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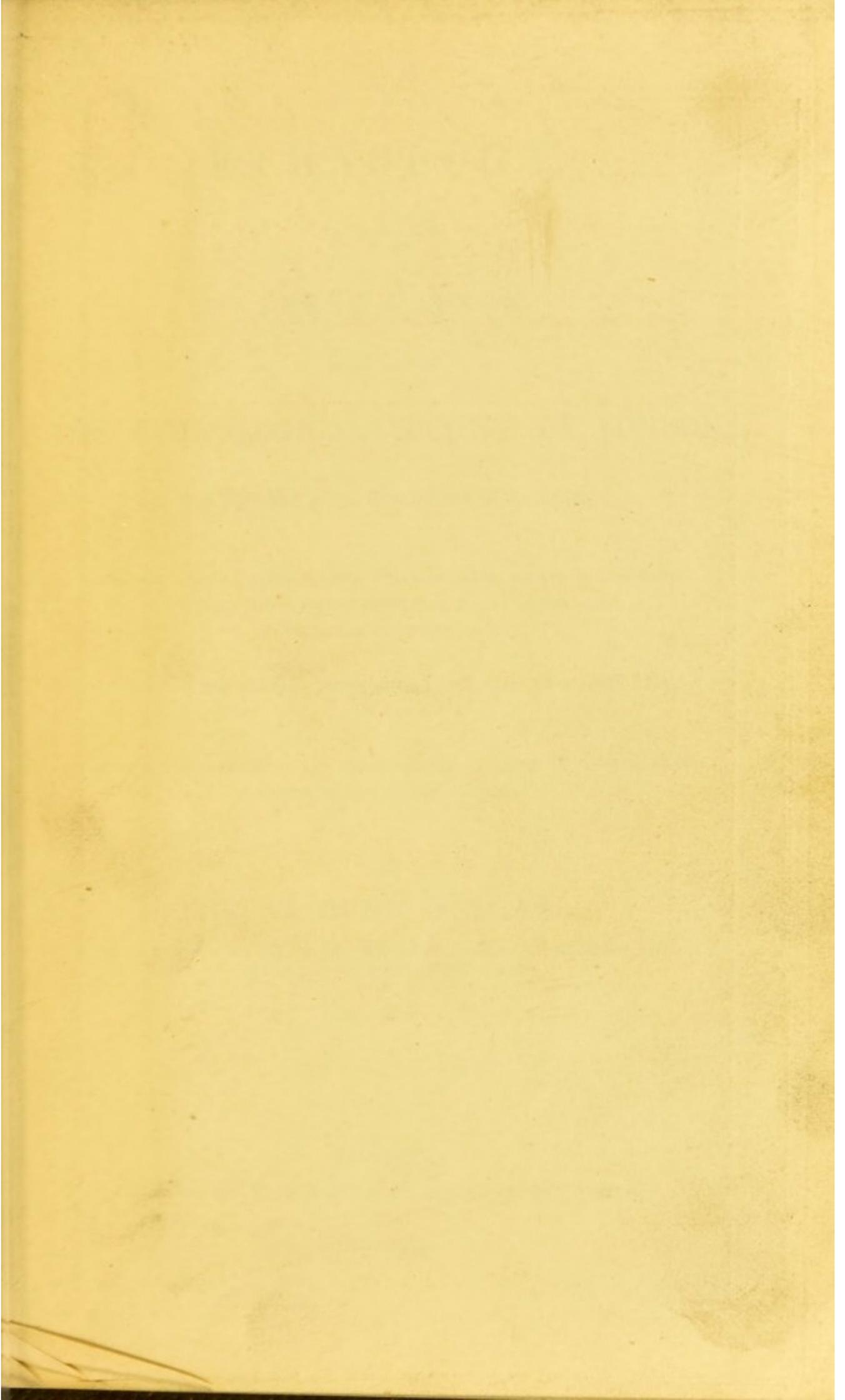
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ETHNOLOGY.

THREE PAPERS

READ BEFORE

THE ETHNOLOGICAL SOCIETY OF LONDON,

And Published in the Transactions of the Society.

I.—ON THE VARYING FORMS OF THE HUMAN CRANIUM, VIEWED IN CONNECTION
WITH THE OUTWARD CIRCUMSTANCES, SOCIAL STATES, AND
INTELLECTUAL CONDITION OF MAN.

II.—ON THE TEGUMENTARY DIFFERENCES WHICH EXIST AMONG THE RACES
OF MAN.

III.—ON THE PHYSIOLOGICAL AND PSYCHOLOGICAL EVIDENCE IN SUPPORT OF THE
UNITY OF THE HUMAN SPECIES.

BY

ROBERT DUNN, F.R.C.S.Eng.,

FELLOW OF THE ROYAL MEDICAL AND CHIRURGICAL SOCIETY: OF THE ETHNOLOGICAL,
AND OF THE OBSTETRICAL SOCIETIES, ETC.

LONDON:

PRINTED BY T. RICHARDS, 37, GREAT QUEEN STREET.

M.DCCC.LXI.

THE HISTORY OF

THE

PROGRESS OF

THE

ARTS AND

MANUFACTURES

OF GREAT BRITAIN

FROM THE

EARLIEST

PERIOD

TO THE PRESENT

TIME

BY

JOHN

SMITH

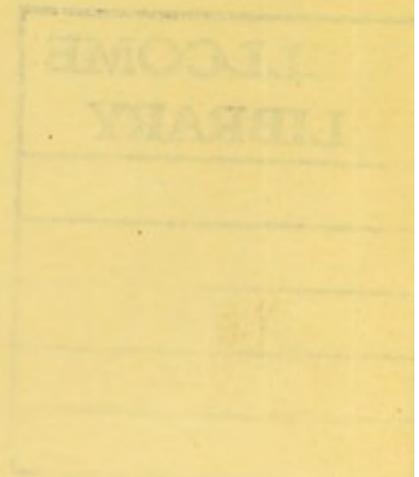
SOME OBSERVATIONS
ON THE VARYING FORMS
OF THE
HUMAN CRANIUM,

CONSIDERED IN RELATION TO
THE OUTWARD CIRCUMSTANCES, SOCIAL STATE,
AND INTELLECTUAL CONDITION OF MAN.

By ROBERT DUNN,

F.R.C.S. ENG., F.E.S. ETC.

1855.



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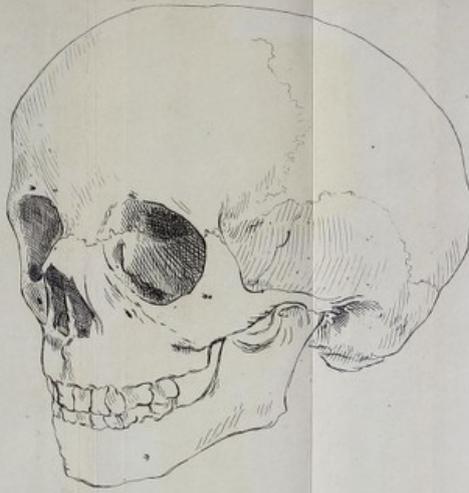
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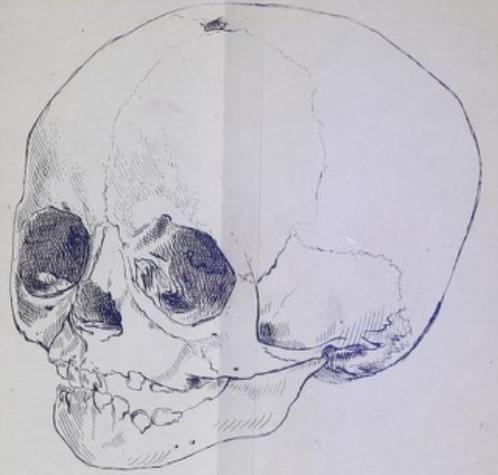
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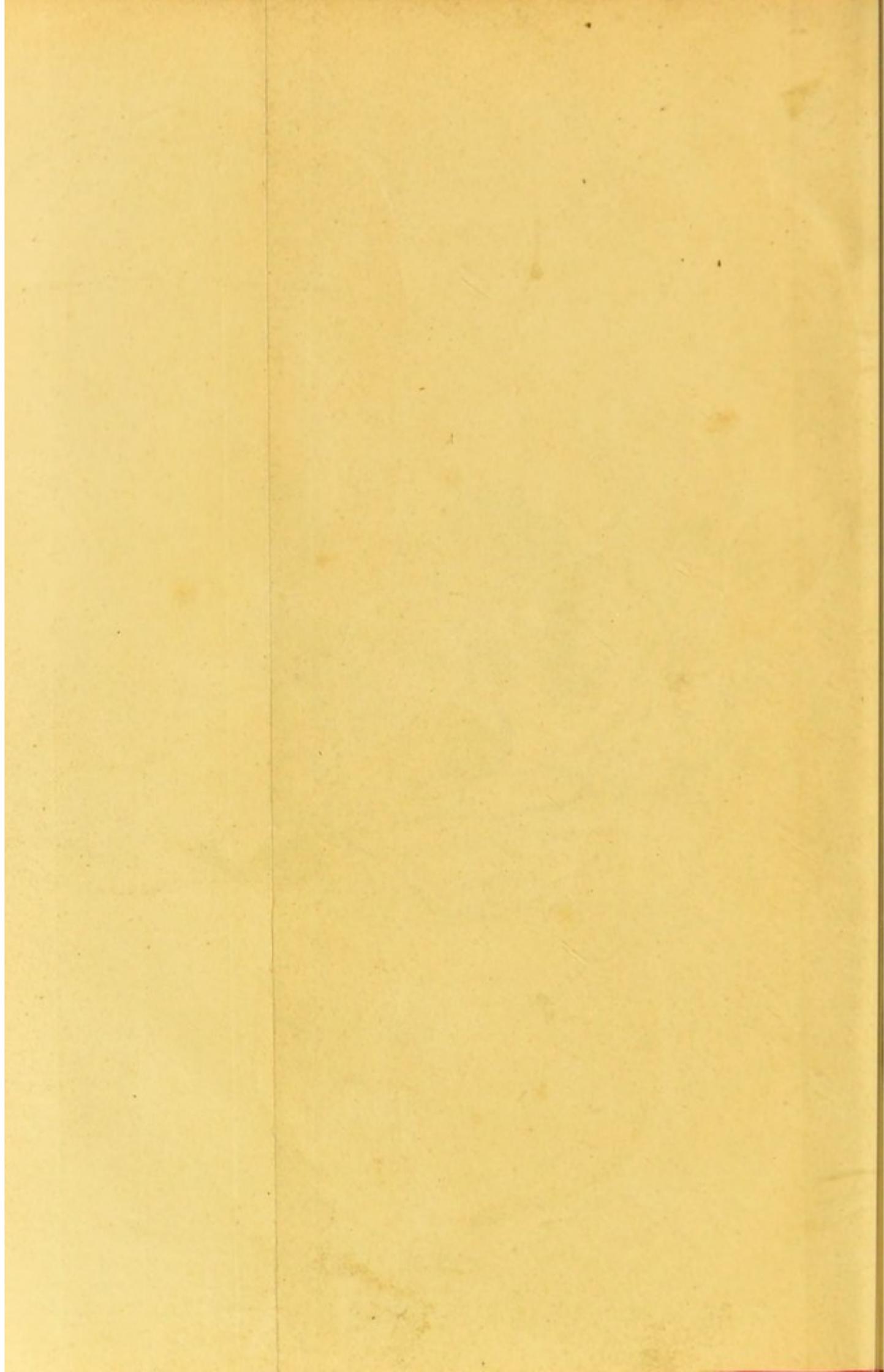
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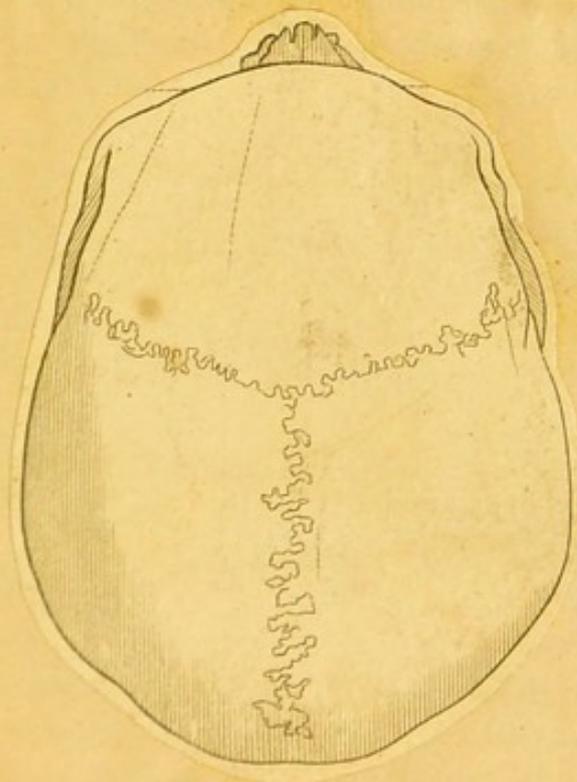
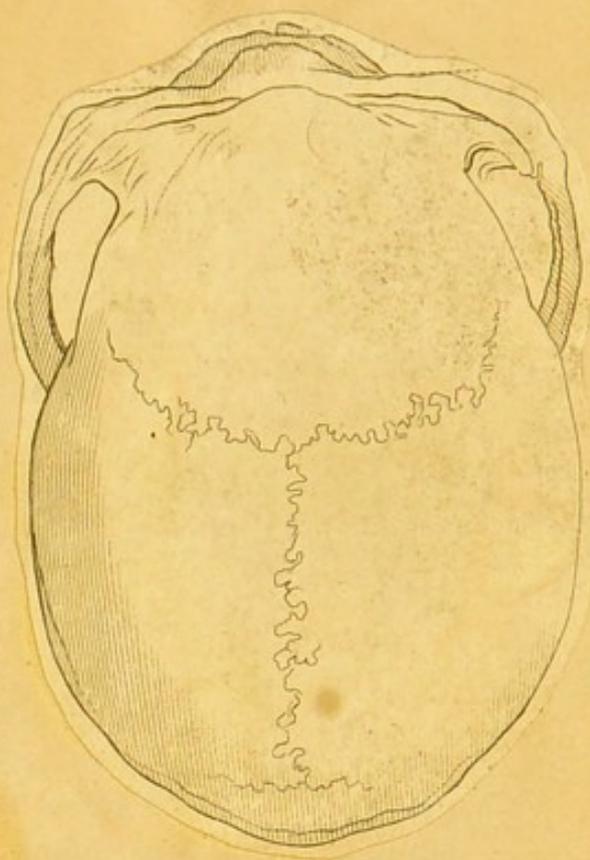
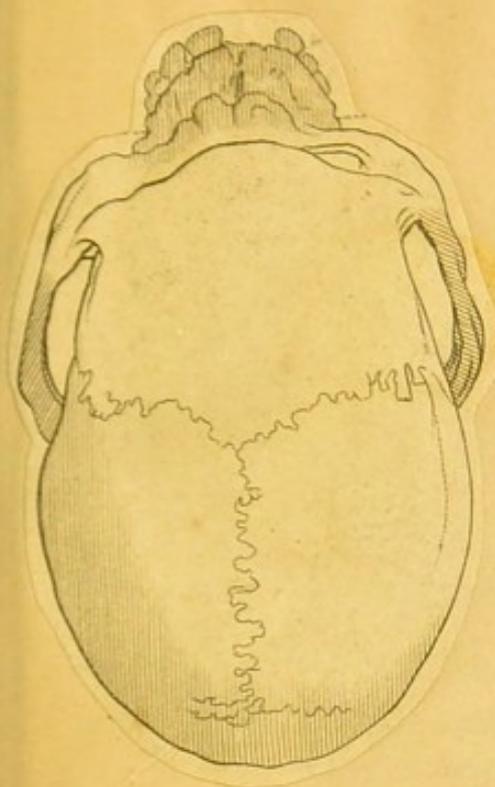


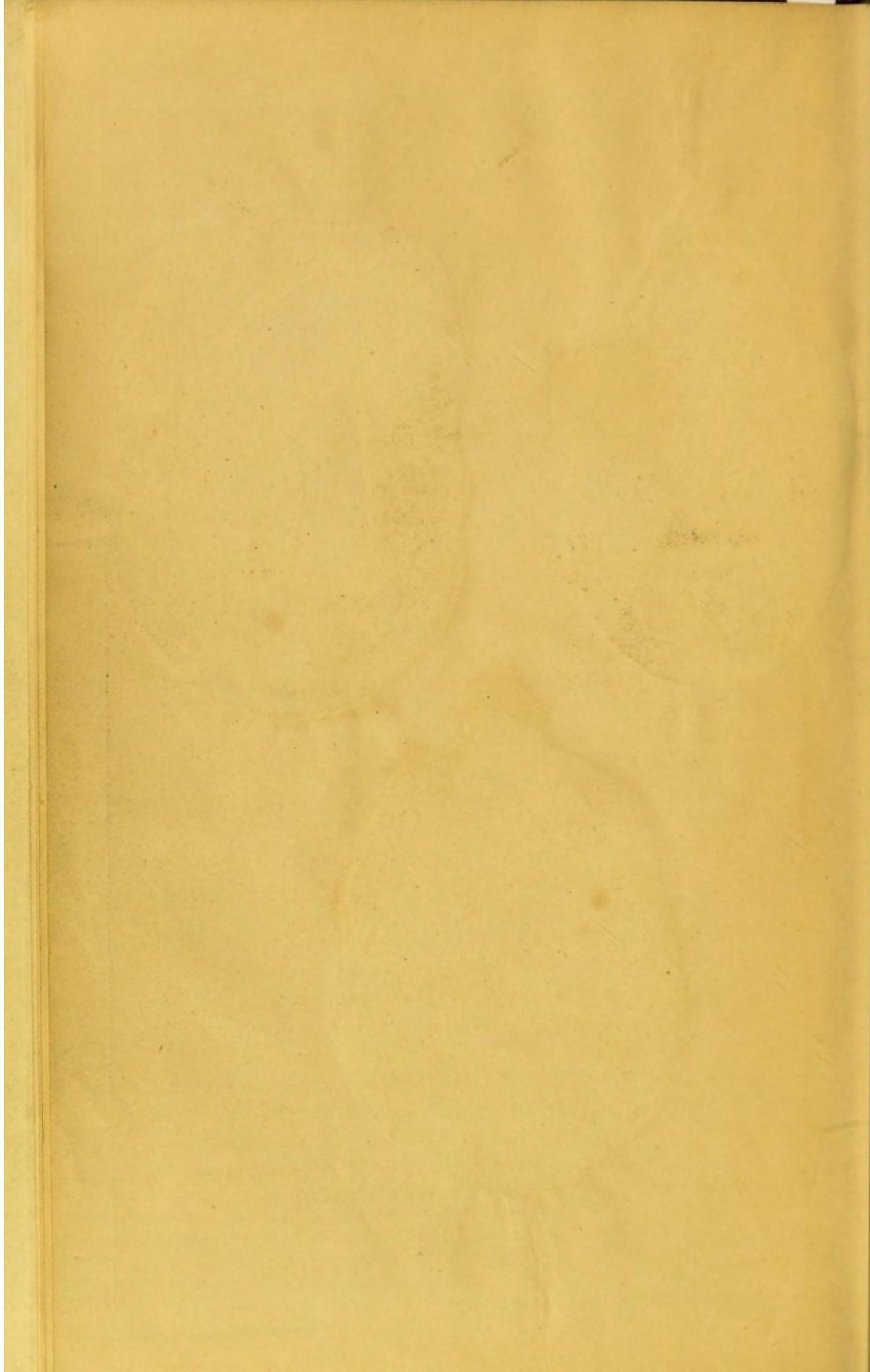
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SOME OBSERVATIONS ON THE VARYING FORMS
OF THE
HUMAN CRANIUM.

IT has been well observed, by an able writer, that “we have histories of the Church, histories of Philosophy, histories of Ancient Empires, and histories of Modern ones; but a history of Man, as a rational and moral being, is wanting;” and he has not unsuccessfully attempted, so far as the confined limits of a “*Small Book on a Great Subject*” would permit, to supply the desideratum, in his Essay, “*On the State of Man before the Promulgation of Christianity*.”* The labours of our great Ethnologist and former President, the late Dr. Prichard, in his elaborate “*Researches into the Physical History of Mankind*,” has thrown a flood of light upon the subject; for not only has Dr. Prichard placed Ethnology on a scientific basis, but of him it has truly been said, in relation to all the collateral departments of inquiry, that “he has acquitted himself *in each*—whether Physical Geography, Anatomy, Physiology, Psychology, History, or Philology—as if each one of them alone had occupied his attention.”† As bearing on the same object, it has appeared to me, while viewing man in his threefold capacity of an animal, moral, and intellectual being, and the brain, or encephalon, as the material organ of the mind,—where the *ultimate molecular changes* precede mental states, and where the *mandates of the will* originate those which terminate in *acts of volition*,—that an inquiry of great ethnolo-

* Published by Pickering, London, 1848.

† *Vide* Edinburgh Review, Vol. lxxxviii. page 487.

gical interest is suggested, from the consideration of the *relations* which co-incidentally exist between the varying forms of the bony envelope of the encephalon, the skull, and the outward circumstances, social state, and intellectual condition of man.

The admirable and valuable paper *on the Human Mouth*, by the late Mr. Nasmyth, read before this Society in 1845, and published in the first volume of its Transactions, has an important bearing upon such an inquiry; and I would here take the opportunity, in reference to it, and to his other physiological and microscopical investigations, of paying a passing tribute of respect to the memory of our departed friend.

We listened to his Paper with interest and pleasure, and we may all peruse it again with profit and advantage. It partakes more of a physiological character than any other paper that has since been read before us; and as we cannot fairly be accused of giving undue prominency in our discussions to physiological considerations, I have felt emboldened to follow his example, and to solicit your attention on the present occasion to some observations, which, perhaps, many who are here present may be inclined to consider as belonging more strictly to physiological psychology than to Ethnology. But be that as it may, it will be readily conceded the subject is of so comprehensive a character, that it is impossible within the limits of an ordinary Paper fully to consider it in all its bearings, and that our minds, whatever may be the subject of discussion, naturally fall into those habits of thought and inquiry to which they are most accustomed.

From the structure of the human mouth, Mr. Nasmyth adduces the *unity* of the species, maintaining, that the original configuration of the jaws was of the vertical or Caucasian type; and, in consequence, that the varieties of development in the mouth are deviations from a perfect form. To my mind, the evidence is irresistible, which is furnished by anatomy, physiology, and psychology, for the *unity of the human species*—that the *genus HOMO is one*; but whether there may have been more creations *than one of the same species*, is another question foreign to our present inquiry, and requiring for its solution other and a different kind of evidence.

Mr. Nasmyth justly observes, "that the natural action of the lower jaw upon the upper may push out, avert, or expand the arch of the upper jaw; but, on the other hand, that it is impossible by any habitual or natural act performed by the mouth, or by the individual, in any way to bring in, or to contract that arch, so as to produce out of the prominent jaw of the negro the vertical or perpendicular jaw of the Caucasian. The prominent character may, indeed, be derived from the vertical, but the vertical can never be produced out of the prominent by habit or exercise."

Compared with that of the lower animals, the *human mouth* presents a medium type, befitting the omniverous character of man, and adapted to the higher and nobler offices of articulate speech. In the Caucasian races, and in their normal development, there is a regular symmetrical arrangement of the teeth—the *best adapted for perfect articulation and mastication*; the entire range forming a perfect parabola, each tooth standing nearly perpendicularly to that portion of the alveolar ridge to which it is attached. But where excessive functional activity is thrown upon the concentric arches of the anterior portions of the jaws, as in the usages of savage life, in seizing, tearing, and dividing the food by the teeth, the front ones become everted, and the jaws prolonged, and thus the *prognathous* type is perpetuated.

The upper jaw yields more readily than the under, from the greater plasticity of the inter-maxillary bones; and these bones becoming everted and tilted in their turn, give rise to the *flattened nose*, as the concomitant of the elongated jaws, so well exemplified in the negro of the Gold Coast, and in the Australian savage.

Where, again, extraordinary energy is directed to the *lateral* and *posterior* portions of the jaws, as in the *grinding exactions* of uncivilized life, *great prominency* is produced in that part of the *superior maxillary* bones into which the *molar teeth* are implanted. And the fangs of these teeth being developed both powerful and divergent, the balls of the cheeks—the molar and super-maxillary bones—are greatly expanded and enlarged, and, through them, the zygomatic arches; thus giving

rise to the lozenge-shaped face and pyramidal head of the Esquimaux.

The most eminent Ethnologists agree with Dr. Prichard that there are *three typical forms* of the human cranium, from which all the existing varieties may be traced—the *prognathous*, or Ethiopian; the *pyramidal*, or Mongolian; and the *oval*, or Caucasian, prevailing respectively and concomitantly in the savage, nomadic, and civilized races of man. “Among the rudest tribes of men,” to use the language of Dr. Prichard, “hunters, and the savage inhabitants of forests, dependent for their supply of food on the accidental produce of the soil or on the chase, among whom are the most degraded of the African nations and the Australian savages, a form of the head is prevalent, which is most aptly distinguished by the term *prognathous*, indicating a prolongation or extension forward of the jaws. A second shape of the head, of a very different character, belongs principally to the *nomadic races*, who wander with their herds and flocks over vast plains, and to the tribes who creep along the shores of the Icy Sea, and live partly by fishing, and in part on the flesh of the reindeer. These nations have broad and lozenge-formed faces, and what I have termed pyramidal skulls. The Esquimaux, Laplanders, Samoiedes, and Kamtschatkans, belong to this department, as well as the Tartar nations, meaning the Mongolians, Tungusians, and the nomadic races of Turks.

“The most civilized races, those who live by agriculture and the arts of civilized life, all the most *intellectually* improved nations of Europe and Asia, have a shape of the head which differs from both the other forms. The characteristic form of the skull among these nations may be termed *oval* or *elliptical*.”

Now the venerable Blumenbach has invested the maxillæ with undue importance in making them the salient points upon which the general character of the head depends. We have seen, from the structure of the human mouth, that the prolongation of the jaws, and the expansion of the cheek bones and the zygomatic arches, are due to the usages of the teeth and the action of the mouth, in the seizing, tearing,

and grinding of the food; in a word, to the exercise of a purely animal function, with which the encephalon has little or no concern.

We are told that the jaws of the negro infant are upright, and there can exist no reasonable doubt that the *lengthened* period of suckling—from two to three years—which prevails amongst them, must give a direct tendency to their eversion. But if that period were limited to a few months, and the exactions of savage life abandoned, we can readily conceive how the elongation of the jaws would cease to be perpetuated, from the mere adoption of the usages of civilized society in reference to food alone.

The distinction, however, between the protuberant and the upright jaw is certainly characteristic and important; and Professor Retzius of Stockholm, after dividing the great family of man into *Dolichocephalæ* and *Brachycephalæ*—into *long-heads* and *short-heads* in proportion to their breadth—has again subdivided each of these two great classes according to the *uprightness* or *prominence* of the jaws, into *orthognathæ* and *prognathæ*. Thus, in the class *Dolichocephalæ*, he has the orders—

1. *Orthognathæ*—comprising the Gauls, Celts, Britons, Scots, Germans, Scandinavians.
2. *Prognathæ*—the Greenlanders, and various North and South-American Indian races, such as the Caribs, Botocudi, &c., Negroes, New Hollanders.

And, again, in the class *Brachycephalæ*, the orders—

1. *Orthognathæ*—comprehending the Slavonians, Finns, and the other Tschudisch races, Affghans, Persians, Turks, Lapps, &c.
2. *Prognathæ*—the Tartars, Kalmucks, Mongols, various North and South-American races, such as the Incas, Carruas, Papoes, &c.

This division of mankind, by Retzius, into *Dolichocephalæ* and *Brachycephalæ*, has an important psychical bearing, inasmuch as it indicates the comparative development of the posterior lobes of the brain, and the extent to which they overlap the cerebellum. On this fact rests the value and impor-

tance of Professor Owen's method of viewing the base of the skull, in reference to the foramen magnum; and it is worthy of remark, that the chief distinction between man and those mammalia whose cerebral organization approach the nearest to his, is, that the posterior lobes of the latter are so little developed, that the cerebellum is left nearly or quite uncovered by them. Mr. Solly has well observed, "It is a curious coincidence, to say the least of it, that as the *longest* heads in the human species contain the most active and intelligent brains, so do we find the greatest advance from the lower forms of brain to the higher, made by *lengthening* the brain, as shewn by the transverse foldings. It is an old adage, and it is a true one, in speaking of a clever man, to say, '*he is a long-headed fellow.*'" *

But it must be acknowledged that no one has studied the varying forms of the human crania, with a view to their psychical significance, with so much care and attention, and on so extended a scale, as the illustrious Gall: it was the labour of his life, and he was the founder of cranial and physiological phrenology. One of the most remarkable men of the age in which he lived, he was alike distinguished for originality and independence of thought, for his powers of observation, untiring industry, and indomitable perseverance. To him, and his able coadjutor, Dr. Spurzheim, cerebral anatomy, † physiology, and psychology, are under great obligations. Since their time, indeed, and both in this country and abroad, great advances have been made towards a more exact knowledge of the functions and special endowments of the nervous centres, so that the progress of physiological discovery may lead us to reject or to modify many of their generalizations and views. But all honour is due to Gall, for he was the first to enunciate clearly the true relations between the psychological nature of man and that of the lower ani-

* Solly on the Brain.

† I had the good fortune to witness Dr. Spurzheim's demonstrations of the brain at St. Thomas's Hospital during the period of my pupilage, and this circumstance gave a bias in my mind towards physiological psychology.

mals; and it is no detraction from his merit to re-consider the system of organology which he propounded by the light which subsequent physiological inquiry and discovery have thrown upon the subject.

Among living physiologists, Dr. Carpenter has done more than any other man to specialize the functions of the nervous centres of the encephalon, and through comparative anatomy, by analytical reasoning and strict induction, to advance our knowledge of the physiological psychology of man.

To my mind he has fully established the following important positions:—

1. The independent character of the sensory ganglia, as instruments of sensation, and of respondent consensual and instinctive actions.
2. The super-added character of the cerebrum, or great hemispherical ganglia, as the phrenic ganglia of the brain, the seat of our intellectual operations and reasoning processes, where ideas are formed, and where the WILL exerts its power.
3. The composite or mixed nature of the propensities, emotions, and moral feelings, as compounded of ideas and the sensorial feelings of pleasure and pain; the former, their intellectual element, having their seat in the hemispherical ganglia, and the latter, or sensational, in the sensorium commune, or sensory ganglia.

It is now, indeed, admitted that there is no point in physiology more clearly made out, than that the cerebrum, or great hemispherical ganglia, are the *phrenic ganglia* of the brain—the seat of perception and of thought—“the sole receptacle,” in the language of Cuvier, “where sensations are *perceived* and *consummated*,”—idealized, and become the pabula of thought. They are the centre of intellectual action and volitional power, the seat of the understanding and the will. But it is equally established, that the development of the cerebrum moulds and fashions, giving shape and configuration, with some well understood limitations, to its bony covering, the skull, so that certain *outward* and *visible signs* become indices of the intellectual power and energy *within*. To be satisfied of this, we have only to contrast the low, narrow, and receding

forehead of the poor idiot, or degraded negro, with that of others, and to compare, as Gall has done, the heads of differently gifted men and distinguished individuals. Throughout the whole of the vertebrate sub-kingdom the type of the brain is the same; but in man, the cerebrum, or hemispherical ganglia, are so enormously developed, that they completely enclose, overlap, and crown the other encephalic centres, giving configuration and volume to the bony envelope; whilst in the lowest of the series the representatives of these hemispheres are limited to the anterior lobes, and reduced to mere laminae or crusts. But they gradually increase in size, complexity of structure, and in the number of their lobes and convolutions, as the animal rises in the scale of intelligence, until they reach their culminating predominancy in man.

Professor Retzius has elaborately investigated the development of the cerebrum in the ascending vertebrata, and its different phases in the human embryo. His observations completely confirm the statements of Tidemann and Serres, as to the order in which the different lobes are evolved; shewing that the *anterior lobe only* exists in fishes; that this enlarges as we ascend through the classes of reptiles and birds, but does not change its character; that the middle lobe is not developed until we reach the mammalian class, presenting itself first in a very rudimentary form, and attaining increased development as we ascend; that the posterior lobe is developed from the back of the middle lobe, making its first appearance in the carnivorous group. To this history the embryonic development of the human cerebrum presents an exact parallel; the anterior lobe making considerable progress before the middle begins to be evolved, and the posterior being the latest in the order of succession.

This tripartite division of the cerebrum into distinct lobes, and the order and succession of their development, are points of great psychological significance; for the observed facts clearly indicate that the cerebral lobes are evolved from *before backwards*, in the order and degree of their importance as psychical instruments, and they point to the middle and posterior lobes, but especially to the latter of these, with peculiar interest. It is only in man that we meet with such

a great development *backwards* of the posterior lobes, and that the cerebellum is completely overlapped and covered by them. The anterior lobes are remarkable for their great extension *forwards*; but it must be conceded that the chief distinction between the cerebrum of man and that of the higher mammalia is much more striking in reference to the *posterior* than to the *anterior* lobes. "The brain of the chimpanze," says Professor Owen, "in the relative proportions of the different parts, and the disposition of the convolutions, especially those of the posterior lobes, approaches nearest to the human brain: it differs chiefly in the *flatness* of the hemispheres, in the *comparative shortness* of the *posterior*, and in the *narrowness* of the anterior lobes."

I am fully aware that some physiologists maintain that this tripartite division of the cerebrum into lobes is altogether arbitrary and useless; and I am free to confess that it is quite impossible, when we survey the cerebrum from above, to point out where the second lobe ends and the third begins; for there is no breach in the continuity of the surface, but between the first and second the *fissura Sylvii* presents a line of demarcation sufficiently distinctive, and on turning the base of the brain upward we at once see the meaning of these divisions.

No one, however, can make any such survey of the brain without being struck with the appearance and character of its convolutions.

A classification of these, begun by Professor Owen, has been greatly extended by M. Leuret, and it is much to be regretted that he did not live to complete his elaborate and valuable researches. The subject is one of great interest and vast importance, for it is an indisputable fact, that the complexity of these convolutions is an index to the place which the animal holds in the scale of intelligence. "Observation," says Leuret, "has shewn what strict induction had led us to conclude, that each group of brains among animals has a type proper to it, and that the type is characteristically manifested by the form of its convolutions." Every family has a brain formed in a determinate manner, and the number, form, arrangement, and relations of the convolutions are found to be in strict accordance with the intelligence dis-

played. He justly makes a distinction between those convolutions which are *primary* and *fundamental*, and to be found throughout the whole series of convoluted brains, occupying the same position, and differing only in their size and extent, and those secondary convolutions which are not constant, even in brains of the same group of animals, but are dependent upon the extent of the *primary* ones, and the connections which they form with others that are near them.*

* Gall was the *first* who *classified* the *convolutions*, and the labours of Gall, Spurzheim, and Holm in this interesting field of inquiry were great and manifold; and I would here take the opportunity of paying a passing tribute of respect to the memory of Mr. H. H. Holm, the friend and pupil of Spurzheim, who studied comparative cerebral anatomy with great enthusiasm. He was a fellow of the Zoological Society, and, residing near the Society's menageries, he had easy access to the collection, of which he availed himself, to study the habits and dispositions of the animals; and having permission to examine the crania and brains of those which died, his anatomical and physiological researches were rightly carried on.

Professor Owen, in his valuable paper on the Anatomy of the Chetah," (*Felis Jubata*), communicated to the Zoological Society on Sept. 10, 1833, and published in the first volume of the Society's Transactions, gives a note from Mr. Holm, containing his opinions of the *functions* of the different convolutions in the brain of the chetah, on a comparison of it with the human brain and that of some other animals. After an elaborate description of the brain of the chetah, Professor Owen says—"Of the constancy of the disposition of the convolutions represented by Gall and Spurzheim as characteristic of the brain of the feline genus, I was *first* assured by our fellow-member, H. H. Holm, Esq., Lecturer on Phrenology, whose attention has long been directed to this part of anatomy." Mr. Holm was a Member of the Royal College of Surgeons, but, enjoying an independency, he devoted himself to the pursuit of phrenology, instead of entering upon medical practice. His lectures were amply illustrated by casts, crania, and brains. He pointed out the cerebral convolutions which constitute the several organs, described the modifications which the convolutions receive, and compared them together to illustrate their magnitudes, positions, junctions, and outer connections with great ability; and so highly did Dr. Spurzheim estimate his talents, knowledge, and zeal, that he made him the special depository of his latest views on the configuration of the cerebral organs in man and the mammalia. Unfortunately, like Leuret, he was cut off in the midst of his labours, and in the fortieth year of his age.*

* *Vide* a Biographical Notice of Mr. Holm in Vol. XIX. Phrenological Journal.

To determine the functions of the primitive convolutions is *the great problem of physiological psychology*. We are required carefully to note the first appearance and progressive development of the primitive and fundamental convolutions from *below upwards*, in the ascending series of animals, and to endeavour to analyze the characters of the different animals, in relation to the objects of their intellectual faculties, in accordance *with their cerebral convolutions as contrasted with mere consensual actions*. Like things are to be compared with like, convolution with convolution, and the same groups in different animals with each other.

Now, proceeding in this way, I think it may fairly be inferred, both from human embryology and comparative anatomy, that the *primitive* and *basement* convolutions of the cerebral hemispheres are the *great internal convolutions—the ourlet* of Foville. The thin laminae or crusts which cover the corpora striata in the brain of the fish are manifestly the homologues of these convolutions: and since it is in the fish that we have the first clear and distinct evidence of the exercise of perception, memory, and volitional power, as opposed to *mere consensual actions*, may we not legitimately conclude, that these great internal convolutions *are the portals to intellectual action, where sensible impressions become perceived and remembered, and where the will exerts its power*; in other words, that they are the organs of *perception of outward existences*, and its associates *memory and volition*? Of all the convolutions of the brain, these great internal convolutions are the most symmetrical: their connections are multitudinous, and commensurate with their importance. They are the most constant and regular of all the convolutions, and each exhibits with its fellow on the opposite side the most exact symmetry.*

* “Of the internal convolution, or that of the corpus callosum, called by Foville, *convolution d’ourlet* (*processo cristato*—Rolando) the principal portion is above and parallel to the corpus callosum: in front it curves down parallel to the anterior reflector of the corpus callosum, as far as the locus perforatus, connecting it with some of the *anterior convolutions*. Behind, it passes in a similar manner round the posterior reflection, connecting itself with some of the *posterior convolutions*, and

First, and anteriorly, they are in intimate connection with those super-orbital convolutions of the anterior lobes, to which pathological investigations point as the organs through which we acquire a knowledge of the physical adjuncts of external existences, such as their size, shape, colour, number, weight or resistance, &c.

Secondly, and laterally, they are connected with those primitive and early-developed basilar convolutions surrounding the fissura Sylvii, and which appear to administer to the universal instinct of *self-conservation*.

Thirdly, and posteriorly, they are in intimate union with those backwardly developed convolutions of the posterior lobes which belong more exclusively to the family of man.

Fourthly, and superiorly, they are connected, through an order of anastomosing convolutions, with those great marginal convolutions which constitute the outer and most exalted boundaries of the hemispheres, and with those which take a longitudinal but tortuous course on the open and outer surface of the brain, thus *connecting perception, the FIRST step above sensation, with the loftier regions of thought*.

Now, the animal appetites of *hunger* and *thirst*, as subjective sensations, have their immediate seat in the *vesicular nervous tissue* of the stomach and mouth. They are instinctive and internal cravings or feelings, implanted by the Author of Nature, in accordance with the "lex nostri con-

in the *middle lobe* forming the hippocampus major, the anterior extremity of which is situate immediately behind the fissura Sylvii and locus perforatus. Its horizontal portion appears to be connected with some nearly *vertical* ones, which seem indeed to branch off from it. It forms, to use Foville's expression, a *hem* or *selvage* to the cortical layer of the cerebral hemispheres. The free margin of this convolution varies its character in different brains, according to the degree of tortuosity it exhibits, and the number of small fissures which are met with in it. The small folds which connect it with other convolutions on the inner surface of the hemisphere vary in number, and are generally found most numerous in the posterior part. Some of these folds are not distinctly visible unless the sulcus above it has been freely opened, as they are situated quite on its floor."—(Dr. Todd, on the Physiology of the Nervous System, "Cyclopædia of Anatomy and Physiology," p. 697.)

servatio," to use the language of Prochaska; for *the instinct of self-preservation* is the most universal instinct in nature, and the very first that is called into action. To it all the special senses are subservient, but first and foremost those of smell and taste. It is the sense of smell which attracts and guides the human infant to the mammary gland of its mother, to satisfy *an internal want or craving*.

But the *desire* for food, the conceiving of the modes, and the adoption of the measures to secure it, necessarily implies the agency of psychical faculties for the gratification of the *propensity* for food; and, if we follow up the cerebral connections of the olfactory peduncles, the special ganglia of the sense of smell, we find that they are not only, in connection with the thalami optici, the *great centres of sensorial feeling*—the foci and point of union of all the nerves of special sensation; but also that they are directly connected with the primitive basilar convolutions which surround the fissura Sylvii, and which are coeval, in point of existence, with the fissura itself.

But it would here be out of place farther to pursue the inquiry into the functions of primitive and fundamental convolutions; and I have to express my regret—indeed we must all regret—that Leuret and Holm should have died in the midst of their labours.

The comparative development of the cerebrum in the typical races of man remains to be investigated; and we have here a field of inquiry fraught with interest, and pregnant with consequences of the highest importance. For, beyond the generally observed facts of a greater posterior development of the cerebrum, and of the presence of some additional convolutions on the superior and anterior parts of the hemispheres, among the intellectual and more cultivated races, nothing that I am aware of has been effected in this interesting field of inquiry. But the institution of a comparison between the brains of different individuals, known to be distinguished for their intellectual powers or special endowments, would lead to the most important results. The value of pathological investigation is not to be underrated, for, if I am not greatly mistaken, it is to post-mortem examinations of the brain, and to pathological investigation, more than to

any other source, that we are to look, not for the discovery of *normal* functions, but for evidence in support or refutation of opinions advanced.

It is a matter of common observation, that the fully-developed cerebra of different individuals present innumerable diversities in *form* and size; so many indeed, and as different as are the diversity and varying phases of the human character amongst us: so that it has reasonably been doubted whether ever two individuals were, in all respects, exactly alike.

To all who are interested in the progress of psychological science, and who have the means of pathological investigation, I would recommend the writings of Gall, and, at the same time, urge upon them the duty of allowing no opportunity to escape them of bringing his dogmata to the test of experience. So far as *outward* and *visible* signs are concerned, he has, from multiplied observations, established certain cranial *landmarks*, which are highly important in the study of the typical races of man. Cranioscopic observations have led to the general belief, so far as this kind of evidence can produce conviction, that the anterior portions of the cerebrum are subservient to perceptive and intellectual operations—that the coronal and ascending regions are associated with our higher sentiments and thoughts; and that the lateral basilar and lower posterior administer to the animal propensities and lower affections of man.*

* A curious and interesting communication, "On the size of the Head, national and provincial, observed by an experienced hatmaker of London," was made to the London Phrenological Society, and published in Vol. IV. of the "Phrenological Journal."* From it we learn that the hatter's method of computing the general size of the head is to take the medium of its length and breadth. "For instance, a hat eight inches long by seven broad makes seven and a half inches diameter for the hatter's measure; seven inches by six gives six and a half inches medium or diameter; and on this principle blocks are used in the manufacturing and measuring of hats to particular sizes, varying from five inches, the size of an infant, to seven and three quarter inches, the general full size of man." The writer remarks—"By this mode of measurement the range of the male head, in England, at maturity, is from

* *Vide* Vol. IV., No. 16, p. 259, "Phrenological Journal."

Before reverting to the typical forms of the skull, and briefly advertent to the existence of historical evidence in

six and a half to seven five-eighths inches, the medium and general size being seven inches:—

“ENGLAND.—Commencing with London,” he says, “a perceptible difference will be observed between the higher and lower classes of society. In the former the majority are above the medium, while amongst the latter it is very rare to find a large head. Taking the two extremes of society, the same rule will be found invariable throughout the country—the middle ranks of life forming a medium between the two.

“Leaving London, to the north and north-east, in the counties of Hertford, Essex, Suffolk, and Norfolk, a greater amount of *small heads* will be found than in any other part of the kingdom. Essex and Hertfordshire are the most remarkable for requiring small-sized hats: seven inches, the medium size given, is here, as in Spitalfields, or among the weavers of Coventry, a full size; six five-eighths to six and a-half are prevailing sizes; and six five-eighths, the usual size for a boy of the age of six years, is here often to be met with in the full maturity of manhood.

“Crossing over the Thames to Kent, Surrey, and Sussex, we observe an immediate increase in size of the usual average, and the inland counties in general, I believe, are upon nearly the same scale. Towards Devonshire and Cornwall the heads are quite of the *full sizes*: many very large hats are required for both counties. The Welsh heads are above the usual average; and in Hereford, on the borders of Wales, they are superior to the London average.

“Travelling towards the North, a gradual increase of size will be observed, the counties of Lancashire, Yorkshire, Cumberland, and Northumberland, having *more large heads* in proportion than any other part of the country. The *largest sizes* I could ever trace have had their origin in the northern part of England or Scotland, the neighbouring portion of the kingdom; and, on the contrary, I have traced repeatedly the *small head* to the districts alluded to as exhibiting that peculiarity, Essex, &c.

“SCOTLAND.—Entering Scotland, the *full-sized head* is known to be possessed by its inhabitants. Large heads are no doubt to be met with in Essex, and small heads in Scotland; but they must be viewed as exceptions rather than as the provincial or national sizes. The contrast in the trade of Essex and Hertfordshire with that of Scotland, in point of size of hats, is very manifest; seven inches, the general medium, being a *large size* in the former counties, is considered in the *North* as approaching to a small size.

illustration of the fact of the conversion of one type into that of another, I have to apologise for the length to which I have carried these observations. Interesting they may be to some who are present; but I cannot conceal from my own mind the apprehension that they do not possess that general interest which has so uniformly characterized the Papers which have been read before us. And indeed, but for the fact that we have for our President so eminent a physiologist as Sir Benjamin C. Brodie, I might, nay, I would, have hesitated before I had entered upon the course I have pursued.*

The protuberant jaw is associated with the narrow and receding forehead—the head may be comparatively long, but it is remarkably narrow in proportion to its length, as in the Negro, Carib, or New Hollander, suggesting the idea of lateral pressure; or it may be short, as in the Tartars, Kalmucks, Incas, Papoes, &c. In the pyramidal type, with the flat and broad face, there is a like narrowness of the forehead, and deficiency of anterior development. The most striking peculiarity in the skull is the *shortness* of the long or antero-posterior diameter in relation to the lateral, being, in the case of the Lapps, only as 1·20 to 1·00.

Dr. Prichard justly remarks—“The greater relative development of the jaws and zygomatic bones, and of the bones of the face altogether, in comparison with the size of the brain, indicates, in the *pyramidal* and *prognathous* skulls, a more ample extension of the organs subservient to sensation and the animal faculties, and such a configuration is adapted, by its results, to the condition of human tribes in the nomadic state, and in that of savage hunters.”

“Respecting the Irish head,—so far as I have experience but my opinion is formed on grounds too partial for a general conclusion,—I should say that the Irish generally possess larger heads than the English. The higher classes from Ireland, residing in this country, are above the English average; and the lower orders exhibit a superiority in size to the English labourers.”

* I have great pleasure in referring to his “*Psychological Inquiries*,” published since this Paper was read, and which has reached a second edition, as a valuable contribution to psychological science.

Now, from what has already been observed, in reference to the structure of the human mouth, we can readily conceive how, under the influence of improved *outward circumstances*, by the mere adoption of the usages of civilized life, in relation to food alone, the elongated jaw, and the expanded zugoma, would, in the course of time, cease to be perpetuated; and such has actually proved to be the case. Every Negro has not the protuberant jaw, nor has every Turk the lozenge-shaped face. Under ameliorating circumstances, and social conditions favourable to the development of the moral feelings and intellectual faculties, these characteristic peculiarities have been softened down, and in some instances have entirely disappeared. The Ethiopian and Mongolian skull have acquired the elliptical or Caucasian type.

According to the concurrent testimony of medical observers, both in the United States and in the West Indies, where the influence of a *higher civilization* has been in powerful operation for a lengthened period of time, an approximation of the *Negro physiognomy* to the European model is progressively taking place, even where there has been no intermixture of European blood: nor is the alteration confined to the head and face. Dr. Hancock, indeed, of Guiana, asserts that it is frequently not at all difficult to distinguish a Negro of pure blood, belonging to the *Dutch* portion of the colony, from another belonging to the English settlement, by the correspondence between the features and expressions of each, and those which are characteristic of their respective masters. The testimony of Sir Charles Lyell, founded on personal observations, made during his recent tour in America, and on *indisputable* information, gleaned by him from others, leads to the same conclusion, that a gradual approximation is taking place in the configuration of the *head* and body of the Negroes to the European model, each succeeding generation exhibiting an improvement in these respects. Dr. Carpenter justly remarks—"It is not a little interesting to observe, that there are elements in the Negro character which have been deemed by competent observers capable of working a considerable improvement on even Anglo-Saxon civilization. Many intelligent thinkers have come to the conclusion, that the boasted

superiority of the latter is, after all, more *intellectual* than *moral*; and that in purity and disinterestedness of the affections, in childlike simplicity and gentleness of demeanour, in fact, in all the milder graces of the Christian temper, we may have much to learn from the *despised Negro*." 'I would expect,' says Dr. Channing, 'from the African race, if civilized, less energy, less courage, less intellectual originality, than in ours; but more amiableness, tranquillity, gentleness, and content. They might not rise to an equality in outward condition, but would probably be a much happier race.' The same observations have been made on the Negroes of the Guinea coast, and their descendants. It is not a little remarkable, that the earliest civilization of which we have any distinct traces in the western portion of the Old World—perhaps the very first development of the arts of life, and of a spiritual philosophy, which man has witnessed—should have presented itself in a race which was not only *African* in its locality, but also in its affinities, such being demonstrably the character of the *ancient Egyptians*. Yet to this race the civilization of Greece, of Rome, and of Western Europe, may be in a great measure ascribed; and long after the time when its power and intelligence had gained their highest state of development, the progenitors of the Anglo-Saxon race, both in this country and in Germany, were in a state of barbaric ignorance and brutality."*

Again, in the Mongolian race we find still more strikingly exemplified, changes in the typical character of the cranium, and of *deterioration* as well as of elevation, under the influence of outward circumstances and social states. Thus, on the one hand, we see in the brutalized and savage Bushman of the Cape the *prognathous* type and a degraded caste of the Mongolian Hottentot race. The process is well known of the conversion of Hottentots into Bushmen. The change of a mild, confiding, and unenterprising race of shepherds, into fierce, suspicious, and vindictive savages, who issue from the

* Dr. Carpenter on the *Varieties of Mankind*, in Dr. Todd's "Cyclopaedia of Anatomy and Physiology."

fastnesses of their rocky deserts only to plunder and destroy, has been witnessed even within the present generation, as the result of the encroachments of European colonization on the one side, and of the Kafirs on the other.

And again, on the other hand, in the case of the Turks of Europe and Western Asia, and of the Magyar race, we have striking illustrations of the change from the pyramidal to the elliptical type of the skull, under the ameliorating influences of civilization. The eastern Turks, retaining the nomadic habits of their ancestors, have retained also their pyramidal conformation, while in the Magyar race, of which the Hungarian nobility is composed, not inferior in physical or mental characters to any in Europe, we see a branch of the great northern Asiatic stock, closely allied in blood to the stupid and feeble Ostiaks and the untamable Laplanders. About ten centuries ago they were expelled, by Turkish invasion, from Great Hungary, the country they then inhabited, which bordered on the Uralian Mountains; and they, in their turn, expelled the Slavonian nations from the fertile parts of Hungary, which they have ever since occupied. Having thus changed their abode, from the most rigorous climate of the old continent—a wilderness where Ostiaks and Samoiedes pursue the chase during only the mildest season—for one in the south of Europe, amid fertile plains, abounding in rich harvests, they laid aside the rude and savage habits which they are recorded to have brought with them, and adopted a settled mode of life. In the course of a thousand years, their type of cranial conformation has been changed from the pyramidal to the elliptical, and they have become a handsome people, of fine stature and of regular European features. Nor is there any reason to regard this as the result of intermarriage with other races, for the Magyars are to this day distinct from the other inhabitants of Hungary.

And thus, in the Mongolian race, we see, on the one hand, the cranial deterioration and debasement carried to the uttermost limits of human degradation; and, on the other, its elevation raised, by symmetrical contour and lofty bearing, to the highest type of intellectual development. Nor is it a little remarkable, that the solitary, but beautiful skull, which the

venerable Blumenbach selected as the type of the highest order—the Caucasian race—if the views of Mr. Norris, and adopted by Dr. Latham, be confirmed,—was really and truly of *Mongolian origin*, and that the Georgian and Caucasian nations—the very people who have been selected as furnishing the type of the highest and most perfect conformation, by Blumenbach are but an *improved race* of a decidedly *inferior stock*.

Lastly, in the oval or Caucasian type, and among the Indo-European races, we find great diversities of cranial configuration; but on the present occasion I shall only briefly advert to the melancholy spectacle amongst ourselves of its degeneration into the prognathous and pyramidal type, under the influence of want, squalor, ignorance, and moral degradation. “There are certain districts in Leitrim, Sligo, and Mayo (as pointed out by an intelligent writer in the Dublin University Magazine, No. 48) chiefly inhabited by the descendants of the native Irish, driven by the British from Armagh and the South of Down, about two centuries ago. These people, whose ancestors were well-grown, able-bodied, and comely, are now reduced to the average stature of five feet two inches, are potbellied, bow-legged, and abortively featured; and are especially remarkable for *open, projecting mouths*, with prominent teeth and exposed gums, their advancing cheek bones and depressed noses bearing barbarism on their very front. In other words, within so short a period they seem to have acquired a prognathous type of skull, like the savages of Australia. In the hordes of wretched Irish, which famine drove to seek subsistence in the sea-ports and manufacturing towns of Great Britain, every gradation was perceptible, from the really noble type of countenance and figure seen in some of them, to that utterly debased aspect which can be only looked at with disgust. Again, it has been well observed, “A certain degree of regression to the pyramidal type may be noticed among the ‘*nomadic tribes*’ which are to be found in every civilized community. ‘Among these,’ says Mr. Henry Mayhew, an acute observer, ‘according as they partake more or less of the purely vagabond nature, doing nothing whatsoever for their living, but moving from place to place, preying on the earnings of the more industrious portion of the community,

so will the attributes of the *nomadic races* be found more or less marked in them; and they are all more or less distinguished by their *high cheek bones* and *protruding jaws*; thus shewing that kind of mixture of the pyramidal with the prognathous type, which is to be seen among the most degraded of the Malayo-Polynesian races.' ”

I cannot more appropriately close this communication, than by a quotation from my friend, Dr. Carpenter, and in acknowledging how much I am indebted for the subject-matter of the present paper to his elaborate and profound article on the Varieties of Mankind, in Dr. Todd's "Cyclopædia of Anatomy and Physiology." The question of psychical conformity or difference among the races of mankind, although one which has a most direct bearing upon their specific unity or diversity, has, besides, an importance of its own, even greater than that which it derives from this source. For, as has been recently argued with great justice and power, the real unity of mankind does not lie in the consanguinity of a common descent, but has its basis in the participation of every race in the same *moral* nature, and in the community of *moral* rights, which have become the privilege of all. "This is a bond which every man feels more and more, the farther he advances in his intellectual and moral culture, and which, in this development, is continually placed upon higher and higher grounds: so much so, that the physical relation arising from a common descent, is finally lost sight of in the consciousness of the higher moral obligations. It is in these obligations, that the *moral rights of men* have their foundation; and thus, while the Africans have the hearts and consciences of human beings, it would never be right to treat them as *domestic cattle* or *wild fowl*, if it were ever so abundantly demonstrated that their race was but an improved species of ape, and ours a degenerate kind of God."

"The *psychical comparison* of the races of man, in a practical point of view, is a most important investigation. And the evidence which has been accumulated on this subject raises no *impossible barrier* as to the unity of the species; the variations in the position and relative development in their respective psychical powers and tendencies not being greater, either in kind or degree, than those which present themselves

between individuals of our own or any other race, by some members of which a high intellectual and moral standard has been attained. The tests by which we recognise the claims of the outcast and degraded of our own, or of any other *highly civilized* community to a common humanity, are the same as those by which we should estimate the true relation of the Negro, the Bushman, or Australian, to the cultivated European. If, on the one hand, we admit the influence of want, ignorance, and neglect in accounting for the debasement of the savages of our own great cities; and if we witness the same effects occurring, under the same conditions, among the Bushmen of Southern Africa, we can scarcely hesitate in admitting that the long-continued operation of the same agencies has had much to do with the psychical as well as the physical deterioration of the Negro, Australian, and other degraded savages; so, on the other hand, if we cherish the hope that the former, so far from being irreclaimable, may at least be brought up to the standard from which they have degenerated, by means adopted to develop their intellectual faculties, and to call forth the higher parts of their moral nature, no adequate reason can be assigned why the same method should not succeed with the latter, if employed with sufficient perseverance. It will be only when the effect of education, intellectual, moral, and religious, shall have been fairly tested, by the experience of *many generations*, in conjunction with the influence of a perfect equality in civilization and social position, that we shall be entitled to speak of any essential and constant psychical difference between ourselves and the most degraded beings clothed in a human form. All the evidence which we at present possess leads to the belief, that, under a vast diversity in degree and in modes of manifestation, the same intellectual, moral, and religious *capabilities*, exist in all the races of mankind, leading us directly to recognise their community of a moral nature with ourselves, and our admission of them into a participation of our own rights."

SOME OBSERVATIONS
ON THE
TEGUMENTARY DIFFERENCES
WHICH EXIST AMONG
THE RACES OF MAN.

BY
ROBERT DUNN, F.R.C.S., F.E.S.,
ETC.

LONDON:
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M.DCCC.LIX.

SOME OBSERVATIONS

TECHNICAL DIFFERENCES

THE PAGES OF MAN

FORGET YOUR OWN NAME

LONDON:

PRINTED BY J. JOHNSON, ST. PAULS CHURCH-YARD

1801

ON THE TEGUMENTARY DIFFERENCES,

ETC.

IN a former communication to this Society—"On the varying forms of the Human Cranium, viewed in connexion with the outward circumstances, social state, and intellectual condition of man"*—I avowed the conviction that, to my mind, the evidence is irresistible, which is furnished by anatomy, physiology, and psychology, that the *genus HOMO is one*; and, taking the three typical forms of the skull, the prognathous, pyramidal, and oval, I adduced some direct historical evidence in proof of the fact of the conversion of one type into that of another, under the varying influence of outward circumstances and civilized states.

On the present occasion, and in support of the same conviction, I beg to solicit your attention to some observations on the tegumentary differences which exist among the races of man, but from which it has been attempted to draw a very opposite conclusion, and to establish the position that these tegumentary

* Published in the Journal of the Ethnological Society, vol. iv, p. 33.

differences may be adduced to prove that the varieties in the races of the great family of man are not derived from one and the same species, but from distinct original stocks. I need scarcely say, that the colour of the skin and the character of the hair are the points at issue. It was long supposed that there existed in the tegumental covering of the Ethiopians a specific structure—the *rete mucosum*—which was the source of their blackness, and that this structure was wanting in the fair skinned races of man. Not many years ago even so great and eminent a physiologist as M. Flourens, in France, was led to believe that he had discovered, in the *rete mucosum*, such structural peculiarities or differences among the fair skinned, the red, and the black races of man, as to warrant the conclusion that they were so many distinct original species. But the revelations of the microscope on this, as on some other disputed points in physiology, have dispelled all the obscurity and doubt in which the subject was enveloped. They have clearly shown, beyond controversy, “that there exists no distinct colouring layer, as a peculiar specific structure, either in the fair or dark skinned races; that the *rete mucosum* is nothing more or less than the latest formed layer of the epidermis, the inner surface of which is continually being renewed as the exterior is worn away;” and that the peculiar hue of the dark skinned races unquestionably depends upon the presence of colouring matter in the pigmental cells of the epidermis itself,—thus and at once demolishing both the hypothesis of Flourens and his conclusions.

But it may be well for us here to pause for a moment, and to consider more minutely, under the light which microscopic investigation has thrown upon the subject, the structure of our tegumentary covering—the skin. Under the impression that all who are present may not be familiar with the subject, I need offer no apology for the adoption of the course I am pursuing, nor for the following details, with which every physiological inquirer is so well acquainted.

The common integument, or investing membrane of the body, consists essentially of two distinct layers or structures. An inner one, the corion, cutis, or true skin; and an outer, the epidermis, cuticle, or scarf skin. Interposed between these, and closely investing the cutis, a third is described as “a basement tissue composed of simple membrane, uninterrupted, homogeneous, and transparent, covered by an *epithelium*, or pavement, of nucleated particles.”

The true skin is a sentient and vascular structure, for it is the seat of the sense of touch; whilst the cuticle, forming its protective covering over the entire superficies of the body, is

insensible and non-vascular. The cutis consists of a fibro-vascular layer, made up of white and yellow fibrous tissue, and of bloodvessels, lymphatics, and nerves. It is chiefly composed of white fibrous tissue, arranged in a reticular manner, the texture becoming very fine and close near the upper surfaces, but more open and loose below, where its larger meshes become filled with clumps of fat cells, and where it passes without any distinct line of demarcation into the sub-cutaneous tissue.

The epidermis or cuticle, the outer layer of our common integument, affording a protective covering to the cutis vera, consists of a series of flattened scale-like cells, agglutinated together in many irregular layers. When these cells are first formed they are spheroidal, and contain nuclei, with soft and moist contents, but in consequence of successive formations beneath them, they are pushed upwards, and in their progress become flattened into irregular scales, lose their nuclei, and are ultimately thrown off, in desquamation, from the surface of the body. And thus between the inner and the outer layers of the epidermis there is a marked difference; for while the deeper seated distinctly present a cellular character, the external layers are scaly. It is a matter of no difficulty to divide the cuticle in two, three, or more laminæ, or, at a certain degree of maceration, to separate the harder from the softer layers, and thus to isolate the structure termed the rete mucosum, which in reality is nothing more than the deepest and most recently formed portion of the epidermis.

Though formerly supposed to be a distinct structure, microscopic investigation has clearly demonstrated the stratum Malpighi to be only the most recently formed portion of the epidermis, whose cells are not yet consolidated by the formation of horny matter in their interior. Many of these deep cells secrete colouring matter, and are hence termed *pigmental cells*. The colour of the skin unquestionably depends upon the presence of these pigmental cells, and the particular tint of the pigment which they secrete. Pigmental cells may, and occasionally do, occur partially, under varying circumstances, among the white races of man; and sometimes among the coloured races they are found wanting, so that the fair skin of the European may present itself in the offspring of the red man or the negro.

Dr. Hutchison, in the *American Journal of Medical Science* for January, 1852, relates a very curious example of change of colour in a negro, on unquestionable authority. "The subject, a negro slave in Kentucky, aged forty-five years, was born of black parents, and was himself perfectly black until twelve years of age. At that time a portion of the skin, an inch wide,

encircling the cranium just within the edge of the hair, gradually changed to white; also the hair occupying that locality. A white spot next appeared near the inner cavities of the left eye; and from this the white colour gradually extended over the face, trunk, and extremities, until it covered the entire surface. The complete change from black to white occupied about ten years; and, but for his hair, which was crisp or woolly, no one would have supposed at this time that his progenitors had offered any of the characteristics of the negro, his skin presenting the healthy vascular appearance of that of a fair complexioned European. When he was about twenty-two years of age, however, dark copper-coloured or brown spots began to appear on the face and hands; but these have remained limited to the portions of the surface exposed to light. About the time the black colour of the skin began to disappear, he completely lost his sense of smell; and since he has become white, he has had measles and hooping-cough a second time."—Dr. Carpenter's *Human Physiology*.

While upon this part of our subject, it may be as well to advert to that appendage of our tegumentary covering, the hair, the character of which has been invested with such undue importance, as to be made the test or criterion of a specific difference in the races of man. The African nations have been emphatically and collectively called woolly haired; but here again the revelations of the microscope have clearly demonstrated that the hair of the negro is not wool, and that in its intimate and essential structure, its sole difference from that of our own consists in having a greater abundance of pigmentary matter contained in its interior. Even in this country and among ourselves, it is no uncommon thing for persons of jet black hair, but of whom the bare idea of the slightest admixture of negro blood cannot for a moment be entertained, to have not only the peculiarity of a greater quantity of colouring matter, but sometimes also to present the African characteristic—hair so crisp and so frizzled as almost to deserve the epithet of woolly. Now the characteristic differences in the structure of the hair and that of wool, as revealed by the microscope, have been admirably pointed out by our great ethnologist, Dr. Prichard.

The hair, like the epidermis, is a beautifully organized structure, and maintains a vital, though not a vascular connexion with the body; for, under the sudden influence of a depressing passion, the whole of the hair of the head has been known to turn grey or of a silvery whiteness in the course of a single night. A hair consists of the bulb or root, the shaft or stem, and the point. In it we distinguish two elementary parts, a cortical or investing substance, of a fibrous horny texture, and

a medullary, or pith-like substance, occupying the interior. The hair expands at the base of the shaft into a bulbous enlargement, and this is lodged within a follicle formed by a depression of the cutis, and lined with a continuation of the epidermis. The whole tissue of the hair is derived from epidermic cells developed at the base of the follicle, which is itself extremely vascular. When the surface of the hair is examined by the microscope, it is seen to be covered with a coating of finely imbricated and flattened cells or scales, their edges forming delicate lines upon the surface of the hair, which are sometimes transverse, sometimes oblique, and sometimes apparently spiral. Within the scaly covering is the fibrous substance, which is translucent, with short longitudinal opaque streaks of darker colour intermixed; it is made up of straight, rigid, longitudinal fibres, and these, when separated, are found to be flattened, broad in the middle, and pointed at each end, with dark and rough edges. Professor Kölliker has shown that the colour of this portion of the hair is due not only to the presence of pigmental granules, either collected into patches, or diffused throughout its substance, but also to the existence of a multitude of *lacunulæ* containing air, which cause it to appear *dark*, by transmitted, and *white*, by reflected light.

The medullary portion occupies the centre or canal of the stem, and ceases towards the point. It is altogether wanting in the fine hair scattered on the general surface of the body.

Now wool, when examined under the microscope, exhibits filaments twisted and matted in all directions,—the shafts of the filaments not keeping a uniform calibre, but are thickened here and there, and often swelled with the appearance of knots. “The fibre of Merino wool,” says Dr. Prichard, “assumes a ribbandlike form with *serrated* edges. When the fibre is viewed as an opaque object, the serrations are found to result from a structure resembling a series of inverted cones, encircling a central stem, the apex of the cone being received into the base of the superior one; each cup-like cone having indented edges directed from root to point. But hair, on the contrary, although covered with scales or rugosities, has no serrations or tooth-like projections.”

To Mr. Youatt belongs the honour of discovering that the *felting* property of wool is dependant upon the *serrated character* of its fibre, and of pointing out that this *serrated character* constitutes the peculiar and diagnostic distinction between wool and hair.

“I have seen and examined,” says Dr. Prichard, “the filaments of hair belonging to different races of men, and compared them with the filaments of wool. Hairs of a negro, of a mulatto,

of Europeans and of some Abyssinians, were, together with the wool of a South-down sheep, viewed both as transparent and opaque bodies. The filament of wool had a very rough and irregular surface, though no serrations, distinctly so termed, were perceptible. The hair of the negro, which was extremely unlike that of wool, and of all the other varieties mentioned, had the appearance of a cylinder with smooth surface; they all appeared, more or less, filled with dark colouring matter, which, however, did not entirely destroy their transparency. The Abyssinian hair was very dark, but so far diaphanous, that a ribbandlike band appeared running down through the middle of a cylindrical tube; and the mulatto hair resembled the Abyssinian in this respect. The filament of European hair seemed almost entirely transparent; it had the appearance of an empty tube, coated internally with something of a dingy or dusky colour, which only prevented it from being quite pellucid. The negro has *hair* properly so termed, and not *wool*. One difference between the hair of the negro and that of an European is, that the former is more curled and frizzled, and another difference is the greater quantity of colouring matter or pigment in the hair of the negro; and it is very probable that this quality is connected with the former, and is its cause, though we cannot determine in what manner the one depends upon the other.”*

According to Vauquelin, the colour of the hair depends on the presence of a peculiar oil in the pigmental cells, which is of a sepia tint in dark hair, blood red in red hair, and yellowish in fair hair.

We may now proceed from the colour of the hair to the consideration of that of the skin; and of the influence of light and warmth in generating colouring matter in the pigmentary cells of the epidermis, we have a familiar illustration in the tanning of the face and the summer freckles from exposure to the rays of the sun. Many and various, we all know, are the expedients adopted by the fair portion of the creation, during a summer's sojourn, under a scourging sun, at the sea side, to guard against the production of such effects from the solar rays.

But, independently of the influence of light and heat, and from morbid or other causes within the body itself, it is no uncommon thing to meet with coloured portions of the skin, and of this we see a daily instance in the colour of the areola of the nipples of the breast during the period of pregnancy.

It is, however, a matter of common observation, and not without significance, that fair skins, from exposure to the sun's

* Prichard's "Natural History of Man", p. 101.

rays, assume a reddish brown tinge; whilst others, amongst whom there previously existed any shade of a dark or swarthy tinge, become of a still more swarthy hue.

Now the remark is significant, inasmuch as we clearly perceive the influence of light and warmth is modified by the complexion of the individual; but then it is not to be forgotten that the complexion itself is sensibly liable to variation within the limits of families, and, as a matter of course, far more so of races. On this point, I need only appeal to common observation,—How often, in the same family, among children of the same parents, do we not see one a *blonde* and another a *brunette*.

But before entering more fully into the consideration of the influence of physical causes—of climate and geographical position—in modifying the colour of the tegumentary covering, I would, and as briefly as possible, advert to the varieties of hue and complexion which are found to prevail among the typical races, so that we may be enabled to form a better and a truer estimate of the value of the colour of the skin, as a characteristic test or criterion of the type of the race with which it may happen to be associated.

And, first, let us advert to the highest—the Caucasian race, with which we are accustomed to associate a fair skin and a ruddy complexion. A brief survey will be sufficient to satisfy us that among the Syro-Arabian and Indo-European nations—the two great groups into which this race is divided—there exists every variety of hue and complexion. To the Syro-Arabian group belongs the Hebrew nation, which has spread itself nearly over the whole habitable globe. Now, while the Jews are still generally recognisable by certain peculiarities of physiognomy, we find among them, in this great metropolis, great variety of complexion. In this country generally, “blue eyes and flaxen hair are not uncommon, but a light brunette hue, with black hair, is most common. In Germany and Poland the ordinary complexion is more florid, with blue eyes and red hair. On the other hand, the Jews of Portugal are very dark, whilst those who have been settled from very remote times in Cochin and the interior of Malabar, are so black as not to be distinguishable by their complexion from the native inhabitants. Now, in the face of these facts, how can we avoid the conviction that the complexion of the Jews tends to assimilate itself to that of any nation in which their residence has been sufficiently prolonged? It is a curious circumstance, that there is at Mattacheri, a town of Cochin, a particular colony of Jews, which arrived, at a comparatively late date, in that country, and which are called Jerusalem or white Jews.”

Again, in the Indo-European group of nations, we have most

striking examples in the variation of the colour of the skin ; for the complexion of the Hindoo does not less differ from that of a Scandinavian than does that of the Negro ; there exists every shade of gradation interposed between the fair hair and blue eyes of the inhabitant of Northern Europe and the jet black of the dweller in the plains of India. Among the Hindoo nation alone, we meet with the most marked diversities of complexion ; some are black as negroes, some are of a copper colour, others little darker than the inhabitants of Southern Europe, and others have actually fair complexions, with blue eyes and auburn or even red hair. "These diversities," it has been justly observed, "appear to be connected with two sets of conditions as their operating causes. The first place must be assigned to the marked differences of climate which prevail betwixt the mountainous elevations of Kashmir, or Kafiristan, and the low plains bordering the great rivers in India. But the distinction of castes is scarcely of secondary consequence, since it perpetuates the same mode of life in particular families from generation to generation, and also tends to render permanent any variety that may spontaneously spring up and restrain it with the limits of the caste in which it occurs. The high caste people of the northern and more elevated parts of India are remarkable for the fairness of their complexions ; while the Affghans, descended from the Median stock, and speaking a dialect derived from the ancient Zend, contain within their passes every variety of complexion, from that of the dark Indian to that of the fair European." In fine, it may be truly said of the Caucasian race, whatever we may assume to be its typical complexion, that that type is subject to every kind and degree of modification.

2ndly. Among the Mongolian nations we meet with a like variety of complexions. It must be admitted, that a certain admixture of a yellow hue is one of their most constant characters, but even this is found to entirely disappear.

Lieutenant-General Briggs, to whom we are so much indebted for the valuable papers which he read before this Society on the Aboriginal Tribes of India, and who has had printed (published?) two lectures which he delivered before the Royal Asiatic Society, has fully established the fact that the aborigines of India are of Scythian origin—Mongolian,—while the Hindoos, of the Caucasian race, came from an opposite direction. The General rejoices in finding that Mr. Hodgson, the late president at Nipal, while labouring on the spot among the Himalaya mountains, has arrived at the same conclusions as himself.

"It is to me," he says, "a source of singular gratification

that my views should so entirely coincide with those of a philosopher who has devoted so much of his life to researches of this nature. He is of opinion that there is an identity both in physiognomy and philology of the several aboriginal races of India which, while it stamps them of one stock, distinguishes them from the Arian race. He declares his conviction that all the aborigines of India are north men of the Scythic stem, but he hesitates to pronounce positively from which of the three great branches they are derived. His opinion, however, inclines him to think that all those who are found on the east of the river Dhansri, in Assam, belong to the Chinese; while those on the west, which include all I have described, belong to the Thibetan branch. Of these he speaks decidedly. The aborigines of India are all of the Tamilian family; they are, says he, now for the most part British subjects. They are counted by millions, extending from the snows to the Cape (Comarin). Yes, in every hilly or jungly tract there exist hundreds of thousands of human beings not materially different from the Germans, as described by Tacitus. These primitive races are ancient heritors of the whole soil, from all the rich and open parts of which they were driven by the usurping Hindoos.*

Now among these aborigines of India, the northern Asiatics, and still existing in the hilly regions of the north, in the Decan, and especially in Ceylon, there is found considerable variety of complexion even within the limits of the same nation. "The Cingalese," says Dr. Davy, "vary in colour from light brown to black; the prevalent hue of their hair and eyes is black, but hazel eyes and brown hair are not uncommon; grey eyes and red hair are occasionally seen, though rarely; and sometimes the light blue or red eye, and light flaxen hair, of the Albino." Dr. Davy, in describing such a one, remarks, that "her complexion would scarcely be considered peculiar in England, certainly not in Norway, for her eyes were light blue, not particularly weak, her hair of the colour that usually accompanies such eyes, and her complexion rather rosy. It is easy to conceive," he adds, "that an accidental variety of this kind might propagate, and that the white race of mankind may have sprung from such an accidental variety. The Indians are of this opinion; and there is a tradition or story among them in which this origin is assigned to us." This tendency towards a fair and even florid complexion, with light blue eyes and bushy hair, can be traced in several other nations of the same type, such as the Mantchoos in China,

* Vide "Two Lectures on the Aboriginal Races of India, as distinguished from the Sanscretic or Hindu Race." By Lieut.-Gen. Briggs. Delivered before the Royal Asiatic Society, May 8th, and June 15th, 1852.

and also among the Chinese themselves. On the other hand, the hardy Samoiedes, Tungasians, and others living on the borders of the Icy Sea, have a dirty brown or swarthy complexion. A scantiness of hair is generally found in the Mongolian type, but there are affiliated tribes whose hair and beards are long and bushy.

In my former communication on the varying forms of the cranium, I adduced, in illustration, the case of the Magyars—the nobility of Hungary,—a handsome people, of fine stature, of European features and complexions, and inferior to none in their physical and mental endowments; and yet there is both historical and philological evidence to prove that they are a branch of the great northern Asiatic stock, and closely allied in blood to the stupid and feeble Ostiaks and the untamable Laplanders, of a dirty brown and swarthy hue. Again, if the views of Mr. Norris be confirmed, they point to the fair Circassian and Georgian nations as being but an improved race of the Mongolian type.

3rdly. Among the Ethiopian or African nations, it has been said, no variety in the colour of the skin exists, blackness, with a reddish or yellowish tinge, being universal; but the remark is founded on ignorance. There does exist great diversity of complexion among the African races. We see in the Kafir tribes high foreheads, prominent noses, a light brown complexion, and red hair; and is the origin of the Kafir different or distinct from that of the Negro, with whom he is connected by varying degrees of affinity? The Fúlaks of central Africa are of a dark copper colour, while the Hottentots of the Cape have a large admixture of yellow. But the widest departure from the blackness of the Negro is found among the African nations who border on the Red Sea. According to M. d'Abbadie, they exhibit specialities on the one hand which approximate closely to the Negro type, while in other respects, particularly in the hue of their skin, the severance is complete; so that they evidently constitute a series of links between the Negro and the ancient Egyptian race. And here, as elsewhere, the lightest complexions and a superior physical conformation characterise the inhabitants of the highlands, whilst the dwellers on the low plains beneath the same latitudes approach nearer to the true Negroes of their neighbourhood, not merely in the blackness of their skin, but in the thickness of their lips, the flatness of their noses, and crispness of their hair. I need not remind you that the researches of Dr. Pritchard lead to the conclusion that the ancient Egyptians were so closely allied to the Negro race that the origin of both was probably the same, and that the complexion of the ancient Egyptians, as repre-

sented by their own artists, seems to have been of a red copper or light chocolate colour, and to have resembled the present complexion of the reddest of the Fúlahs and Kafirs. But instances enough, I hope, have been adduced to show that the complexion and colour of the skin is no such definite and characteristic distinction as to sever the Negro races from other branches of the family of man.

And to me it only seems necessary to take a very cursory glance at the Oceanic races—the Malayo-Polynesian—to be perfectly satisfied how futile is the attempt, where the diversities are so great and so numerous, to make the colour of the skin and the character of the hair criteria by which to distinguish these races from the other typical stocks.

And, lastly, of the American races the epithet “red men” is by no means characteristic. Some of the American Indians are copper coloured, some as fair as any Europeans, others are of a brown or yellow complexion, and others nearly, if not quite, as black as the Negroes of Africa.

After the cursory survey which I have taken, we may now return, and, I hope, better prepared, to the consideration of the operating physical causes, which exert a modifying influence upon the colour of the skin. Among the first, and by far the most important, are climate and geographical position; for it may be asserted without the fear of contradiction, that it is only in the intertropical regions, and in the countries bordering upon them, that we meet with the greatest depth of colour in the skin. All the nations inhabiting those regions exhibit a tendency to complete blackness, though it must be admitted, such a tendency, by other circumstances, may be kept in check. Next to geographical position, elevation above the sea level, and the degree of humidity in the air, are generally allowed to be the two physical conditions which exert the greatest modifying influence upon the colour of the skin. Sir R. Schomburgk and M. D’Orbigny lay great stress on the influence of the latter, humidity—and, by each, as the result of personal and independent observation on the inhabitants of the new world, it is remarked, that people who live under the damp shade of dense and lofty forests, are comparatively fair; whilst those exposed to solar heat on dry and open spaces, are of a much deeper hue. Again, it is a matter of common observation, that elevation has the same effect upon the human complexion which it has upon the growth of plants, and that the inhabitants of mountainous districts are fairer than those on the plains at their base.

It must be admitted, as I have already observed, that the influence of light and warmth are at first modified by the original

complexion of the individual, but I think that direct historical evidence abundantly proves, that a continued exposure for a sufficiently lengthened period of time, leads to one uniform result. To quote from a writer, to whom I am greatly indebted, "We have seen," says he, "that the Arab, living in the country of the negro, becomes of negro blackness; that the negro, dwelling on the banks of the Nile, presents the dark red tinge of the ancient Egyptian; that the Jew, transplanted into the northern regions of Europe, has the original swarthy complexion of his race replaced by a fair hair, and even a florid hue, whilst another offset of the same stock rivals in blackness the Hindoos among whom he dwells; that the Hindoo, when he migrates to the high lands of the Himalaya range, becomes, in process of time, as fair as the Europeans, who have come thither from the far north; that the natives proved by the affinities of language to be the descendants of the great Arian stock, which has dispersed itself through every variety of climate, admit of every variety of colour; and that equal and similar varieties of colour abound among the members of other groups of nations, as among the American and Polynesian, whose geographical distribution and linguistic affinities afford a strong presumption of a common origin. We cannot conceive that any candid person can weigh this mass of evidence without coming to the conclusion, that the most extreme differences of complexion are unsafe indications of an original distinctness of race, and that these differences owe their origin far more to the prolonged influence of external physical conditions, than to any other assignable cause."*

On the other hand, those ethnologists who maintain the doctrine of originally distinct types, are driven to the necessity of admitting not three or five merely, but twenty or upwards; there seems to be no limit to the number, for it must increase, as our knowledge extends, and we are continually hearing of tribes with whose physical characters we are little acquainted. But even admitting the theory of distinct stocks, we should expect, as a necessary consequence, that each race should be characterised by fixed and definite distinctions, common to all its sub-divisions; but, on the contrary, do we not actually find these characters becoming softened down, and all verging to one common type?

To conclude, does not the survey which we have taken force upon our minds the conviction, that the colour of the skin, and the character of the hair, are absolutely valueless as distinctive characteristics of race?

* Edinburgh Review, vol. lxxxviii, p. 458.

The more closely and carefully we study the typical races, and the effects of climate and position on their geographical distribution, the more we are constrained to admit that tegumentary differences present to us no impassable barrier against the conclusion, that all the existing varieties of the great family of man are derived and descended from a single stock. On the contrary, does not the conviction become irresistible for the unity of the human species, when we look around us in this great metropolis, and behold, amid the "chosen people," the Hebrew nation, the descents of Abraham, every variety of complexion, from the fair-haired, rosy and ruddy faced Englishman, to the crisp and frizzley-haired, and dark and dusky countenance of the swarthy Negro.

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LIST OF THE BEAVER SPECIES

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ON THE
PHYSIOLOGICAL AND PSYCHOLOGICAL
EVIDENCE IN SUPPORT
OF THE
UNITY OF THE HUMAN SPECIES.

BY
ROBERT DUNN, F.R.C.S., F.E.S.,
ETC.

[From the Ethnological Transactions.]

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M.DCCC.LXI.

PHYSIOLOGICAL AND PSYCHOLOGICAL EVIDENCE

THE NATURE OF THE SENSES

In two former communications to the Society—(the "On the
 Nature of the Sense of Touch" and "On the Nature of the
 Sense of Hearing") I have endeavored to show that the
 sense of touch is not a simple sensation, but a complex
 one, and that the sense of hearing is not a simple
 sensation, but a complex one. I have endeavored to
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ON THE
PHYSIOLOGICAL AND PSYCHOLOGICAL EVIDENCE,
ETC.*

IN two former communications to this Society,—One “*On the varying forms of the Human Cranium, viewed in connection with the outward circumstances, social state, and intellectual condition of man ;*” and the other, “*On the Tegumentary differences which exist amongst the different races of men*”,—I have enforced the argument for the unity of the human species. But to my mind, the evidence which is furnished by physiology and psychology on the same subject is equally conclusive, and I have on the present occasion to solicit your attention to some observations bearing on this view of the question, and which, unless I am greatly mistaken, tend to strengthen and confirm the conviction, that the genus *Homo* is one. I make no apology, for asking the attention of the Society to considerations on a subject so strictly and decidedly physiological and psychological ; for, on a review of the past, I am quite sure no one can accuse us of indulging too freely or too often in such themes, at our evening meetings. On the contrary, indeed, to me it is a marvel, that papers of a physiological bearing should have so rarely been read before us ; and which, seeing that Ethnology comes legitimately within the province of the medical inquirer, can, I fear, only be accounted for by what is certainly a still far greater marvel,—that, in this great metropolis, so few of our medical brethren should be associated with us. It is true, that our society had its origin among them, and I well remember the enthusiasm which existed, and in which I participated, at the time of its inauguration. It is equally true, that its presidential chair is at the present time filled by a distinguished member of our profession,† and that it has not only been filled by a Brodie and a Conolly, but even by Dr. Pritchard himself,—our great ethnologist,—the founder of Ethnological science in this country ; still, and I must say it,—ethnology, or at least the Ethnological Society of London, has not received from the medical profession of this great metropolis that general and cordial support which might have been expected, and to which I think it is entitled ; for surely “the proper study of mankind, is man,” in all his varieties and diversified aspects ; and moreover, if there be one branch of the inquiry more interesting than another, it is unquestion-

* Read, July 20th, 1859.

† Sir James Clarke, Bart.

ably that in relation to the psychological differences which exist among, and which characterize, the different races of the great family of Man.

On a general survey of the whole animal kingdom, it must be conceded, that man is the only being adapted by his anatomical structure and organization to go erect, so that the graphic and descriptive contrast of the poet is not more pointed than it is just.

“Pronaque cum spectent, animalia cetera terram,
Os homini sublime dedit; cœlumque tueri
Jussit; et erectos ad sidera tollere vultus.”

The erect attitude, and biped progression are peculiarly and exclusively the prerogatives of man, and at a glance they reveal to us his most obvious and distinguishing characteristics. For those anthropomorphous animals whose structure and organization approximate the most to his are all *quadrumanus*, and having opposable *thumbs* upon their lower as well as upon their upper extremities, they are not fitted for the erect attitude, nor for biped progression, but they are admirably adapted and organized for living upon trees, for climbing, *grasping*, and *holding*;—in the expressive language of Cuvier, they are

“Les grimpeurs, par excellence.”

But they want, as firm supports for the erect posture and biped progression, the breadth, strength, and solidity of the human foot,—Man’s large and prominent os calcis, with which to tread upon the earth; his capacious and expanded pelvis, as a basis of support to the upright trunk; and the length and strength of his lower limbs, for progression and support. It has been aptly remarked,—“No instance has ever been produced of a monkey supporting the body *in equilibrio* on *one foot only*, and that the cause of this prerogative of the human organization is to be found, in the breadth of the human foot, in the resting of its entire surface upon the ground, on the bony and muscular strength of the lower extremity, and in the length of the cervix femoris.”*

The Myth of the *Wild-man* of the woods has vanished from among us, but, strange to say, Lamarck’s theory of the transmutation of species, and that man is the lineal descendant from the monkey, has been revived of late. This fanciful hypothesis has found a warm and zealous advocate in the popular author of *The Vestiges of the Natural History of Creation*;—one, of whom it has been truly said, “that his clear, pleasant, racy

* Lawrence’s Lectures on the Natural History of Man.

self-sufficient style, has captivated, when the dry, heavy, technical disquisitions and manuals of professors have disgusted;" and of whom the late gifted professor, Edward Forbes, has justly observed, that "The *man* who succeeds in half persuading the majority of his readers of his six editions, and a supplement to boot, that they and all mankind are the lineal descendants of mud-worms, and monkeys, and this too in spite of the protests of all living investigators of these several animals, anatomically and palæontologically considered (man included) has a power within him which might be turned to better purposes, and when he has added *knowledge to that power*, will, we trust, do so, calmly confessing his sins and publicly recanting his faith in the transmutation of species."* This ingenious advocate admits his inability to indicate the branch of the simian family from which we are the lineal descendants; nor has he been pleased to inform us, whether he holds to the opinion of Monboddo and Rousseau, and believes with these philosophers, that men like their reputed ancestors, had originally tails. But he does maintain the necessity of two local origins for the human race; one for the Asiatic, European, and American varieties, and another for the African; and that the former, he says, "seem to be connected with the great development of the *Quadrumana* in Southern Asia, and the latter with that of Western Africa. The Chimpanzee, and more especially the *Troglodytes Gorilla*, among apes and monkeys, may be *proximus huic*; still to man, even in his lowest and most degraded type, there can be no dispute that it is "*longo sed proximus intervallo*." For, in the eloquent language of Professor Sedgwick, "Man stands by himself the despotic lord of the living world; not so great in organic strength as many of the despots that went before him on nature's chronicle, but raised far above them all by a higher development of brain; by a frame-work that fits him for the operations of mechanical skill; by superadded reason; by a special instinct for combination; by a prescience that tells him to act prospectively; by a conscience that makes him amenable to law; by conceptions that transcend the narrow limits of reason; by hopes that have no full fruition here; by inborn capacity of rising from individual facts to the apprehension of general laws; by a conception of a cause for all the phenomena of sense; and by a consequent belief in a God of nature."†

The barrier is indeed impassable which separates man from

* Literary Papers of Professor E. Forbes.

† Sedgwick's Discourse on the Studies of the University of Cambridge.

the chimpanzee, and the claims to a *common humanity* are immediately recognised, for they are irresistible, wherever *two-handed* and *two-footed man* makes his appearance, however debased the type may be and mean the garb in which that humanity is clothed. Having already, however, whilst considering the varying forms of the human cranium, and the tegumentary differences which exist among the different races of men, indicated the legitimate inference to which such considerations so clearly and indisputably conduct us,—I need not now dwell upon those minor anatomical peculiarities which have been noticed among the different races of men; such as the differences of stature; the varying shapes of the pelvis; the cucumber shin of the negro; the elongation of his heels, and the breadth and flatness of his feet—for they present no valid objection, but, on the contrary, rather tend to strengthen and enforce the argument for the unity of the human species.

On entering, however, upon the consideration of the physiological evidence, the narrow limits of a paper like the present, necessarily restrict me to its more salient points. Dr. Prichard, indeed, has exhausted the subject, and all naturalists and physiologists—and who, of all others, are the best qualified to form a correct opinion on the subject—have subscribed to the *truth* of Dr. Prichard's general axiom, that while on the one hand, the great laws of the animal economy, such, for instance, as those expressive of the periods and duration of life, the economy of the sexes, the phenomena of parturition and of reproduction, are *constant and regular in each* particular species of *animals*, with only occasional slight deviations, resulting from external influences, so, on the other hand, in regard to these same particulars, there is found to exist *decided differences* among races of animals which are specifically distinct, however much they may appear to resemble each other.

Now recognizing in this axiom a *physiological fact*, and applying it as a test of the unity of species in the case of the whole family of man, the legitimate inference is clear and indisputable.

First, in reference to age, there is a remarkable uniformity in the average duration of life among all the nations of the earth when placed under similar circumstances in regard to climate and modes of life. The extreme age of the Negro and American Indian is as great as that of the European. But the contrast between man and those anthropomorphous animals, whose organization approaches the nearest to his, is striking; the utmost limit to which the life of the troglodytes gorilla extends is not more than thirty years, and the age of the inferior species of the chimpanzee does not range so high.

Secondly. As to the period of puberty, and the first appearance of the catamenial flux, there is found to exist great uniformity throughout the habitable globe. In proof of this, Mr. Robertson of Manchester, with great labour and indefatigable industry, has collected a mass of evidence from all parts of the world. He has established beyond contradiction that there exists no considerable difference either in the average period of puberty, or in the earliest date of menstruation, among the various tribes who are scattered over the whole habitable earth from the equator to the poles; and that neither does a cold climate retard, nor a warm one accelerate it, as has been popularly supposed. The only marked exception occurs in the case of the Hindoo females, with whom, on an average, the catamenial flux appears about two years earlier than it does among other nations. But Mr. Robertson justly, in my opinion, considers that the peculiar habits of the Hindoos tend in more ways than one to *force* forward the period of puberty. For instance, "It is the law of the Shastras, that females shall be given in marriage *before* the occurrence of menstruation, and that, should *consummation not* take place until after this event, the marriage is a *sin*. Accordingly it is the custom in Lower Bengal to send the girl at the age of nine years to the house of her husband, unless the latter be so distant that it cannot be done. And two ancient Hindoo sages are of opinion, that if the marriage is not consummated before the first appearance of the catamenia, the girl becomes "*degraded in rank*." But at Bangalore it would seem that this revolting custom does not obtain, the husband refraining from taking his wife to his own house, till not less than sixteen days have elapsed subsequently to puberty. Now, as has been well observed, "it can scarcely be questioned, that such a premature sexual excitement will have a tendency to accelerate the period of puberty; and that when this is constantly acting through a long succession of generations, an early puberty may come to be the character of the race."

Again, according to Mr. Robertson's inquiries, the *frequency of the catamenial flux*, and the *epoch of life to which it extends*, are equally constant among different races, and the duration of pregnancy, as we are all well aware, is the *same amongst all*.

Thirdly. *As to the economy of the sexes*. The *fertility of hybrid races*, and even where the affinity is most remote, is beyond all dispute. Indeed, "*half-castes*" very generally combine the best attributes of the two races from whence they originate: thus, when the parents are Europeans on the one side, and the aborigines of any country on the other, we find the intelligence and mental activity of the

European, and the climatic adaptation of the *native*, developed. It was, indeed, at one time believed, on the authority of Count Strzlecki, that when a native female of the American, Polynesian, or Australian races, has once been impregnated by a European male, she thenceforth loses all power of conception from intercourse with the male of her own race. But the utter baselessness of a belief so inconsistent with all the known facts connected with the history of the human race, has been indisputably proved, so far as the aboriginal females of Australia are concerned, by Dr. F. R. H. Thomson, surgeon in the Royal Navy; and in proof of this, I need only remind you of the paper which he read before this society, and which is published in the third volume of its *Transactions*, "On the reported incompetency of the 'Gins,' or Aboriginal Females of New Holland, to procreate with a native male after having borne half-caste children to a European or white." Dr. Thomson, indeed, admits that, wherever European settlers are commingled with the Aborigines of Australia, the native race disappears. This, however, he maintains, does not arise *from any deviation* of nature's laws, "but because the European, wherever he takes with him his civilization, takes with him his vices also; so that drunkenness and syphilitic disease soon become rife among the neighbouring population and cause their decline. "We all know," says he, "that many tribes of both North and South American Indians are extinct, and that in the gradual disappearance of such races, there is a degree of infecundity connected with their decline, and with the advance of civilized life into their distant prairies; but it has resulted from the diseases, the altered habits, the enervating and depressing vices which the white man takes with him, when he goes forth to seek a new home in the land of savages." He thus concludes, "That the various races of mankind can commingle and procreate without losing the capability of reproducing again, with their peculiar division of the human species, is abundantly proven, wherever the European has turned his steps. Let it be to North or South America, India, Africa, Japan, China, Polynesia—the traveller will find the half-caste, the mulatto, the creole, the olive—too often the elder brother of the *jet black*—the brown, the olive, and unmixed younger children to confirm, what is now asserted confidently, to hold good of the Aborigines of New Holland."*

I cannot dismiss the consideration of the physiological evidence without adverting to the confirmation which the revelations of the microscope have given to the dicta of Holy Writ—

* Journal of the Ethnological Society, vol. iii, p. 246.

that "God has made of one blood all the nations of the earth, to dwell upon all the face of the earth; for these prove to demonstration that human blood, whether from Caucasian, Mongolian, Æthiopian, or half-caste, presents the same identical corpuscles, and contains the same elementary constituents—in other words, that the blood is precisely the same in all the races of man.

We may now proceed to the most interesting and important branch of the whole inquiry—the *psychological*: for, beyond all dispute, it is in the *physical character and its manifestations* that the attributes of humanity essentially and peculiarly consist. Before entering, however, upon the consideration of the psychological evidence in support of the unity of the human species, it appears to me to be expedient for its better understanding and appreciation, to pass in review the leading phenomena of the mental states, taking a cursory glance as we proceed, at the more prominent facts of comparative psychology.

Now the more closely we observe and diligently study the composite nature of man, as an animal and social, a moral and religious, as well as an intellectual and thinking being, the more clear and irresistible becomes the conviction, that the genus homo is endowed with innate and instinctive cravings and impulses—animal appetites and instincts; with personal or individual, and social propensities and affections; with emotional, moral, and religious intuitions and feelings, as well as with intellectual faculties, reasoning and reflective powers.

Man, of whatever race, is at first the mere creature of sensation and instinct. As soon as embryonic life is passed, and an independent individual existence is established, the nascent consciousness becomes awakened—the senses coming into play from the moment of birth. And thus his outer life begins with consciousness, and with consciousness it ends. But as for consciousness itself, that is an ultimate fact, beyond which we cannot penetrate. It is an essential attribute of animal life; not a particular faculty, co-ordinate with the other mental faculties, but the universal condition of intelligence. It is equivalent, in short, to the knowledge that we possess of our own personal identity, for it is implied in every sensation which we experience, and in every mental act that we perform—on *feeling, perceiving, willing, and thinking*. We are all aware that the great and fundamental mystery of life consists in the relations of consciousness, and of that dynamical agency, or intellectual force, which we call volition, or the will, to the functions of the special senses, and to those of the perception and intellectual faculties, which connect man as a sentient, percipient, and thinking being, with his own organization and

with the world without. But consciousness is one and indivisible; its unity is the deepest and most indisputable fact in the nature of man, and we can best conceive of it in relation to time, not only as an incalculably rapid succession of acts or states, but as passing through a series of successive developments.

Now, there are three phases of consciousness common to all the races of man, successively developed,—the sensational, the perceptive, and the intellectual, and under these, all the mental phenomena of man, of whatever kind, are comprised and may be grouped. To *feel*, to *perceive*, and to *think*, in other words, *sensation*, *perception*, and *intellection*, are different and distinct acts or states of consciousness, successively developed. For we feel, before we can perceive, we perceive and form ideas before that we can think,—and long ere we can either reason or reflect, we manifest the animal instincts and the social propensities, affections and feelings. Self-consciousness as the earliest, is necessarily the lowest, phase of mental development, for in it the mind, at first, exists in a state of bare receptivity; the senses, indeed, come into play from the moment of birth, but the intelligence is purely *sensational*, the feelings are simply those of pleasure and pain, and the impulses to action are innate and instinctive. All our actions are automatic reflex, consensual, and instinctive, until the perceptive consciousness has been developed. But I need not dwell upon the phenomena of the sensational consciousness,—that is, on the intuitions of the special senses,—sensori-motor, consensual, and instinctive feelings and actions, for these at least, beyond all dispute, are common to all the races of man.

And so too, it is equally evident, are the instinctive intuitions of the perceptive consciousness, for they are a common inheritance. The instincts, as the untaught activities of our animal nature, are *innate*, and as subjective feelings they arise in obedience to certain laws of our nature, or are brought into action in direct response to stimuli acting upon the sensational consciousness from *without*;—but, no sooner has the perceptive consciousness begun to dawn, than greater mental activity is manifested, increasing in intensity and energy, as the sphere of its action is widened; arising, not only from the direct conflict of the perceptive faculties with the external world, but also from the development of the will or intellectual force, and from the evolution and play of the individual or personal and social propensities and affections, and of the emotional, moral, and religious intuitions and feelings. For, in the second stage of our mental progress, *ideas* are formed and retained in the mind, for *memory* exists, *volitional power* is developed and exercised, and *emotional sensibility* is awakened and

manifested ; and thus, in the progress of mental development, to the sensational the perceptive phenomena are superadded ; these are *ideation* and *volition*, with their associates *memory* and *emotional sensibility*. The genesis of the *will* and of the *memory* is in the perceptive consciousness ; and it is, through the perceptive consciousness, that the animal propensities and affections, and the emotional, moral, and religious impressions and feelings are evolved and brought into play. For the perceptive consciousness is not limited in the sphere of its action to the mere ideation of external existences, their sensible qualities and physical attributes. It has a far more extended range, for excepting the sensational intuitions, all our immediate or intuitive knowledge of whatever kind, appertaining to man, as a social, moral, and religious being, has its origin or source in perceptive experience. Long before he has attained even to the utterance of articulate speech, and as soon as the perceptive consciousness begins to dawn, and the power of recognition is awakened, he is able *intuitively* to interpret the tones, gestures, and expressions of emotion, and becomes sympathetically affected by them. Before all teaching, he has an intuitive æsthetic sense of the true, the beautiful, and the good ; of sublimity in nature, and of harmony in sound. Moral intuitions of right and wrong, and emotional of *awe*, *veneration* and *reverence*. Thus, an intuitive apprehension of *right* and *wrong* is attached to certain actions, and evidently *precedes* in his mind any distinct comprehension of the language, by which moral truths are conveyed. The flush upon the cheek, and the early sense of shame, come before there has been any traces of thought, as the consequences of misconduct or crime. In the expressive language of Lord Bacon—"The light of nature not only shines upon the human mind, through the medium of the *rational faculty*, but by an *internal instinct*, according to the law of conscience, which is a sparkle of the purity of man's first estate." And so again with the moral are closely connected the religious intuitions of his soul. These are developed more or less distinctly amongst the earliest of human sentiments, in the form of *awe*, *veneration*, and *reverence*, inspired by objects of sublimity, grandeur, vastness, and mystery. In process of time, other elements, first the intellectual, then the moral, are joined to our primary intuitions, until at length man reaches the elevation of an intelligent, voluntary, and cheerful dependence upon an Infinite and all-perfect Being."

In man's moral and religious attributes the inferior animals do not participate, and this constitutes an immutable distinction between him and them. In regard, however, to sensa-

tional and perceptive experience—to the phenomena of the sensational and perceptive consciousness, they both stand on the same platform; for the mental process is alike *intuitive* in all, and the difference is one of *degree*, and not of *kind*. In some respects, indeed, they far surpass him, for he has neither the far-seeing eye of the eagle, nor the scent and smell of the hound. The true difference between man and the lower animals rests specifically and fundamentally on the greater number and higher nature of his perceptive and intellectual faculties, and on his moral and religious attributes. The dog not only knows his own master, and remembers scenes and actions where they have been associated together, but, from habitual companionship, acquires an intuitive comprehension of his master's emotional nature, which enables him at once and without hesitation to recognise its manifestations, and causes him to be sympathetically affected by them. He may be said to have well nigh all the rudiments of our perceptive knowledge—ideation, emotion, memory, and volition, but he holds them in an instinctive form. He recognises his master by certain characteristics, but disguise them and you baulk his instinct. He is deficient in *reflective*, as opposed to *intuitive* or *immediate* knowledge.

It is, however, through the phenomena of the intellectual consciousness, retrospection, and the operations of thought, ratiocination, and reflection, that man is raised so immeasurably above the brute creation, and attains to his dominant mental development in the highest reason, and the freest will. The human mind, rising above sensation, and above perception, soars into the region of representative knowledge, and grasps through the intellectual and reflecting faculties, abstract ideas, and necessary and universal truths; finding articulate utterance and expression for them in the noble faculty of speech in language.

If such, then, be the leading phenomena of the mental states, it remains to be inquired whether they are a common inheritance, and manifested by the whole family of man.

But before doing this, there is another attribute of humanity—the exclusive prerogative of *man*, yet *common to all the races of man*—the *faculty of articulate speech*, which is far too important to be overlooked. It is the crowning gift of his beneficent Creator, and as a distinguishing and characteristic attribute of humanity, it not only now, but has always existed among all the nations of the earth. It is, indeed, as natural for man, constituted as he is, and endowed with the faculty of speech, when vividly affected, to give expression and to find utterance in articulate sounds, for his feelings, emotions, ideas,

and thoughts, as it is for him voluntarily to use his locomotive powers in progression. To the natural language of inarticulate sounds, gestures, and actions, he at first added the conventional language of signs, and afterwards alphabetical writings, until, in the fulness of time, his invention of the art of printing consummated the benefits derived from the noble prerogative of speech.

As the instrument of thought and reasoning, the value and importance of language is paramount. We reproduce in speech the mutual relation of our thoughts to objects, and the order and relation of our thoughts themselves. Words are thus the pabulum of thought. They are, in fact, the final expression of that mental process, as well as the depository of its final results, by which knowledge becomes definite, *exact*, and *communicable*, and through which the human mind, elevated above *sensation* and above *perception*, soars into the region of representative knowledge, and rising to its highest phase of development, gives to reason its all but infinite range, and all but omnipotent force. Philological researches into the origin and structure of languages have a direct bearing upon the great question at issue. They furnish a powerful argument in support of the identity and unity of the human species, by establishing, among other points, that of the genealogical relations of tribes, long since dispersed, from their original centres, and associated at present by strongly-marked physical and psychical differences. Had I the time, I would still have to regret my utter inability to follow up this subject; but the philological researches into the origin of languages—their analysis, composition, and classification, which originated in the speculations and discoveries of Leibnitz, have been successfully pursued by William Von Humboldt, Bunsen and others abroad, and by Prichard and Latham among ourselves. To our honorary associate, the late Baron Bunsen, we are especially and greatly indebted; and most sincerely do I wish that I could rouse into activity the mental energy of some of the fellows of this society, who from their philological attainments are so eminently qualified to discuss this subject, and to place before us the bearings of the philological evidence on the great problem we are now considering. It must be conceded, that it is to philological inquiry we must look for the chief evidence in determining the question of the radiation of the human family from a single centre, or from several centres.

We may now revert to the inquiry, whether the psychical characters or phenomena of the mental states, which I have dwelt upon, are common to all the races of man. Not only to the European as the most civilized, but also to the bushman,

the negro, and the Australian savage—the most degraded types of the genus *homo*—and whom it has been a fashion with some to represent as little better than improved apes, and as having no sufficient claims to the brotherhood of humanity.

Truly the contrast when “*we look on this picture and then on that*” is striking and startling. And vividly has this contrast been depicted, and cogently has it been reasoned upon, by Dr. Prichard. “Let us imagine for a moment,” says he, “a stranger from another planet to visit our globe, and to contemplate and compare the manners of its inhabitants; and let him first witness some brilliant spectacle in one of the highly-civilized countries of Europe—the coronation of a monarch—the installation of St. Louis on the throne of his ancestors, surrounded by an august assembly of peers and barons, and mitred abbots, anointed from the cruise of sacred oil brought by an angel to ratify the divine privilege of kings. Let the same person be carried into a hamlet in *Negroland*, in the hour when the sable race recreate themselves with dancing and barbarous music; let him then be transported to the saline plains, over which bald and tawny Mongols roam, differing but little in hue from the yellow soil of their steppes, brightened by the saffron flowers of the iris and tulip; let him be placed near the solitary den of the *bushman*, where the lean and hungry savage crouches in silence like a beast of prey, watching with fixed eyes the birds which enter his pitfall, or the insects and reptiles which chance brings within his grasp; let the traveller be carried to the midst of an Australian forest, where the squalid companions of kangaroos may be seen crawling in procession in imitation of quadrupeds. Can it be supposed that such a person would conclude the various groups of beings whom he had surveyed to be of *one* nature, *one* tribe, or the offspring of the same *original stock*? It is much more probable that he would arrive at an opposite conclusion.” But he justly adds, “It is only by tracing the history of the diversified human races from ancient times, and by comparing the former with the present state, we are made aware of the great changes which time and circumstances have effected in the condition of particular nations, and are brought to admit the probability of the opinion, that being apparently so different in their manner of existence, they can be in any way allied.

“It is this inquiry that brings within our observation, in the first instance, one of the great distinctions between the nature of man and that of animals. I allude to the *uniformity* of habits in successive generations which prevails through all the tribes belonging to the lower departments of the living

world, and *variations* which take place in human races, and their tendency to improve or to alternate periods of improvement with reverses and retrograde changes.

The Numidian Lion and the Satyr of the desert, the monarchies of Bees and the republics of African Termites, are precisely today what they were in the age of Æsop and in the kingdom of Juba; while the descendants of the tribe, who are described by Tacitus as living in squalid misery in solitary dens, amid the morasses of the Vistula, have built St. Petersburg and Moscow, and the posterity of cannibals and Phthirophagi, now feed on pillaus and wheaten bread. When we consider that the habits of men are so changed in some races whose past and present state comes within the sphere of history, we cannot presume to determine that such differences as those to which we have before adverted may not have been the result of circumstances favouring the progressive improvement of our race, and in other instances preventing it, or forcing a tribe already civilized to return to the brutality of savage life.*

After a thorough and searching investigation into the history of the different savage nations, and proving beyond controversy, that they are all *degraded castes* from recognized human races, and after illustrating the fact in the conversion of the Hottentots into Bushmen, for the change of a mild, confiding, and unenterprising race of shepherds, into fierce, suspicious, and vindictive savages, who issue from the fastnesses of their rocky deserts only to plunder and destroy, as has been witnessed even within the present generation, as the result of the encroachments of European colonization on the one hand, and of the Kafirs on the other, Dr. Prichard thus concludes:—
 “We contemplate among all the diversified tribes who are endowed with reason and speech the same internal feelings, appetencies, aversions, the same inward convictions, the same sentiments of subjection to invisible powers, and more or less fully developed, of accountableness or responsibility to unseen avengers of wrong, and agents of retributive justice, from whose tribunal men cannot even escape by death. We everywhere find the same susceptibility, though not always in the same degree of forwardness or ripeness of improvement, of admitting the cultivation of these *universal endowments*, of opening the eyes of the mind to the more clear and luminous views which Christianity unfolds, and of becoming moulded to the institutions of religious and of civilized life; *in a word, the same inward and mental nature is to be recognised in all the*

* Dr. Prichard's Natural History of Man, p. 487-8.

races of men. When we compare this fact with the observations, fully established, as to the specific instincts and separate psychical endowments of all the distinct tribes of sentient beings in the Universe, we are entitled to draw confidently the conclusion, that all human races are of one *species* and one *family*." In these sentiments and in this conclusion I think we must all cordially agree with Dr. Prichard; for, as assuredly as God made of one blood all the nations of the earth, so has he endowed them all with the same animal, intellectual, moral, and religious nature, and thus has he bound them together—in accordance with the high behest, that they should increase and multiply, and replenish the earth, *in one common bond of universal brotherhood.* But, again I would ask, are we not, from a strictly psychological view of the subject necessarily led to the same conclusion. It is never to be forgotten, that man is born into the world, not a mere blank recipient of impressions, and that the human mind comprehends *implicitly* from its earliest existence *every thing* which its interior nature is calculated afterwards to develope. For the germs (so to speak) or essential elements of all his mental activities, his sensational, emotional, perceptive, and intellectual as constituent endowments, are present *from the first.* They exist implicitly, *ab initio*, in every *mens sana*, and in due order and succession, they are each severally evolved *explicitly* as the successive phases of consciousness become developed.

To my friend, the late Mr. George Combe, belongs the honour of having first clearly demonstrated that the harmony which exists between the constitution of nature and the mental constitution of man is an all pervading principle of Creation, and a perfect and beautifully symmetrical system—thus indisputably establishing the fact, that the world throughout its constitution is framed in admirable adaptation to the faculties of man, as an intelligent, a moral, and a religious being.

But by no teaching, by no training or culture can we create a new mental faculty, any more than we can invent a new law of nature, or give a new organ of sense; and thus while on the one hand, where the germs or essential elements of an intellectual, moral, or religious nature are wanting and do not exist implicitly, *ab initio*, whatever may be the race to which the individual belongs, whether Caucasian, Mongolian, or Ethiopian, it is hopeless to expect that such a nature can be educed and evolved, so on the other hand, and as the tree is known by its fruit, wherever we meet with unmistakable evidence of the workings of an intelligent nature, and with proofs of the existence of moral and religious intuitions manifesting themselves in the sympathies and susceptibilities

of affection, and in an internal consciousness of accountability, more or less obscurely developed in the feelings of self-condemnation for guilt, and the desire of expiation, we at once recognize the germs or essential mental endowments, however obscurely they may be developed, of our *common* humanity or brotherhood. And to what race can we point as destitute of the instinctive, sensational, perceptive, and intellectual intuitions of the mind. The Hottentots, as a branch of the Mongolian race, and from whom the *Bushmen* are a degraded caste, may not range high in the scale of civilization and refinement: but let me remind you of what Holbein, the Dutch voyager, has said of them:—their besetting sin was indolence,—dirty and slothful in their habits, they seemed to hate the trouble of thought,—but they were not deficient in intellect. He knew many who understood Dutch, French, and Portuguese to a degree of perfection;—one particularly, who learned English and Portuguese in a very short time, and who understood and spoke them with surprising propriety and readiness. They had a firm belief in *supreme powers*, both of good and evil, and religious rites to conciliate them. They held the soul to be *immortal*. They opposed the introduction of christianity at first; but eventually lent a more ready and willing ear to its preachings, than any other uncivilized nation had done, and speedily improved, through its reception, not only in moral character and conduct, but also in outward circumstances and prosperity. So again of the negro race, can we not point to distinguished characters, both in literature and science amongst them? And as to the general character of their mental endowments, Dr. Carpenter has well observed—“It is not a little interesting to remark, that there are elements in their character, which have been deemed by competent judges, capable of working a considerable improvement in even Anglo-Saxon civilization; for many intelligent thinkers have come to the conclusion, that the boasted superiority of the latter, is after all, more *intellectual* than *moral*, and that in purity and disinterestedness of the affections, in child-like simplicity and gentleness of demeanour; in fact, in all the milder graces of the Christian temper, we have much to learn from the despised *negro*. And what were the aspirations, or rather, reasonable hopes, of the philanthropic Channing, after much observation on the race. “I would expect of them, says he, if civilized, less energy, less courage, less intellectual originality than in ours; but more amiableness, tranquillity, gentleness and content; they might not rise to an equality in outward circumstances, but they would probably be a much happier race.”

I need not further enlarge upon this point—but with the recognition of the *right* of the degraded bushman and the negro to our common humanity assuredly comes the *claim* of the duties of brotherhood towards them, and they incur a grave responsibility, who would enslave and hold in bondage their fellow men, “as *domestic cattle* or *wild fowl*.” Before that all important *unity* of the human species which has its firm and solid basis in the participation of every race, in the same intellectual, moral and religious nature, and in the community of the same social and moral rights, alike the privilege of all, the unity from the consanguinity of a common descent, sinks into comparative insignificance. But to conclude—Admitting that the unity of the species by physiological and psychological evidence has been established, the “*quæstio vexata*” still remains: Have there been more creations than one of the same genus, more Adams and Eves than one single pair?

That distinguished naturalist, Professor Agassiz, contends, that it is impossible to account for the geographical distribution and varieties of conformation of many existing species of animals, and he includes man in the number, without having recourse to the idea, that instead of the individuals of a species having descended from a *single parentage*, or pair of ‘*protoplasts*,’ they are the offspring of several distinct pairs of ‘*protoplasts*’ first introduced in different localities, all presenting the same essential nature, modified in accordance with the special conditions in which each was destined to exist. But to this hypothesis of the radiation of species from several distinct centres, the late professor Edward Forbes was strongly and decidedly opposed. Maintaining as he did, that the peculiarities in the geographical distribution of existing species, is quite reconcilable with the idea of *migration* from *single* centres, and that generally speaking they necessarily lead to this idea; whilst, on the other hand, in those instances in which detached or outlying spots occur, remote from the principal area of distribution, and from each other, he considers that these represent the original extent of range, which has been subsequently interrupted by geological changes, that have been fatal to the existence of the species, over the intermediate connecting area; and he affirms, that in many cases, these peculiarities may be thus explained, by known geological changes since the introduction of the species in question. It is greatly to be regretted, that he did not live to give his matured views on the subject to the world in a more complete form than by oral discourses.

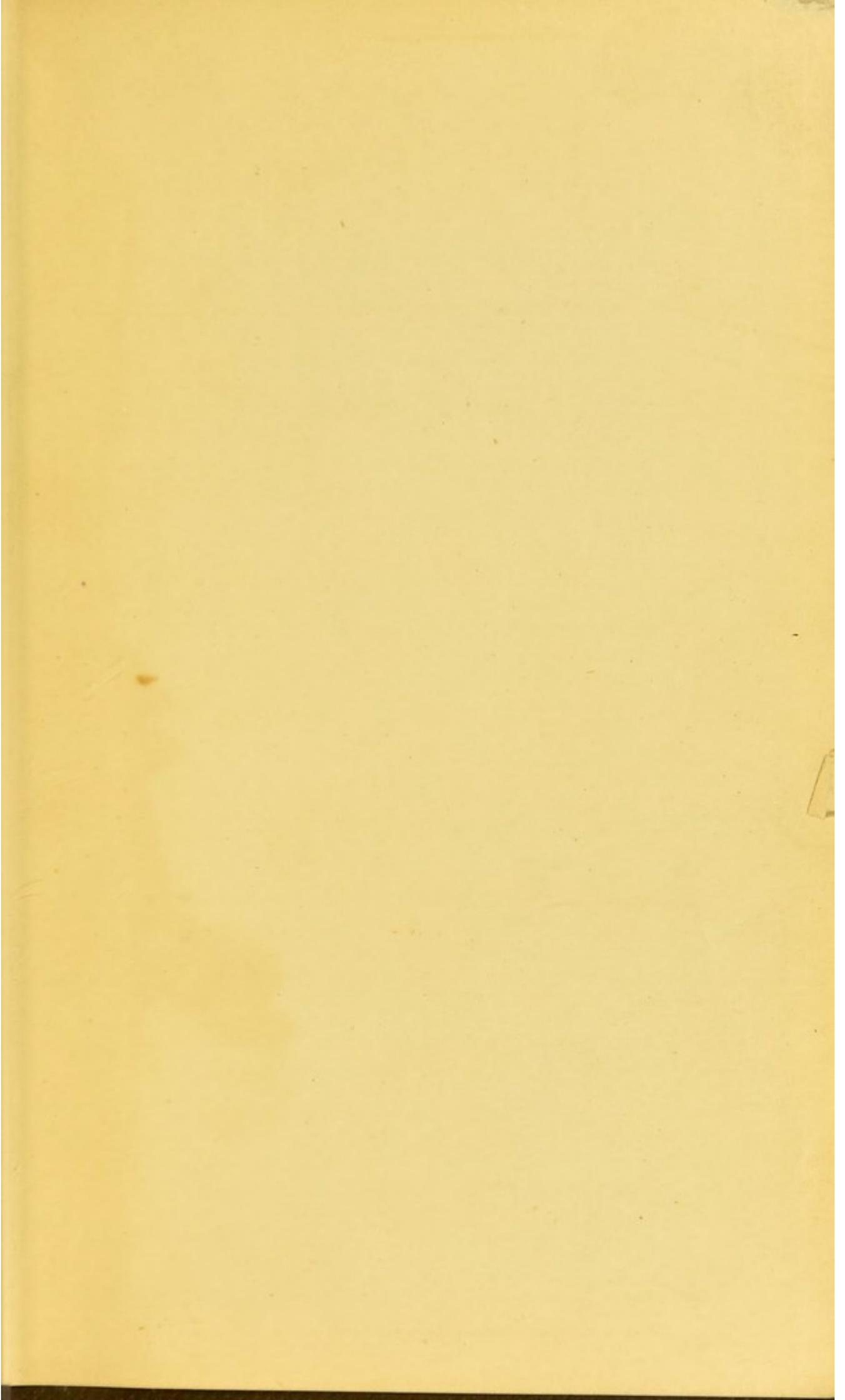
With Prichard, Latham, and Forbes, my own mind at present

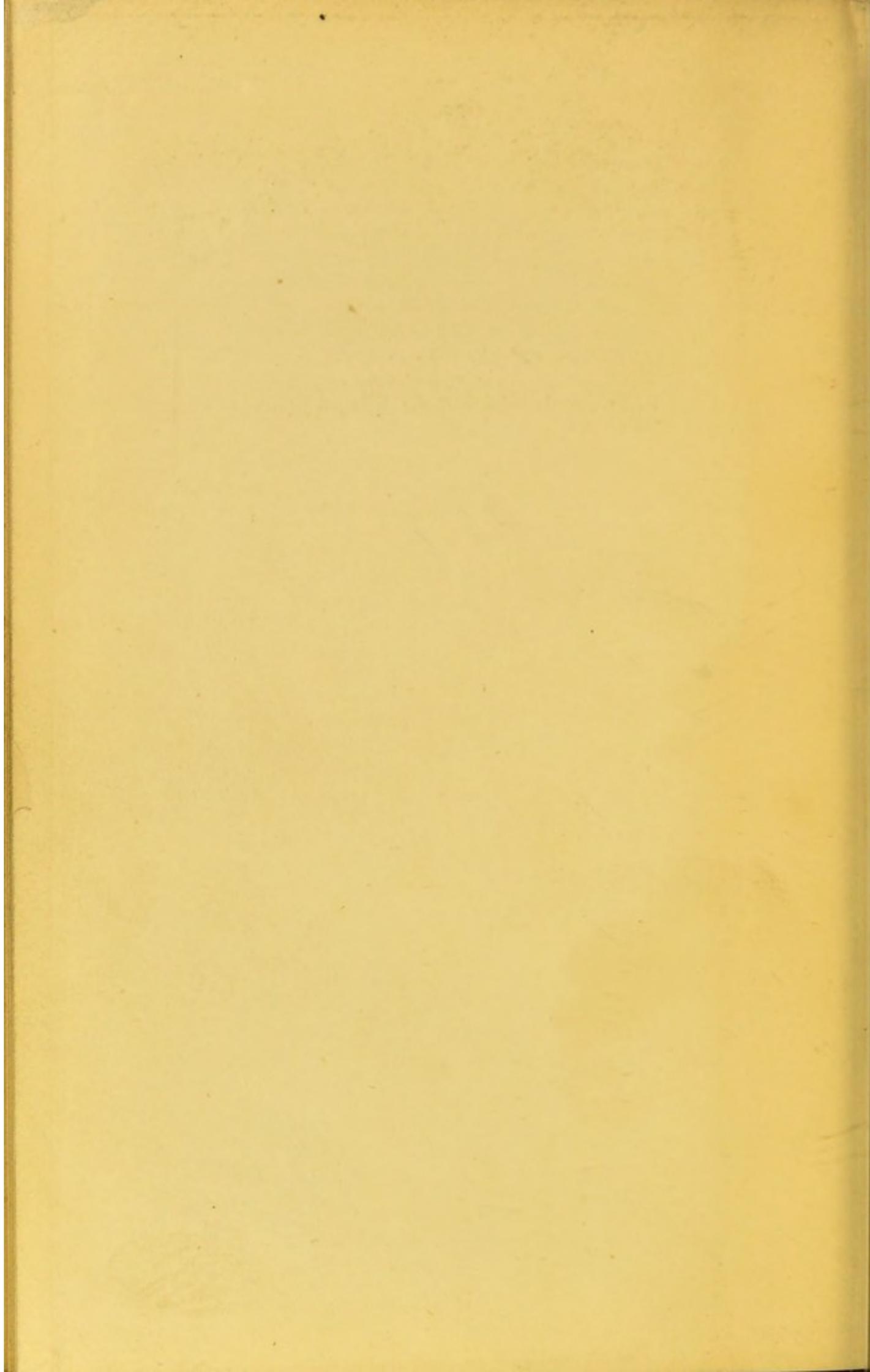
rests in the conviction so well expressed by Dr. Carpenter, that the supposition of a number of distinct '*protoplasts*,' one for each principal region of the globe, is not required to account for the extension of the human family over its area, and it does not afford any assistance in accounting for the phenomena of their existing distribution; since each principal geographical area contains races of very diversified physical characters, the affinity of whose languages makes it next to certain that they must have had a common descent."*

* Dr. Carpenter, On the Varieties of Mankind, in Dr. Todd's Cyclopædia of Anatomy and Physiology, vol. iv, p. 1364.

The first part of the book is devoted to a general
 introduction of the subject. The author discusses the
 history of the subject and the various methods
 which have been employed in its study. He then
 proceeds to a detailed description of the
 various parts of the system, and finally
 concludes with a summary of the results
 which have been obtained.







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