EDUCATION AND BRAIN DEVELOPMENT: A PSYCHOLOGICAL PROBLEM.

BY

WILLIAM AINSLIE HOLLIS, M.D., F.R.C.P.,

CONSULTING PHYSICIAN, SUSSEX COUNTY HOSPITAL, BRIGHTON;
FORMERLY PRESIDENT OF THE BRITISH MEDICAL ASSOCIATION.

THE full advantages which the amended Education Bill will confer on the nation can only be realized during the next generation, when the present race of boys and girls will have arrived at maturity, and will have become capable of taking the governance into their own hands. Meanwhile much depends upon the method of teaching; and in that regard there seems to the writer to be a want of appreciation among some of those in authority of the great part the biological development of a child's brain must take in all such work. The need there must always be of suiting the crop to the soil; of eradicating the twining vetches of fancy, ever ready to sprout in the illiterate brain, and of substituting for them those "seedlings of observance," the grist of fact.

A Developmental Quadrilogy.

From Hesiod to Varro, from Lucretius to Shakespeare,* poets have dabbled fondly with the various ages through which an elderly man must pass. More recently biochemists have reverted to the same subject. The writer offers in the present article a further instalment. Ontogeny suggests that during embryonic and fetal life each one of us has passed through a brief replica of phylogenetic evolution from a simple life to the complexities of a modern existence. The change, clearly marked by the developmental phases of the nervous system, is mainly due to secretions from endocrine glands, and their action upon the growing tissues. After birth this process continues, and it may be traced to the need for information of the body's position in space, and for the further need of bringing that information under the control of the afferent nerves. The method adopted will be fully explained elsewhere. The developmental phases may be divided into four: (1) The automatic; organic, vegetative. (2) The instinctive; intuitive. (3) The emotional (due to "restrained impulse"). (4) The rational; reflective. Yet we must not suppose that the more recently formed elements tyrannously dominate and suppress the activities of the earlier ones, but that by a harmonious co-operation between them the best functional results are obtained.

The Automatic Phase.

Throughout our lives many of the most important functions of our bodies are carried on automatically—that is, unconsciously. It is not necessary to dwell upon this phase. The infant's nervous system for the first three or four months of life is apparently indifferent to any but hereditary influences. All his movements are automatic, and education can accomplish little to right what is wrong at this early age. All activities are under the joint control of a linked system of metameres, represented by the grey matter of the spinal cord, associated with the sympathetic nerves and ganglia, and also with the myenteric plexuses, those islets of ganglionic tissue which suggest "that thoughts may arise in a man's bowels as well as impulses suggesting ideas."¹

The Intuitive Phase.

Palaeontologists can only conjecture how an anthropoidal brain has seemingly been transferred from a position above the archenteric tube to a polar one more nearly in line with the metameric linkage above mentioned. The tube itself presumably before being scrapped was converted into a "spinal canal." In phylogeny obsolete organs by such conversion are occasionally offered a new lease of life, maybe one more in accord with an existing phase of development. We retain within our bodies many samples of this evolutionary (or is it "revolutionary"?) change—among others the pineal gland, the vermiform appendix, perhaps, too, the nasopharynx!

As regards its nervous equipment the twentieth century European infant for three or four months, in its relations to its surroundings, resembles one of the lower vertebrates (a

Dipnoan, for instance), whose nervous equipment for a life-long existence in this wicked world consists of these very ganglia! True volitional acts are absent. Perhaps the nearest approach to voluntary movement is to be found in the "purposive reflexes" of this period. Its movements if not automatic are still under the régime of a polar bulb (the medulla oblongata and its ganglia), in the metameric system of spinal nerves. The lip, palmar grip, and plantar (extensor) reflexes disappear, or change their significance as years roll on. The last two in so doing strengthen the evidence otherwise attainable from geology and anatomy, which points with no uncertain finger to man's quadrumanous ancestry in the far-distant past.² Education at this stage of an infant's life must be restricted to its mother and its welfare. Smell and taste are fairly well developed during the first few weeks of life; but the alimentary system is quite incapable of assimilating starch food until the eleventh month "owing to the absence of amylolytic power in the saliva and pancreas" (Still). Breast-fed babies start the race of life under the most favourable conditions.

At the age of 3 or 4 months the child usually holds up its head for the first time voluntarily, and the movement presumably marks the beginning of a régime of the basal ganglia in front of the pyramids. Babinski has shown how, in the adult, disease of the pyramidal tracts—the paths along which voluntary impulses pass to the spinal cord—effects changes in the plantar response. Loss of the normal dorsal flexion in that case means injury to nerve centres above the tracts; in other words, "the separation of the propriospinal apparatus from the ne-encephalic elements" (Astwazaturof). In the baby's case the active intervention of the cerebral cortex to control the lower (propriospinal) nerve plexuses is at this stage of ontogenetic development most improbable, yet the extensor response is normal up to the sixth month; from that month onward to the eighteenth plantar and dorsal flexion are equally common. In the adult these results might presumably mean many esoteric lesions to the alienist. I must leave them at that. In our babies it simply means that the little fellow is striving to stimulate his bulbar ganglia to functionate efficiently. A healthy child does so during the next twelvemonth. The conjecture is strengthened when we remember that the funiculus and the tubercle of Rolando are greyish in colour, and are better marked in the child than in the adult.

During the first few months of automatic life the afferent nerve centres gradually assume their functions. The eyes and nose learn to differentiate between the varying waves of light and the many odour-bearing molecules. The skin, too, quickly recognizes the variations of temperature and the soft caress. Usually full functional efficiency is a gradual process. Each advance is made at a fairly definite date. Take the eyesight, for instance. Within a few weeks of birth most children are pleased at a bright light. "He is long in being able to distinguish colours." When twelve months old he may know red from yellow, but he will not recognize blue and green until he is two or three years old (J. Thomson, M.D.). If there are three groups of colour sensation—red-green, yellow-blue, and white-black—and if our perception of colour rests primarily on the metabolism of a special substance in the visual mechanism of each group (Mering), the katabolic effect of white, yellow, and red light on the visual (retinal?) tissues is evidently sooner noticed by the polar nerve centres of an infant's brain than are the slower anabolic results of the shorter (chemical) rays. If the fundamental difference of maleness and femaleness depends upon a difference "in the ratio of katabolic and anabolic processes," as seems probable, metabolism has much to answer for.³

The Emotional Phase.

If we exclude the cerebral hemispheres, the cerebellum with its appendages is the largest association-complex in man's central nervous system, yet until recently it has received scant attention from physiologists. Palaeontology clearly indicates that the vertebrate cerebellum was structurally differentiated long before the neopallium, and in the central nervous system a lobe must be fairly complete structurally before it can function efficiently. The cerebellum is usually considered to be an outgrowth from the oriented linkage of basospinal ganglia around the central endings of certain afferent nerves "which bring

[3008]

* Hesiod and Lucretius treat of the phylogeny of man for the most part; the others of his ontogenetic development.

into the nervous system special information" about the body's environment, and its functions are to co-ordinate and supervise that information before distributing it to those lower ganglia directly concerned in activating the peripheral neuro-muscular apparatus.⁴ The exact period in the life of a growing child when its voluntary movements are mainly, if not entirely, dominated by the cerebellum has not yet been fully defined. On the other hand, the cerebellum of some of the lower vertebrates is the largest collection of neuro-muscular association areas in the brain, and it undoubtedly dominates and supervises their voluntary muscular activities. For these reasons the anatomy and, so far as is known, the psychology of two groups of vertebrates—namely, the large class of birds, and the armadillos (the digitigrade Dasypods of the so-called Edentate family), will be very briefly reviewed.

The Cerebellar "Worm" in Avian Life.

(a) The birds apparently became separated from the reptiles in early Mesozoic times. They are sharply differentiated from the latter by the possession of feathers, and by their high tissue metabolism. All birds are bipeds, and the majority (Carinatae) are fliers. The general shape, structure, and the functions of their bodies are in that case adapted for flight. The skeleton, lightened by many air cavities, is much ankylosed, and is strengthened by bony outgrowths for the support of the great central limb muscles. The joint movements, too, are in many cases definitely restricted in range and direction. The motions of the hand, for instance, are limited "to those of abduction and adduction necessary for the folding up and expansion of the wing; the hand is thus fixed in a state of pronation" (Owen).

(b) The organs of sight and hearing are as a rule well developed, but the senses of smell, touch, and taste are feeble. The central nervous system is highly oriented. The corpora striata, anterior commissure, and pedunculi cerebri are relatively large; but the pallium and corpus callosum are represented by thin white strips of tissue, mostly smooth, and containing little grey matter. In domestic fowls, and in some birds of prey, there is a slight depression upon the surface of the pallium marking the position of the Sylvian fissure of the primate brain. The organ which supervises and regulates the many voluntary neuro-muscular activities of a bird is the cerebellar "worm"; the appendages are not developed. In sagittal section the "worm" shows an *arbor vitae*, produced by repeated transverse folding of the whole organ (F. Hans Gadow).

(c) Avian life is highly emotional. The young flier meets "thrills and shakes" that would nerve-shock any but the staidest human. Walking, hopping, running, diving, swimming, and even dancing are all within the scope of avian activities. As regards the higher mental attributes, birds in common with many vertebrates have "call notes." The avian notes are produced at the two extremities of the palato-tracheal tract. They vary from the in-drawn cluck of the broody hen to the operatic melody of the educated bullfinch. They represent the primitive wish of sentient beings to express their ideas to each other.* Other phases of economic life, sanitation, education of their young, the use of tools and their making, and even the elements of surgery, have been shown by competent observers to have a place in a bird's life. Again, in the pugnacity developed by land-greed, the so-called "territorial aggressiveness" of some birds; in the right of the strong to eject and slay their weaker kinfolk and to occupy the latter's derelict homes, we perhaps have glimpses of *Kultur* that a cerebellar "worm," untrammelled and supreme, can achieve. Finally, as already stated, musical sounds are much in favour with birds; yet the "worm" has a far closer relationship to the end fibres of the optic lobes than it has with the nucleus of Deiters's or other otic ganglion, and we must expect optic impressions to exert greater influence upon avian emotions than do auditory ones. Birds are always strongly attracted by light reflex. Even if we exclude the "Jackdaw of Rheims" as unreliable, there are daily incidents in a bird's life that can only be explained thus. Even logic cannot be entirely withdrawn from the purview of avian mentality so long as a caged inmate by means of a suitable apparatus supplies itself with drinking water by drawing a bucketful—and an inference at the same time.

* The following references deal with statements successively made in the present paragraph. "Clucks" are fully discussed in *Lancet*, 1901, i, p. 50; also in the *Journ. Anat. and Phys.*, same year. Many birds show an elementary knowledge of sanitation by the removal of the fledgling's excreta from the nest. Major Hollis writes me from the near East that he has seen a kite teaching its young how to fly. The parent enticed its young from the nest on the roof to the edge by walking backwards while with a choice morsel in its beak. When they arrived at the edge it fluttered just beyond their reach until, overbalancing, they had flown to the ground. Mr. C. J. Carroll (*Irish Naturalist*, May, 1916) tells how ravens teach their young by a regular course of training to ward off the attacks of peregrines. Mr. Owen (*British Birds*, July, 1916) records how carefully sparrow-hawks keep their nests sanitary while the chicks are very young. Miss N. F. Lazard (Linnean Society, April 19th, 1917) offers evidence that the African grey parrot is not only a tool-user but a tool-maker as well. J. H. Owen (*British Birds*, January, 1917), in a paper "On the breeding habits of the red-backed shrike," noticed that when a gluttonous youngster had swallowed a larger "cast" than it could conveniently eject, and was in danger of choking, the parent thrust its beak down the little one's throat, and so removed the offending morsel.

The Role of the Cerebellum in Dasypods and in Other Mammals.

The locomotory apparatus of birds differs essentially from that of mammals. A bird's movements are mainly effected by *simultaneous* motions in paired limbs (for example, flying, hopping, swimming, diving, etc.), and, furthermore, these movements are strictly limited in range and direction by bony outgrowths. Mammalian and, indeed, quadrupedal locomotion generally is effected by the *alternate* motions of paired limbs. Again, owing to the polarity of a highly oriented linkage of spinal metameres, the supervision and direction of a bird's actions by a centrally situated association area became feasible, and is consequently adopted. Mammals, mankind especially, perhaps owe their supremacy in the animal world to the fact that the mobility of peripheral limb-joints, particularly the *manus*, warrants the doing of delicate operations otherwise impossible. A less oriented central nervous system presumably requires a less centralized cerebellum. Hence the gradual evolution of the appendages.

(a) The armadillos are a survival of a bygone age when exoskeletons were fashionable. The harmless, well-protected creatures are found in South America. The genealogical tree of even a "middle class" dasypod may well date back to the Pleistocene era. If so, animals then lived whose activities were dominated by a cerebellar complex, for, although the latter organ is well represented, as are also the olfactory lobes, the pallium is almost smooth, and the corpus callosum, joining the two lateral halves, is barely observable. In the broad banded armadillo, three slight depressions on either side of the pallium foreshadow the chief fissures of the primate brain.⁵ These anatomical details suggest that dasypods, like birds, are still dominated as regards their voluntary activities by the cerebellum.

(b) As regards their daily life, the armadillos (divided by naturalists into several species) have little to interest us. They are burrowing animals, and live mainly upon roots, decayed fruit, and carrion. They can quickly form a burrow in suitable soil, with their strongly-clawed forepaws and their long snouts. Some have been known to burrow into a recently formed grave. When hunted for their flesh in the open they can move rapidly upon the tips of their claws. When caught, some species roll themselves into a ball; but none seemingly show fight. Their eyesight and sense of smell are presumably good.

A Cerebellar Régime (?) in Childhood and Adolescence.

The evidence attainable from the biology of birds and dasypods suggests that the cerebellum (specially the *vermis*) is capable of supervising the voluntary activities of a neuro-muscular system up to a "point." The question we shall now consider is the effect of this doctrine on the brain-development and education of a child. We have already learnt that each of us during ontological development passes through a phase of automatic (involuntary) life ere we become intuitively volitional; and that these two stages of "life's highway" are fairly well defined in duration by—for the most part—an improved functional efficiency in certain sense organs being observable, on the one hand, and by a more rapid reflex *arc*al response on the other. These heritable conditions ostensibly dominate childhood until the third year. Subsequently other expressive reactions to environmental change are noticeable in the child's mentality, reactions which cannot be ascribed to any purely intuitive phase, yet fit in well with the functions of a well-endowed cerebellum, such as we suppose a budding "homo sapiens" to be likely to possess. Among these emotional reactions the "call notes" take a prominent place; for in them we may perceive the inchoation of articulate speech, the ruling emotion of democratic governance. The only call note the broody hen makes is an indrawn "cluck," produced probably by the tongue pressed against the opening in the split palate. Some Red Indians, Hottentots, and others, mainly dolichocephalic aborigines, still have their indrawn "clicks" in their spoken languages. European children when they begin to talk often utter words with an intake of the breath. Perhaps they revive an inherited memory of some early ancestor, who used this form of utterance. Many cases of asphyxiation among tribal chieftains as a direct result of rhetorical vehemence at meal time doubtless contributed to check this custom. Again, the musical "call notes" of birds remind us of the significance of the words of the ancient preacher: "Curse not the rich in thy bedchamber, for a bird of the air shall carry the voice, and that which hath wings shall tell of the matter" (Eccles. x, 20). Specially is it the case if "that which hath wings" is a member of the R.A.F. upon scouting duty. Music is associated, as we know, with the soaring lark "that at heaven's gate sings," yet it has been left to an inquiring correspondent of a daily paper, after recounting the brilliant exploits of the R.F.C. men in the relatively early days of the war, to remark "that many of them are men

of great musical talent." Maybe the thrill of the lofty expanse appeals to the emotions of the musician more strongly than it does to others. And hence that predilection.

In childhood the fear of pain stimulates the dormant cerebellar cortex. A healthy baby cares little for a tumble when he begins to toddle. The growing child learns the need of balancing himself. Falls are hurtful, and many may be avoided with care. Other ancient parts of our brains are the basal ganglia in front of the cerebellum. By the middle peduncles the great receptacles of outside news can send the same at once to the cerebellum, there to be rearranged and sifted by suitable cortical synapses before its return to lower distributing centres for appropriate responsive movements; some peripheral cutaneous impulses pass directly to the cerebellum, a shorter route. Maybe habits of life and conduct mainly depend upon systems of interrelated synapses in the higher centres, which act as centres of resistance to nervous impulse. By distributing selective impulses, and by linking up one impression with another, these systems form habits.⁶ The impulsive, not to say "thoughtless," acts of childhood are in that case the direct result of a cerebellar régime uncontrolled by the higher cerebral centres.

Mainly about Noses.

The neopallium seems to have grown around the olfactory lobes in the early vertebrate types much as the cerebellum grew around the central endings of other sensory nerves, and the correlation of cerebral development with the growth of the adrenalin cortex in human ontology may be accepted as consistent with known facts.⁷ Man's progenitors with "herd instincts" and omnivorous appetites were probably among the first mammals to acquire this evolutionary arrangement for the closer co-operation and supervision of sensory impulses forwarded from the lower (sympathetic and other) centres. Palaeontology meanwhile offers us no reliable data in support of the above theory, and we must rely upon the biological facts which natural history supplies in its aid. The reason for this need is not far to seek. The oldest human fossil skull is presumably some thousands of millennia more modern than the Eocene epoch wherein the pallial changes happened. The recent discovery in Queensland of a fossil skull⁸ definitely shows that man's brain first acquired its human status while his features still retained much of the grossness of the ape's. Owen divided the ape family into "three very natural groups," according to the shape of their noses. The seasonal variations in the duration of daylight over much of the land owing to the inclination of the earth's axis of rotation to the plane of the ecliptic must have greatly increased the functional value of the eoanthropic nose when artificial luminants were scarce and expensive. Ape-like men trusted to their noses and ears at night, when much of life's work was done. Night prowling begets stealthy movements and craftiness, in which the cat family delights. The need for slimness in those far-off times was urgent, and that very urgency doubtless stimulated the adrenalin development of man's neopallium.

The Reflective Phase and the Growth of Fancy.

Andrew Lang once wrote: "Curiosity and credulity are the characteristics of the savage intellect." They are also the peculiar attributes of childhood.

Hitherto we have attempted—with what success it is for the reader to decide—to give a brief survey of man's phylogenetic evolution by following out, so far as facts permit us to do so, the main outlines of biogenic evolution generally and noticing any striking similarity between them all. When an inquirer draws nigh unto the stupendous brains of mankind generically, and of the civilized races in particular, he must tread with caution lest he rouse "the dogs of war" and they "cry havoc" much to his discomfort! It is all very well to repeat the wise saw of the Spartan ephor, Chilon. "Know thyself," indeed; why, no one has ever had that experience. Burns was nearer the truth when he wrote the tag, "To see ourselves as others see us." His great head has solved the problem. None of us really "know ourselves"; if we want a clear knowledge of ourselves we must needs ask our public to help us. Apologizing for this long although important digression, we shall now get on with the work before us.

Any theory respecting the gradual evolution of man's higher mentality will naturally tread upon the toes of a good many experts in these branches of science. I know my own limitations, and wish to offer the following suggestions as a provisional theory, leaving it to others, if they think fit, to elaborate it afterwards.

We have already learnt from the biology of the lower animals (including the birds) that the first depressions to appear upon the pallium are the depressions representing by their position the great fissures of the human brain. We also know that the Sylvian fissure was the earliest to appear; and that at the bottom of that fissure is Broca's convolution, which is specially concerned with speech. The next most important fissure is undoubtedly the Rolandic. Hedging this fissure are two important gyri—the ascending frontal and the ascending parietal. The functions of these gyri have been mapped out by both physiologists and pathologists. They seemingly co-ordinate and supervise the afferent impulses already retained in the great basal ganglia, after these impulses have run the gauntlet maybe of the linked synapses in the cerebellar cortex. By so doing their relations with such impulses are far closer than they otherwise would be. For instance, the fifth nerve, as it rises from the brain, is probably the only nerve of taste (Starling). While the nasopharyngeal mucosa is associated with word utterance, the ascending root of the fifth is placed in the pons between the roots of the auditory and facial nerves, three ganglia largely concerned with the production and apprehension of spoken words. Again, the olfactory lobe by two roots is closely connected with the gyrus fornicatus and the gyrus hippocampi. The point to be emphasized is not entirely anatomical. Speech, which depends upon voice sounds, requires at least two individuals for its comprehension, the speaker and the listener. Phylogeny has presumably found vocal inflexions an easy task, and many vertebrates are able to make known their urgent needs by voice sounds. Few, however, have elaborated a sufficiency of different sounds expressive of different ideas to name such a group of sounds a language.

The orientation of a series of linked metameres before alluded to gave the frontal (polar) end supreme authority over all the hinder ganglia. By implication the fore end was also the latest neuronic complex to be evolved, and man's neopallium was structurally completed from behind forwards like other parts of the system. The frontal lobes then would be the last part of the brain to acquire complete functional efficiency. War-time observations upon lesions of the prefrontal lobes suggest that young soldiers make little (if any) use of these comparatively recent evolutionary zones, and that in some cases men may feel "undue happiness" when some injury has placed the lobes permanently out of action.⁹ On the other hand, we have anatomical evidence that the older (from an evolutionary standpoint) lobes—namely, the occipito-temporo-parietal—are well developed in men of great intellect.¹⁰ European infants are born with posterior dolichocephaly, and their occiputs are relatively smaller than the rest of their skulls to suit the needs of bony outlet of the maternal pelvis. A secretion from the adrenalin cortex subsequently builds up the brain of a healthy child in accord with its heritable ontogenetic development. Maybe during this critical period of developmental growth the older cortical neurons of the cerebellum, with their many interrelated synapses, at times become unstable, and revive the fears and fancies of some bygone ancestor.* Small-headed peoples with posterior dolichocephaly (such as Papuans, Polynesians, Australians, and many negro tribes) are the most uncultured races of the present-day. (a) Their languages, unwritten, consist of primitive vocal sounds; and (b) they have a widespread belief in the presence of little malignant demons.¹¹ As regards (a), although some cultured races of eolithic man may have decorated their caves with pictorial devices, an art subsequently lost at a later epoch, yet a permanent record of ideas by letter symbols was delayed for many millennia, doubtless owing to anatomical and psychological difficulties in attuning fingers to respond with precision to delicate psychomotor impulses. The oldest book extant comes from Egypt. Its author, Pathotep, broaches the perennial problem, the social position of woman. In his address

* So far as Scotsmen are concerned, the Report of the Registrar-General for Scotland, 1895, supports the view of the instability of the higher nerve centres throughout the period of adolescence.

to husbands he wrote: "Fill your wife's stomach and clothe her back, and her love shall reward you, as a well-tilled estate rewards the cultivator." Even in those far-off days, six thousand years ago, woman looms large on the family horizon. While the sex of the little demons that harass the lives of the small-headed peoples is doubtful, the deities presiding over the fortunes of the bigger-headed races of the ancient Eastern world were as a rule both bisexual and anthropomorphous. The male element, Khôen-yang, of China and India, originating in a solar myth, ascribed to a god both generative and destructive powers; the recurrent dryness of summer often destroying the springtide fertility of the moist earth.¹² Yet it is around the female element that the main interest centres. Throughout the Eastern world for many centuries the goddess of love and fertility, Kwan Yin, the "Turanian Venus" of China and Japan, and her child, Zen-Zai, embodied the solar nymphaean myth above mentioned. The goddess has been identified at different times and by various nations as the Assyrian Semiramis, Astarte, and Ishtar, goddess of love and chase, the Persian Anaitis, and later in Europe as Aphrodite, Artemis, Juno, and Venus. She was subsequently associated with the cult of the Virgin Mary.

The Birth of Altruism and the Development of Conscience, and Scapegoats.

Love of offspring and preservation of racial characters are the bases upon which the attractive presentment of a spirit of universal altruism is built. Among the lower animals—and we must search the depths ere we exploit the shallows—parental love lasts so long as the offspring are unable to fend for themselves. When that event takes place the loving guardianship of the parent disappears and is replaced by callous indifference. The change shows the shallowness of altruism among the lower animals. Man is not exempt. The black Negro and the white Arab and Kabyle (specially when the last two are mixed with negro blood) are apparently incapable of realizing even parental love. While our troops were engaged in raiding hostile Arab camps in Mesopotamia, it was a common event for nursing mothers to throw their babies violently away among the sand dunes, and so to free themselves from an incumbrance to rapid flight. Many millennia ago in the Far East the brachycephalic races there dwelling found that this callous conduct did not "pay." Certain slim and sly individuals, calling themselves "prophets," "soothsayers," or what not, professed to exorcise devils, heal the sick, and act as medical missionaries to the community generally. These quacks, with the help of their kings and other great men, instituted an annual spring festival, the Socaea, lasting five days. At this feast, which was characterized in ancient Assyria by extreme lewdness and intemperance, a King-God, the "Zoganes," was elected for the five days. During his short reign he was seemingly allowed the run of the real king's harem, from which he selected a queen. At the end of his term of office he was either hung, crucified, or burnt on a funeral pyre. By so doing he carried away with him the sins of his people, so that they started a fresh year freed from sins and innocent of crime. The mythical founder of the Babylonian empire, Ninus, married Semiramis, the daughter of a fish goddess, and made her his empress. Semiramis, not satisfied with this dignity, persuaded Ninus to be the "Zoganes" at the next Socaea. He was therefore immolated on a funeral pyre so that his beautiful consort might be relieved for awhile from the burden of her many sins. Such was the scapegoat.

The Futurist Superman and his Education.

Few of us activate a tithe of our cortical brain cells during an average lifetime. Large tracts of association territory, such as the right cerebral hemispheres, are rendered useless by defective education.¹³ Maybe the cortical areas in the "comparatively recent" evolutionary zones in the prefrontal lobes are still functionally inefficient, and are therefore rarely, if ever, called into activity. Wartime surgery shows that we only use a third of the fibres in a peripheral nerve trunk to carry on our life's work; in other words, we fail to use to its full extent the mechanism at our disposal to obtain a fuller and more complete knowledge of our surroundings than is otherwise possible. If the mentality of the coming race is to be

developed, and their outlook upon the world broadened, teachers must seek to stimulate some of these dormant brain cells into healthy activity, and meanwhile they might teach the young the cult of ambidexterity!

REFERENCES.

- ¹ The Hunterian Oration, by Sir J. Bland-Sutton, BRITISH MEDICAL JOURNAL, vol. i, p. 275. The anatomy was worked out by Gaskell.
- ² BRITISH MEDICAL JOURNAL, 1916, vol. ii, p. 219.
- ³ *Evolution of Sex*, by Geddes and Thomson, 1889 (see *Nature*, February 14th, 1918).
- ⁴ See an address by Professor G. Elliot Smith, Manchester Literary and Philosophical Society, 1916; also a lecture by Professor Sherrington, Royal Institution, January 23rd, 1917.
- ⁵ Description of *Xenurus uncinatus* (broad-banded armadillo): Garrod, *Proceedings of the Zoological Society*, 1878, p. 230.
- ⁶ See a paper by S. Bent Russell, *Psychological Review*, vol. xxiii, No. 3.
- ⁷ The researches of T. B. Elliott, mentioned by Sir John Bland-Sutton in the Bradshaw Lecture, BRITISH MEDICAL JOURNAL, 1917, ii, p. 609.
- ⁸ Dr. S. A. Smith: The Fossil Skull found at Talgai, Queensland; Royal Society, February 22nd, 1917.
- ⁹ L. Roncoroni, in a report to the Medical Society of Parma (*Il Morgagni*, July 9th, 1916).
- ¹⁰ See BRITISH MEDICAL JOURNAL, vol. ii, Epitome, p. 9; also *The Clinic of John B. Murphy*, vol. viii, p. 811.
- ¹¹ Euphoria (undue happiness) oftentimes comes with lesions of the frontal lobes.
- ¹² Luciani's *Human Physiology*, translated by Miss Welby, 1915, vol. iii.
- ¹³ *The Scapegoat*, by Professor Frazer, D.C.L., 1913 (the Golden Bough Series), pp. 74, 80, 83, et aliter.
- ¹⁴ See Virgil's *Georgics*, ii, 324.
- ¹⁵ I referred to this subject many years ago. "On Lopsided Generation, or Right-handedness," *Proc. Camb. Philos. Soc.*, November 30th, 1874; also *Journ. Anat. and Physiol.*, vol. ix, p. 265.

RESTORATION OF FUNCTION AFTER PENETRATING GUNSHOT WOUNDS OF THE KNEE-JOINT.

(Preliminary Communication.)

BY

MAJOR JOHN EVERIDGE, F.R.C.S.ENG., R.A.M.C.T.,

With Note by

COLONEL A. FULLERTON, C.M.G., A.M.S.,

CONSULTING SURGEON.

THOSE of us who are on service abroad have little opportunity of studying the advance in military orthopaedics which is becoming such an important element of our organization. In the vast majority of hospitals in France beds cannot be spared for retention of cases which have arrived at the stage where restorative measures are to be adopted. This, from a surgical point of view, is most unsatisfactory, but we must bow to the inevitable.

There are certain cases where, at any rate, the commencement of restitution of function is advisable before evacuation to England, for reasons which I shall give. These are penetrating wounds of joints, particularly knee-joints.

It is common knowledge how successful are the immediate results of the present-day operative methods carried out at clearing stations and base hospitals. We have been astounded by the way in which the knee recovers from the insults it has been subjected to, and we have learned to look upon the synovial membrane of a joint as being almost as good a friend as the peritoneum. To my mind, however, there is still something wanting.

It was my habit up till the end of last year to send cases which had healed by first intention after removal of foreign bodies, etc., from the knee-joint, to England about the tenth day after operation, when all doubt as to the presence of sepsis had dispersed. My custom was to ascertain on the day of departure if there was any movement of the knee-joint present, and to send Medical Research correspondence cards with the patients, for information of progress, especially of ultimate mobility. The information was, as a rule, forthcoming, but generally brought disappointment, for, according to these reports, restoration of function was not commensurate with the immediate success of the operation.

Several factors may account for this.

1. The patient may not arrive, or arrive too late, at a home hospital where orthopaedic measures are understood and practised. It would appear that each day's delay before the carrying out of efficient movements, etc., will add very considerably to the time of ultimate recovery.

2. The psychological factor must not be ignored. It is no evidence of poor morale, but a natural consequence that a man who has become accustomed to the comforts of a home hospital, perhaps near his native city, will not be over enthusiastic to get back to the trenches, probably to a new unit. His will to recover or not to recover, where