disulphide were placed in a flask arranged over a water bath. A large globe had been previously sealed on to the neck of the flask, through tubuli in which the carbon electrodes were inserted. To a third tubulus of the globe an upward condenser was fitted, the interior tube of which was finally bent downwards to serve as a gas delivery tube. The water bath was then heated and the carbon disulphide maintained in rapid ebullition, the electrodes were approached until the powerful current from accumulators was transmitted, and then withdrawn so as to generate the arc. The electric arc in carbon disulphide vapour under these conditions is a remarkable phenomenon; it is seamed with a dark band passing along its centre from pole to pole, and the brightest spots of the incandescent terminals are just where the band appears to touch them. The carbon disulphide was kept boiling and the arc passing for a couple of hours, during which the globe was filled with the vapour, which condensed in the condenser, and fell back into the flask. The interior of the apparatus soon commenced to blacken with liberated carbon, which collected upon the surface of the liquid, and an extraordinarily strong tear-exciting odour soon made itself evident in the neighbourhood of the apparatus. At the conclusion of the experiment the residual liquid was cherry-red in colour, and was transferred to a closed vessel containing copper turnings in order to remove the free sulphur present. After being thus left for a week it was filtered, and the carbon disulphide evaporated at a low temperature in a current of dried air, in order, if possible, to isolate the substance endowed with the powerful odour. Eventually a few cubic centimetres of a deep red liquid, the new sulphide of carbon, were left, which possessed the odour in greater intensity, a trace of the vapour producing a copious flow of tears, accompanied by violent and persistent catarrh of the eyes and mucous membrame. A drop of the liquid, moreover, at once blackened the skin.

The specific gravity of this liquid is 1·2739, so that it sinks under water, with which it does not mix. When heated it polymerises into a hard black substance. If the rise of temperature is gradual the change occurs quietly, but when rapidly heated to 100-120° the polymerisation takes place with explosive force, the interior of the vessel being covered with projected deposits of the black substance. Analyses both of the liquid and of the black solid indicate the same empirical formula, C_3S_2, and molecular weight determinations of the liquid, dissolved in benzene, by Raoult's method, agree closely with the molecular weight corresponding to that formula. The liquid can be partially distilled at 60° *in vacuo*, a small portion, however, always polymerising. The liquid, moreover, spontaneously changes in a few weeks into the more stable black solid modification. The solutions of the liquid in organic solvents likewise slowly deposit the black form.

The liquid readily ignites, burning with a luminous flame, and forming dioxides of carbon and sulphur. Caustic alkalies dissolve it, forming dark coloured solutions from which dilute acids precipitate the polymerised black compound. With alcoholic potash the action is very violent. A drop of concentrated sulphuric acid causes instant passage to the black form accompanied by a hissing noise. Nitric acid provokes an explosion and ignition, but 70 per cent. acid dissolves it completely and quietly.

The black polymeric modification is readily soluble in caustic alkalies, but acids reprecipitate it unchanged. When heated it undergoes a remarkable change, sulphur subliming, and a gas, inflammable and containing sulphur, but not carbon disulphide, is liberated, the nature of which is reserved for a further communication.

The liquid sulphide combines readily with six atoms of bromine, with evolution of heat. The substance is readily isolated when bromine is dropped into a solution of C_3S_2 in chloroform, as it is insoluble in that solvent. Strangely enough this compound, $C_3S_2Br_6$, is endowed with a pleasant aromatic odour, two substances of frightful odours thus uniting to form an agreeably odoriferous compound, a striking example of the effect of chemical combination. A. E. TUTTON.

DR. GREGORY'S JOURNEY TO MT. KENIA.

AT the meeting of the Royal Geographical Society on Monday evening, Dr. J. W. Gregory read a paper, of which the following is a full abstract:—

It has long been known that the lakes of Equatorial Africa are developed on two types, first those which have low shores and are rounded in shape, and second those which have high, steep shores and are long and narrow. The lakes of the latter group, moreover, are distributed on a definite plan, occurring at intervals along lines of depression across the country. The chief of these runs from Lake Nyasa through a large series of lakes, including Natron, Nawasha, Baringo and Basso Narok (Lake Rudolf); from the last of these the line of depression runs through Abyssinia into the Red Sea, which continues the same type of geographical structure for 18° to the north; thence it can be followed up the Gulf of Akaba to the Dead Sea and Jordan Valley. It seems not unlikely that the whole of this great line is due to one common earth movement of no very great age, for the traditions of the natives around Tanganyika, of the Somalis and Arabs, and of the destruction of Sodom and Gomorrah may have reference to it. It was the interest which these problems excited that led to Dr. Gregory's desire to visit the district, as he was recently enabled to do, by the permission of the Trustees of the British Museum. He started with a large expedition, intended to explore this "Rift Valley" in the neighbourhood of Lake Rudolf, which landed at Lamu, and thence started up the Tana Valley, where it unfortunately collapsed. On his return to Mombasa Dr. Gregory himself organised a small caravan of forty Zanzibaris, and travelled to the highest part of the "Rift Valley" between Nawasha and Baringo, examining its structure and natural history. The most risky part of the journey was crossing the high plateau of Leikipia, which has only twice before been traversed, by Teleki and Höhnel in 1887, and by the German Emin Relief Expedition under Dr. Peters in 1889-1890. Mr. Joseph Thomson reached its western side, but had to abandon his camp and escape under cover of night. The expedition crossed Leikipia by a new route, and traversing the plateau which is marked as the site of the "Aberdare Mountains," reached Northern Kikuyu without trouble, except for want of food. The natives at first refused to sell any, as some white men who had visited a neighbouring district had seized food without payment, shot the elders, and carried off the young men as porters. After much "shauri" the natives were satisfied as to the peaceful object of the expedition, the right of blood-brotherhood was celebrated, and food obtained. The party then turned north, to the western foot of Mount Kenia. Most of the men were left in the camp while Dr. Gregory and twelve men started for the central peak. Three days were spent cutting away through the dense forest and bamboo jungle on the lower slope. Owing to the damp, mist, and cold, this work was very severe on the Zanzibaris. On the fourth day they emerged on to the Alpine pasturages, only to be caught in a furious blizzard of snow and hail, which necessitated camping for the night on a frozen peat bog. Next day a tent was carried higher up, as a base for reconnoitring excursions. The most important of the peaks on the south slope was ascended, and named Mount Höhnel, after the Austrian explorer. Five glaciers and eight lakes were discovered, as well as an interesting flora and fauna. A small shelter-tent was taken to near the end of the largest glacier, in readiness for an ascent of the central peak. A snow-slip during a severe storm in the night nearly buried this, and did cover all the food. The ascent had therefore to be attempted after a night's exposure to a severe storm, and without food. The main glacier, which was named after the late Prof. Carvell Lewis, was explored, and the *névé* field at its head crossed to the main south *arête*. After ascending this for some distance it became badly corniced, the risks of further progress were too serious to be encountered alone, and after reaching the height of a little over 17,000 feet it was necessary to return. In a subsequent attempt on the west *arête*, Dr. Gregory was caught in a severe snowstorm, which rendered the route followed in the ascent impassable, and might have entailed serious consequences. He was then recalled to attend to his men, many of whom were suffering severely from the cold and altitude, and an immediate descent to Leikipia was necessary; he had, however, achieved the five purposes for which he visited the mountain.

During the return to the coast much new ground was covered with some interesting topographical results; but except for securing a passage across Kikuyu, by curing the chief of toothache, this part of the journey presented little of general interest.

In conclusion, some of the scientific results of the expedition were summarised, though it was said to be too early to do this properly. Among the more interesting results was the discovery of the former greater extension of the glaciers of Mount

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Kenia, as their moraines were found 5000 feet below their present level; this would have a great influence in the distribution of the Alpine flora in equatorial Africa. In spite of the numerous detailed studies of Kilima Njaro, no such evidence had been recorded from that mountain. The fish faunas are remarkably mixed, and show, as has long been surmised, that the distribution of the African rivers was once very different from the present. The geological results of the expedition suggest that at one time the Nile did not flow from the Nyanza, but rose in the mountains to the north; and the drainage of the lakes flowed away to the east and then to the north, past the site of Lake Rudolf to the Red Sea. Thus it was pointed out that the exploration of this part of Africa is of value not merely as supplying topographical information, but from its bearing on some important problems of geographical evolution.

THE GEOLOGY OF AUSTRALIA.[1]

IN the distant future the antiquity that this country can ever possess is the history of the occupation by its present holders; its aboriginal people have not furnished any evidence of a past history, insomuch, had it happened that they had become extinct a quarter of a century before their discovery, the only traces of prior occupation would have been in the form of stone knives and hatchets and flint spearheads. Interwoven with the history of the progress of discovery and occupation is that of the successive additions to our knowledge of its physical structure and its natural history. The records of botanical science and of geographical exploration have been brought up to a recent date; but the annals of the history of geological progress have not yet been consecutively placed on record. In the selection of a subject for my address I had experienced great difficulty in discriminating between personal interest and representative duty, and in choosing a "century of geological progress" for my theme I have sacrificed the former.

The labour involved in the preparation of this address has been very heavy, as I have read a hundred volumes to produce a very modest account; thus what I have done looks small when I recall the continuousness of the effort that accomplished it. The history of the progress of geology in Australia is intimately associated with that of its geographical discovery and of its advancement in scientific culture; it will constitute a chapter in the early history of modern Australia, and I venture to give some connected view of it, which, however bad it may be, is better than to have no view at all; moreover, there are associated with the subject personal histories which should be recorded whilst the knowledge of them is still within our memory. And although it is my special object to depict actual culminating results without any extended notice of the facts and events which may have led up to them, yet to a certain extent a knowledge of such facts and events is essential to their proper appreciation, and may be productive of increased interest.

Just prior to the close of the last century, the controversy between the Wernerian and Huttonian schools, or between Vulcanists and Neptunists, relating to the origin of the crust of the earth, was at its height. The Huttonian theory, which prevailed, recognises that the strata of the present land surfaces were formed out of the waste of pre-existing continents, and that the same forces are still active. The characteristic feature of Hutton's theory is the exclusion of all causes not recognised to belong to the present order of nature. With the opening of the present century a new school arose, which laid the foundation of modern geology. Three men were largely concerned in this achievement—Cuvier, Lamarck, and William Smith; the two former in France had all the powers which great talent, education, and station could give, whilst the last was an English land surveyor without culture or influence. George Cuvier laid the foundation of comparative osteology, recent and fossil; Lamarck that of invertebrate palæontology; whilst Smith established the fundamental principles of stratigraphical palæontology, viz. the superposition of stratified rocks and the succession of life in time.

The earliest geological observations relating to Australia antedate by only a few years the beginning of this century, so that the history of our progress in geology is concurrent with that of modern geology, and it affords grand illustrations of the methods of application of the laws as they were successively evolved in the European schools, to an area so distantly removed from that which gave them birth. Thus our history begins at a most fortuitous period. No prejudices or scholastic disputations have retarded our progress, for those who have aided in the work were disciples in the modern school of geology. And though, on a retrospective glance, we may hesitate to attach any high value to the labours of pioneer geologists, yet we should not forget that our horizon is so much vaster than theirs was, and to the extension of it they had lent their aid. And though it may be true that if the geological progress of the first half of this century were quite ignored, we would not probably suffer any great loss, as I believe that nearly all the areas explored at the earliest period have been re-examined in later times by men more carefully trained than was previously possible, nevertheless the gradual accumulation of data supplies us with a history, and makes us better acquainted with the causes that at certain times made that progress slow, or even retarded it. For the first three or four decades of this century our geological knowledge had been almost entirely the outcome of maritime surveys, whilst in later years it has been largely supplemented by inland exploration; thus, for a half-century or so the geological progress is part of the history of topographical discovery, which explains why our earlier geological information is inseparable from the achievements of such renowned geographers as Flinders, Baudin, King, Sturt, Mitchell, Stokes, Wilkes, Leichardt, Gregory, &c. The subsequent history of our geological progress commences with the establishment of systematic geological surveys in New South Wales and Victoria, which afterwards led to their extension to the other provincial areas. Almost simultaneously, universities were founded at Melbourne and Sydney; thus whilst the surveys dealt with geology more in its industrial applications, the universities upheld its value on purely scientific grounds. By these agencies a large interest was awakened in the science, and many in whom zeal had been latent were added to the ranks of geological investigators. Much of the knowledge gained in these various ways is expressed on the geological map of Australia, published by the Victorian Government in 1887. The several steps by which this map has been built up, I will endeavour to make known to you, and though my geological reminiscences do not extend far back, yet they embrace some of the most important discoveries made on this continent; at the same time I would wish to avoid the mistake of claiming too large an authority on account of my years.

Though the discovery of Australia may date back to the middle of the sixteenth century, yet it continued a *terra incognita*, at least from a scientific point of view, until Cook—the Columbus of the south—began in 1770 the present phase of scientific expeditions; and though geology reaped no gain, yet in botany was laid the foundation of a knowledge of that marvellous and peculiar flora of Australia through the labours of Banks and Solander, the companions of Cook.

Vancouver, who discovered King George Sound in 1791, describes the summit of Bald Head to be covered with a coral structure, amongst which are many sea-shells, and argued a modern date of elevation. However faulty the interpretation of the nature of the data may be, yet the deduction is sound, and that may be claimed as the first recorded geological observation for Australia, made 102½ years ago.

Coal was discovered in New South Wales in 1797, first to the south of Sydney, and in the same year on the banks of the River Hunter, at what is now Newcastle.

Flinders and Bass, jointly and separately, between the years 1797 and 1798, had explored the coast-line southward from Sydney, reaching as far west as Western Port, and embracing the circumnavigation of Tasmania. The more prominent rock phenomena were described. In 1801 Flinders was commissioned to complete the examination and survey of New Holland. The coast-line of Australia was traced with care as far as the tropics; Flinders paid much attention to physiographic features, whilst Brown collected rock specimens. The rock specimens collected on this survey were reported on by Dr. Filton in 1825, but beyond their mere enumeration and their agreement with those of the same denomination from other parts of the world, no attempt was made to chronologically arrange them; others collected by Brown, during his sojourn in New South Wales, were reported on by Dean Buckland in 1821, hereafter referred to.

Contemporaneously with the marine survey by Flinders was

[1] A part of the inaugural address delivered at Adelaide, on September 26, 1893, by Prof. Ralph Tate, the newly elected President of the Australian Association for the Advancement of Science.

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