TRANSACTIONS

OF

THE GEOLOGICAL SOCIETY

OF SOUTH AFRICA.

No. 1.

INAUGURAL ADDRESS BY THE PRESIDENT, DR. EXTON, F.G.S.
(Delivered April 8th, 1895.)

Gentlemen,—At the meeting in February at which the Geological Society of South Africa was first instituted, you did me the very great honour of placing me in the chair as the first President of the newly-formed Society. I mentioned at that meeting, as some excuse for my shortcomings, that for some years I had not been directly engaged in geological work; and I, therefore, feel the greater responsibility which devolves upon me in presiding over this unusually important meeting—a meeting which I may say marks a distinct epoch in the life of the Rand, and I trust I may say also, in the history of science in South Africa.

As a Society, we feel proud of the number of members who have joined our ranks, not only of specialists who are in active work in the field of geology, and those whose duties in connection with the mining industry secure them a very practical acquaintance with the rocks and their stratification; but also that much larger class who have neither time nor opportunity to make an elaborate study of geological phenomena, but whose aspirations are to know something of the structure of the earth upon which they live? These papers which are already promised to the Society cannot fail to offer many attractions, and, I trust, many advantages also.

The Council of this Society has taken much pains in drafting a series of rules and regulations which have been amended and accepted at the general meeting held on the 11th March. It is hoped they will be found to be of such a nature as will conduce to the well-being and prosperity of the Society. If at any future time it may be considered necessary to revise or alter these regulations, I may point out that it will be desirable to devise some means of reaching the non-resident members and of obtaining an expression of opinion from them upon the working of our rules and upon any suggested alteration.

In forming a new Society we must begin with a clear conception of the object we have in view. Primarily, this is to obtain an accurate knowledge of the rocks composing the framework of this southern portion of the African continent, to determine the manner in which the various strata have been built up, the processes of their formation, the order in geological time of their appearance, their relation to each other, and also in some instances to note the changes they have undergone through the agency of heat, pressure and such other causes. It is only by careful and diligent accumulation of facts by trustworthy observers, accompanied by rock-specimens, which our Museum will afford the opportunity of exhibiting, that we can hope to unravel the complicated theories which pointed the remark made to our Vice-President, Mr. Ballot, "that geologists differ so much." We must endorse Mr. Ballot's answer by making it our ambition to reduce to order what from insufficient knowledge may have appeared contradictory. It is upon the skeleton of observed facts, such as has been commenced by Mr. Draper, our energetic secretary, in the section he has made over the line of country between Pretoria and the Vaal River at Vereeniging, that the body of geological work in South Africa must eventually be built up.

A no less important enquiry, which beyond the accumulation of rock-specimens has a peculiar fascination for the naturalist, is the position in the vegetable and animal kingdoms, as well as their place in the geological world, of those different plants and animals whose fossil remains are evidence of their having in former ages lived and flourished upon the earth amid surroundings which it is the geologist's province to explain. Like as we know the history of the native races, the Bushmen and Hottentot succeeded and supplanted by the Bantu hordes, we may be able to point out the history of the living things, vegetable and animal, which by their fossil remains have left their impress upon the successive periods in geological time, exemplified in the stratification of the rocks. In these and the terrestrial revolutions to which they bear witness we have one of the most interesting subjects of geological investigation.

Let us look for a moment on the fossil, Gale-saurus, a reptile found in the Stormberg beds which I mentioned at the preliminary meeting of this Society. I then pointed out that along with very decided reptilian characteristics, the Gale-saurus has remarkable modification of its dental system. Its teeth by their size and shape in both the upper and lower jaw, admit of division into incisors, canines, and molars, as they are seen in the class Mammalia, with this further analogy with mammals, that the teeth are implanted into sockets in the jaw, and not merely cemented upon, or, as it were, soldered to the surface of the jawbone, as is the case with other lizards. But the investigations of

the palæontologist have brought to light another interesting feature in the bony structure of this old-world lizard, which takes us back into the region of legend and romance. I shall not go far into the domain of comparative anatomy, but shall content myself with the general statement, that in all essential features of his organisation man resembles other mammals in his anatomical structure ; but along with this general resemblance, man retains some rudimentary organs which are valueless for the purposes of life, rudimentary organs which throughout the animal world are the exponents of a relationship to pre-existing species. Deeply seated within the human brain, and close to the optic lobes, an off-set to the brain, the function of which is intimately connected with the visual apparatus, there is a small body called the Pineal Gland, which has hitherto been a puzzle to physiologists. The philosopher Descartes hazarded the speculation that it might be the seat of the soul. It may be stated shortly that no vertebrate animal is without this gland. It is larger in the infant than it is in the adult, and as we descend the scale of Nature we find in some lizards the gland is much prolonged, and ends externally in an eye with distinct visual apparatus, which lies just within the skull, behind an aperture known to anateonists as the Parietal Foramen. We do not know that in any living species this eye is of any real service, the point of interest being that structually the eye is there. Prof. Agassiz insists that the old-world animals resemble the embryonic forms of existing species. In the New Zealand gecko (Rynchocephalus) the rudimentary middle eye is found at the end of a prolongation which in man is known as the Pineal Gland ; and the Parietal Foramen exists in the large water-lizard of this country, the Varanus Niloticus, commonly called the Liguan. From the great size of this foramen in some of the extinct fossil reptilia, there is no doubt they possessed effective median eyes situated in the centre of the forehead. Thus we are carried back through legend and tradition to the one-eyed human monsters recorded as existing in the past. The Cyclopes of the Odyssey appeared as a race living individually in caves, and having one eye in the centre of the forehead. As a race they were supposed to be connected with Neptune and the forces of the sea, and it requires but little exercise of the imagination to call up the acquatic one-eyed monster reptilia floundering in the chaotic seas of the remote past ; whilst the very names of the Cyclopes—Brontes, Steropes, and Arges—typify the thunder and energy and flare of a volcanic eruption—a natural force in more active operation during the dim ages of the earth's formation. Japan, India, and China afford abundant evidence in their sculptures and paintings of the idea of deformed human monsters having a prominent median eye, and for this no explanation is forthcoming, beyond its having been handed down by tradition from some common origin in past ages.

It is to be hoped that with the increased facilities which this Society may afford, the number of students in the department of Palæontology will be greatly increased, and that this branch of geological science, than which none is more intensely interesting, nor more fertile in its additions to human knowledge, may gather fresh impulse under the stimulus of our newly-formed Society.

We are required, however, to seek aid from every available source ; and as Palæontology in its observations upon the sequence and variation of ancient forms is looked upon as an almost separate province in geological science, so a still newer branch is found in the department of Petrology, which treats of the mineral and by examining their chemical constituents. recording their behaviour under the blow-pipe, the result of submitting them to the action of re-agents, their crystalline character, their appearance under the microscope, and their optical properties, enables the specialist to decide the position of that which is old, and to detect the affinities of the new.

But it is obvious that in a subject which has so many technical details it is only those who have made it a special study who can be expected to grapple with the problems presented. The results to science are found in a nicer definition, and in a stricter nomenclature. How important to geology this is we shall see from a single example in our South African rocks. Almost the first thing to arrest the attention of Mr. Andrew Bain was what he termed the boulder-clay, or claystone porphyry, afterwards by Mr. Wylie called trap-conglomerate, and which is now generally known as the Dwyka-conglomerate. From its very remarkable nature, it has given rise to many and varied opinions as to its origin, some of them of the most extravagant character. On the one hand we have the theory of glacial action, from which has been deduced the idea of a severe Antartic climate having oscillated again and again over South Africa, and on the other, the opposite extreme is urged in the statements that it has "markedly the aspect of a volcanic breccia." Prof. Seeley, who visited South Africa a few years ago, speaks from personal observation upon this much misunderstood conglomerate. He says that "large fragments of all ginds of rocks are included in it, and these materials are cemented together with a fine substance which under a magnifying power suggests that it has been the dust of volcanic ash ejected into the air, which has fallen into water and then consolidated as with cement the pebbles and boulders stretching on a vast seashore, which afterwards came to assume many of the characteristics of volcanic rock." Mr. Dunn observed the occurrence of both large and small pieces of amygdaloid in this conglomerate, which must have been poured out as lava. Finally,

Mr. Wilson Moore unhesitatingly places the Dwyka conglomerate amongst the volcanic rocks, his opinion being based upon fine sections submitted to microscopic examination, and other tests which are fully detailed in his paper read before the Association of Engineers and Architects in October last, which is well worthy of patient study. A point which requires stronger emphasis than it has yet received is the complete absence of any organic remains known to have been found in the Dwyka conglomerate.

To get at the truth from amidst so many and divergent opinions, we require greatly extended observation upon the occurrence of this conglomerate, as well as upon the position of the strata with which it is associated; but it is to the science of Petrology to expound the composition and structure of its constitutent parts, which is the work of the laboratory, that we must look as the instrument for the interpretation of the enigma.

In considering the geology of South Africa, one feature upon which all observers are agreed is the enormous amount of denudation that has taken place in this southern portion of the continent, wearing away the higher plateaux, leaving flat-topped hills still covered by caps of trap-rock indicating the original level of the country, excavating extensive valleys, and depositing in primeval ages the Ecca beds, and in later and quieter times the Kimberley shales, and Karoo beds extending over hundreds of miles of country. These strata contain plentiful wreckage of the old granite. They have also well-defined and characteristic fossils of both vegetable and animal organisms. To use the words of Professor Seeley, "these fossils are each in its class limited to some particular bed of rock, itself formed by aqueous deposits in which the organism had lived and where it was covered up." But nothing has yet been met with either in the flora or fauna indicating a marine origin.

From Mr. Stow's observations, the Kimberley shales die out against the oldest crystalline rocks of South Africa, which appear at the surface at the present day in the Transvaal. At the Vaal River what is called by Mr. Stow "the ancient conglomerate" is the basement rock. In this conglomerate nodules of granite and gniess are found, along with pebbles of anaygdaloid, chert, and quartzite. We know that granite is, as Dr. Livingstone said, the backbone of the country, and it shows here and there through the skin. Now, I want to associate two facts of observation—the position of the granite along with the oldest igneous rocks at the higher altitudes, and the basic conglomerate at the lower levels. In the early days of the Diamond Fields I made observations upon Mr. Stow's Vaal River conglomerate at the Pniel mission station, and along the extensive tracts between the Vaal and Hart Rivers. I found this conglomerate at Kanye, the chief town of the Bangwaketzi. It appears further north at Logagen, the headquarters of the old

chief Sechele. It is again found at Enguameni, in the Matabele country, and Dr. Livingstone reports a similar conglomerate at Cassange, in 10 deg. South Latitude. We thus find a recurrence of similar geological phenomena repeated at intervals along nearly the same line of longitude, and extending from south to north through 18 degrees of latitude.

Here in Johannesburg we are on the western watershed of the range of highland which run in a more or less north-westerly direction right up to the Zambesi. At Bamangwato, the granite backbone appears at the surface and continues right on to the river Shashi. At the river Tati a talcose slate is found dipping at an angle of 60 deg. towards the south-west. Some miles further northward the old igneous rocks are again met with and continue for 50 miles further, right into Matabeleland. There is evidence of slow upheaval all along the line, and in some places the granite has the appearance of an intrusive rock. There is some ground for comparison of the high Mashonaland with the Godwaan plateau and the neighbourhood of De Kaap ; and if we may indulge a further parallelism, of the richer gold fields, must be sought along the western watershed of Matabeleland, where the river Gwai runs towards the Zambesi, and westward from the Gwai in the direction of the N'twetwe salt pans.

But to come back to our own neighbourhood. All observers have arrived at the same conclusion, that the geological formation of the Witwatersrand is of a very exceptional character, and that, geologically speaking, it bears no resemblance to anything hitherto discovered. In the year 1889 I sent to the Geological Society of London a collection of specimens of gold-bearing conglomerate from the Black Reef, on the east, to the Paarl Central, on the west, with, in many instances, examples of the wall-casing of the Reef both north and south. Special reference was made to the narrow band of white friable sandstone contiguous to and lying on the South leader. The probability that the gold-bearing conglomerate has been laid down by aqueous agency begins to assume greater plausibility from the better knowledge we are gaining through the mass of evidence brought forward by the most careful and trustworthy observers. The super-position of the conglomerate upon shales, and the subsequent upheaval of the beds, from the horizontal to their present semi-perpendicular position, being a point about which there can now be little doubt. But what concerns the mining industry to a greater degree is that the same observers are in perfect unison upon this one fact, that there is nothing in the known world approaching the banket reef of Witwatersrand, either in the extent of country through which it is found, or the average uniformity in its mineral richness ; and the extent of its capabilities are not yet known If we consider that within the past twelve months there has been an output of gold to the value of seven

millions sterling, and when we see from the working of new companies, and from the more scietific methods of treating the ores, that this output is steadily increasing, you will feel confident that there is sufficient reason for the fact that these gold-fields form a centre to which the whole civilised world is looking with profound admiration and eager expectation.

But there is another factor in connection with the gold-mining industry which we accept too readily as a matter of course, and that is the coal supply, not considering the utter impossibility of working the mines without the steam-power generated by coal. Since the supply of wood for fuel (which was used in the early days of the Rand) not only failed to keep pace with the growing demand, but by its great expense stopped the development of the poorer mines, and threatened to render the cost of production in the richer mines greater than the value of the gold obtained. So far back as 1854 Dr. Sutherland directed attention to the existence of coal in Natal. Mr. Dunn's observations, made on behalf of the Colonial Government, were published in 1879, the chief results of which consisted in establishing the relation of the Ecca beds and Karoo series to the coal seams of the Cape Colony. Indeed up to 1883 so little had been done by way of proving the existence of workable coal seams that Professor Green, in his report to the Colonial Government recommended that "suitable rewards should be offered for the discovery of coal, as likely to be attended with useful results." Active search has resulted in discovering the existence of coal at various points over a wide extent of country. It is, of course, of the highest importance that coal should be free-burning and have the property of giving out heat; and these qualities are acknowledged to have been deficient in the coal obtained from seams first opened out in the Colony. Professor Rupert Jones has summarised there ports of Mr. Dunn, Mr. North, Professor J. Green, and others, who all agree in attributing the deposits of coal to vegetable matter subsiding in fresh water lakes. The absence of marine fossils was also noted by each observer. Subsequent flooding of such lakes by currents bearing sand and mud would account for the shales with which the coal is so plentifully interstratified. Comparisons of Colonial coal with English shows that the difference is not great but such as might arise if the African coal were formed under water into which vegetable matters were discharged along with mud, the presence of the mud being shown in microscopic sections by a thin coating of incombustible matter surrounding the particles of carbon, which accounts also for the large percentage of ash in such specimens. Further evidence of the coal having been formed from drift vegetation lies in the absence of an underclay beneath the coal seams, such as is generally found below European and American coal beds, and in which the roots of stigmariæ and other plants are to be found. Accord-

ing to the observations of Mr. Draper, the coal now being worked at Vereeniging by Messrs. Lewis & Marks has a soft layer of whitish clay underlying the coal, but, as if to prove the futility of applying general theory to each particular case in South African geology, this underlying clay is apparently a decomposed sheet of dolerite, which has intruded below the coal, and, in many parts, has penetrated into it, changing the coal into coke in the neighbourhood of the intrusion, and giving it more the nature of anthracite throughout its entire area. The endeavour to establish a geological horizon for the coal beds in South Africa has not hitherto led to much practical result. We have Prof. Seeley's recent opinion that coal must not be looked for below the strata containing the remarkable characteristic fossil reptilia. Further we have Mr. Stow's original deduction that coal would be found from 70 to 150 feet below the silicified tree stems which he traced over a large area in the north of the Cape Colony, and over a still greater extent in the Free State, which he termed the forest zone. This agrees with the observations of mining engineers in other countries, that when fossil stems of trees are met with, they are generally resting upon, or at no great distance from coal beds. Mr. Stow's prediction that the coal would be found to crop out on the north-west of his forest zone has since been abundantly verified at the Vaal River. Nothing like a true carboniferous system has yet been made out for South Africa, and though ferns, such as Glossopteris, have been found, this and some others are looked upon as remnants of carboniferous plants that have survived into Jurassic times. The Pecopteris which I show you was obtained near Rouxville, in the Orange Free State, and this with two other allied species are the most characteristic fossils also found in the plant beds at Newcastle, in Australia. In his address before the British Association, held in Montreal, Mr. Blanford endeavoured to trace a parallelism between the flora of our Stormberg beds with that of the Queensland coal-measures, and also with the Raj Mahal beds of India, an interesting subject, which will, I trust, receive further development at the hands of some of our enquirers into geological truth. It is a matter of history that Prof. Drummond in his work entitled "Tropical Africa" refers to a locality near Lake Nyassa where coal was found some years ago by Mr. Cecil Rhodes (now the Right Honourable). In a report by Prof. Rupert Jones on the fossils found and associated with the Nyassa coal, it is extremely interesting to learn that some remains of Palæoniscoid fish were discovered, and that fish of the same kind and order are also found in the Karoo formation of the Orange Free State and Cape Colony. Along with these fish remains there were examples of Cyrenæ and Iridina, fossil shells which have been previously described from the Karoo series also. Prof. Jones observes that the wide extension northwards of the Karoo formation, as repre-

sented in the fish and plant remains obtained near Lake Nyassa is one of the most important additions to our knowledge of African geology. It has been used as a reproach against the early investigators that most of the discoveries of minerals in South Africa have been rather by accident than by enterprise; but this reproach is now being done away with by, on the one hand, the magnificent undertaking which has revealed a succession of gold bearing beds down to a depth of 3,500 feet; and on the other, the boring which has proved the unique geological fact of a coal seam more than 60 feet thick in the Great Eastern Collieries. The search for wealth has stimulated the enterprise; and science must now lay hold of the observed facts to elucidate the problems involved. Nothing could give a better *raison d'etre* for the Geological Society of South Africa.

The address having been read, Mr. A. R. Sawyer formally moved a vote of thanks to the President for the able and interesting paper he had contributed.

Mr. Reunert, in seconding, said that, as Dr. Exton had remarked, the formation of the Geological Society marked a distinct epoch in the life of the Rand, and he also hoped, and, indeed, believed that it would mark a great epoch in the history of South African science. It was indeed evidence of the activity and scientific leanings of Johannesburg that there should have been inaugurated here the first Geological Society in South Africa that showed distinct signs of being a permanent institution. He was sure everyone present must have listened with the greatest interest and pleasure to the really able inaugural address of their President. There was one question, however, he should like to ask. It was about the Amygdaloid formation in the Kimberley beds. Were they geologically the same as the conglomerates at the Vaal River, over which the shales thin out as they touch the river region, getting vastly thicker beyond?

Dr. Exton regretted that, his observations at Kimberley being necessarily superficial, he could not give the information desired.

Resuming, Mr. Reunert said that in old magazines and scientific papers there was much valuable and interesting geological information affecting South Africa. In the old Cape magazines they could find very valuable articles by the pioneers of geology in this country. He thought the Society should make it its work to collect the papers and articles, and have them reprinted. He was sure they would make a most interesting volume.

Mr. Wilson-Moore, in supporting the motion, spoke eulogistically of the address. It possessed not only scientific interest, but it contained matter of much practical interest, and raised many points which it would be the work of the Society to discuss in the future. There was only one slight criticism he had

to make to the paper, and that was the implied correlation of rocks in reference to granite. Granite was of all ages, from the Silurian even to the Tertiary period.

The President then explained that his paper was of necessity of a very general nature and did not go into details. He quite recognised the force of Mr. Wilson-Moore's remarks. But in an address such as he had to deliver on the present occasion he could not digress much, but had to treat the matter from a very general standpoint. But the Society would be very much pleased indeed if Mr. Wilson-Moore were to read a paper on granites and the basic conglomerates of the district—a subject of which he had much knowledge.

Mr. Harvey, the only living member of the first Geological Society ever formed in South Africa (the Grahamstown Society) next supported the motion. He had listened with very great pleasure to Dr. Exton's address. Referring to the now defunct Grahamstown Geological Society, he said it had done much good work in its day. It had issued several valuable publications, and practical classes were formed for the teaching of geology. In the Museum at Grahamstown were several specimens that he thought might help to solve some of the palæontological problems hinted at in the address.

Dr. Exton then thanked the members for the kind manner in which they had received his paper. But it had been a labour of love. He trusted they would not be like the Grahamstown Society, which had ceased to exist, but that their work should be carried on ; that they should enlarge their borders : and that as time went on the amount of work they did would grow. and that intrinsically it would become more and more valuable.

Plates of Mr. Stow's section of the Vaal River formations (presented by Dr. Exton) having been shown, it was remarked by one of the members that Mr. Stow's body was now lying in a grave without even a headstone to it, strange indifference truly toward the memory of one who had done so much for South African geology. The President explained the sad circumstances of the case.

Mr. Rodgers announced that he intended presenting some sandstone slabs from the Basutoland border of the Free State, containing fossilised fish.

Dr. Exton said the present would be a very acceptable one. The fossils were most interesting, and one species, an old-world type having the heterocercal tail, was identified with fossil remains that had been found in formations in both North America and Australia. This fact showed what interesting developments they might hope for in their prosection of the study of geology in South Africa.

Mr. Draper said they should not be stay-at-home geologists, confining their work to the reading of reports and papers. They

ought to go out and explore and investigate and make discoveries, for there was plenty to make. They should, with this view, organise excursions. He had a short time ago visited the Kroomdraai caves, or, rather, the formations that once had been caves, and he found them most interesting from a geological point of view. There was much to discover there. He, therefore, suggested that they make a beginning by making up a party to go and explore this interesting geological ground. They would make a thorough examination in four days, and the time would be well spent.

This having been agreed to, the meeting—which had been a success in every respect—was brought to a close.