Wind-Action in Egypt

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If now we refer Colonel Mason's chronometric differences to Captain Watson's Rejaf, we obtain the following results:—

	Lat. N.			Long. E.		
	°	'	"	°	'	"
Ladó	5	1	12	31	48	23
Beden	4	35	48	31	34	56
Kiri	4	18	10	31	39	15
Labore	3	55	42	31	50	11
Dufi	3	34	55	32	1	32
Magungo	2	14	22	31	30	32
Kavali	1	22	20	30	30	10

I am quite willing to admit that the above results can in no way be looked upon as final, but the agreement between them, whether due to a happy accident or to the skill of the observers, is very remarkable. For the present, at all events, these positions cannot arbitrarily be shifted to the east or west, as appears to have been done by Dr. Hassenstein, who places Gondokoro 6' 27", Ladó 4' 11", and Rejaf 5' 41" further west than I have done, whilst moving Dufi 2' 58" to the east of the meridian adopted by me in the above list. It is obvious, too, that any so-called trigonometrical operations, which are dependent upon positions thus arbitrarily shifted, must be vitiated at their very fountain-heads. I have the very highest opinion of the excellent work done in the regions of the Upper Nile, by painstaking explorers like Schweinfurth, Junker, and Emin Pasha, and for Dr. Hassenstein's conscientious labour in placing the results achieved by them before us, but before we shall be at all in a position to give a satisfactory delineation of these compass and itinerary surveys it is absolutely necessary that we should be furnished with a small number of points, the geographical co-ordinates of which have been determined by trustworthy observations.

Wind-action in Egypt.

By W. M. FLINDERS PETRIE.*

EGYPT is an especially favourable country for studying certain causes of geographical and geological change. The absence of all effective vegetation above the Nile level, enables any one to see the surface conditions at a glance. The absence of rain, except in occasional storms, leaves the wind-action in remarkable prominence, and allows us also to see the effects of a different climate, now long past. And the presence of dated monuments throughout the country, extending farther back in history than any other series of man's works, gives

* Read to the Geographical Section of the British Association, Newcastle, Sept. 1889.

more precision to estimates of time than can be obtained elsewhere. Though my own work has been among the historical remains, yet many geological evidences have come before me, to which I wish to draw attention in hopes that some thorough examination of so valuable a district may be made.

The Isthmus of Suez is an important tract both for the geographical and biological questions of the connection of that sea with the Mediterranean, and also for the various events connected with that region. But the evidences of change there are more complicated than we might suppose; upheaval, depression, and denudation all coming into play. That the Delta as a whole is sinking, and sinking at about the rate at which the Nile deposits are being piled upon it, seems certain. At Naukratis, on the west side of the Delta, the rise of land by deposits has been $4\frac{1}{3}$ inches per century; and at Tanis on the east side, and nearer to the coast, the water-level as shown by a well there has risen $4\frac{1}{4}$ inches per century, though the country is now barely above the sea. At Ismailiyeh in the middle of the Isthmus of Suez, the land has, on the contrary, risen. The present lake there is necessarily on the sea-level, as the canal opens into it; and 10 or 15 feet above the water may be seen a line of thin fragile shells which seem probably to have been formed near the water surface, and which cannot have been exposed for long ages, to judge by their condition. The same late date of this elevation is also shown by the pottery of a Roman village stopping short at the level of the shells, and not extending down to the present water. The position of this site is W.N.W. of Tusun, at the spot marked *Bu.* in the War Office map. The elevation of this region accords with the historical evidence of the head of the Red Sea having extended up to Ismailiyeh; as, when it was 15 feet lower, the submerged region would have been much larger than at present.

These changes of level are, however, but a part of the modifying forces. The wind-action, which is so strikingly seen in this region, is probably quite as powerful a cause of changes as the elevation of the land. The most visible signs of such a force are seen on the western side of Lake Ismailiyeh. Here a high sand-dune forms the limit of the lake, sloping down into it at the angle of rest, and often obliging the traveller to walk in the water in order to pass the foot of the slope. At such points as this it is evident that the lake must be rapidly filled up and modified. But the historical evidence shows that the whole hills have been swept away from the surrounding country in the last two thousand years. The Greek camp of Daphnæ, about 12 miles from Kantara on the Suez Canal, and bordering on the marshes of Lake Menzaleh of the Mediterranean coast, was surrounded by a wall of crude brick about 40 feet thick, and over a mile in circuit. In proportion to the thickness, and to other such Egyptian town-walls, the height was certainly 30 feet, and probably more. Yet the whole of this mass

of hard mud brick has been so utterly swept away by the wind that only the buried foundation remains. Rain has had no share in the actual removal of the clay, as there is no wash from the wall upon the ground on either side. The whole mass, at least 40 feet by 30 in section, has been carried away and deposited elsewhere by the wind alone.

The above is not an isolated case. Some 15 miles to the west is the ancient cemetery of Tell Nebesheh. The tombs have been built of mud brick in a large rise of sandy ground, such as is often seen in the mud flats of the Delta. These tombs were subterranean chambers about six feet high, with well-shafts leading to them. But only two or three now exist entire, sufficient to explain the remains of the others. In most cases the chamber has been nearly removed by the wind-denudation of the whole hill. This shows that about eight feet, or more, of soil has been carried away in 2600 years, or nearly four inches per century. The wall of crude brick around the temple at Tell Nebesheh, though 30 to 40 feet thick, has been swept away by the wind like the wall of Daphnæ, down to the ground-level.

The question naturally arises, where has all the material thus removed been deposited? In a continuous desert the sand-dunes may march on slowly for years, and the furious sand-storms drop their burdens only to be picked up again in the next gale. But in a district intersected by marshes and lakes there is a perpetual trap for all loose material, and whatever touches the wet surface never rises again. Hence all the water will be continually rendered shallower by constant filling up in high winds, and great extents of sandy marsh and very shallow lakes will be formed. This is precisely what we find the most prominent feature of all this region.

Subtracting then the effects of the causes which we have seen to be at work, the deposit of the Nile, the changes of level of land, and the denudation by the wind, we may form some idea of what the appearance of the district must have been some few thousand years ago, when the earliest monuments of human occupation were erected. At that time the eastern side of the Delta must have been more like a part of the neighbouring desert, with hills about 30 or 40 feet high; the Nile flowing down between them, and spreading out into the side valleys, depositing the Nile mud as a level bottom across the valleys. Gradually the deposits rose, the wind ploughed down the hills, and laid the material in the water around, until at present we only see the tops of the denuded hills just appearing as patches and ridges of sand amid an expanse of mud. Meanwhile the coast sank, and the large region of Menzaleh was in Arab times inundated by the sea, and lost to cultivation. The Isthmus at the same time was rising; until, by the general elevation, and the masses of sand blown into the water, the head of the Red Sea was broken up and formed only a chain of half-choked saline lakes,

through which the Suez Canal now runs. But whether we turn to the north coast or to the Isthmus, we see that the wind-action is probably a cause of change of equal power with the deposits of the Nile or the variations of level of the land.

So far we have only reviewed the changes of the historical period ; but up the Nile valley are some of the most brilliant evidences of the enormous climatic differences which rendered the country in the prehistoric human period wholly different from what it now is. That the land was lower, and that the Nile ran into a long estuary, in prehistoric times is usually granted. But there is also no question that a great rainfall over all the country swelled the volume of the river, so that it far exceeded the present stream of even the inundation. The problems yet to be solved are, what was the limit of salt water, and the limits of river and estuary ? What was the volume of the Nile ? and what was the date in chronology and in civilisation when the present state of the country was established ? As illustrations in point I would instance the following examples. The enormous rainfall of the Nile valley is shown by the cliffs at Thebes. There a narrow ridge of limestone, a sort of wall, separates the vertical cliffs at Deir el Bahri from the equal precipices at the head of the Valley of the Tombs of the Kings. This ridge cannot possibly have received surface flow from either end—nor, being limited by cliffs on either side—can more than the catchment of a few hundred feet in width have ever poured over the edges of this dividing wall. Yet the hard limestone is grooved out into a row of wide pipe-shaped grooves down either face, the breadth and close order of which show the volume of rain which must have poured down them. The same story is shown equally plainly in the watercourses which cut up the Nile cliffs into a fringe of ridges divided by deep ravines. These ravines are often a couple of miles in length, and a quarter of a mile in width, cut down through two or three hundred feet depth of rock by a waterfall, of which the evidence remains in the precipitous head of the ravine, the polished rock surfaces over which the cascade has poured, and the deep cauldron scooped out by the descending stream. Yet the catchment basins of such eroding forces are sometimes not over a few square miles in area.

That such erosion took place during the period of the high level of water in the valley, be it fluvial or estuarine, is shown by the height reached by the great banks of debris washed out of the ravines, and piled up as a foreshore to the cliffs next below those torrential valleys. This is very finely seen at Beni Hasan. And it seems most probable that the celebrated wash-beds at Thebes, in which General Pitt Rivers—and later myself—have found wrought flints, were also deposited beneath the water, by the torrent from the Valley of the Kings' Tombs. It seems improbable to suppose a subaerial stream spreading out its material in such a wide fan ; rather we see, both here and at Beni Hasan, how

a subaerial stream will, on the contrary, cut through such broad beds of subaqueous deposit by deep subsequent ploughings. That the age of the high water was within the human period, and that therefore the Theban beds might be subaqueous, is proved by the river-worn palæolith of characteristic appearance, which I picked up hundreds of feet above the present Nile on the desert cliffs of Esneh.

I have now briefly shown what an interesting ground for research still awaits the geographer and geologist in Egypt; and how the conditions of the country render certain problems far more simple than they are in lands with continuous rainfall. Let us hope that our present facilities in Egypt may bring about some complete study of the subjects on which we have now touched.

*An Expedition across Australia from South to North, between the
Telegraph Line and the Queensland Boundary, in 1885-6.*

By DAVID LINDSAY, F.R.G.S.

Map, p. 704.

THE following is an account, slightly abridged, of Mr. David Lindsay's interesting journey across Australia, undertaken at his own risk and expense, in 1885-6, in which he passed through a large tract of previously unexplored country in the Northern Territory of South Australia, a little west of the Queensland boundary. This experienced pioneer and surveyor in the Australian wilds has since, between September 1887 and March 1888, crossed the continent a second time, from Port Darwin to Adelaide, accompanied only by a native boy, and taking four horses as baggage animals. The first journey was undertaken with camels, partly hired and partly supplied by the well-known promoter of Australian exploration, Sir Thomas Elder.

Exploration of the Finke River.—In November 1885, I left Dalhousie with my companions, Lieutenant Dittrich and Warman, and six camels, and proceeded to explore the Finke River.

From Dalhousie I sent down a collection of plants to be forwarded to Baron von Mueller for classification. In this collection, as well as in all others subsequently sent, were as far as possible three specimens of each plant, so that one complete set could be kept by the Baron, one by the Geographical Society of Melbourne, and the third for Lieutenant Dittrich and myself to dispose of as we might think fit. A box of photographs was also sent, together with native weapons, seeds, and other interesting articles. As much information as possible about the language, manners, and customs of the natives was obtained, and put together in a report by Lieutenant Dittrich.

We followed the Finke from a water-hole known as Muckarrina, and for a few miles it was a broad flooded valley, beautifully timbered and grassed, having sandhills on both sides, the tableland having ended at Muckarrina; suddenly the valley narrowed to a mere hollow between the sandhills with a few box-trees here