1808. The experiments of the florists began in 1813, and a writer in a horticultural magazine of 1818 says that with each new year came new varieties until the kinds seemed almost like new creations, so different were they in color and form. Count Lilieur several years before had purples, dark reds, cherry-reds, buffs and

* Linguistic errors may not vitiate anatomic knowledge, but such inaccuracies as *plexi* as a plural of *plexus*, and *pontic*, *pontine* or *pontal* as the adjective from *pons*, tend to arouse in classical scholars a general distrust of their perpetrators.