

vessels of the stem, is not supported by others. One hypothesis is that the disease is due to degeneration of the particular variety attacked, another that manure and soil may have a disturbing influence on the metabolism and ferments of the plant. No one has yet succeeded in infecting healthy stock with leaf-roll. It is readily transmitted by tubers, and, Count Arnim thinks, possibly by seeds also. In spite of all the attention devoted to the investigation of this disease, its cause is still a mystery, and until this is solved it is impossible to suggest general preventive measures. On no account should the tubers from a leaf-roll plant be used as seed.

During the meeting Wittmack summarised his views on the tuber-bearing species of *Solanum*. He holds that all European potatoes come from one true species, *Solanum tuberosum*, that *S. Maglia* is also a true, closely allied species, and that both differ from *S. Commersonii*. He praised highly the drawings, made for Sutton and Sons, of the *Solanums* by Worthington Smith. Wittmack was sent by the German Government to inspect the plots of *S. Commersonii* violet, believed by Labergerie and Heckel to be a valuable disease-resisting variety, and, they think, derived from *S. Commersonii* by mutation. It appears, however, to be identical with Paulsen's Blue Giant, a variety of *S. tuberosum*, and, like all other varieties, liable to leaf-blight and other potato diseases.

Lindner directed attention to the difficulties of identification of fermentation organisms. He proposed the creation in Berlin of a central station where photomicrographs of such organisms from all parts of the world could be stored, named when necessary, and registered for consultation. He illustrated his views by three volumes of such photographs, and in the course of the meeting used them to name a soil organism exhibited by H. Fischer. Housseus described the rice industry in Siam, and urged the claims of rice on the Germans as a cheap and nutritious food. Ewert described the over-wintering of the conidia of *Fusicladium*, the cause of apple and of pear spot. The systematists devoted one day to the reading of papers by Drude, Gilg, Diels, Ross, &c. Schwendener was elected honorary president of the Deutsche Botanische Gesellschaft, before which, at a morning sitting, two important papers were read, one by Senn on the movements of chromatophores, including a beautiful illustration of diatom cell-division, and another by Kniep on assimilation activity under different rays of light.

A special feature of this year's meeting, which ought not to go unrecorded, was the testing in different localities of the wine of the district. On the last day at Geisenheim the three bodies sat in common for three hours to test no fewer than thirty-five different kinds of wine, provided by the Rheingau Wine Society.

Some forty members subsequently spent several days in botanical excursions in the valleys of the Nahe and Mosel. At Bertrich fine specimens of *Buxus sempervirens* and *Acer monspessulanum* were to be seen growing in plenty on the rocky slopes. On the shores of the crater-lake (Pulvermaar) at Gillenfeld, *Pilularia globulifera* formed a regular sward.

It was agreed to meet next year at Münster in time to allow members to attend the International Botanical Congress, and also the Seed-testing Conference at Brussels at Whitsuntide.

T. J.

THE BRITISH ASSOCIATION AT WINNIPEG
SECTION H.
ANTHROPOLOGY.

OPENING ADDRESS (ABRIDGED) BY PROF. JOHN L. MYRES,
M.A., F.S.A., PRESIDENT OF THE SECTION.

The Influence of Anthropology on the Course of Political Science.

ANTHROPOLOGY is the Science of Man. Its full task is nothing less than this, to observe and record, to classify and interpret, all the activities of all the varieties of this species of living being. In the general scheme of knowledge, therefore, anthropology holds a double place, according to our own point of view. From one standpoint it falls into the position of a department of zoology, or geography; of zoology, since man, considered as a natural

species, forms only one small part of the animal population of this planet; of geography, because his reason, considered simply as one of the forces which change the face of nature, has, as we shall see directly, a range which is almost world-wide. From another point of view anthropology itself, in the strictest sense of the word, is seen to embrace and include whole sciences such as psychology, sociology, and the rational study of art and literature; since each of these vast departments of knowledge is concerned solely with a single group of the manifold activities of man. In practice, however, a pardonable pride, no less than the weighty fact that man, alone among the animals, truly possesses reason, has kept the study of man a little aloof from the rest of zoology. Dogmatic scruples have intervened to prevent man from ever ranking merely as one of the "forces of nature," and have set a hard problem of delimitation between historians and geographers. And the pardonable modesty of a very young science—for modern anthropology is barely as old as chemistry—has restrained it from insisting on encyclopædic claims in face of reverend institutions like the sciences of the mind, of statecraft, and of taste.

Yet when I say that anthropology is a young science I mean no more than this, that in the unfolding of that full bloom of rational culture, which sprang from the seeds of the Renaissance, and of which we are the heirs and trustees, anthropology found its place in the sunlight later than most; and almost alone among the sciences can reckon any of its founders among the living. This was of course partly an accident of birth and circumstance; for in the House of Wisdom there are many mansions; a Virchow, a Bastian, or a Tylor might easily have strayed through the gate of knowledge into other fields of work, just as Locke and Montesquieu only narrowly missed the trail into anthropology.

But this late adolescence was also mainly the result of causes which we can now see clearly. Man is, most nearly of all living species, the "ubiquitous animal." Anthropology, like meteorology, and like geography itself, gathers its data from all longitudes, and almost all latitudes, on this earth. It was necessary therefore that the study of man should lag behind the rest of the sciences, so long as any large masses of mankind remained withdrawn from its view; and we have only to remember that Australia and Africa were not even crossed at all—much less explored—by white men, until within living memory, to realise what this limitation means. In addition to this, modern Western civilisation, when it did at last come into contact with aboriginal peoples in new continents, too often came, like the religion which it professed, bringing "not peace but a sword." The customs and institutions of alien people have been viewed too often, even by reasonable and good men, simply as "ye beastlie devices of ye heathen," and the pioneers of our culture, perversely mindful only of the narrower creed, that "he that is not with us is against us," have set out to civilise savages by wrecking the civilisation which they had.

Before an audience of anthropologists, I need not labour the point that it is precisely these two causes, ignorance of many remoter peoples, and reckless destruction or disfigurement of some that are near at hand, which are still the two great obstacles to the progress of our science. But it is no use crying over spilt milk, and I turn rather to the positive and cheering thought that the progress of anthropology has been rapid and sure, in close proportion to the spread of European intercourse with the natives of distant lands, and that its further advance is essentially linked with similar enterprises.

Anthropology and Politics in Ancient Greece.

Philosophy, as we all know, begins in wonder; it is the surest way to jostle people out of an intellectual groove into new lines of thought, if they can be confronted personally and directly with some object of that numerous class which seems uncouth only because it is unfamiliar. The sudden expansion of the geographical horizon of the early Greeks, in the seventh and sixth centuries B.C., brought these earliest and keenest of anthropologists face to face with peoples who lived for example in a rainless country, or in trees, or who ate monkeys, or grandfathers, or called themselves by their mothers' names, or did other disconcerting things; and

this set them thinking, and comparing, and collecting more and more data, from trader and traveller, for an answer to perennial problems, alike of their anthropology and of ours. Can climate alter character or change physique, and if so, how? Does the mode of life or the diet of a people affect that people's real self, or its value for us? Is the father, as the Greeks believed, or the mother who bore them, the natural owner and guardian of children? Is the Heracles whom they worship in Thasos the same god as he whose temple is in Tyre? Because the Colchians wear linen, and practise circumcision, are they to be regarded as colonists of the Egyptians? or can similar customs spring up independently on the Nile and on the Phasis? Here, in fact, are all the great problems of modern anthropology, flung out for good and all, as soon as ever human reflective reason found itself face to face with the facts of other human societies, even within so limited a region as the old Mediterranean world.

And I would have you note that these old Greek problems, like all the supreme problems of science old and new, were not theoretical problems merely. Each of them stood in direct relation to life. To take only cases such as I quoted just now from the Father of History—is there, for example, among all the various regions and aspects of the world, any real earthly paradise, any delectable country, where without let or hindrance the good man may lead the good life? Is there an ideal diet, an ideal social structure, or in general, an ideal way of life for men; or are all the good things of this world wholly relative to the persons, the places, and the seasons where they occur? I do not mean that the ancient Greeks ever found out any of these things, for all their searching; or even that all ancient seekers after marvels and travellers' tales were engaged consciously in anthropological research at all. I mean only this: that the experiences, and the problems, and the practical end of it all, were as certainly present to the minds of men like Herodotus and Hippocrates, as they have been in all great scientific work that the world had seen.

In the same way it has for some while been clear to me that neither Plato nor Aristotle, the great outstanding figures of fourth-century Greece, was constructing theories of human nature entirely in the air. Their conceptions both of the ideal state of society, and of the elements which were fundamental and essential in actual societies as they knew them, were determined to a very large extent by their observation of real men in Sparta, Persia, or Scythia. But it is also clear that much that had been familiar to the historians of the fifth century, and particularly to Herodotus, had fallen out of vogue with the philosophers of the fourth. Systematic clearness had been attained only by the sacrifice of historic accuracy. Thucydides, in fact, standing right in the parting of the ways between history and rhetoric, might fairly have extended his warnings to a dissociation of history from political philosophy, which was just as imminent.

Anthropology and the Renaissance.

At the Revival of Learning it was the same as in the great days of Greece. New vistas of the world were being opened up by the voyagers; new types of men, of modes of life, of societies and states, were discovered and described; new comparisons were forced upon men by new knowledge crowding thick into their minds; and new questions, which were nevertheless old as the hills, made eddies and rapids in the swift current of thought, and cried out for an answer. Take the central political problems, for example: What constitutes the right to govern, and what is the origin of law? In mediæval Europe this was simple enough. The duke, or the king, or the bishop governed by authority of the emperor, or the pope; and pope and emperor ruled (like Edward VII.) "by the Grace of God." Yet here, in Guinea, in Monomotapa, in Cathay, and in Peru, were great absolute monarchies which knew nothing of the pope or the emperor, and were mighty hazy about God. Yet their subjects obeyed them, and gave good reasons for their obedience, and chiefest of their reasons (as in all times and places) was this: "We should be much worse off if we didn't."

Unsocial Man and the Pre-Social State.

It would take me very far afield if I were to try to show how this universal answer came to change its ground from politics to anthropology, so that to the question—how men knew that they would be much worse off if they didn't—the answer came, that "once upon a time they had been much worse off, because they didn't." For my present purpose it is enough to note that, in all ages, philosophers who set out to define the nature of the State, have become involved in speculations about its origin; that historians in their researches into its origin have been forced into conclusions as to its nature; and that in both cases every belief about the Nature of the State has been found to involve a belief about a State of Nature; an answer of some kind, that is, to the question whether man was originally and naturally a social animal, or whether at some early period of his history he became social and domestic. In the latter event, how was domestication effected, and what sort of thing was undomesticated man? In the ancient world, after long controversy, Aristotle's definition of man as the "social animal" had carried the day, and ruled that question out of court. But at the Revival of Learning, the unnatural behaviour of certain actual societies towards their individual members had revived irresistibly the whole question whether society was part of the natural order at all, and not a "device of the heathen," a mistake or a *pis aller*; and whether, if society was not thus "natural," men would not really be better off if they returned to their natural, pre-social, unsocial state, and began again at the beginning, to work out their own salvation. This belief in a pre-social state played a large part in the political philosophy of the seventeenth and eighteenth centuries; and conversely it was the very fact that the pre-social state as a philosophical conception fell out of vogue at the beginning of the nineteenth, which has distinguished modern political philosophy so markedly from its predecessors.

The Patriarchal Theory.

All theories of a Social Contract as the starting-point of human societies presupposed that mankind had actually passed through a Pre-Social State; and the proof which had been offered of this supposition, though partly theoretical and *a priori*, had partly also been inductive and based on experience. Further, the experience of "primitive Man" which was actually open to the philosophers of the seventeenth and early eighteenth centuries had been, in fact, such as to force the conclusion not merely that a Pre-Social State had once existed, but that some barbarous peoples had not yet emerged from it. It was a sad error of observation, as we now know, which led to that conclusion; but given the travellers' tales, in the form in which we can read them in the "Cosmographies" and "Voyages" of the time, I do not see how that conclusion could have been avoided without culpable neglect of such evidence as there was. If blame is to be assigned in this phase of inquiry at all, it is to be assigned to the travellers and traders, for making such poor use of their eyes and ears. All, however, that I am concerned to establish at present is this, that one of the most important and far-reaching speculations of modern political philosophy, the speculation as to a Pre-Social Condition of Mankind, and a Social Contract which ended it and brought in Society and the State, arose directly and inevitably from the new information as to what primitive man *was* and *did*, when he was studied in the seventeenth century at Tombutum, or Saldanha Bay, or the "backwoods of America," or the "bank of the Orinoco river."

But the Social Contract Theory has long since passed out of vogue. Its political consequences are with us today, like the political consequences of the belief in the Divine Right of Kings; but the theories themselves are dead, and likely to remain so. Plato and Aristotle, with their belief in Man as a Naturally Social Animal, have come by their own again, for most of us, if not for all: and the search for an ideal State, which shall realise and fulfil Man's social instincts, is again in full cry.

What part, if any, has the direct study of barbarous people played at this fresh turn of the wheel? Let us look once again at the state of geographical knowledge, and more particularly, as before, at the regions in which

by transitory chance of circumstances, there was most to be learned at the moment. First, the British occupation of India was the occasion, on the one hand, of the discovery of Sanskrit, the creation of this science of comparative philology, and the demonstration of a new link of cultural affinity over the whole realm of Aryan speech. The same political event led no less directly to the discovery of the patriarchal structure of Hindoo society, and so through the comparative study of Indian, Roman, and ancient Celtic and Teutonic law to an inductive verification of Aristotle's doctrine of the "naturalness" of patriarchal society. This doctrine dominated political science for nearly fifty years. "The effect of the evidence derived from comparative jurisprudence," Sir Henry Maine could write in 1861,¹ "is to establish that view of the primeval conditions of the human race which is known as the Patriarchal Theory. There is no doubt, of course, that this theory was originally based on the Scriptural theory of the Hebrew patriarchs in Lower Asia. . . . It is to be noted, however, that the legal evidence comes nearly exclusively from the institutions of societies belonging to the Indo-European stock, the Romans, Hindoos, and Slavonians supplying the greater part of it; and indeed the difficulty, at the present stage of the inquiry, is to know where to stop; to say of what races of men it is *not* allowable to lay down that the society in which they are united was originally organised on the patriarchal model." And he refers explicitly to the former controversy between Filmer and Locke, to point out how the tables had now been turned upon the latter.

Thus in the half-century which intervenes between Herder and Maine, the political philosophy of Europe seemed to have turned almost wholly from exploration to introspection; from the Pacific to early Rome and the German forests; and from the study of survivals in the modern practice of savages, to that of primeval custom betrayed by the speech and customs of the civilised world. It was Aristotle over again, with his appeal to custom, ancestral belief, and canonical literature, following hard upon the heels of the visionary revolutionary Plato. Maine's own words, indeed, about Rousseau² would be applicable almost without change to the course of Greek thought in the fourth century B.C. "We have never seen in our own generation," he says, "indeed the world has not seen more than once or twice in all the course of history, a literature which has exercised such prodigious influence over the minds of men, over every cast and shade of intellect, as that which emanated from Rousseau between 1749 and 1762. It was the first attempt to re-erect the edifice of human belief after the purely iconoclastic efforts commenced by Bayle, and in part by our own Locke, and consummated by Voltaire; and besides the superiority which every constructive effort will always enjoy over one that is merely destructive, it possessed the immense advantage of appearing amid an all but universal scepticism as to the soundness of all foregone knowledge in matters speculative. . . . The great difference between the views is that one bitterly and broadly condemns the present for its unlikeness to the ideal past, while the other, assuming the present to be as necessary as the past, does not affect to disregard or censure it."

I have devoted some space to these first steps of Linguistic Palæontology and Comparative Jurisprudence because the method of inquiry which they announced promised at first sight to make good a very serious defect in the instruments of anthropological research. Human history, outside of Europe and of one or two great oriental States like China, hardly went back beyond living memory; even Mexico had no chronicles beyond the first few hundred years, and the records of old-world States like China, which at first sight offered something, turned out on examination to have least to give. They had lived long, it is true, but their lives had been "childlike and bland," devoid of change, and almost empty of experience. Consequently there was no proof that the "wild men" of the world's margins and byways were really primitive at all. The Churches held them children of wrath, degenerate offspring of Cain; the learned fell back upon pre-Adamite fictions, to palliate, rather than to explain their invincible ignorance of Europe and its ways.

¹ Maine, "Ancient Law," pp. 121-3.

² *Ibid.*, pp. 86-9.

Here, however, in the new light thrown by the history of speech, there seemed to be a prospect of deep insight into the history of human societies. Disillusionment came in due course, when doctors disagreed; but illusion need never have taken the form it did, had either the philologists or the philosophers realised that all the really valuable work was being done within the limits of a single highly special group of tongues; that the very circumstance that this group of tongues had spread so widely, pointed to some strong impulse driving the men who spoke them into far-reaching migrations; that one of the few points upon which linguistic palæontologists were really unanimous was that both the Indo-European and the Semitic peoples, in their primitive condition, were purely pastoral; and that this pastoral habit was itself an almost coercive cause for their uniformly patriarchal organisation. The last point, however, belongs so completely to another phase of our story that it is almost an anachronism to introduce it here. It serves however to indicate, once again, if that be necessary, how completely the philosopher, and even the man of science, is at the mercy of events in the ordering of his search after knowledge. It is, indeed, almost true to say that if the primitive Aryan had not had the good fortune not merely to live on a grass-land, but also to find domesticable quadrupeds there, there could no more have been a science of comparative philology in modern Europe than there could be among the natives of your own Great Plains or of the Pacific Coast: for in no other event would there have been any such "family of languages" to compare.

In the absence of warning thoughts like these, however, the comparative philology and the comparative law of the patriarchal peoples of the North-West Quadrant and of India went gaily on. What Maine had done for India, Maine himself, with Solm and von Maurer, in Germany; Le Play, de Laveleye, and d'Arbois de Joubainville in France; W. F. Skene in far-off Scotland; Whitley Stokes and others in Ireland; Rhys in Wales; and Mackenzie Wallace and Kovalevsky in Russia, had done for the early institutions of their respective countries: all emphasising alike the wide prevalence of the same common type of social structure, based upon the same central institution, the Patriarchal Family, with the *Patria Potestas* of its eldest male member as its overpowering bond of union; and Maine's own words do not the least exaggerate the beliefs and expectations which were evoked by this new aspect of the Study of Man.

The Matriarchate in Southern India, Africa, and North America.

The Patriarchal Theory lasted barely fifty years. It had owed its revival, as we have seen, to two fresh branches of research, comparative jurisprudence and comparative philology, both stimulated directly by the results of European administration in Northern India. It owed its decline to the results of similar inquiries in other parts of the world, stimulated no less directly by other phases of the great colonising movement, which marks, above all other things, the century from 1760 to 1860. Here again a small number of examples stand out as the crucial instances. British administration in India had, of course, been extended over the non-Aryan south, as well as over the north; and in Travancore, and other parts of the Madras Presidency, British commissioners found themselves confronted with types of society which showed the profoundest disregard of the Patriarchal Theory. Like the Lycians of Herodotus, these perverse people "called themselves after their mothers' names": they honoured their mother and neglected their father, in society, and government, as well as in their homes; their administration, their law, and their whole mode of life rested on the assumption that it was the women, not the men, in whom reposed the continuity of the family and the authority to govern the State. Here was a *parecbasis*, a "perverted type" of society, worthy of Aristotle himself. It is a type which, as a matter of fact, is widely distributed in Southern and South-eastern Asia, and had been repeatedly described by travellers from the days of Tavernier (in Borneo) and Laval (in the Maldivé Islands), if not earlier still. It existed also in the New World, and Lafitau had already compared the Iroquois with the ancient Lycians. But it was Buchanan's account of the Nairs of the Malabar

Coast, published in 1807, which came at the "psychological moment," and first attracted serious attention. At the other extremity of India, also, analogous customs were being recorded, about the same time, by Samuel Turner in Tibet, which might have given pause at the outset to the speculators who hoped to base general conclusions on anything so special and peculiar as the customs of Aryan India.

Similar evidence came pouring in during the generation which followed; partly, it is true, as the result of systematic search among older travellers, but mainly through the intense exploitation of large parts of the world by European traders and colonists. Conspicuous instances are the Negro societies of Western and Equatorial Africa, first popularised by the re-publication of William Bosman's "Guinea" (1700), in Pinkerton's "General Collection of Voyages and Travels" (London, 1808, &c.), and by Proyart's "Histoire de Loango" (1776), which also reached the English public in the same invaluable collection. But it was from the south that the new African material came most copiously, in proportion as the activity of explorers, missionaries, and colonists was greater. Thunberg's account of the Bechuanas¹ takes the lead here; but for English thought the principal authorities are, of course, John Mackenzie² and David Livingstone.³

It was not to be expected that America, which had made such remarkable contributions to the study of Man in the seventeenth and eighteenth centuries, should fall behind in the nineteenth, when its vast resources of mankind, as of Nature's gifts, were being realised at last. From Hunter,⁴ Gallatin,⁵ and Schoolcraft,⁶ in the 'twenties, to Lewis Morgan⁷ in 1865, there was hardly a traveller "out West" who did not bring back some fresh example of society destructive of the Patriarchal Theory.

As often happens in such cases, more than one survey of the evidence was in progress simultaneously. Bachofen was the first to publish,⁸ and it is curious that his great book on "Mother-right" appeared in the very same year as Maine's "Ancient Law." Lubbock's "Prehistoric Times," in the next year, represents the same movement of thought in England in a popular shape, but almost independently. In America, Lewis Morgan, whom I have noted already as an able interpreter of Iroquois custom, followed up his detailed studies of Redskin law by a Smithsonian monograph in 1871 on "Systems of Consanguinity and Affinity of the Human Family," and, in 1877, by his book on "Ancient Society." Meanwhile Post had published his great work on the "Evolution of Marriage"⁹ in 1875, and J. F. McLennan his first "Studies in Ancient History" in 1876. It was the generation of Darwin and of the great philologists, as we have seen, and "survivals" were in the air: Dargan¹⁰ pointed out traces of the Matriarchate in the law and custom of Germany, and Wilken¹¹ in those of early Arabia. The period of exploration, if I may so term it, closed on this aspect of the subject with Westermarck's "History of Human Marriage," which was published in London in 1891.

Australian Evidence: Totemism and Classificatory Kinship.

I have now mentioned India, South Africa, and North America, three principal fields of English-speaking enterprise during the nineteenth century, and have indicated the contribution of each to modern anthropology in its bearing on political science. Only Australia remains; and, though Australia's task has been shared more particularly with

¹ Pinkerton, vol. xvi.

² John Mackenzie, "Ten Years North of the Orange River" (1859-69). Edinburgh, 1871.

³ David Livingstone, "Narrative of an Expedition to the Zambesi and its Tributaries (1858-64)." London, 1865.

⁴ Hunter, "Manners and Customs of several Indian Tribes located West of the Mississippi." Philadelphia, 1823.

⁵ Gallatin, "Archæologia Americana." Philadelphia (from 1820 onwards).

⁶ Schoolcraft, "Travels in the Central Portions of the Mississippi Valley" (New York, 1825); "Notes on the Iroquois" (1846).

⁷ Lewis H. Morgan, Proc. Am. Acad. Arts and Sciences, vii., 1865-8.

⁸ Bachofen, "Das Mutter-recht." Stuttgart, 1861.

⁹ Hermann Post, "Die Geschlechts-genossenschaft der Urzeit und die Entstehung der Ehe." Oldenburg, 1875.

¹⁰ Dargan, "Mutter-recht und Raub-ehe und ihre Reste im Germanischen Recht und Leben." Breslau, 1883.

¹¹ Wilken, "Das Matriarchat bei den alten Arabern." Leipzig, 1884.

North America, I shall be doing no injustice to Lewis Morgan or to McLennan if I couple with their names those of Fison and Howitt,¹ as the discoverers of classical instances of societies which observe neither paternal nor maternal obligations of kinship as we understand them, but have adopted those purely artificial systems of relationships which in moments of elation we explain as "Totemic," or, in despair, describe as "classificatory."

Hermann Post: Comparative Jurisprudence.

Our retrospect, therefore, of the last fifty years shows clearly once again how intimately European colonisation and anthropological discoveries have gone hand in hand: first to establish a "Matriarchal Theory" of society as a rival of the Patriarchal; and then to confront both views alike with the practices and with the theories of "Totemism."

From the point of view of political science, all this mass of inquiries finds applications already in more departments than one; though it is probably still too early to appraise its influence adequately. The new Montesquieu has not yet arisen to interpret to us the "Spirit of the Laws." Most directly, perhaps, we can trace such influence in the "Comparative Jurisprudence" of Hermann Post, whose first work on the "Evolution of Marriage" appeared, as we have seen, in 1875. Post's general attitude is best seen in his "Introduction to the Study of Ethnological Jurisprudence," which was published in 1886, and in his "African Jurisprudence" of 1887.² As the result of a survey of social organisations, considered as machinery in motion, Post points out very justly that it is useless to attempt to explain social phenomena on the basis of the psychological activities of individuals, as is too commonly assumed, because all individuals whose conduct we can possibly observe have themselves been educated in some society or other, and presume in all their social acts the assumptions on which that society itself proceeds. "I take the legal customs of all peoples of the earth," so he wrote in 1884,³ "the residual outcome of the living legal consciousness of humanity, for the starting-point of my inquiry into the science of law; and then, on this basis, I propound the question, What is law? If by this road I arrive eventually at an abstract conception of law, or at an idea of law, then the whole fabric so created consists, from base to summit, of flesh and blood." It is the same method, of course, which had already yielded such remarkable results to Montesquieu, and even to Locke. The point of view is no longer that of a Maine or a McLennan, students of patriarchal or of matriarchal institutions by themselves. It is that of a spectator of human society as a whole; and such a point of view only became possible at all when it was already certain that no great section of humanity remained altogether unexplored, however fragmentary our knowledge might still be, of much that we ought to have recorded. And its immediate outcome has been to throw into the strongest possible relief the dependence of the form and still more of the actual content of all human societies on something which is not in the human mind at all, but is the infinite variety of that external Nature which Society exists to fend off from Man, and also to let Man dominate if he can.

This was, of course, already the standpoint of Comte, with his emphasis on the *monde ambiant*. But Comte, the citizen of a State which except in Canada had failed to colonise, and therefore had little direct contact with non-European types of society, confined himself far too exclusively to European data. His strength is precisely where the science of France was so magnificently strong in his day, in the domain of pure physics; it is his analogies between politics and physics which are so illuminating in his work, as in that of his English compeer, Herbert Spencer;⁴ and it is the weakness of both in the direction

¹ Fison and Howitt, "Kamilaroi and Kurnai." Melbourne and Sydney, 1880.

² Hermann Post, "Einleitung in das Studium der ethnologischen Jurisprudenz" (Oldenburg, 1886); "Afrikanische Jurisprudenz" (1887). His position is, however, already clear in his first synthetic work, "Dr. Ursprung des Rechts," 1876, as well as in his earlier book on Marriage For a good summary of Post's views see Th. Achelis, "Die Entwicklung der modernen Ethnologie" (Berlin, 1889), pp. 113-28, and the same writer's "Moderne Ethnologie" (1896).

³ Post, "Die Grundlagen des Rechts" (1888).

⁴ Compare Quetelet's 'Essai de Physique sociale' (1842), as a symptom of the trend of French thought at this stage.

of anthropology which mainly accounts for the shortness of their respective vogues.

Friedrich Ratzel: Anthro-geo-graphy.

At the point which we have now reached in this rapid survey of our science, it was obviously to Geography—the systematic study of those external forces of Nature as an ordered whole—that Anthropology stretched out its hands; and it did not ask in vain. But while English geography had remained exploratory, descriptive, and (like English geology) *historical* in its outlook, the new German science of *Erdkunde*—“earth-knowledge” in the widest sense of the word—had already come into being on the basis of the labours of Ritter and the two Humboldts, and under the guidance of such men as Wagner, Richthofen, and Bastian; the last named also an anthropologist of the first rank. It was, thus, to a distinguished pupil of Wagner, Friedrich Ratzel, that anthropology owed, more than to any other man, the next forward step on these lines. In Ratzel's mind, History and Geography went hand in hand as the precursors of a scientific Anthropology.¹ History to define *when*, and in what order, Man makes his conquests over Nature; Geography to show *where*, and within what limits, Nature presents a conquerable field for Man. Much of this, of course, was already implicit in the teaching of Adolf Bastian, whose monumental volumes on “Man in History” had appeared at Leipzig as early as 1860; his “Contributions to Comparative Psychology” in 1868; and his “Legal Relations among the Different Peoples of the Earth” in 1872²—three years before Post's first essay. But Bastian, inaccessible for years together in Tibet or Polynesia, was rather an inspiration to a few intimate colleagues than a great propagandist; and besides, it was not until the appearance of his “Doctrine of the Geographical Provinces” in 1886³ that he touched on this precise ground, and by that time Ratzel's “History of Man” had already been out for a year.⁴

Epilogue.

These examples, I think, are sufficient to show how intimately the growth of political philosophy has interlocked at every stage with that of anthropological science. Each fresh start on the never-ending quest of *Man as he ought to be* has been the response of theory to fresh facts about *Man as he is*. And, meanwhile, the dreams and speculations of one thinker after another—even dreams and speculations which have moved nations and precipitated revolutions—have ceased to command men's reason when they ceased to accord with their knowledge.

And we have seen more than this. We have seen the very questions which philosophers have asked, the very questions which perplexed them, no less than the solutions which they proposed, melt away and vanish, *as problems*, when the perspective of anthropology shifted and the standpoint of observation advanced. This is no new experience; nor is it peculiar either to anthropology among the natural sciences, or to political science among the aspects of the Study of Man. It is the common law of the mind's growth, which all science manifests, and all philosophy.

And now I would make one more attempt to put on parallel lines the course of political thinking. It is not so very long ago that a great British administrator, returning from one of the gravest trials of statesmanship which our generation has seen, to meet old colleagues and classmates at a college festival, gave it to us as the need he had most felt, in the pauses of his administration, that there did not exist at present any adequate formulation of the great outstanding features of our knowledge (as distinct from our creeds) about human societies and their mode of growth, and he commended it to the new generation of scholarship, as its highest and most necessary task, to face once more the question: What are the forces, so far as we can know them now, which, as Aristotle would have put it, “maintain or destroy States”?

But if a young student of political science were to set

¹ Ratzel, “Anthro-geographie” Leipzig, vol. i., 1882; ii., 1891.

² Bastian, “Der Mensch in der Geschichte” (Leipzig, 1866); “Beiträge zur vergleichenden Psychologie” (Berlin, 1868); “Rechtsverhältnisse bei verchiedenen Völkern der Erde” (Berlin, 1872).

³ Bastian, “Zur Lehre von den geographischen Provinzen.” Berlin, 1886.

⁴ Ratzel, “Völkergunde” (Leipzig, 1885). His *method* is best studied in the first volume of his “Anthro-geographie” (Leipzig, 1882).

himself to this life work, where could he turn for his facts? What proportion of the knowable things about the human societies with which travellers' tales and the atlases acquaint him could he possibly bring into his survey, without a lifetime of personal research in every quarter of our planet?

I have in mind one such student setting out this coming session to investigate, on the lines of modern anthropology, the nature of *Authority* and the circumstances of its rise among primitive men; and the difficulty at the outset is precisely as I have described. In the case of the “black fellows” of Australia such a student depends upon the works of some four or five men, representing (at a favourable estimate) one-twentieth even of the known tribes of the accessible parts of that continent. For British South Africa he would be hardly better served; for British North America, outside the ground covered in British Columbia by Boas and Hill-Tout, he would have almost the field to himself; and the prospect would seem to him the drearier and the more hopeless when he compared it with things on the other side of the forty-ninth parallel.

Now, our neighbours south of that line have the reputation of being practical men; in other departments of knowledge they are believed to know well “what pays.” And I am forced to believe that it is because they know that it *pays*, to know all that can still be known about the forms of human society which are protected and supervised from Washington, that they have gone so far as they have towards rescuing that knowledge from extinction while still there is time. The Bureau of Ethnology of the United States of America is the most systematic, the most copious, and, I think, taking it all in all, the most scientific of the public agencies for the study of any group of men, *as men*. The only other which can be compared with it is the ethnographical section of the last census of India, and that was an effort to meet, against time, an emergency long predicted, but only suddenly foreseen by the men who were responsible for giving the order. Thus, humanly speaking, it is now not improbable that in one great newly settled area of the world every tribe of natives, which now continues to inhabit it, may at least be explored, and in some cases really surveyed, before it has time to disappear. But observe, this only applies to the tribes which now continue to exist; and what a miserable fraction they are of what has already perished irrevocably! It is no use crying over spilt milk, as I said to begin with; the only sane course is to be doubly careful of whatever remains in the jug.

An Ethnological Survey for Canada.

And now I conclude with a piece of recent history, which will point its own moral. When the British Association met first outside the British Isles, it celebrated its meeting at Montreal by instituting, for the first time, a section for Anthropology; and it placed in the chair of that section one of the principal founders of modern scientific anthropology, Dr. Edward Burnett Tylor, then recently installed at Oxford, and still the revered Professor of our science there. Through his influence mainly, but with the active goodwill of the leading names in other sciences in Canada, a research committee was formed to investigate the north-west tribes of the Dominion; and for eleven consecutive years expeditions wholly or partly maintained by this Association were sent to several districts of British Columbia. These expeditions cost the Association about 1200l. in all. I am glad to think that the chief representative of this Committee's work, Dr. Franz Boas, has long since realised, in his great contributions to knowledge, the high hopes which his early reports inspired.

When the Association met the second time on Canadian soil, at Toronto, the occasion seemed opportune for a fresh step. Dr. Boas had already undertaken work on a larger scale and under other auspices. But it was thought likely that if a fresh Committee of the Association were appointed, with wider terms of reference and further grants, it would be possible to select and to train a small staff of Canadian observers, and by their means to produce such a series of preliminary reports on typical problems of Canadian anthropology as would satisfy the Dominion Government that the need for a thorough systematic survey was a real one, and that such a survey would be practicable with the means and the men which

Canada itself could supply. Among the leading members of this Ethnographic Survey Committee I need only mention three—the late Dr. George Dawson, Mr. David Boyle, and Mr. Benjamin Sulte, each eminent already in his own line of study, and all convinced of the great scientific value of what was proposed. The first year's enterprise opened well; workers were found in several districts of Canada; the Association sent out scientific instruments, and formed in London a strong consultative committee to keep the Canadian field-workers in touch with European students of the subject. But the premature death of George Dawson in 1901 broke the mainspring of the machine; the field-workers fell out of touch with one another and with the subject; the instruments were scattered, and in 1904 the Ethnographic Survey Committee was not recommended for renewal.

I need not say how great a disappointment this failure has been to those of us who believe that in this department of knowledge Canada has great contributions to make, and who know—as this meeting too knows perfectly well—that if this contribution to knowledge is not made within the next ten years, it can never be made at all. I am not speaking merely of the urgency of exact study of the Indian peoples. This indeed is obvious and urgent enough; and the magnificent results of organised effort in the United States are there to show how much you too can still rescue, if you will. But at the moment I appeal rather for the systematic study of your own European immigrants, that stream of almost all known varieties of white men with which you are drenching yearly fresh regions of the earth's surface, which if they have had experience of human settlements at all, have known man only as a predatory migratory animal, more restless than the bison, more feckless and destructive than the wolf. Of your immigrants' dealings with wild nature, you are indeed keeping rough undesigned record in the documents of your Land Surveys, and in the statistics of the spread of agriculture over what once was forest or prairie; and in time to come, *something*—though not, I fear, much—will exist to show what good (and as likely as not, also, what irremediable harm) this age of colonisation has done to the region as a whole. But what you do not keep record of is Nature's dealings with your immigrants; you do not *know*—and so long as you omit to *observe*, you are condemned not to know—the answer to the simple all-important question, *What kinds of men do best in Canada? What kind of men is Canada making out of the raw material which Europe is feeding into God's Mills on this side?*

Over in England, we are only too well aware how poor a lead we have given you. We, too, for a century now, have been feeding into other great winning chambers the raw crop of our villagers. We have created (to change the metaphor), in our vast towns, great vats of fermenting humanity, under conditions of life which at the best are unprecedented, and at their worst almost unimaginable. That is *our* great experiment in modern English anthropology—*What happens to Englishmen in City slums?* and we shall hear, before this meeting ends, something of the methods by which we are attempting now to watch and record the outcome of that experiment in the making of the English of to-morrow. We are beginning to know, in the first place, what types of human animal can tolerate and survive the stern conditions of modern urban life. We are learning, still more slowly, what modes of life, what modified structure of the family, of the daily round, of society at large, can offer the adjustment to new needs of life, which human nature demands under this new, almost unbearable strain. We are seeing, more clear in the mass, even if hopelessly involved in detail, the same process of selection going on in the mental furniture of the individuals themselves; new views of life, new beliefs, new motives and modes of action; new, if only in the sense that they presuppose the destruction of the old.

That is our problem in human society at home. And yours, though it has a brighter side, is in its essentials the same. Geographers can tell you something already of the physical "control" which is the setting to all possible societies on Canadian soil. Scientific study of the vanishing remnants of the Redskin tribes may show you a little of the effects of this control, long continued, upon nations

whom old Heylin held to be "doubtless the offspring of the Tartars." Sympathetic observation and friendly intercourse may still fill some blanks in our knowledge of their social state; how hunting or fishing—or, in rare cases, agriculture—forms and reforms men's manners and their institutions when it is the dominant interest in their lives. But what climate and economic habit have done in the past with the Redskins, the same climate and other economic habits are as surely doing with ourselves. In the struggle with Nature, as in the struggle with other men, it is the weakest who go to the wall; it is the fittest who survive. And it is our business to *know*, and to record for those who come after us, what manner of men we were when we came; whence we were drawn, and how we are distributed in this new land. An Imperial Bureau of Ethnology, which shall take for its study all citizens of our State, as such, is a dream which has filled great minds in the past and may some day find realisation. A Canadian Bureau is at the same time a nearer object, and a scheme of more practicable size. In the course of this meeting, information and proposals for such a Bureau of Ethnology are to be laid before this section by more competent authorities than I. My task has only been to show, in a preliminary way, what our science has done in the past, to stimulate political philosophy, and to determine its course and the order of its discoveries.

"Some men are borne," said Edward Grimstone just three centuries ago, "so farre in love with themselves, as they esteeme nothing else, and think that whatsoever fortune hath set without the compass of their power and government should also be banished from their knowledge. Some others, a little more careful; who finding themselves engaged by their birth, or abroad, to some one place, strive to understand how matters pass there, and remaine so tied to the consideration of their owne Commonweale, as they affect nothing else, carrying themselves as parties of that imperfect bodie, whereas in their curiositie they should behave themselves as members of this world." It is as "members of this world," I hope, that we meet together to-day.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY PROF. E. H. STARLING, M.D.,
F.R.S., PRESIDENT OF THE SECTION.

The Physiological Basis of Success.

DURING past years it has been customary for the Presidents of Sections in their addresses either to give a summary of recent investigations, in order to show the position and outlook of the branch of science appertaining to the Section, or to utilise the opportunity for a connected account of researches in which they themselves have been engaged, and can therefore speak with the authority of personal experience as well as with that imparted by the presidential Chair. The growing wealth of publications with the special function of giving summaries and surveys of the different branches of science, drawn up by men ranking as authorities in the subject of which they treat, renders such an interpretation of the presidential duties increasingly unnecessary, and the various journals which are open to every investigator make it difficult for me to give in an address anything which has not already seen the light in other forms. The Association itself, however, has undergone a corresponding modification. Founded as a medium of communication between workers in different parts of the country, it has gradually acquired the not less important significance of a tribunal from which men of science, leaving for a time their laboratories, can speak to an audience of intelligent laymen, including under this term all those who are engaged in the work of the world other than the advancement of science. These men would fain know the lessons that science has to teach in the living of the common life. By standing for a moment on the little pinnacle erected by the physicist, the chemist or the botanist, they can, or should be able to, gain new hints as to the conduct of the affairs of themselves, their town or their State. The enormous advance in the comfort and prosperity of our race during the last century has been due to the application of science, and this meet-

ing of the Association may be regarded as an annual mission in which an attempt is made to bring the latest results of scientific investigation into the daily routine of the life of the community.

We physiologists, as men who are laying the foundation on which medical knowledge must be built, have as our special preoccupation the study of man. Although every animal, and indeed every plant, comes within the sphere of our investigations, our main object is to obtain from such comparative study facts and principles which will enable us to elucidate the mechanism of man. In this task we view man, not as the psychologist or the historian does, by projecting into our object of study our own feelings and emotions, but by regarding him as a machine played upon by environmental events and reacting thereto in a way determined by its chemical and physical structure.

Can we not learn something of value in our common life by adopting this objective point of view and regarding man as the latest result of a continuous process of evolution which, begun in far-off ages, has formed, proved and rejected myriads of types before man himself appeared on the surface of the globe?

Adaptation.

In his study of living beings, the physiologist has one guiding principle which plays but little part in the sciences of the chemist and physicist, namely, the principle of adaptation. Adaptation or purposiveness is the leading characteristic of every one of the functions to which we devote in our text-books the chapters dealing with assimilation, respiration, movement, growth, reproduction, and even death itself. Spencer has defined life as "the continuous adjustment of internal relations to external relations." Every phase of activity in a living being is a sequence of some antecedent change in its environment, and is so adapted to this change as to tend to its neutralisation and so to the survival of the organism. This is what is meant by adaptation. It will be seen that not only does it involve the teleological conception that every normal activity must be for the good of the organism, but also that it must apply to *all* the relations of living beings. It must therefore be the guiding principle, not only in physiology, with its special preoccupation with the internal relations of the parts of the organism, but also in the other branches of biology, which treat of the relations of the living animal to its environment and of the factors which determine its survival in the struggle for existence. Adaptation therefore must be the deciding factor in the origin of species and in the succession of the different forms of life upon this earth.

Origin of Life.

A living organism may be regarded as a highly unstable chemical system which tends to increase itself continuously under the average conditions to which it is subject, but undergoes disintegration as a result of any variation from this average. The essential condition for the survival of the organism is that any such disintegration shall result in so modifying the relation of the system to the environment that it is once more restored to the average in which assimilation can be resumed.

We may imagine that the first step in the evolution of life was taken when, during the chaotic chemical interchanges which accompanied the cooling down of the molten surface of the earth, some compound was formed, probably with absorption of heat, endowed with the property of polymerisation and of growth at the expense of surrounding material. Such a substance could continue to grow only at the expense of energy derived from the surrounding medium, and would undergo destruction with any stormy change in its environment. Out of the many such compounds which might have come into being, only such would survive in which the process of exothermic disintegration tended towards a condition of greater stability, so that the process might come to an end spontaneously and the organism or compound be enabled to await the more favourable conditions necessary for the continuance of its growth. With the continued cooling of the earth, the new production of endothermic compounds would probably become rarer and rarer. The beginning of life, as we know it, was possibly the forma-

tion of some complex, analogous to the present chlorophyll corpuscles, with the power of absorbing the newly penetrating sun's rays and of utilising these rays for the endothermic formation of further unstable compounds. Once given an unstable system such as we have imagined, with two phases, viz. (1) a condition of assimilation or growth by the endothermic formation of new material; (2) a condition of "exhaustion," in which the exothermic destructive changes excited by unfavourable external conditions came to an end spontaneously—the great principle of natural selection or survival of the fittest would suffice to account for the evolution of the ever-increasing complexity of living beings which has occurred in the later history of this globe. The adaptations, *i.e.* the reactions of the primitive organism to changes in its environment, must become continually more complex, for only by means of increasing variety of reaction can the stability of the system be secured within greater and greater range of external conditions. The difference between higher and lower forms is therefore merely one of complexity of reaction.

The naked protoplasm of the plasmodium of Myxomycetes, if placed upon a piece of wet blotting-paper, will crawl towards an infusion of dead leaves, or away from a solution of quinine. It is the same process of adaptation, the deciding factor in the struggle for existence, which impels the greatest thinkers of our times to spend long years of toil in the invention of the means for the offence and defence of their community or for the protection of mankind against disease and death. The same law which determines the downward growth of the root in plants is responsible for the existence to-day of all the sciences of which mankind is proud.

The difference between higher and lower forms is thus not so much qualitative as quantitative. In every case, whatever part of the living world we take as an example, we find the same apparent perfection of adaptation. Whereas, however, in the lower forms the adaptation is within strictly defined limits, with rise in type the range of adaptation steadily increases. Especially is this marked if we take those groups which stand, so to speak, at the head of their class. It is therefore important to try and find out by a study of various forms the physiological mechanism or mechanisms which determine the increased range of adaptation. By thus studying the physiological factors, which may have made for success in the struggle for dominance among the various representatives of the living world, we may obtain an insight into the factors which will make for success in the further evolution that our race is destined to undergo.

It is possible that, even at this time, objections may be raised to the application to man of conclusions derived from a study of animals lower in the scale. It has indeed been urged, on various grounds, that man is to be regarded as exempt from the natural laws which apply to all other living beings. When we inquire into the grounds for assuming this anomalous, this outlawed condition of man, we generally meet with the argument that man creates his own environment and cannot therefore be considered to be in any way a product of it. This modification or creation of environment is, however, but one of the means of adaptation employed by man in common with the whole living kingdom. From the first appearance of life on the globe we find that one of the methods adopted by organisms for their self-preservation is the production of some artificial surroundings which protect them from the buffeting of environmental change. What is the mucilaginous envelope produced by micro-organisms in presence of an irritant, or the cuticle or shell secreted by the outermost cells of an animal, but the creation of such an environment? All unicellular organisms, as well as the units composing the lowest metazoa, are exposed to and have to resist every change in concentration and composition of the surrounding water. When, however, a body cavity or *coelom*, filled probably at first with sea-water, made its appearance, all the inner cells of the organism were withdrawn from the distributing influence of variations in the surrounding medium. The coelomic fluid is renewed and maintained uniform in composition by the action of the organism itself, so that we may speak of it as an environment created by the organism. The formation of a body cavity filled with salt solution at once increased the range of adaptation of the animals endowed therewith. Thus

it enabled them to leave the sea, because they carried with them the watery environment which was essential for the normal activity of their constituent cell units. The assumption of a terrestrial existence on most parts of the earth's surface involved, however, the exposure to greater ranges of temperature than was the case in the sea, and indicated the necessity for still further increase in the range of adaptation. Every vital process has its optimum temperature at which it is carried out rapidly and effectively. At or a little above freezing point the chemical processes concerned in life are suspended, so that over a wide range of the animal kingdom there must be an almost complete suspension of vital processes during the winter months, and at all times of the year a great dependence of the activity of these processes on the surrounding temperature. It is evident that a great advantage in the struggle for existence was gained by the first animals which succeeded in securing thermal as well as chemical constancy of environment for their cells, thus rendering them independent of changes in the external medium. It is interesting to note that the maintenance of the temperature of warm-blooded animals at a constant height is a function of the higher parts of the central nervous system. An animal with spinal cord alone reacts to changes of external temperature exactly like a cold-blooded animal, the activity of its chemical changes rising and falling with the temperature. In the intact mammal, by accurately balancing heat loss from the surface against heat production in the muscles, the central nervous system ensures that the body fluid which is supplied to all the active cells has a temperature which is independent of that of the surrounding medium. These are fundamental examples of adaptation effected by creation of an environment peculiar to the animal. Numberless others could be cited which differ only in degree from the activity of man himself. In some parts of this country, for instance, the activity of the beaver in creating an artificial environment has until lately been more marked than that of man himself. We are not justified, then, in regarding mankind as immune to the operation of natural forces which have determined the sequence of life on the surface of the globe. The same laws which have determined his evolution and his present position as the dominant type on the earth's surface will determine also his future destiny.

We are not, however, dealing with or interested in simple survival. Lower forms of life are probably as abundant on the surface of the globe as they were at any time in its history. Survival, as Darwin pointed out, is a question of differentiation. When in savage warfare a whole tribe is taken captive by the victorious enemy, the leaders and fighting men will be destroyed, while the slaves will continue to exist as the property of the victors. Survival, then, may be determined either by rise or by degradation of type. Success involves the idea of dominance, which can be secured only by that type which is the better endowed with the mechanisms of adaptation required in the struggle against other organisms.

Among the many forms of living matter which may have come into being in the earlier stages of the history of the earth, one form apparently became predominant and must be regarded as the ancestor of all forms of life, whether animal or vegetable, viz., the nucleated cell. The almost complete identity of the phenomena involved in cell division throughout the living kingdom indicates that all unicellular organisms and all organisms composed of cells have descended from a common ancestor, and that the mode of its reproduction has been impressed upon all its descendants throughout the millions of years which have elapsed since the type was first evolved. The universal distribution of living cells renders it practically impossible for us to test the possibility of a spontaneous abiogenesis or new formation of living from non-living matter at the present time. We cannot imagine that all the various phenomena which we associate with life were attributes of the primitive life stuff. Even if we had such stuff at our disposal, it would be difficult to decide whether we should ascribe the possession of life to it, and there is no doubt that any such half-way material would, directly it was formed, be utilised as pabulum by the higher types of organism already abounding on the surface of the globe.

Integration and Differentiation.

An important step in the evolution of higher forms was taken when, by the aggregation of unicellular organisms, the lowest metazoon was formed. In its most primitive forms the metazoon consists simply of a cell colony, but one in which all individuals are not of equal significance. Those to the outer side of the mass, being exposed to different environmental advantages from those within, must even during the lifetime of the individual have acquired different characteristics. Moreover, the sole aim of such aggregation being to admit of cooperation by differentiation of function between the various cell units, the latter become modified according to their position, some cells becoming chiefly alimentary, others motor, and others reproductive. Cooperation and differentiation are, however, of no use without coordination. Each part of the organism must be in a position to be affected by changes going on in distant parts, otherwise cooperation could not be effected. This cooperation in the lowest metazoon seems to be carried out by utilisation of the sensibility to chemical stimuli already possessed by the unicellular organism. We have thus coordination by means of chemical substances ("hormones") produced in certain cells and carried thence by the tissue fluids to other cells of the body, a mechanism of communication which we find even in the highest animals, including man himself. To such chemical stimuli we may probably ascribe the accumulation of wandering mesoderm cells—i.e. phagocytes—in an organism such as a sponge, around a seat of injury or any foreign substance that has been introduced. By this mechanism it is possible for distant parts of the body to react to stimulation of any one part of the surface. Communication by this means is, however, slow, and may be compared to the state of affairs in civilised countries before the invention of the telegraph, when messengers had to ride to different parts of the kingdom in order to arouse the whole nation for defence or attack.

Foresight and Control.

Increased speed of reaction and therefore increased powers in the struggle for existence were obtained when a nervous system was formed, by a modification of the cells forming the outer surface of the organism. By the growth of long processes from these cells a conducting network was provided, running through all parts of the body and affording a channel for the rapid propagation of excitation from the surface to the deeper parts, as well as from one part of the surface to another. From this same layer were produced the cells which, as muscle fibres, would act as the motive mechanism of the organism. Thus, from the beginning, the chief means of attack or escape were laid down in close connection with the surface from which the stimuli were received. A further step in the evolution of the nervous system consisted in the withdrawal of certain of the sensory or receptor cells from the surface, so that a specially irritable organ, the central nervous system, was evolved, which could serve as a distributing centre for the messages or calls to action initiated by changes occurring at the surface of the body. At its first appearance this central nervous system would hardly deserve the epithet of "central," since it formed a layer lying some distance below the surface, and extending over a considerable area; though we find that very soon there is an aggregation of the special cells to form ganglia, each of which might be regarded as presiding over the reactions of that part of the animal in which it is situated. Thus in the segmental worm-like animals a pair of ganglia is present in each body segment, and the chain of ganglia are united by longitudinal strands of nerve fibres to form the ganglionated cord, or central nervous system.

Such a diffused nervous system, in which all ganglia were of equal value, could, however, only act for the common weal of the whole body when a reaction initiated by stimulation at one part was not counteracted by an opposing reaction excited from another part of the surface. For survival it is necessary that in the presence of danger, i.e. an environment threatening the life of the individual or race, the whole activities of the organism should be concentrated on the one common purpose, whether of escape or defence. This could be effected only by making one part of the central nervous system predominant over all other parts, and the part which was chosen for this

predominance was the part situated in the neighbourhood of the mouth. This, in animals which move about, is the part which always precedes the rest of the body, and therefore the part which first experiences the sense impressions, favourable or dangerous, arising from the environment. It is this end that has to appreciate the presence or approach of food material, as well as the nature of the medium into which the animal is being driven by the movements of its body. Thus a predominance of the front end of the nervous system was determined by the special development at this end of those sense organs or sensory cells which are *projicient*—i.e. are stimulated by changes in the environment proceeding from disturbances at a distance from the animal. The sensory organs of vision and the organs which correspond to our olfactory sense organs and are aroused by minute changes in chemical composition of the surrounding medium, are always found especially at the front or mouth end of the organism. The chances of an animal in the struggle for existence are determined by the degree to which the responses of the animal to the *immediate* environment are held in check in consequence of stimuli arising from *approaching* events. The animal, without power to see or smell or hear its enemy, will receive no impulse to fly until it is already within its enemy's jaws. It must therefore be an advantage to any animal that the whole of its nervous system should be subservient to those ganglia or central collections of nerve cells which are in direct connection with the projicient sense organs in the head. This subservience is secured by endowing the head centre with a power, firstly, of controlling and abolishing the activities (i.e. all those aroused by external stimuli) of all other parts of the central nervous system, and, secondly, of arousing these parts to a reaction immediately determined by the impression received from the projicient sense organs of the head and originated by some change in the surroundings of the animal which has not yet affected the actual surface of its body.

Education by Experience.

The factors which so far determine success in the struggle for predominance are, in the first place, foresight and power to react to coming events, and, in the second place, control of the whole activities of the organism by that part of the central nervous system which presides over the reaction. The animal therefore profits most which can subordinate the impulses of the present to the exigencies of the future.

An organism thus endowed is still, however, in the range of its reactions, a long way behind the type which has attained dominance to-day. The machinery we have described, when present in its simplest form, suffices for the carrying out of reactions or adaptations which are determined immediately by sense impressions, advantage being given to those reactions which are initiated by afferent stimuli affecting the projicient sense organs at the head end of the animal. With the formation of the vertebrate type, and probably even before, a new faculty makes its appearance. Up to this point the reactions of an animal have been what is termed "fatal," not in the sense of bringing death to the animal, but as inexorably fixed by the structure of the nervous system inherited by the animal from its precursors. Thus it is of advantage to a moth that it should be attracted by, and fly towards light objects—e.g. white flowers—and such a reactivity is a function of the structure of its nervous system. When the light object happens to be a candle flame the same response takes place. The first time that the moth flies into and through the candle flame, it may only be scorched. It does not, however, learn wisdom, but the reaction is repeated so long as the moth can receive the light stimuli, so that the response, which in the average of cases is for the good of the race, destroys the individual under an environment which is different from that under which it was evolved. There is in this case no possibility of educating the individual. The race has to be educated to new conditions by the ruthless destruction of millions of individuals, until only those survive and impress their stamp on future generations whose machinery, by the accumulation and selection of minute variations, has undergone sufficient modification to determine their automatic and "fatal" avoidance of the harmful stimulus.

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The next great step in the evolution of our race was the modification of the nervous system which should render possible the education of the individual. The mechanism for this educatability was supplied by the addition, to the controlling sensory ganglia of the head, of a mass of nervous matter which could act, so to speak, as an accessory circuit to the various reflex paths already existing in the original collection of nerve ganglia. This accessory circuit, or upper brain, comes to act as an organ of memory. Without it a child might, like the moth, be attracted by a candle flame and approach it with its hand. The injury ensuing on contact with the flame would inhibit the first movement and cause a drawing back of the hand. In the simple reflex mechanism there is no reason why the same series of events should not be repeated indefinitely, as in the case of the moth. The central nervous system, however, is so constituted that every passage of an impulse along any given channel makes it easier for subsequent impulses to follow the same path. In the new nerve centre, which presents a derived circuit for all impulses traversing the lower centres, the response to the attractive impulse of the flame is succeeded immediately by the strong inhibitory impulses set up by the pain of the burn. Painful impressions are always predominant. Since they are harmful, the continued existence of the animal depends on the reaction caused by such impressions taking the precedence of and inhibiting all others. The effect therefore of such a painful experience on the new upper brain must far outweigh that of the previous impulse of attraction. The next time that a similar attractive impression is experienced the derived impulse traversing the upper brain arouses, not the previous primary reaction, but the secondary one, viz. that determined by the painful impressions attending contact with the flame. As a result, the whole of the lower tracts, along which the primary reaction would have travelled, are blocked, and the reaction—now an educated one—consists in withdrawal from or avoidance of the formerly attractive object. The burnt child has learnt to dread the fire.

The upper brain represents a nerve mechanism without distinct paths, or rather with numberless paths presenting at first equal resistance in the various directions. As a result of experience, definite tracts are laid down in this system, so that the individual has the advantage not only of his lower reflex machinery for reaction, but also of a machinery which with advance in life is adapted more and more to the environment in which he happens to be. This educable part of the nervous system—i.e. the one in which the direction of impulses depends on past experience and on habit—is represented in vertebrates by the cerebral hemispheres. From their first appearance they increase steadily in size as we ascend the animal scale, until in man they exceed by many times in bulk the whole of the rest of the nervous system.

We have thus, laid down automatically, increased power of foresight, founded on the Law of Uniformity. The candle flame injures the skin once when the finger is brought in contact with it. We assume that the same result will follow each time that this operation is repeated. This uniformity is also assumed in the growth of the central nervous system and furnishes the basis on which the nerve paths in the brain are laid down. The one act of injury which has followed the first trial of contact suffices in most cases to inhibit and to prevent any subsequent repetition of the act.

The Faculty of Speech.

If we consider for a moment the vastness and complexity of the stream of impressions which must be constantly pouring into the central nervous system from all the sense organs of the body, and the fact that, at any rate in the growing animal, every one of these impulses is, so to speak, stored in the upper brain, and affects the whole future behaviour of the animal, even the millions of nerve cells and fibres which are to be found in the human nervous system would seem to be insufficient to carry out the task thrown upon them. Further development of the adaptive powers of the animal would probably have been rendered impossible by the very exigencies of space and nutrition, had it not been for the development of the power of speech. A word is a fairly simple motor act and produces a correspondingly simple sensory

impression. Every word, however, is a shorthand expression of a vast sum of experience, and by using words as counters it becomes possible to increase enormously the power of the nervous system to deal with its own experience. Education now involves the learning of these counters and of their significance in sense experience; and the reactions of the highest animal, man, are for the most part carried out in response to words and are governed by past education of the experience-content involved in each word.

The power of speech was probably developed in the first place as a means of communication among primitive man living in groups or societies; as a means, that is to say, of procuring cooperation of the different individuals in a task in which the survival of the whole race was involved. But it has attained still further significance. Without speech the individual can profit by his own experience and to a certain limited extent by the control exercised by the older and more experienced members of his tribe. As soon as experience can be symbolised in words, it can be dissociated from the individual and becomes a part of the common heritage of the race, so that the whole past experience of the race can be utilised in the education—i.e. the laying down of nerve tracts—in the individual himself. On the other hand, the community receives the advantage of the foresight possessed by any individual who happens to be endowed with a central nervous system which transcends that of his fellows in its powers of dealing with sense impressions or other symbols. The foresight thus acquired by the whole community must be of advantage to it and serve for its preservation. It is therefore natural that in the processes of development and division of labour, which occur among the members of a community just as among the cell units composing an animal, a class of individuals should have been developed, who are separated from the ordinary avocations, and are, or should be, maintained by the community, in order that they may apply their whole energies to the study of sequences of sense impressions. These are set into words which, as summary statements of sequence, are known to us as the Laws of Nature. These natural laws become the property of the whole community, become embodied by education into the nervous system of its individuals, and serve therefore as the experience which will determine the future behaviour of its constituent units. This study of the sequence of phenomena is the office of Science. Through Science the whole race thus becomes endowed with a foresight which may extend far beyond contemporary events and may include in its horizon not only the individual life, but that of the race itself as of races to come.

Social Conduct.

I have spoken as if every act of the animal were determined by the complex interaction of nervous processes the paths of which through the higher parts of the brain had been laid down by previous experience, whether of phenomena or of words as symbolical of phenomena. The average conduct, however, of the individual, determined at first in this way, became by repetition automatic—i.e. the nerve paths are so facilitated by frequent use that a given impulse can take only the direction which is set by custom. The general adoption of the same line of conduct by all the individuals of a community in face of a given condition of the environment gave in most cases an advantage to those individuals who were endowed with a nervous system of such a character that the path could be laid down quickly and with very little repetition. Thus we get a tendency, partly by selection, largely by education, to the establishment of reactions which, like the instincts of animals, are almost automatic in character. As MacDougall has pointed out, the representations in consciousness of automatic tendencies are the emotions. Moral conduct, being that behaviour which is adapted to the individual's position in his community, is largely determined by these paths of automatic action, and the moral individual is he whose automatic actions and consequent emotions are most in accord with the welfare of his community, or at any rate with what has been accepted as the rule of conduct for the community.

Rise in Type dependent on Brain.

Thus, in the evolution of the higher from the lower type, the physiological mechanisms, which have proved the

decisive factors, can be summed up under the headings of integration, foresight and control. In the process of integration we have not only a combination of units previously discrete, but also differentiation of structure and function among the units. They have lost, to a large extent, their previous independence of action and, indeed, power of independent action, the whole of their energies being now applied to fulfilling their part in the common work of the organism. At first bound together by but slight ties and capable in many cases of separating to form new cell colonies, they have finally arrived at a condition in which each one is absolutely dependent for its existence on its connection with the rest of the organism and is also essential to the well-being of every other part of the organism.

This solidarity, this subjection of all selfish activity to a common end, namely, preservation of the organism, could only be effected by a gradual increase in the control of all parts by one master tissue of the body, the actions of which were determined by impulses arriving from sense organs which themselves were set into activity by coming events. We thus have with the rise in type a gradually rising scale in powers of foresight, in control by the central nervous system, and in the solidarity of the units of which the organism is composed.

In the struggle for existence the rise in type has depended therefore on the central nervous system and its servants. Rise in type implies increased range of adaptation, and we have seen that this increased range, from the very beginning of a nervous system, was bound up with the powers of this system. Whatever opinion we may finally arrive at with regard to the types of animals which we may claim as our ancestors on the line of descent, there can be no doubt that Gaskell is right in the fundamental idea which has guided his investigations into the origin of vertebrates. As he says, "the law for the whole animal kingdom is the same as for the individual. Success in this world depends upon brains." The work by this observer which has lately appeared sets forth in greater detail than I have been able to give you to-day the grounds on which this assertion is based, and furnishes one of the most noteworthy contributions to the principles of evolution which have been published during recent years.

We must not, however, give too restrictive or common a meaning to the expression "brains" used by Gaskell in the dictum quoted above. By this word we imply the whole reactive system of the animal. In the case of man, as of some other animals, his behaviour depends not merely on his intellectual qualities or powers, to which the term "brain" is often in popular language confined, but on his position as a member of a group or society. His automatic activities in response to his ordinary environment, all those social acts which we ascribe in ourselves to our emotions or conscience, are determined by the existence of tracts in the higher parts of his brain, access to which has been opened by the ruthless method of natural selection and which have been deepened and broadened under the influence of the pleasurable and painful impressions which are included in the process of education. All the higher development of man is bound up with his existence as a member of a community, and in trying to find out the factors which will determine the survival of any type of man, we must give our attention, not to the man, but to the tribe or community of which he is a member, and must try to find out what kind of behaviour of the tribe will lead to its predominance in the struggle for existence.

Political Evolution.

The comparison of the body politic with the human body is as old as political economy itself, and there is indeed no reason for assuming that the principles which determine the success of the animals formed by the aggregation of unicellular organisms should not apply to the greater aggregations or communities of the multicellular organisms themselves. It must be remembered, however, that the principles to which I have directed your attention are not those that determine survival, but those which determine rise of type, what I have called success. Evolution may be regressive as well as progressive. Degeneration, as Lankester has shown, may play as great a part as evolution of higher forms in determining survival. The world still contains myriads of unicellular

organisms as well as animals and plants of all degrees and complexity and of rank in the scale of life. All these forms are subordinate to man, and when in contact with him are made to serve his purposes. In the same way all mankind will not rise in type. Many races will die out, especially those who just fall short of the highest type, while others by degradation or differentiation may continue to exist as parasites or servants of the higher type.

Mere association into a community is not sufficient to ensure success; there must also be differentiation of function among the parts, and an entire subordination of the activity of each part to the welfare of the whole. It is this lesson which we English-speaking races have at the present time most need to learn. In the behaviour of man almost every act is represented in consciousness as some emotion, experience or desire. The state of subordination of the activities of all units to the common weal of the community has its counterpart in consciousness as the "spirit of service." The enormous value of such a condition of solidarity among the individuals constituting a nation, inspired, as we should say, by this spirit of service, has been shown to us lately by Japan. In our own case the subordination of individual to State interests, such as is necessary for the aggregation of smaller primitive into larger and more complex communities, has always presented considerable difficulty and been accomplished only after severe struggle. Thus the work begun by Alexander Hamilton and Washington, the creation of the United States, is still, even after the unifying process of a civil war, incomplete and marred by contending State and individual interests. The same sort of difficulties are being experienced in the integration of the units, nominally under British control, into one great nation, in which all parts shall work for the good of the whole and for mutual protection in the struggle for survival.

The Lesson of Evolution.

Just as pain is the great educator of the individual and is responsible for the laying down of the nervous paths, which will determine his whole future conduct and the control of his lower by his higher centres, so hardship has acted as the integrator of nations. It is possible that some such factor with its attendant risks of extermination may still be necessary before we attain the unification of the British Empire, which would seem to be a necessary condition for its future success. But if only our countrymen can read the lesson of evolution and are endowed with sufficient foresight, there is no reason why they should not, by associating themselves into a great community, avoid the lesson of the rod. Such a community, if imbued by a spirit of service and guided by exact knowledge, might be successful above all others. In this community not only must there be subordination of individual to communal interests, but the behaviour of the community as a whole must be determined by anticipation of events—*i.e.* by the systematised knowledge which we call Science. The universities of a nation must be like the eyes of an animal, and the messages that these universities have to deliver must serve for the guidance and direction of the whole community.

This does not imply that the scientific men, who compose the universities and are the sense organs of the community, should be also the rulers. The reactions of a man or of a higher mammal are not determined immediately by impulses coming from his eyes or ears, but are guided by these in association with, and after they have been weighed against, a rich web of past experience, the organ of which is the higher brain. It is this organ which, as the statesman of the cell community, exercises absolute control. And it is well that those who predicate an absolute equality or identity among all the units of a community should remember that, although all parts of the body are active and have their part to play in the common work, there is a hierarchy in the tissues—different grades in their value and in their conditions. Thus every nutritional mechanism of the body is subordinate to the needs of the guiding cells of the brain. If an animal be starved, its tissues waste; first its fat goes, then its muscles, then its skeletal structures, finally even the heart. The brain is supplied with oxygen and nourishment up to the last. When this, too, fails, the animal dies. The leading cells have first call on the resources of the body. Their needs,

however, are soon satisfied, and the actual amount of food or oxygen used by them is insignificant as compared with the greedy demands of a working muscle or gland cell. In like manner every community, if it is to succeed, must be governed, and all its resources controlled by men with foreseeing power and rich experience—*i.e.* with the wisdom that will enable them to profit by the teachings of science, so that every part of the organism may be put into such a condition as to do its optimum of work for the community as a whole.

At the present time it seems to me that, although it is the fashion to acquiesce in evolution because it is accepted by biologists, we do not sufficiently realise the importance of this principle in our daily life, or its value as a guide to conduct and policy. It is probable that this doctrine had more influence on the behaviour of thinking men in the period of storm and controversy which followed its promulgation fifty years ago, than it has at the present day of lukewarm emotions and second-hand opinions. Yet, according to their agreement with biological laws, the political theories of to-day must stand or fall. It is true that in most of them the doctrine of evolution is invoked as supporting one or other of their chief tenets. The socialist has grasped the all-importance of the spirit of service, of the subordination of the individual to the community. The aristocrat, in theory at any rate, would emphasise the necessity of placing the ruling power in the hands of the individuals most highly endowed with intelligence and with experience in the affairs of nations. He also appreciates the necessity of complete control of all parts by the central government, though in many cases the sense organs which he uses for guidance are the traditions of past experience rather than the science of to-day. The liberal or individualist asserts the necessity of giving to each individual equal opportunities, so that there may be a free fight between all individuals in which only the most highly gifted will survive. It might be possible for another Darwin to give us a politic which would combine what is true in each of these rival theories, and would be in strict accord with our knowledge of the history of the race and of mankind. As a matter of fact the affairs of our States are not determined according to any of these theories, but by politicians, whose measures for the conduct of the community depend in the last resort on the suffrages of their electors—*i.e.* on the favour of the people as a whole. It has been rightly said that every nation has the government which it deserves. Hence it is all-important that the people themselves should realise the meaning of the message which Darwin delivered fifty years ago. On the choice of the people, not of its politicians, on its power to foresee and to realise the laws which determine success in the struggle for existence, depends the future of our race. It is the people that must elect men as rulers in virtue of their wisdom rather than of their promises. It is the people that must insist on the provision of the organs of foresight, the workshops of exact knowledge. It is the individual who must be prepared to give up his own freedom and ease for the welfare of the community.

Whether our type is the one that will give birth to the super-man it is impossible to foresee. There are, however, two alternatives before us. As incoherent units we may acquiesce in an existence subordinate to or parasitic on any type which may happen to achieve success, or as members of a great organised community we may make a bid for determining the future of the world and for securing the dominance of our race, our thoughts and ideals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ST. ANDREWS.—At a meeting of the University Court held on Saturday last, Dr. Arnold Hartley Gibson, senior demonstrator and assistant lecturer in engineering and lecturer on hydraulics at Manchester University, was appointed to the chair of engineering at University College, Dundee, in the room of Prof. Fidler, resigned.

Mrs. Edwin Neave was appointed lady warden of University Hall, St. Andrews, in the room of Miss Melville, who was recently appointed to Queen Margaret's College, Glasgow.