plans of study laid down in the technical high-schools of Germany, in the technical schools of England and of our own country, may be profitably followed.

In 1897, we expressed the view which seems thoroughly applicable now and which will perhaps bear repetition here. We said: "It seems, therefore, that the demand of the present time and of the immediate future can be met only by broadly educated men: by men who have been trained, not only in chemistry itself, but in the great principles of physics as well. A good technical chemist must be first of all a thoroughly educated chemist. After that, to attain the highest success in this country, he must be educated in the principles of engineering; the production and applications of heat; the production and applications of electricity; the transmission of power, the movement of liquids; in general, the means whereby the reactions of chemistry may be carried out in a large way We need, therefore, chemical engineers, and these in the nature of the requirements must be broadly and thoroughly educated men. While they must be trained in the work of the research laboratories, which are being organized in connection with many of the great industries, they must likewise be prepared to put into practical operation in a large way the results of the researches they have been called upon to make."

These truths have not changed and if these conditions of education and training are fully met, the progress of our chemical industries must be greatly augmented, the science must, by reaction, be actively advanced and following the experience of our German confrères in the words of Meyer, we may look hopefully forward, and in the near future proudly backward, to accomplishments greater than the world has ever known.

WM. MCMURTRIE.

NEW YORK.

*MAN'S PLACE IN NATURE.**

IN the opening paragraphs of his most memorable contribution to knowledge ('Man's Place in Nature,' 1863), Huxley made mention of certain similarities between the activities of anthropoids and those of men; and, while the burden of the work was devoted to structural homologies, the initial keynote was retouched here and there throughout the discussion. Huxley's classic contribution to anthropology needs no encomium; it was a pioneer's mile-mark of progress, erected under difficulties; and it suffices that all later travelers have found it in the direct way of experiential truth. Yet it is worth while, now and then, to take stock of advances subsequent to, and largely consequent on, the Huxleian declaration.

Since Huxley's pioneer work, a host of investigators have carried forward the study of structural homologies connecting the genus *Homo* with lower genera and orders; and to-day the physical similarities are among the commonplaces of knowledge, whatsoever the background of philosophical opinion concerning cause and sequence. During the last decade or two the investigators themselves, with scarce an exception, have gone one step further, and now include sequence of development from lower to higher forms as among the commonplaces of opinion, whatsoever the background of metaphysical notion as to cause. There the strictly biologic aspect of the question as to man's place in nature may safely be considered to rest; there has been little advance in opinion beyond that of the pioneer in 1863; but the data have been multiplied, and the knowledge and opinion have been diffused widely.

Since Huxley's epoch-marking memoir

*Address of the retiring President of the Anthropological Society of Washington, delivered before the Washington Academy of Sciences and Affiliated Societies, February 26, 1901.

was first published, occasional contributions have been made to knowledge of the activities displayed by various sub-human animals, and during the last quarter of the nineteenth century a science (which has been called the New Ethnology) has been organized to deal with the activities of mankind; yet singularly little has been done in the way of tracing activital homologies between the genus *Homo* and lower genera. It is indeed conventional for sociologists, and customary for comprehensive writers on anthropology, to instance the social habits of mammals and birds, and even of insects and infusoria, as analogous to human society; one naturalist has gone so far as to study various mammals and birds in their activital aspects, thereby opening a most attractive field in science as well as in literature; but investigators have not turned seriously toward the habitual activities displayed by the anthropoids—still less have comparative studies been made of the activities normal to both the higher quadrumana and the lower races of mankind, albeit this is perhaps the most inviting field now open to research. Thus far this line of inquiry grovels in the stage of travelers' tales: the gorilla-hunter tells how the family sire sleeps at the foot of a tree in which mother and young are nested; the naturalist in Liberia incidentally describes the use by monkeys of stick and stone implements, while the Bornean tourist tells of the simian servant who prefers the society of human masters to that of his kin and discriminates among the garments he is permitted to wear; but there is a woeful dearth of critical observation and a lamentable lack of judicious generalization pertaining to this promising meeting-ground of zoology and anthropology. So this aspect, too, of the great question concerning man's place in nature remains nearly as it was left by Huxley; the data are more abundant, and opinion has been both clarified and diffused; yet definite homologies remain practically unfound, if not unsought, and the scattered facts have thrown little light on cause, less on sequence.

Since Huxley's prime, the New Ethnology has arisen; and it has opened a vista of facts and relations which apparently escaped the keen vision of the pioneer in 1863—the vista embracing thought, with all the other psychic factors pertaining to the activities, sub-human as well as human. This vista is perhaps the broadest and most attractive ever opened by science: When Galileo descried the harmonious paths of the planets in a sun-centered system, he raised the minds of men to a new plane; when Newton grasped the idea of gravitation, he gave human thought a new hold on nature; when Darwin discerned the lines of specific development, he wrought a revolution in the world of intellect; but when students still living scanned the lines of activital development and realized that thought itself is bred by the very activities over which it comes later to hold dominion, they opened a new intellectual world—a world at once so novel and so commanding that some of the students themselves are fain to sit at the gate and view the prospect as fleeting phantasm rather than veritable reality. Nor is their hesitation either unprecedented or unpardonable: When the biologists of only one long generation ago unrolled the scroll picturing the origin and perpetuation of species through natural interactions, their interpretation seemed too simple to be true; when the anthropologists of the present generation unrolled a similar scroll picturing the origin of activities (arts, industries, laws, languages, doctrines) through natural interactions and self-developed interrelations—and in this way alone,—their interpretation in turn seemed too simple to be true; and when the anthropologists of the old century's end (and

of this Society) unroll a scroll picturing the origin and development of thought itself through the long chain of interactions between the thinking organism and external nature—and in this way alone,—they foresee that their interpretation must seem too simple to be true—though they find comfort in the teachings of experience that in the long run simple explanations are preferred, that simple doctrines at last prevail, indeed that the progress of knowledge is best measured by its own simplification. But even after full allowance for hesitation and doubt, it must still be said that the opening of the post-Huxleian vista has had much effect; it has widened the view of nature to include the psychical as well as the physical aspects of organisms; it has correspondingly narrowed the range of extra-natural explanations of phenomena; and, specifically, it has revealed a new class of homologies among the races of men and between these and sub-human organisms. So the homologies recognized to-day as defining man's place in nature are of three classes: (1) structural, as wrought out by Huxley; (2) activital, as suggested by Huxley and wrought out by Powell; and (3) mental, or psychic. Expressed otherwise, man's place in nature is now defined, first by what mankind and their kindred *are*, second by what they *do*, and third by what they *think*. And the chief progress of the post-Huxleian epoch, albeit practically confined to *Homo sapiens* in various grades of development, has followed the lines of psychic homologies.

It is just to say that the foundation for modern knowledge of psychic homologies was laid by Tylor in his 'Primitive Culture' (1871), and especially in the seven notable chapters on animism elaborated in successive editions; for he showed that a certain type of philosophy is of world-wide extent, and is, or has been, shared by every race, every known people, whatsoever their diversities of color or condition. This foundation was gradually raised into a definite platform partly by Tylor in later publications, partly by Powell in brief memoirs on 'The Mythology of the North American Indians' (1879) and 'Activital Similarities' (1881), in which it was shown that the interactions between distinct peoples and similar environments frequently produce similar activities, howsoever diverse the peoples themselves; and important additions to the platform were made by Brinton in various contributions summarized in his 'Religions of Primitive Peoples' (1897), in which he showed that the human mind, even in its more complex operations, reflects environment with striking fidelity. True (as recently shown by Boas*), the products of interaction between peoples and environment are in some measure inconsistent and may even at first sight seem contradictory; but, as pointed out on a previous occasion,† the incongruities shrink or disappear when the comparisons are confined to peoples in corresponding degrees of cultural development.

The modern platform for the study of psychic homologies may be defined briefly in terms of a few generalizations, which seem to be consistent with the sum of knowledge concerning the psychic attributes of both human and sub-human organisms, viz.: (1) the mentality of animals is instinctive rather (or more) than ratiocinative, and for each species responds practically alike to like stimuli; (2) the savage mind is shaped largely by instinct, and responds nearly alike to like stimuli; (3) all barbaric minds are measurably similar in their responses to environmental stimuli; (4) civilized minds rise well above instinct, and

*'The Mind of Primitive Man,' SCIENCE, Vol. XIII., 1901, pp. 281–289.

†'Cardinal Principles of Science,' *Proceedings of the Washington Academy of Science*, Vol. II., 1900, p. 11.

work in fairly similar ways under like stimuli; and (5) enlightened minds are essentially ratiocinative, largely independent of instinct, and less uniform in their responses to external stimuli than those of lower culture. The several generalizations are mutually and significantly harmonious; they combine to outline a course of development beginning in the animal realm with organisms adapted to environment through physiologic processes, and ending in that realm of enlightened humanity in which mind molds environment through nature-conquest;* and they measure the gradual mergence of bestial instinct in the brightening intellect of progressive humanity. To, or at least toward, this platform those working anthropologists concerned with the broader aspects of the science have been pressed by accumulating observations and generalizations; yet the platform owes much of its character and most of its strength to the concurrent development of a scientific psychology at the hands of a notable group of experimentalists in psychic phenomena. The several generalizations embodied in the platform have already been summarized as the latest and most comprehensive among the principles of science, *i. e.*, the responsivity of mind;† and by aid of this principle, psychic homologies may be traced between higher culture-grades and lower, and from people to people and tribe to tribe, down to the plane of lowest savagery—where the lines cease for lack of data, leaving the lowly mind in a state even more suggestively akin to that of the subhuman organism than is the lowest human skeleton to that of the highest anthropoids.

Especially within the last decade of the old century, anthropologists have come to recognize a course of development of the esthetic arts—a sort of natural history of esthetics, arising in symbolism, running through conventionism, and maturing in a degree of refined realism found satisfying by civilized and enlightened peoples. Now a significant feature of this development is found in the fact that the initial symbolism is zoic or animistic, putatively if not patently. The esthetic hunger of primitive artists is sated by the carving of totems on reefs or rocks, by the molding of animal effigies, perhaps by the delineation and painting of zoic pictographs; as the artists rise in the scale of culture the zoic designs are partly conventionized (eventually passing into arbitrary alphabets), partly perpetuated in more realistic forms still conceived as fraught with mystical meaning, like the asp of Egyptian sculpture, the dragon of oriental painting, the curiously vestigial unicorn of a modern nation's coat-of-arms, and even the eagles of other national insignia. So, also, when primal man first yields to the charm of music, his songs and accompaniments mimic the rhythmic footfalls of feared or venerated animals, the rustling sounds of animal movements, the inchoate melody of animal voices; when he enters the demesne of drama, his characters are beasts or uncanny monsters tricked out in zoic trappings; and it is only after long stages of development that anthropomorphic motives are introduced, and that the music and drama rise to the plane of realistic representation. In some cases, if not commonly, the germ of esthetic development quickens in painting of face or body, to grow into tattooing; in simplest form the painted devices may serve as

* Cf. 'The Seri Indians,' *Seventeenth Annual Report, Bureau of American Ethnology*, 1898, p. 269.

† "The cardinal principles of science may be reckoned as five: the indestructibility of matter, the contribution chiefly of Chemistry; the persistence of motion, the gift mainly of physics; the development of species, the offering of the biotic sciences; the uniformity of nature, the guerdon of geology and the older sciences; and the responsivity of mind, the joint gift of several sciences, though put in final form by anthropology." *Proceedings of the Washington Academy of Sciences*, Vol. II., 1900, pp. 11–12.

beacon-marks for the identification of kindred (like the face-marks of various animals), as among Seri matrons,* or may symbolize fearsome animals; as among Sioux warriors; but in every well-known case the motive is symbolic expression of zoic attributes. From these germinal efforts of esthetic faculty to that modern stage of art in which the noblest realism and the highest idealism are wedded, the way is long; but every step is marked by the dropping of zoic motives and the substitution of motives springing from human attributes and aspirations.

Within a few years working anthropologists have come to recognize more or less clearly a natural history of industries, comparable with that of arts—a course of development also arising in symbolism, running through instinct-guided conventionism, and maturing in that sublimest product of mentality, invention. It has long been known that barbaric artisans seek omens among birds, borrow lore from beasts, and run to zoic motives in decoration;† it has long been known, too, that savage huntsmen not only imitate the movements of feral animals in the chase and seek to incite their weapons and strengthen their arms by zoic trophies, but even mimic the carnivores' blood-craze in berserker rage at times of battle; and more recently it has been noted that the most primitive implements are of tooth, claw, shell and bone, selected and used as emblems of zoic power. In a typical tribe—the Seri, most primitive of known Amerinds—the pristine implement is a sea-lion tooth, differentiated into arrow, harpoon and fire-stick; the teeth themselves are classed as stones, and natural pebbles are used for tools emblematic of the zoic organs, while the methods of chase and warfare still mimic the habits of local beasts. The lines of human progress from primal savagery to enlightenment may be traced in terms of development of each or all of the great groups of activities; and while all the tracings conform so closely as to inspire confidence in each, no outline is more definite than that represented by the stages of industrial progress—stages best defined in terms of the mind-led activities of which artifacts are normal products. These stages (beginning with that typified by the Seri) are: (1) Zoömimic, in which bestial organs are used as arrows and other implements, to which magical powers are imputed by dominating zootheistic faith; (2) Protolithic, in which naturally formed stones are used for cleavers and other implements, under the sway of mystical faith modified by experience of mechanical chance; (3) Technolithic, in which design-shaped stones are used for knives and other implements in ways revealing the germ of invention; and (4) Metallurgic, in which ores are smelted and used for tools under the influence of invention.* Whether the progress be traced through these stages or otherwise, the way from the simple industries of the prime to the elaborate devices of modernity is long, very long; yet a full half of the steps are marked by the dropping of zoic motives and the substitution of motives expressing man's growing consciousness of power in nature-conquest.

Since Tylor traced primitive culture, and especially since Morgan wrote on 'Ancient Society' (1877), it has been recognized that all known primitive peoples are banded in consanguineal groups, while advanced peoples are bound in larger groups by laws defining proprietary and personal rights;

* The somatic and telic functions of face-painting are discussed in 'The Seri Indians,' op. cit., pp. 167 et seq.

† Even the faith-guided anti-zoic motive of arabesque decoration attests the force of the zoic tendency and the effect required to divert it.

* The stages and transitional sub-stages are set forth in greater detail in 'The Seri Indians,' op. cit., pp. 249–254.

and during the last decade or two working anthropologists have come to recognize the course of development of social organization in its several stages, *i. e.*, the natural history of law. Now it is significant that the most primitive social bond (found alike in America, Africa, Australia and parts of Asia) is that fixed by the ocular blood kinship of maternity, and that the next great stage is defined by paternal relationship; for in both stages the lines seem to be homologous with the instinctive habits of sub-human species, while the earlier the more closely approaches the low plane of brute knowledge —so far as this can be inferred from brute conduct. The researches among the aborigines of America have thrown strong light on the lowly laws of primitive peoples; for it has been ascertained that both savage clans and barbaric gentes are bound not merely by community of blood, but welded into homogeneous units by community of faith in zoic tutelaries—faith so profound, so blent with fear and hope, so impressed by recurrent ceremony from birth to maturity and thence to old age and death, as to dominate every thought and regulate every action. The Amerind tribesmen are grouped by totems (or tutelaries) of Wolf, Badger, Bear, Fox, Deer, Coyote, Eagle, Bluejay, etc.; they call themselves wolves, or badgers, or Bears, or Eagles, and glory in the strength and magical prestige believed to be brought them by their genii; most of them recite traditions of descent from the tutelary animals, or else from fantastic monsters invested with their attributes; and every adequately studied tribe has been found to possess a traditional genesis or sacred cosmogony in which the tutelaries, and perhaps other beasts, are glorified if not deified. The exoteric bond of clan or gens is blood-kinship; but the union is reinforced by an incomparably stronger esoteric bond of animistic belief. The way from beast-clanship to free citizenship is long—so long as to afford the most striking measure of human progress; yet every step of the way is marked by the elimination of zoic concepts and by the substitution of those concepts of higher humanity forced on the genus *Homo* through the ceaseless strife for nature-conquest.

During some decades past, students of aboriginal tongues have been impressed by the failure of primitive folk to discriminate clearly between men and animals in their every-day speech; and this lowly habit forms one of the phenomena which have served (as recently shown by Powell *) as a guide to the natural history of languages. Many Amerind tribes denote themselves by a term connecting animals, either in general or of a particular class, and when pressed to specify are compelled to employ an affix or adjective to distinguish the human kind (often considered inferior) from the rest; some, like the Papago, trace human genealogy through only a few generations, forward or backward, and conceive the lines as beginning and ending in an undifferentiated magma of zoic life designated by a single term; while some groups have progressed so far in the way of human superiority as to dignify themselves by the expressions 'Real Men,' 'True Men,' etc., in contradistinction from alien tribes and other contemptible creatures. The scroll picturing the development of language is expanded about midlength by the addition of the scriptorial branch, representing the growth of graphic expression: and it is quite in accord with the growth-lines of oral expression to find that the earliest essays in ideography are pictures of zoic objects, or objects to which zoic attributes were manifestly imputed. Most of the primal features of modern alphabets have been conventionized beyond recognition, but the hieroglyphs

* 'Philology, or the Science of Activities designed for Expression,' *The American Anthropologist*, Vol. II., 1900, pp. 603–637.

of Mexico and Egypt and the ideographs of China are among the clearer vestiges of primitive standards, while the fancy-wrought constellations of the celestial sphere —birth-mates of pre-Cadmean characters remaining unchanged by reason of remoteness from practical affairs—still conserve the graphic zoolatry in which writing began. The way from lowly language linking men and beasts in word and sign to a discrete graphic vocabulary is long; yet the earlier steps were unquestionably marked by the dropping of instincts shared by brutes and the substitution of humanitarian concepts impressed by ever-widening human associations.

Since Tyler taught the world-wide range of animism in 1871, anthropologists have grouped the myths and faiths of mankind in a series of stages outlining a course of development—a natural history of doctrine —coming up through a slavish and despairing hylozoism, and ascending thence through higher zootheism and broadening worship of nature-powers on successive planes each brighter and more humane than the last. The zoic factors in primitive arts, industries, laws and languages were manifestly made potent in the olden time, as they are to-day among lowly folk, alike by overweening faith and ever-present custom; they were, and still are, kept alive not only by recurrent ceremony and daily taboo and hourly precept, but by tireless study of animal contemporaries whose habits huntsmen must know under pain of hunger; so that much (perhaps most) of the sentient feeling of primal man must have been—as it is to-day among his survivors—of animal contemporaries. In savage life men and their animal associates are compelled to consecrate their best efforts to a study of each other; in affairs of feeling and faith as in matters of immediate utility, the association engenders habits of body maturing in instincts eventually ripening into action-shaping habits of mind; and the strongest mentality is naturally the more deeply influenced—until continued experience of superior faculty awakens consciousness of superior power, stirs the sleeping giant of self-confidence and rends the shackles of zoophobia forever.

> Lo, the poor Indian! whose untutored mind
> Sees *Beasts* in clouds, or hears *them* in the wind:

so a modern Pope would write of the American natives; and so, too, he might write of any and all other aborigines made known through the researches of the last half-century. The upward way from primal beast-faith through concurrent fetichism and shamanism, and thence through mysticism and all manner of occultism, is long and need not now be traced; it suffices that all of the earlier and many of the later steps were marked by the dropping of zoic motives or vestiges, and the substitution of ever nobler motives and imageries.

When the scrolls picturing activital development are brought together—when the natural history of doctrines is outlined over those of languages, laws, industries and arts—the leading lines are found consistent in every essential feature; and all are seen to rise from a mentality both reflecting and approaching that of lower animals (though just how closely may not be measured until the sub-human mind is better understood) toward the higher human plane revealed in science and statecraft. The savage Seri—lowest of American tribesmen —is loathed by Caucasian neighbors as an uncanny beast, and it is a revelation to find that he reciprocates the loathing and glories in the contumely, feeling that it allies him the more closely with venerated consociates like puma and shark, and divides him the more widely from the hated white creatures of unnatural ways; and the sentiment of the Seri is measurably common to all

aborigines of strong individuality. The impressive fact, learned alike through observation of a typical tribe and through analysis of the mental operations of primitive peoples in general, is that the savage stands strikingly close to sub-human species in every aspect of mentality as well as in bodily habits and bodily structures.

Since Huxley's prime the chief advances in anthropology have related to what men *do* and what men *think;* and the progress has been such as to indicate with fairly satisfactory clearness the natural history of human thinking as well as that of human doing. Thereby man's place in nature may be defined more trenchantly than was possible in 1871: (1) As shown by Huxley, the structure of *Homo sapiens* is homologous with that of lower orders, while the morphologic differences between highest anthropoids and lowest men are less than those separating lowest men from highest men; (2) As suggested by Huxley and established by later researches, the activities of *Homo sapiens* are homologous with those of the anthropoids, while the activital range between club-using gorilla and tooth-using savage is far narrower than that separating the zoomimic savage from the engine-using inventor; (3) As shown by the latest researches, the mental workings of *Homo sapiens* are homologous with those of lower animals, while the range from the instinct and budding reason of higher animals to the thinking of lowest man would seem far less than that separating the beast-fearing savage from the scientist or statesman. The resemblances and differences in doing and thinking may not yet be measured in definite units, as are cranial capacities and facial angles (though the recent progress in experimental psychology gives promise of quantitative determinations of general sort at no distant day); yet the relations are hardly less clear and tangible than those customarily measured in inches and ounces and degrees.

So, in the light of the latest researches, man must be placed wholly within the domain of nature, yet above all other organisms at heights varying widely with that highest product and expression of nature, mental power.

W J McGee.

THOMAS BENTON BROOKS.

Thomas Benton Brooks was born June 15, 1836, at Monroe, N. Y. He died November 22, 1900, at his home near Newburg, only a few miles from his birthplace, but during the sixty-four years of his life he had gone far, not only to distant countries but also to fields of experience and thought remote from his early environment. Born to the associations and inheritance of a small farm in a country district, he made his way to a prominent position in engineering and geology by his energy, ability and originality.

His early training and also his later education embodied more practise than theory. The district school, two years (1856–58) at the School of Engineering, Union College and a single course of lectures on geology under Lesley at the University of Pennsylvania (1858–59) cover his formal education, but he seized with eager purpose opportunities to learn in the school of practise. By observation of field methods he fitted himself to pass from axeman to rodman, levelman, transit man and topographer, first on surveys for the Erie Railroad and later on the newly initiated topographical and geological surveys of New Jersey in 1853. In this latter connection he served as axeman to an Austrian who employed a then little-known instrument, a plane table, and Brooks by watching him became so proficient in its use that he succeeded his chief. He was then seventeen. Subsequently, while a student at Union College, he made