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Morocco and Its Future: Discussion

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- (c) "Rapport au Comité du Maroc," *Renseign. Col. Afrique française*, 1908.
- (d) "Une Leçon de Géographie Physique sur le Maroc," *Rev. de Geog.*, 1909.
- (e) "Le Maroc et ses Richesses naturelles," *La Géographie*, 1910.
- (f) "L'Amalat d'Oudja: étude de geog. phys.," *La Géographie*, 1911.
- (g) Numerous short geological papers in the C. Rd. Ak. Sc. Paris, 1906-10.
- (h) "La Géologie du Maroc et la genèse de ses chaines," *Annales de Geog.*, 1912.

JULIUS HANN.—'Handbuch der Klimatologie.' Stuttgart, 1911.

K. KNOCH.—"Die Niederschlagsverhältnisse der Atlasländer," *Jahresb. Frankfurter Verein f. Geog. and Statistik*, 1905-6.

N. LARRAS.—"La Population au Maroc," *La Géographie*, 13, 1906.

A. PHILIPPSON.—'Das Mittelmeergebiet.' Leipzig, 1904.

V. PIQUET.—'La Colonisation française dans l'Afrique du Nord.' Paris: Colin. 1912.

L. RAYNAUD.—'L'Hygiène et la Médecine au Maroc.' Alger, 1902.

LE MARQUIS DE SEGONZAC.—'Voyages au Maroc.' Paris, 1903.

'Au Cœur de l'Atlas.' Paris, 1910.

Prof. MYRES (after the paper): This has been a paper of a rather different character from many which have been before the Department in the last few sessions. Whereas other papers have dealt with geographical detail, or with special problems, this is an attempt—and I think a successful attempt—to put together the main results of other people's work in an area which has for the moment a peculiar interest of its own. The result is, that we are confronted, as we should expect, with a variety of problems, all worthy to be discussed on a more elaborate scale than is possible within the limits of a single paper. I think we have to congratulate Mr. Ogilvie on the way in which he has brought out the salient results and suggested matters for discussion now. I will ask Captain Lyons if he will say a few words.

Captain H. G. LYONS: I have nothing very definite which I can say from personal knowledge, but I should like to give a note of warning with regard to that Saharan area of barometrical low pressure, as being a fact which is often stated, but upon which it is not well to lay too great stress. Of course, observations are very rare there, and observations at points of which the altitudes are definitely determined are rarer still; but as they accumulate it seems more likely that the Sahara is a vast region of only comparatively low pressure than of a very marked low pressure, and, as such, affecting strongly the air circulation. As regards Mr. Ogilvie's paper, I welcome it as a critical discussion of an area and of a large amount of observational material in this country where the descriptive material is so abundant, and where such critical discussions of it are only too infrequent. I am sure such a study as this is an excellent preparation for a practical investigation of the area in the field, and I feel very strongly that the furtherance of such investigations by those who are adequately trained, and who have prepared themselves in such a way as Mr. Ogilvie has, ought to be one of the foremost aims of this Society.

Dr. FALCONER: I fear I cannot say much with regard to Mr. Ogilvie's paper. I wish, however, to congratulate him on the success with which he has brought together the results of other workers, and correlated the various observations which have been made throughout the country. I am a little sorry that Mr. Ogilvie has

not stated in detail the sources from which he has taken the various portions of the paper. In place of the general bibliography, it would be useful to have references given at the foot of each page, showing which author is responsible for the information. One or two points are, perhaps, open to discussion. For example, Mr. Ogilvie speaks of some of the surface features of the present day being due to the dipping of geomorphological axes. That is a matter of very great interest, and one which would have borne much fuller treatment in the paper. There is also a remark about some of the valleys of to-day being defined by the lines of Variscan folds. Those very early lines may perhaps in some cases have affected the present topography of a country, but I think it is very doubtful whether it is true in many cases. It has been suggested that these Variscan folds are responsible for the parallelism of some of the rivers in the north of France; but it seems somewhat rash to assume that the topography of the present day should be defined by a very ancient system of folding in a land which has been subjected more than once to repeated crustal movement and erosion. Then I should like to ask Mr. Ogilvie whether he has any information as to the occurrence of a recent pluvial period in Morocco. Throughout the greater part of the Sahara and the Sudan there is evidence that there has been a pluvial period within comparatively recent times, and that since then there has been a period of desiccation in certain places, and especially in the Sahara. Can any of the surface features of Morocco be ascribed to erosion during this recent pluvial period in Africa? Could the *black earth* of which Mr. Ogilvie has spoken be in any way due to alluvial accumulation during this period? If the organic matter in it arises simply from the decomposition of annuals, there seems no reason why this *black earth* should not be in process of accumulation at the present day. Perhaps Mr. Ogilvie could add some information upon this point. I think, however, that Mr. Ogilvie has done a very useful piece of work in combining all these scattered observations in such a way as to make them more accessible and more valuable to future workers.

Dr. H. R. MILL: It has given me great pleasure to read this paper and especially to hear the summary in which Mr. Ogilvie has put the facts before us. I think it promises well for the rising generation of geographers when a piece of work like this is put together in so workman-like a way. It is important that the work of specialists in different departments should be combined in such a manner as to throw light upon the real problems of geography as a science, and I think that in this paper that has been gone about in just the right manner. I only wish there were more papers of the kind brought before the Society not only at the Research meetings but at the evening meetings as well, because it is important that before any one attempts to do original work in the field he should have learned how to co-ordinate the work of others and to ascertain what is already known about the region he is going to visit. The expression "pluvial period" touches upon a subject I have studied a little. I do not know on what evidence the pluvial period in the Sudan may rest, but I do know that in arid regions as a rule the effect of short but exceedingly heavy torrential rains is far greater in the work of excavating river-valleys than it is in a cultivated land where there is a tough layer of vegetation covering the soil. How far the appearance of extensive aqueous erosion may be due to short and very violent outbursts of rain in an otherwise comparatively dry country, rather than to a "pluvial period" is a question worth considering. We know for a fact that even in our own country there have been cloudbursts in the Lake District and mountains of Wales which produced an enormous amount of erosion in the course of a single afternoon and have cut channels so deep that the normal weathering of a century has not sufficed to obliterate or even to soften the gash in the hillside. Most probably the observations in the Sudan which were referred to took full account of

this possibility, and without knowing more than I do about this, I dare say I should not have referred to it. I must again congratulate Mr. Ogilvie on the very excellent piece of synthetic work he has done and on the admirable way in which he has presented it.

Prof. A. J. HERBERTSON: The type of paper Mr. Ogilvie has given us this afternoon is very valuable. He has not merely summarized the recent literature on the subject, but, as he was prevented from going to Morocco himself, he did the next best thing by consulting the chief authorities in Paris. There are a number of very interesting points arising from the morphology of this region. I have been very much struck by the meeting in Western Morocco of Armorican and Variscan folds; for the junction in France is very much farther to the east. In the south of the Atlas the contact between the great tableland and the folded Mid-World Mountains seems more mixed than at the eastern end of the Mediterranean, in Northern Syria. It would be valuable to have a detailed comparative study of the zones of contact between them in Morocco in the west, in Syria in the east, and in the middle, where apparently a more complex connection exists between the Central Apennines, Southern Italy, Sicily, the eastern Atlas, and the Sahara Tableland.

With regard to the low rainfall to the west of the Atlas I used the late Prof. Fischer's results in making a rainfall map of Africa over a dozen years ago, but I did so with some reservations, because it is quite possible that the steppe character of that region may be due to the soil as much as to the rainfall. If you compare Map I., showing the geomorphology, and Map III., you will notice that the patch of lowest rainfall in the west occupies the eastern half of the Meseta region but avoids the older and harder parts of that foreland. I have to thank Mr. Ogilvie for giving us this very clear account of Morocco, and for suggesting so very many problems which this region presents.

Mr. A. E. KITSON: In complimenting Mr. Ogilvie on his paper I wish to endorse what Captain Lyons has said of its usefulness to geographers who may desire to do further work in Morocco. Brief notes on the geology of the country, given with the geographical description of the different areas and fault lines, would be very useful, and I hope Mr. Ogilvie will include them in his paper. In its late Tertiary elevation the western coast-line of Morocco shows a resemblance to the eastern Guinea coast, but in addition to the two main elevations are there any indications of minor ones of that age, such as is evidenced in Southern Nigeria by coastal plains and entrenched valleys? The marked feature of the Southern Nigerian coast-line is its great delta and its low littoral deposits of sand, mud, and swamp vegetation. While apparently delta deposits of importance are absent from Morocco are there any important littoral deposits, other than river bars, on the Atlantic coast?

Prof. MYRÈS: When I ask Mr. Ogilvie to reply to the criticisms that have been made, I should like, at the same time, to express to him the thanks of the Committee for bringing this material before us and putting it in so compact and useful a form. We have here a particularly interesting region from the geographical point of view, because, to put shortly what seems to me to be its fundamental character, it is an area of which the geomorphology is of the same type as is characteristic of other parts of the Mediterranean region, while it lies sufficiently far west to be exposed to climatic conditions which are far more Atlantic than Mediterranean.

In his first diagram Mr. Ogilvie coloured the Riff series of folds differently from those of the Atlas and indicated important differences in their origin and structure. It would be very interesting if he would work out those differences in greater detail, particularly in regard to their consequences in the surface characters of the two regions. Some of these suggest themselves at once. In a more detailed

geological map, such as that which is appended to M. Gentil's paper, the proportion of the Jurassic surface to the non-Jurassic and pre-Jurassic surfaces of the two regions is very different. In the Riff very much the larger area is pre-Jurassic, and that in itself is an important factor in determining the surface soil and the vegetation of this district. In the same way the area of "irrigable oasis" is extensive and continuous along the mainly jurassic slopes of the Atlas, but (at all events on such condensed maps that we have here) no such feature appears along the foothills of the Riff; and one would like to know how far the detritus brought down by the torrents of the Riff is of a quality inconsistent with the development of any irrigation culture.

One valuable feature of Mr. Ogilvie's paper is, that it indicates clearly how slight and provisional much of our knowledge of Morocco is. Even for so fundamental a factor as the rainfall we are still largely dependent upon Dr. Fischer's inferences from the vegetation, very ingenious, and probably in their main outlines, accurate; and there is one point there which at the outset seems to suggest caution. How far has Dr. Fischer's inference from vegetation to rainfall taken account of the very high figures for dew in the non-rainy season, in a very important part of the region? This circumstance, that the total amount of moisture available for plants is not to be directly correlated with the actual rainfall, comes out again if we discuss that curious deposit of black earth on the Atlantic lowland. Mr. Ogilvie made the ingenious suggestion that it was largely due to the decay of the annual vegetation; rather a difficult hypothesis to follow out, though it is not easy with our present knowledge to devise an alternative. It occurs to me, however, that where, in addition to a seasonal rainfall, you have a very copious dew, particularly in the drier parts of the area, the conditions may be favourable for the preservation of the remains of the lowlier forms of plant life, moulds and the like, in a fine soil which seems to be partly loess.

Another point about the water supply is this: how far there is any variety in the water supply of the different oases? Are they mainly, as some of the large ones appear to be from the map, of the Damascus type, where a river coming from adjacent highlands is beginning to spread and lose itself on the edge of a low arid region, or how far, as along the south side of Algeria, are the oases artesian?

With regard to the interaction of climate and structure, what strikes a historical geographer very markedly is that through the circumstance that here a bit of what I might describe as South Mediterranean country runs out into an Atlantic supply of moisture, you probably have the superficial conditions, the unspoiled vegetation and surface covering, more nearly preserved than anywhere else. I have therefore considerable hope that as the country becomes more accessible to the harmless variety of traveller, we may get information, not merely as to the undestroyed condition of such vegetation, but as to the habits of human life which it engenders; habits on which have been based the great Mediterranean civilizations themselves. We have not, of course, in Morocco, what we have further east, the clues as to natural lines of development supplied by the Carthaginian exploitation, which in Tunis did for a while so much good and ultimately so much harm, by destroying the forests and installing that kind of temporary irrigation-culture, the failures of which are so disastrous if, and when, its energy once flags.

Comparing once again Moroccan conditions with those further east, I suspect that torrential rainfall may produce disproportionately large effects even when the total quantity of rain is small. One instance is the observation of the French geologist, Gaudry, in the Vale of Sparta, where in the course of three days he saw alluvium deposited to a depth of three metres ('Animaux fossiles et Geologie de l'Attique' (1862), 450-1). Another comes from Mr. Hogarth in his account of a rain-

burst in Eastern Crete—one of the most graphic descriptions of that kind in recent geographical literature where the whole of a river-valley was altered in the space of a few hours, to the complete destruction of the works of man ('Accidents of an Antiquary's Life' (1910), pp. 79–87). After a single cloud-burst of that kind you practically start with a fresh piece of the world.

And we have not only had material for discussion in this room, but also valuable suggestions for work in the field. If we compare Mr. Ogilvie's bibliography with the recorded visits of travellers of the chief nationalities, I think we shall be struck with the small number of British travellers whom he has found worthy of a place in his list, and I hope that in that respect his paper may mark the turning of a new leaf.

Mr. A. G. OGIIVIE: I should like to thank the various speakers for their kind references to my paper. It will certainly give me much pleasure if the paper can be of any use at all in any of the ways suggested. I have listened with great interest to the remarks which have been made, and I look forward to going farther into the subject in the light of those remarks. Dr. Falconer has suggested that I should supplement this paper by a resumé of the geology. This has been so well done in an article by M. Gentil in the current number of *Les Annales de Géographie* that it is quite unnecessary for me, who am not a geologist, to attempt to do such a thing. The dipping of the axis of folding in the Atlas has been thoroughly investigated by M. Gentil, and he points out that in the formation of the Strait of Gibraltar both a dipping of the axis and faulting have played a part.

As regards the effect of folding upon the valleys in the western High Atlas, the map by Gentil in the French edition of Suess's work shows well how the deep gorges follow generally the Variscan direction—doubtless coinciding with the less resistant strata.

I believe geologists have recently shown that traces of Variscan folds occur as far south as Senegal. Gentil believes this system to run north-eastwards through Morocco, but he draws a branch which diverges in the Meseta and follows the Armorican direction to the West Coast.

Mr. Kitson has referred to the nature of the volcanic rocks. Perhaps the most striking volcanic area is that at the junction of the High- and Anti-Atlas. It is shown by Gentil to be a neck of a large Tertiary volcano; but all vestiges of the crater have disappeared.

In discussing the Riff we must remember that only its E. and W. ends have been examined by geologists. The representation of the geology of the interior has therefore been largely inferred from descriptions by other observers, notably from those of de Segouzac.

Remarks have been made about the evidences of a Pluvial Period in the past. Fischer describes the great alluvial or diluvial deposits at the base of the Atlas in his work in Petermann. He shows that they are composed entirely of water-worn material varying greatly in size from boulders to the finest sand, and he suggests that they may be fluvio-glacial deposits of the Ice Age or fluvial deposits of a pluvial period. In the vicinity of the mountains much of the rainfall comes in short thunderstorms which, as Dr. Mill has suggested, can do a great deal of work in a short time in arid climates. No doubt this should be borne in mind in considering the origin of these deposits.

The Tirs is regarded by Fischer as an aeolian deposit, while Gentil believes it to be the residue of the dissolved limestone upon which it always lies. Both authors refer to the decay of annuals as producing the black colour, but I do not remember that either mentions the influence of the humbler vegetable forms which probably are important in this respect.

The chairman has remarked that no zone of irrigation oases is shown on the map in the foothills of the Riff. This part of the map is copied from Fischer, who drew along the Atlas a zone where cultivation is possible only by irrigation. He regards the Riff foothills as within the zone of possible cultivation without irrigation. In drawing the isohyets of the Meseta Fischer had to depend largely upon the vegetation for the interior, but at the coast, *i.e.*, where the dews are most marked, he had rainfall observations for several coastal towns.

With regard to the type of water supply existing in the oases of the Saharan border. Those on the Draa, the Ziz and the Gir are situated where the streams emerge from narrow valleys in the hills and are beginning to lose themselves in the sand. The oases in Algeria on the eastern border of Morocco, such as Figig and Aïn-Sefra, have an artesian supply.

REVIEW OF THE RESULTS OF TWENTY YEARS OF ANTARCTIC WORK ORIGINATED BY THE ROYAL GEOGRAPHICAL SOCIETY.

By Sir CLEMENTS R. MARKHAM, K.C.B., F.R.S.

THE time has arrived for explaining briefly the plan and objects of the renewal of the Antarctic exploration which I, as President of the Royal Geographical Society, originated in 1893, in concert with my expert polar advisers. For our chosen leader must have reached the South Pole last January, and is on the eve of completing geographical discoveries in the first direction we selected.

The actual knowledge we possessed in 1893 is best explained by dividing the Antarctic region into four quadrants, each having the Pole as their apex, and the Antarctic circle as their arcs:—

90° E. to 180°—*The Victoria Quadrant.*

180° to 90° W.—*The Ross Quadrant.*

90° W. to 0°—*The Weddell Quadrant.*

0° to 90 E.—*The Enderby Quadrant.*

We knew from Balleny, Dumont d'Urville, and Wilkes that there is more or less land along the arc of the Victoria Quadrant, from Biscoe and Kemp that there is land along the arc of the Enderby Quadrant. Ross had boldly forced his way through that close pack which had stopped every one else, in sailing vessels, had sighted the east coast of Victoria Land with its lofty mountains and active volcano, and had discovered the extraordinary phenomenon known as the "great ice barrier." Weddell, in the quadrant which bears his name, had found that the land was not near the arc of that quadrant, but far to the south, not in sight even in 74° 15'; while Biscoe had discovered a long island or peninsula, which was named Graham Land, extending from the Antarctic towards the Andean region. In the Ross Quadrant Cook and Bellingshausen had discovered that there