SCIENCE.—SUPPLEMENT.

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THE ORIGIN OF LANGUAGES, AND THE ANTIQUITY OF SPEAKING MAN.

IN the study of every science there arise from time to time difficult questions or problems which seem to bar the way of the student in one direction or another. It becomes apparent that on the proper solution of these problems the progress of the science mainly depends ; and the minds of all inquirers are bent earnestly on the discovery of this solution. Such, in biology, are the questions of the origin of life and the genesis of species. Anthropology, and its auxiliary or component sciences of comparative philology, ethnology, and archaeology, have their share of these problems. Among them, two of the most important are undoubtedly, in philology, the question of the origin of linguistic stocks, and in archaeology, the question of the epoch at which man acquired the faculty of speech. A brief consideration of these questions, in the light cast upon them by the most recent discoveries, may therefore be deemed to form an appropriate introduction to the work of our section.

The question of the origin of languages must be distinguished from the different and larger question of the origin of language, which belongs rather to anthropology proper than to the science of linguistics, and will come under consideration in the later part of our inquiry. Nor yet does our question concern the rise and development of the different tongues belonging to one linguistic stock or family, like the sixty languages of the Aryan or Indo-European stock, the twenty languages of the Hamito-Semitic family, the one hundred and sixty-eight languages enumerated by Mr. R. N. Cust as composing the great Bantu or South African family, and the thirty-five languages of the wide-spread Algonkin stock. Such idioms, however much they may differ, are in their nature only dialects. The manner in which these idioms originate is perfectly well understood. But we have no satisfactory theory to explain the distinction between the families themselves. When, for example, we have traced back the Aryan languages and the Semitic languages to their separate mother-tongues, which we are able to frame out of the scattered dialects, we find between these two mother-tongues a great gulf, which no explanation thus far proposed has sufficed to bridge over. How strongly the sense of this difficulty has been felt by the highest minds engaged in philological study, will be evident from two striking examples. Sixty years ago, Baron William von Humboldt found it (as Dr. Brinton states) "so contrary to the results of his prolonged and profound study of languages, to believe, for instance, that a tongue like the Sanscrit could ever be developed from one like the Chinese, that he frankly said that he would rather accept at once the doctrine of those who attribute the different idioms of men to an immediate revelation from God." Fifty years later Prof. Abel Hovelacque, in his work, 'La Linguistique,' declared, as the final conclusion of science, that there could be no conceivable community of origin between systems so unlike as that of the Indo-European and that of the Semitic tongues. "The abyss between the two systems," he affirms, "is not merely profound : it is impassable."

The number of distinct linguistic stocks is computed to exceed two hundred, most of which are found on the western continent. Various attempts have been made to explain their origin, but none have gained general acceptance. Some of the most eminent philologists have given up the question, in despair of a solution. Yet the simple and sufficient explanation has been lying close at hand, awaiting only, like many other discoveries in science, the observation of some facts of common occurrence to bring it to light. In the present case, the two observers who have made the conclusive facts known to us have both been Americans, and both of them writers of more than ordinary intelligence ; but both were entirely unknown in this branch of investigation, and both, moreover, had the ill-fortune of publishing their observations in works of such limited circulation that their important contributions to science have hitherto failed to attain the notice they deserved.

Before setting forth the facts, it will be well to state at once the result of the inquiry. Briefly, then, the plain conclusion to which all the observations point, with irresistible force, is that the origin of linguistic stocks is to be found in what may be termed the language-making instinct of very young children. From numerous cases, of which the history has been traced, it appears that,

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when two children who are just beginning to speak are left much together, they sometimes invent a complete language, sufficient for all purposes of mutual intercourse, yet totally unintelligible to their parents and others about them. The first to observe, though not the first to publish, an instance of this nature was Miss E. H. Watson, a lady of Boston, the authoress of several esteemed works on historical subjects. In giving to the world, in 1878, a treatise by her father, the late George Watson, on 'The structure of language,' she prefixed to it an essay of her own on the 'Origin of language,' in which an interesting account is given of the 'childrens' language.' The children in question were twin boys, born in 1860, in a respectable family, residing in a suburb of Boston. They were constantly together, and an intense affection existed between them. "At the usual age," the authoress states, "these twins began to talk, but strange to say, *not* their 'mother-tongue.' They had a language of their own, and no pains could induce them to speak anything else. They persistently refused to utter a syllable of English. Their mother relates that although she could not understand their language, she contrived, by attention, to discover what they wished or meant." The important information is added that "even in that early stage, the language was complete and full; that is, it was all that was needed. The children were at no loss to express themselves in their plays, — their 'chatterings' with each other all day." At last they were sent to a school, where they gradually learned English, as children learn a foreign language, and the memory of their own speech faded from their minds.

Miss Watson, unfortunately, did not become aware of these circumstances until some time afterwards, when all recollection of this peculiar language was lost, except of a single word. Another observer, at about the same time, was more fortunate. A physician of Albany, Dr. E. R. Hun, in an article published in 1868, in the *Monthly journal of psychological medicine*, under the title of 'Singular development of language in a child,' has given a clear and scientific account of a similar phenomenon, with specimens of the language. In this case the speech was invented by a little girl, aged four years and a half, in conjunction with her brother, eighteen months younger than herself. About twenty of the words are given, most of which were used in several allied acceptations, — as *mea*, meaning both cat and furs; *migno-migno*, water, wash, bath; *bau*, soldier, music; *odo*, to send for, to go out, to take away; *waia-waiar*, black, darkness, a negro. The language had its own forms of construction, as in *mea waia-waiar*, 'dark furs' (literally, 'furs dark'), when the adjective follows its substantive. Dr. Hun adds, "She uses her language readily and freely, and when she is with her brother they converse with great rapidity and fluency."

Further inquiries have shown that such cases of child-language are by no means uncommon and these cases, it must be considered, are, after all, merely intensified forms of a phenomenon which is of constant recurrence. The inclination of very young children to employ words and forms of speech of their own is well known, though it is only under peculiar circumstances that this language acquires the extent and the permanence which it attained in the cases now recorded.

In the light of the facts which have now been set forth, it becomes evident that, to insure the creation of a speech which shall be the parent of a new linguistic stock, all that is needed is that two or more young children should be placed by themselves in a condition where they will be entirely, or in a large degree, free from the presence and influence of their elders. They must, of course, continue in this condition long enough to grow up, to form a household, and to have descendants to whom they can communicate their new speech. We have only to inquire under what circumstances an occurrence of this nature can be expected to take place.

There was once a time when no beings endowed with articulate speech existed on the globe. When such beings appeared, the spread of this human population over the earth would necessarily be gradual. So very slow and gradual, indeed, has it been, that many outlying tracts — Iceland, Madeira, the Azores, the Mauritius, St. Helena, the Falkland Islands, Bounty Island, and others — have only been peopled within recent historical times, and some of them during the present century. This diffusion of population would take place in various ways, and under many different impulses; — sometimes as the natural result of increase and overcrowding, sometimes through the dispersion caused by war, frequently from a spirit of adventure, and occasionally by accident, as when a canoe was drifted on an unknown shore. In most instances, a considerable party, comprising many families, would emigrate together. Such a party would carry their language with them; and the change of speech which their isolation would produce would be merely a dialectical difference, such as distinguishes the Greek from the Sanscrit, or the Ethiopic from the Arabic. The basis of the language would remain the same. No length of time, so far as can be inferred from the present state of our knowledge, would suffice

to disguise the resemblance indicating the common origin of such dialect-languages. But there is another mode in which the spread of population might take place, that would lead in this respect to a very different result. If a single pair, man and wife, should wander off into an uninhabited region, and there, after a few years, both perish, leaving a family of young children to grow up by themselves and frame their own speech, the facts which have been adduced will show that this speech might, and probably would, be an entirely novel language. Its inflections would certainly be different from those of the parent tongue, because the speech of children under five years of age has commonly no inflections. The great mass of vocables, also, would probably be new. The strong language-making instinct of the younger children would be sufficient to overpower any feeble memory which their older companions might retain of the parental idiom. The baby-talk, the 'children's language,' would become the mother-tongue of the new community, and of the nation that would spring from it.

Those who are familiar with the habits of the hunting tribes of America know how common it is for single families to wander off from the main band in this manner, — sometimes following the game, sometimes exiled for offences against the tribal law, sometimes impelled by the all-powerful passion of love, when the man and woman belong to families or clans at deadly feud, or forbidden to intermarry. In these latter cases, the object of the fugitives would be to place as wide a space as possible between themselves and their irate kindred. In modern times, when the whole country is occupied, their flight would merely carry them into the territory of another tribe, among whom, if well received, they would quickly be absorbed. But in the primitive period, when a vast uninhabited region stretched before them, it would be easy for them to find some sheltered nook or fruitful valley, in which they might hope to remain secure, and rear their young brood unmolested by human neighbors.

If, under such circumstances, disease or the casualties of a hunter's life should carry off the parents, the survival of the children would, it is evident, depend mainly upon the nature of the climate and the ease with which food could be procured at all seasons of the year. In ancient Europe, after the present climatal conditions were established, it is doubtful if a family of children under ten years of age could have lived through a single winter. We are not, therefore, surprised to find that no more than four or five linguistic stocks are represented in Europe, and that most of these are believed to have been of comparatively late introduction. In California, on the other hand, where the climate is mild and equable beyond example, and where small fruits, roots, and other esculents, abound at all seasons of the year, the aborigines are found to speak languages belonging to no less than nineteen distinct stocks. In Brazil, where the same conditions prevail, more than a hundred stocks, lexically distinct, have been found to exist. A review of other linguistic provinces yields results which strongly confirm the views now presented. A curious ethnological fact which tends in the same direction is the circumstance, which has been noticed by Major Powell, that, as a general thing, each linguistic family has its own mythology. Of course, when the childish pair or group, in their isolated abode, framed their new language and transmitted it to their descendants, they must necessarily at the same time have framed a new religion for themselves and their posterity; for the religious instinct, like the language-making faculty, is a part of the mental outfit of the human race.

But we are now brought face to face with another problem of great difficulty. The view which has just been presented shows that all the vast variety of languages on earth may have arisen within a comparatively brief period; and many facts seem to show that the peopling of the globe by the present nations and tribes of men is a quite recent event. The traditions of the natives of America, North and South, have been gathered and studied of late years, by scientific inquirers, with great care and valuable results. All these traditions, Eskimo, Algonkin, Iroquois, Choctaw, Mexican, Maya, Chibcha, Peruvian, represent the people who preserved them as new-comers in the regions in which they were found by the whites. Ethnologists are aware that there is not a tradition, a monument, or a relic of any kind, on this continent, which requires us to carry back the history of any of its aboriginal tribes, of the existing race, for a period of three thousand years. In the Pacific Islands the recent investigations have had a still more striking and definite result. We know, on sufficiently clear evidence, the times when most of the groups, from New Zealand to the Sandwich Islands, were first settled by their Polynesian occupants. None of the dates go back beyond the Christian era. Some of them come down to the last century. In Australia, the able missionary investigators have ascertained that the natives had a distinct tradition of the arrival of their ancestors, who entered by the north-west coast. It is most unlikely that, among such a barbarous and wandering race, a tradition of this nature should be more than two thousand years old. Probably it is much less ancient. We know

positively that the neighboring group of New Zealand was settled only about five hundred years ago. Passing on to the old continent, we find that the Japanese historical traditions go back, and that doubtfully, only to a period about twenty-five hundred years ago; those of China only about four thousand years; those of the Aryans, vaguely, to about the same time; the Assyrians, more surely, a little longer; and the Egyptians to the date fixed by Lepsius for Menes, not quite four thousand years before Christ. No evidence of tradition, or of any monument of social man, points to his existence on the earth at a period exceeding seven thousand years before the present time. Yet the investigations which have followed the discoveries of Boucher de Perthes have satisfied the great majority of scientific men that human beings have been living on the globe for a term which must be computed, not by thousands of years, but by tens and probably hundreds of thousands. Writers of all creeds, and of all opinions on other subjects, concur in the view that the existence of man goes back to a remote period, in comparison with which the monuments of Egypt are but of yesterday; and yet these monuments, as has been said, are the oldest constructions of social man which are known to exist. How shall we explain this surprising discrepancy? How shall we account for the fact that man has existed for possibly two hundred thousand years, and has only begun to form societies and to build cities within less than seven thousand years? In other words, how, as scientific men, shall we bring the conclusions of geology and palaeontology into harmony with those of archaeology and history?

Fortunately, the geologists and physiologists themselves, by their latest discoveries, have furnished the means of clearing up the perplexities which their earlier researches had occasioned. We learn from these discoveries that while a being entitled to the name of man has occupied some portions of the earth during a vast space of time, in one and perhaps two geological eras, the acquisition by this being of the power of speech is in all probability an event of recent occurrence. The main facts on which this opinion is based must necessarily, in this summary, be very briefly stated.

The earliest men of whom we have any certain knowledge, the paloeolithic men, as they are styled, are distinguished by scientific investigators, as is well known, into two distinct races, belonging to widely different epochs. Prof. Boyd Dawkins styles the earlier race the 'river-drift men,' and the later the 'cave-men.' The river-drift men were, in his view, hunters and savages of the lowest grade. In his opinion, this race is now "as completely extinct as the woolly rhinoceros or the cave-bear." We have, he considers, no clue to its ethnology; and its relation to the race that succeeded it is doubtful. The cave-men were of a much higher order, and were especially remarkable for their artistic talents. Prof. de Quatrefages distinguishes the types of the two races as the 'man of Canstadt' and the 'man of Cro-Magnon,'—terms derived from places where crania belonging to these races have been found. Prof. A. de Mortillet knows the earlier race as the 'Chellean man' or the 'man of Neanderthal,' and the later as the 'Magdaleoran man,'—designations also derived from localities where their remains or their implements have been discovered. An under-jaw of an individual of this race, the celebrated 'jawbone of La Naulette,' affords what Prof. de Mortillet considers decisive evidence that its possessor had not the faculty of speech. This evidence is thus stated by him: "In the middle of the inner curve of the jaw, in place of a little excrescence called the 'genial tubercle,' there is a hollow, as with monkeys. Speech or articulate language," he continues, "is produced by movements of the tongue in certain ways. These movements are effected mainly by the action of the muscle inserted in the genial tubercle. The existence of this tubercle is therefore essential to the possession of language. Animals which have not the power of speech do not possess the genial tubercle. If, then, this tubercle is lacking in the Naulette jawbone, it is because the man of Neanderthal, the 'Chellean man,' was incapable of articulate speech."

In 1880, another jawbone belonging to this race was found by Prof. Maschka in the Schipka cave, in north-eastern Moravia; and in this jaw, also, the 'genial tubercle' was lacking. The inference derived from this evidence is strengthened by the peculiar shape of the crania belonging to this race, which are singularly low in the frontal region, leading to the belief that the third or lower frontal convolution of the brain, sometimes called 'Broca's convolution,' was imperfectly developed in the men of this race, as it is known to be in the anthropoid apes. It is in this convolution that Dr. Paul Broca has determined the seat of the faculty of language, Any lesion or disease of this part of the brain, as medical men are aware, produces aphasia, or the loss of the power of speech.

The succeeding race, the cave-men, or men of Cro-Magnon, possessed, as their osseous remains show, not only the 'genial tubercle,' but remarkably high and well-developed crania. Prof. de Quatrefages pronounces them 'a magnificent race.' Their carved and engraved implements display a superior artistic faculty. In the opinion

of Dr. Broca, they were 'on the threshold of civilization.' They seem to have been contemporaries and perhaps offshoots of the highly endowed populations of early Egypt and Assyria. These singularly gifted populations of north-eastern Africa, south-western Asia, and western Europe were, so far as can be judged from the existing evidence, the earliest representatives of speaking man on the globe. Yet there can be no doubt that they were descended from the river-drift race. We have not here to deal with the origin of a new species, but simply with that of a variety. That in some family of the primitive speechless race two or more children should have been born with the faculty and organs of speech is in itself a fact not specially remarkable. Much greater differences between parents and offspring frequently appear. Among these, for example, is one so common as to have received in physiology the scientific name of polydactylism, — a term applied to the case of children born with more than the normal number of fingers. M. de Quatrefages mentions that in the family of Zerah Colburn, the celebrated calculator, four generations possessed this peculiarity, which commenced with Zerah's grandfather. In the fourth generation four children out of eight still had the supernumerary fingers, although in each generation the many-fingered parent had married a person having normal hands. Plainly, he adds, if this Colburn family had been dealt with like the Ancon breed of sheep, a six-fingered variety of the human race would have been formed; and this, it may be added, would have been a far greater variation than was the production of a speaking race descending from a speechless pair. The appearance of a sixth finger requires new bones, muscles, and tendons, with additional nerves leading ultimately to the brain. There is good reason to believe that the first endowment of speech demanded far less change than this.

Many skilled observers have sought to discover by various indications, such as the accumulation of débris in caves, the layers of earth formed by streams, the growth of bogs, and other evidences, the time which has elapsed from the era of the cave-men and the neolithic race to our own time. All their conclusions are in substantial accord. While the existence of the earlier race, the river-drift race, goes back to an indefinite period, which, according to some opinions, may exceed two hundred thousand years, nearly all the estimates place the appearance of the neolithic race, or men of the polished-stone epoch, within seven thousand years, and that of their predecessors, the cave-men, within eight thousand years, from our own time.

The question of the region in which speaking man first appeared is one on which there is room for a wide difference of opinion. It is a question about which no one will venture to dogmatize. The natural supposition, of course, would be that this first appearance took place somewhere near the centres of the earliest civilization. These centres were in Egypt and Assyria. Between those countries lies Arabia, in which, amidst the sandy desert that protects the land from invasion, there are many oases, large and small, blessed with a most genial climate and a fruitful soil. From that primitive centre, if such it was, the increasing population would speedily overflow into the plains of Mesopotamia and the fertile valley of the Nile; and there, or in their near vicinity, nearly all the animals which were first tamed, and nearly all the plants which were first cultivated, would be found. We need not be surprised, therefore, to find that the great majority of investigators have looked to south-western Asia for the primitive seat of the human race. The most distinct tradition that has come down to us of the earliest belief respecting the creation of man — the tradition which is preserved in the Hebrew narrative — places it in an oasis on the Arabian border, and dates it apparently at about the time when, as all the evidence seems to show, man endowed with speech first appeared.

The conclusions to which this inquiry, guided by the most recent discoveries of science, has directed us, may be briefly summed up. We find that the ideas of the antiquity of man which have prevailed of late years, and more especially since Lyell published his notable work on the subject, must be considerably modified. No doubt, if we are willing to give the name of man to a half-brutish being, incapable of speech, whose only human accomplishments were those of using fire and of making a single clumsy stone implement, we must allow to this being an existence of vast and as yet undefined duration, shared with the mammoth, the woolly rhinoceros, and other extinct animals. But if, with many writers, we term the beings of this race the precursors of man, and restrict the name of men to the members of the speaking race that followed them, then the first appearance of man, properly so styled, must be dated at about the time to which it was ascribed before the discoveries of Boucher de Perthes had startled the civilized world, — that is, somewhere between six thousand and ten thousand years ago. And this man who thus appeared was not a being of feeble powers, a dull-witted savage, on the mental level of the degenerate Australian or Hottentot of our day. He possessed and manifested, from the first, intel-

lectual faculties of the highest order, such as none of his descendants have surpassed. His speech, we may be sure, was not a mere mumble of disjointed sounds, framed of interjections and of imitations of the cries of beasts and birds. It was, like every language now spoken anywhere on earth by any tribe, however rude or savage, a full, expressive, well-organized speech, complete in all its parts. The first men spoke, because they possessed, along with the vocal organs, the cerebral faculty of speech. As Professor Max Müller has well said, "that faculty was an instinct of the mind, as irresistible as any other instinct." It was as impossible for the first child endowed with this faculty not to speak, in the presence of a companion similarly endowed, as it would be for a nightingale or a thrush not to carol to its mate. The same faculty creates the same necessity in our days; and its exercise by young children, when accidentally isolated from the teachings and influence of grown companions, will readily account for the existence of all the diversities of speech on our globe.

WHAT IS NERVE-FORCE?

A DISTINGUISHED biologist has remarked, with great truth, that the study of the nervous system is the true field of battle for physiologists, all other investigations, however interesting and important, being of the nature of skirmishes, preparatory for and surely leading up to the final conflict, in which we must engage before we can hope to gain a position from which nature's most mysterious processes are laid bare to our view. Of all the functions of the nervous system, the one which, at first sight, would seem most accessible to investigation, is that of the nerve-fibre itself. What conception can we form of the physical or chemical changes which take place in those white glistening bands which are for us the only channels through which knowledge of the physical universe can be obtained, and which also enable us to impress upon the world around us the evidence of our conscious personality?

With the discoveries of Du Bois Reymond, the hope arose that nerve-activity might be explained as an electrical phenomenon, and the attempts made to build up a satisfactory electrical theory of nervous action have been numerous and ingenious. The important facts which forbid the identification of nerve-force with electricity are: the absence of an insulating sheath on the nerve-fibre, the slow rate at which the nerve-force is transmitted, and the effect of a ligature on a nerve in preventing the passage of nerve-force, while not interfering with that of electricity. The electrical phenomena connected with the functional activity of nerves (action-current, electrotonus) appear, therefore, to be secondary in their character, and not to constitute the essential process in nerve action. In this connection should be noted an experiment of d'Arsonval,[1] which shows how the electrical phenomena associated with the activity of nerves may be imitated by purely physical means. This observer filled a glass tube, of one or two millimetres interior diameter, with drops of mercury alternating with drops of acidulated water, thus forming a series of capillary electrometers. The tube was closed at its two ends with rubber membranes, and was provided with lateral openings by which its interior could be connected with electrical conductors. A blow upon one of the membranes caused an undulation of the liquid column, which was propagated from one end to the other of the tube, and was accompanied by a wave of electrical oscillation, which was propagated at the same rate. The phenomenon is, according to d'Arsonval, to be explained as follows: The blow upon the membrane changes the form of the surface of contact between the first two cylinders of mercury and acidulated water. This change of form is transmitted to the following cylinders with a rapidity dependent upon the nature of the fluid. But each of these changes of shape is accompanied by the production of an electric current (Lippmann's phenomenon, due to variation of superficial tension), and the tube is therefore traversed by an electric wave, which necessarily has the same rate as the undulation of the liquid column. The analogy between this phenomenon and the wave-like propagation of the action-current in nerves is sufficiently obvious.

In studying the nature of nerve-force, two alternatives present themselves. We may conceive the impulse to be conducted through the nerve-fibre by a series of retrograde chemical changes in the successive molecules of the nerve-substance, the change occurring in one portion of the fibre acting to produce a similar change in the neighboring portion. As this process is associated with the using up of organic material, and the consequent discharge of potential energy in the successive portions of the nerve, the theory may be called 'the discharging hypothesis.' The burning of a line of gunpowder may be taken as an example of this sort of action. On the other hand, we may conceive that the nerve-force is transmitted from molecule to molecule by some

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[1] *Comptes rendus soc. biol.*, April 3, 1886.