chemistry must be raised to a higher plane among the biological sciences.

THE NAVIGATION OF THE NILE.

THE Nile, which during thousands of years has attracted much attention from the intelligent portion of mankind, yet remains in many respects the most interesting of the great rivers of the globe. Its sources, which for so long a time were a mystery, have within the last quarter of a century been rediscovered; but that rediscovery has only rendered it more interesting, and more worthy of study.

The great fluctuations in its flow, and the remarkable, almost mathematical, regularity, year after year, of these fluctuations, can now be practically studied, and their causes clearly understood.

Having its great first reservoir under the equator, we now know that it derives its waters from the region between a few degrees south of that line, and latitude about 13° north. It receives its last affluent, the Atbara, south of latitude 13° north, and yet continues its flow, notwithstanding evaporation, receiving nothing, and giving life to the lands it traverses, until it pours the waters of south central Africa into the Mediterranean Sea, in latitude 32° north, carrying in those waters, each year, masses of the *débris* of the mountains of the interior to continually fertilize and extend its delta.

Early in June of each year the flow is the least. The current near Cairo has then a rapidity of only a little more than one mile per hour, and the amount of water passing is only from four hundred to five hundred cubic yards per second. Before the end of June the annual rise commences; and by the end of September the rapidity of the current reaches nearly, if not quite, three and a half miles per hour, the quantity of water passing a given point becoming from *nine thousand* to *ten thousand* cubic yards per second.

Late in October, or early in November, it commences a somewhat rapid decline, which continues until January, when the decline becomes more gradual and regular; this gradual decline continuing until about the end of May, when the minimum flow is again reached, to give place the following month to the new annual rise.

The great regularity of the fluctuations is due to the peculiar sources of supply, and the admirable system of reservoirs and checks which nature has there provided.

The Egyptian Nile is formed by the junction, at Khartum, of the Blue Nile and White Nile.

The Blue Nile (*Bahr-el-Azrack*), taking its rise in the centre of Abyssinia, and fed by the rains which yearly fall in the mountains of that country during the months of April, May, June, July, and August, furnishes the great masses of water which cause the rapid summer rise, and also furnishes the rich silt, which, torn from the mountains of Abyssinia, spreads over the cultivatable lands of Egypt, and yearly renews the fertility of those lands.

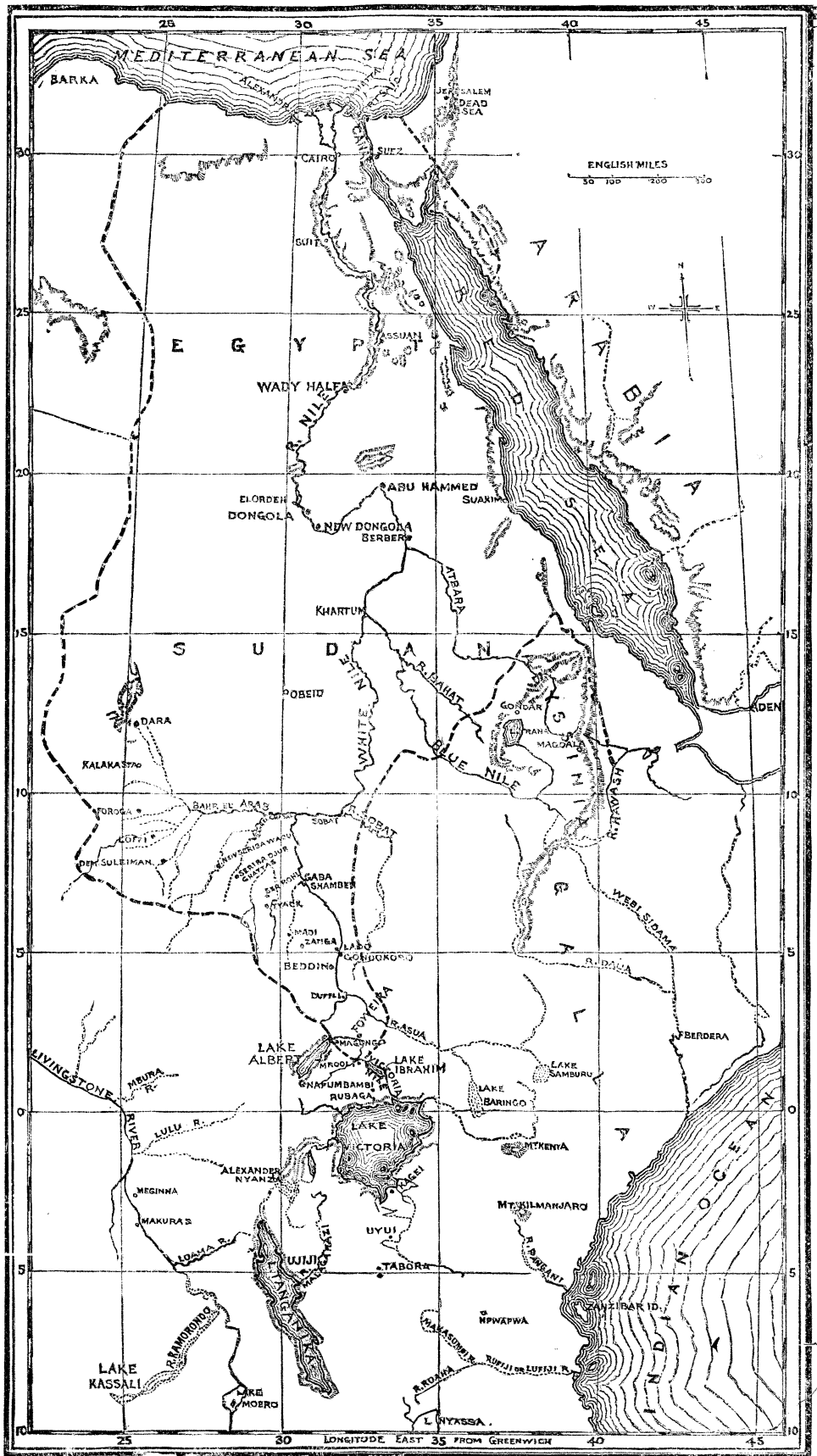
The White Nile (*Bahr-el-Abiad*), flowing from the great reservoir under the equator, guarded in that and the subordinate reservoirs, Lake Ibrahim and Lake Albert, and guarded also by the great system of dams called 'the cataracts,' furnishes the steady flow of clear water which continues throughout the year.

No human engineer has ever devised, on anything like so grand a scale, so admirable a system for the collection, preservation, and distribution of irrigating waters, as has there been formed by nature for the supply of Egypt.

Lake Victoria, with a surface of some forty thousand square miles, collects and stores, for the use of the Sudan and Egypt, the rain-water falling on a basin of more than a hundred and sixty thousand square miles of surface. The average yearly rise of the lake may be fairly taken, according to observations made on the spot, as two feet, which gives for distribution through its only outlet, the Victoria Nile (the Somerset of Speke), the enormous volume of more than sixty-eight thousand million cubic yards of water per annum, or more than two thousand cubic yards per second.

It will be seen that this storage is so well devised, that, in order to give *one inch* of rise to the Victoria Nile, more than *twenty-eight hundred millions* of cubic yards must be stored in this great reservoir.

Then come the two secondary reservoirs, — first Lake Ibrahim (discovered by Col. Long in 1874), in latitude north $1\frac{1}{2}°$, which must be filled before the flow can continue on towards Egypt; and then Lake Albert, which must be filled over its surface of perhaps three thousand square miles before the direct distribution of waters through the White Nile can fairly commence. But this is not all that nature has there done to regularize the great distribution. Between Lakes Ibrahim and Albert, there is a great system of natural dams in the cataracts which are found between Foweira and Lake Albert. Then coming north, down the White Nile, we find, first at Duffli, and soon again at Beddin, successions of rapids, the results


MEDITERRANEAN SEA
BARKA
ALEXANDRIA
JERUSALEM
DEAD SEA
CAIRO
SUEZ
ENGLISH MILES
50 100 200 300
SUIT
E G Y P T
ASSUAN
WADY HALFA
NILE R.
ARABIA
DESERT
ABU HAMMED
SUAKIM
EL ORDEB
DONGOLA
NEW DONGOLA
BERBER
ATBARA
KHARTUM
S U D A N
WHITE NILE
R. DAHAT
GONDAR
ADEN
DARA
OBEID
KALAKA
BLUE NILE
FOROGA
BAHR EL ARAB
SOBAT
R. SOBAT
DEM SULEIMAN
GABA SHAMBE
R. YABUS
WEBI SHEBELI
R. DABIA
BEDDINO
DUFFILE
R. ASUA
BERDERA
LAKE ALBERT
LAKE IBRAHIM
LAKE SAMBURU
LAKE BARINGO
RUBAGA
MT. KENYA
LAKE VICTORIA
ALEXANDER NYANZA
MEGINNA
MAKURA
MT. KILIMANJARO
UYUI
TABORA
UJIJI
TANGANYIKA
MPWAPWA
ZANZIBAR I.
LAKE KASSALI
R. RAMORORO
LAKE MOERO
L. NYASSA
INDIAN OCEAN
LONGITUDE EAST FROM GREENWICH
25
30
35
40
45
10
5
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5
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15
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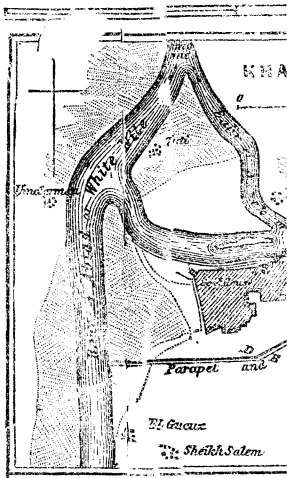
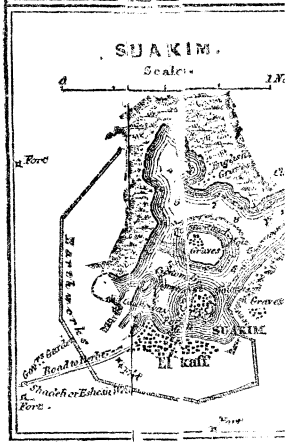
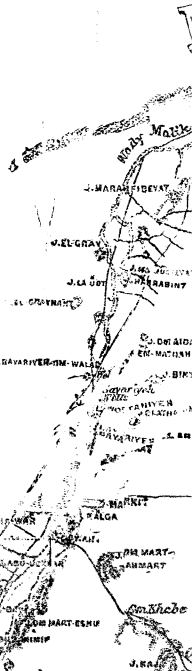
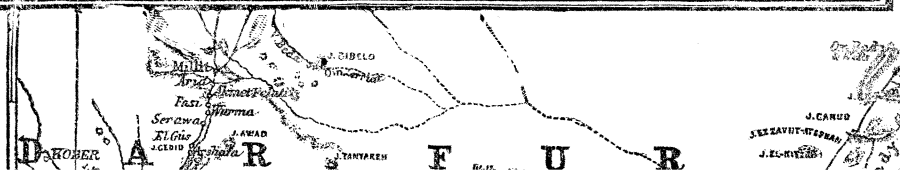
25
30

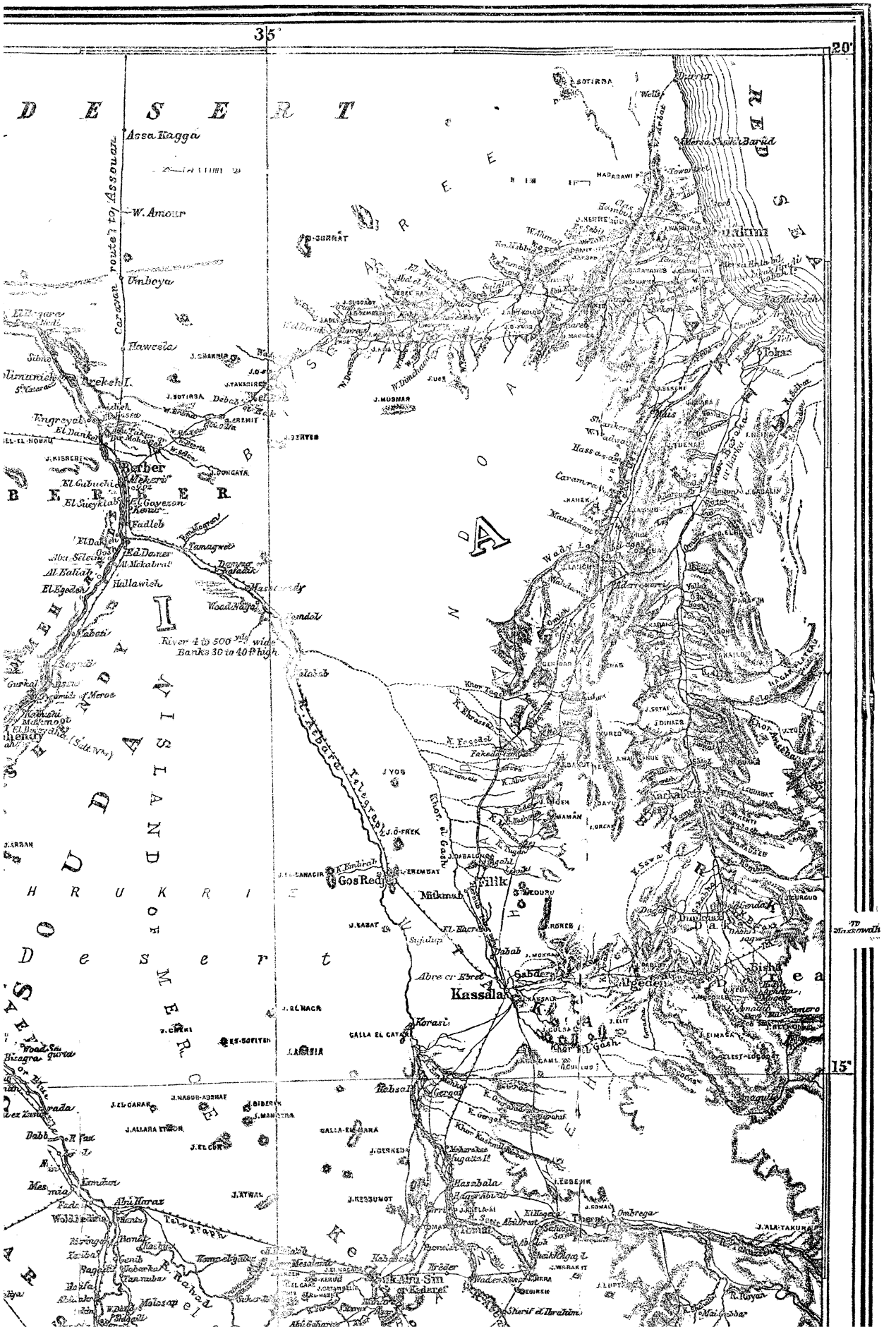

White Nile
Parapet
El Gucux
Sheikh Salem


SUAKIM
Scale
Fort
Harbour
Coral Reefs
Quarantine
SUAKIM
Fort


Wady Matik
J. MARAHBEYAT
J. EL GRAY
J. EL GOT
J. RAVARIVER-IM-WALS
J. BIKI
J. MARKET
J. KALGA
J. Khebe
Bukolale
J. IGUA
J. CANUD
J. EL ZAYUT-ET-ERAN
J. EL-HIMEIR
J. GHEHENIFA


Mellit
Fasher
Serawa
El Gitis
J. GEDID
J. AWAD
J. TANYAREH
DARFUR


KHARTOOM.
Scale.
NUBIAN DESERT
BAYÛDA DESERT
ARGAB-TESSEAGOA-DESERT
DAR MONASIR
DAR HASANIYEH
Old Dongola
Dongola el Agûz
OM-DIAYR DESERT
BAYUDA STEPPE DESERT
KHARTOOM
Shendy
Metemmeh
Berber
Abu Hamed
Wad Medani
Sennar
Kassala
Gedaref
Gallabat
Matamma
Suakim
Red Sea Coral Banks
Delligo
Cataract of Kaibar
Hannek
Abu Dom
Ed Debba
Merowe
Korti
Wad Shely
Ed Duaim
Om Sherore
Om Kadada
Om Kaddada
Om Sayala
Om Gohi
Om Guerfa
Om Kaddar
Om Kaja
Om Khabe
Om Rahail
Om Dahan
Om Dafuga
Om Samuel
Om Balaga
Om Shekoa
Om Sharo
Om Shekoa
Om Sherore
Om Sherore
Om Sherore


35°
20°
15°
DESERT
Assa Kagga
W. Amour
Caravan route to Assuan
Umboya
Hawecla
Berber
BERBER
Fadleb
Hallawieh
River 4 to 500 yds wide
Banks 30 to 40 ft high
R. Atbara
ISLAND OF MEROE
Desert
Gos Redjeb
Filik
Mikmah
Kassala
Korasi
Algeden
Gabderat
Abu Sin
Kedaref
Haszbala
Tiger
Ombrega
Sherif el Ibrahim
Red Sea
Gulf of Suakin
Barka
Gash
Khor el Gash
Khor Baraka
Khor Kashm el Girba
Khor Arbaat
Khor Adda
Khor Tokar
Khor Handub
Khor Gulsa
Khor Gemeil
Khor Lud
Khor Ela-ai
Khor Abu Sin
Khor Kedaref
Khor Sherif el Ibrahim
Khor Mai Gabbar
Khor Tuyan
Khor Sheraf
Khor Mokram
Khor Roreb
Khor Embirol
Khor Fessadi
Khor Tokar
Khor Handub
Khor Gemeil
Khor Lud
Khor Ela-ai
Khor Abu Sin
Khor Kedaref
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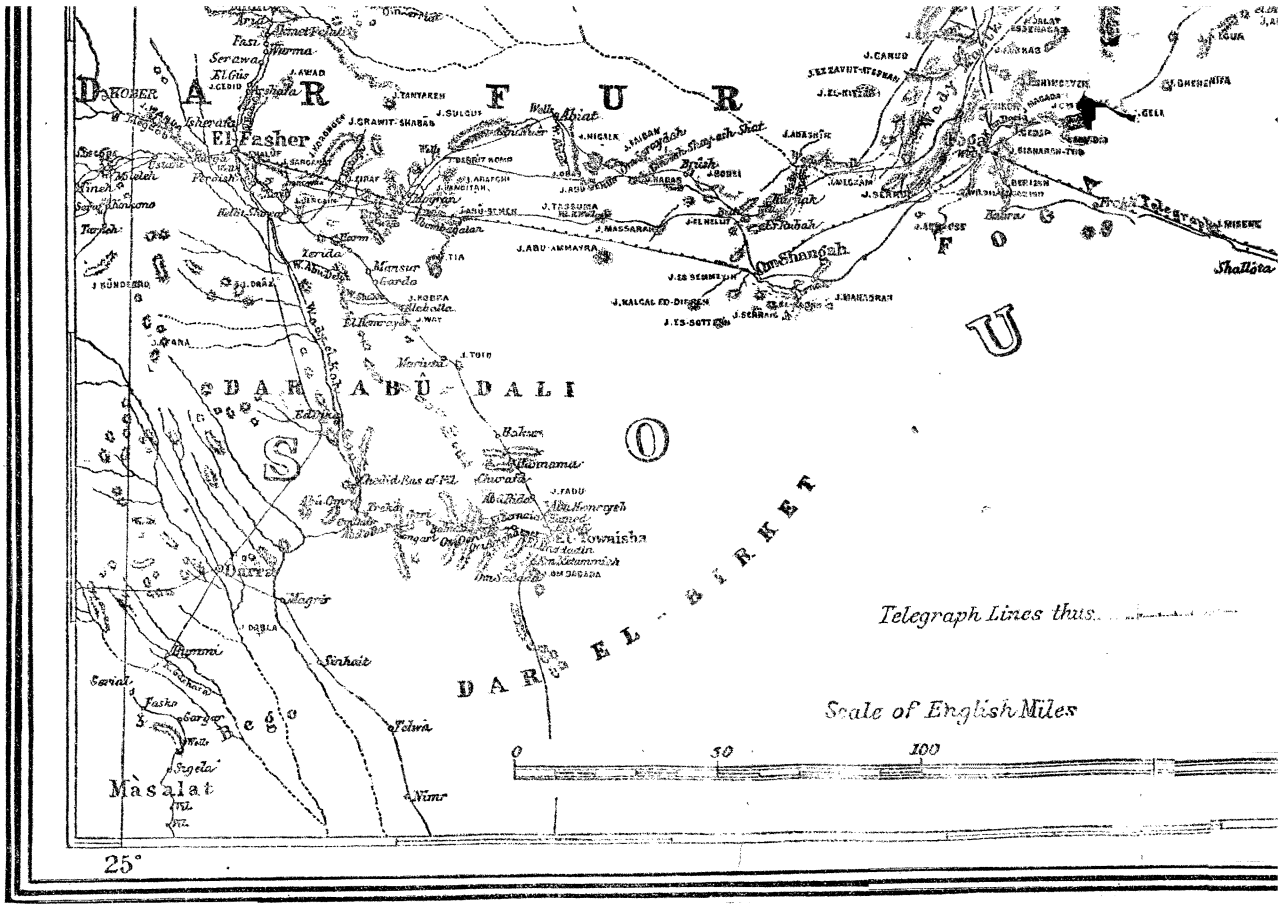
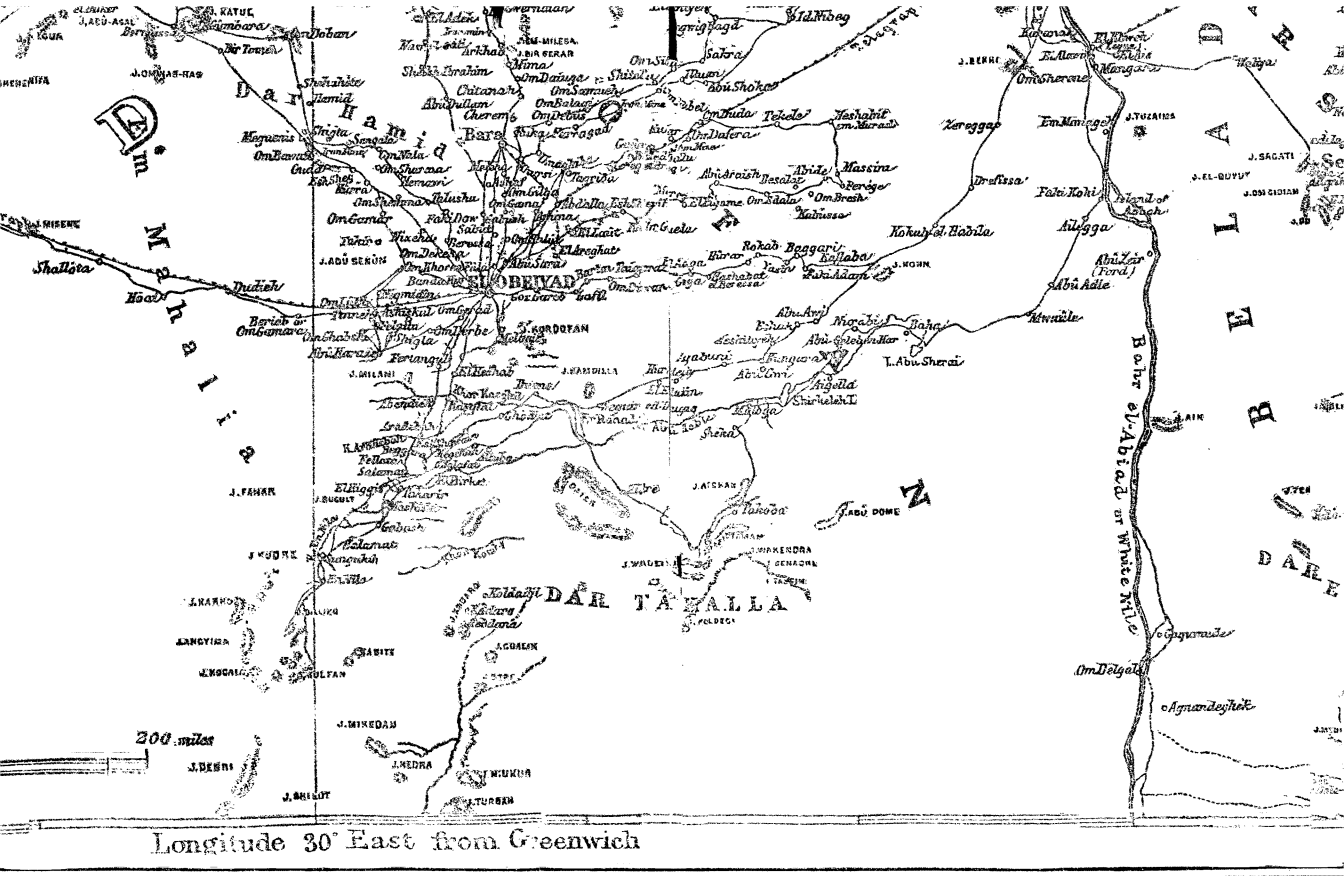
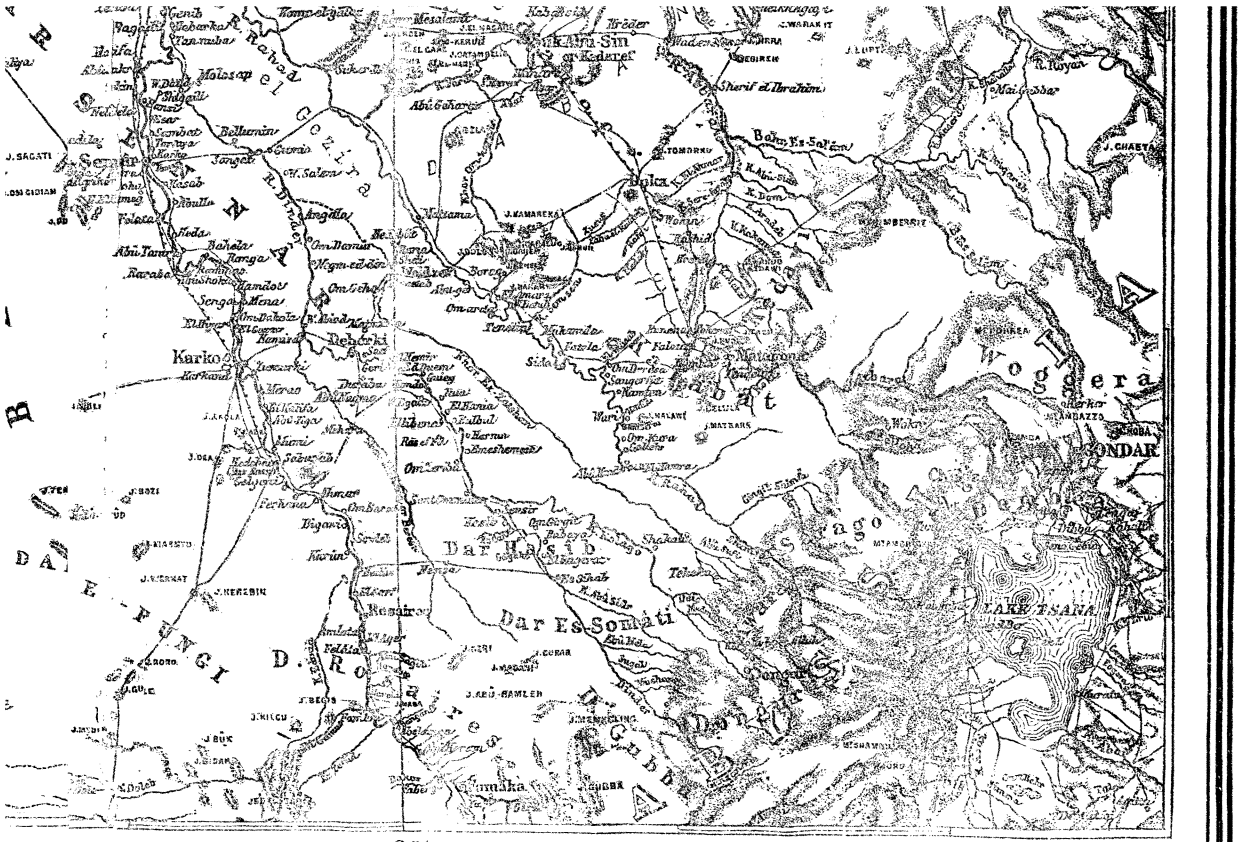
Khor Embirol
Khor Fessadi



SUDAN AND NUBIA (A



A (AFTER WYLD), WITH THE COURSE OF THE NILE F



35

E FROM ITS SOURCE.

SCIENCE, November 14, 1884.

of other natural dams; and these we find repeated between Khartum and Berber, below Abu-Hamed, between that and Dongola, and between Dongola and Wadi-Halfa. At the last-named place is found what is called the second cataract; and still farther down the course of the river, at Assuan, is the well-known 'first cataract.' Thence to the sea the course of the great river is unobstructed in its flow, except by the works of man. The great viceroy, Mehemet-Ali, caused, at immense cost, the construction of the famous *barrage du Nil* ('the dam of the Nile') a few miles to the north of Cairo, in the endeavor to make art complete, by a dam, what nature had so well done in Central Africa and Nubia for securing regular irrigating-supplies.

The cataracts which play so important a part in the preservation and regulation of the Nile flow, are formed by masses of granite rock, which at intervals cross the course of the stream, making enduring dams. It is easy to perceive, that, should they be worn away or destroyed, the flow of the river would be made much more rapid during the seasons of high water; and the Nile would become, in Nubia, a fierce torrent during high water, and a nearly dry channel for a considerable portion of the year.

The natural destruction of these great dams by the formation of pot-holes, and the friction of *débris* passing over them, is, from the nature of the rock, very slow. From such observations as have been made, it is probable that the natural wearing-away hardly exceeds six feet in one thousand years; and there is a corresponding effect in the natural rising of the river-bed below the cataracts and in the delta by the deposit of silt from the turbid waters.

The Nile is navigable at all seasons of the year, by steamboats of light draught, from the mouth to Assuan (the first cataract), between the first and second cataracts (Assuan to Wadi-Halfa), between near Berber and Khartum, between Khartum and a point a little to the south of Gondokoro, and between Duffli and Lake Albert. It is only during the season of high water that boats can descend the Nile, passing the cataracts between Berber and Assuan.

The great danger to boats descending these fierce rapids during high water is found in the eddies near the river-banks, islands, and large rocks. The current is so rapid, and the friction on either hand so great, that the water seems to *heap up* in mid-channel, where the current is the strongest; and great skill on the part of the steersman, and prompt and vigorous work on the part of the engineer of the steamer, or oarsmen of a row-boat, are necessary to keep the boat on the ridge of the current. If the boat is permitted to slide off this ridge, she is quickly caught by the eddies, and almost invariably lost. This is so well understood by the Nubian boatmen, that, while they work with a will at the oars in these descents, they always have their personal effects packed in a snug parcel beside them, ready to seize; and they leap overboard, each with his parcel on his head, the moment the boat gets into a hopeless position.

The work of towing or warping boats up against the current is more difficult, but far less dangerous, than the descent.

CHAS. P. STONE.

A MUSSULMAN PROPAGANDA.

THE attention of geographers has of late been particularly attracted by the operations of a Mussulman confraternity known as the Sénousians, or the Brotherhood of Sidi Mohammed Ben Ali es-Senousi, the founder of the order. Of this now powerful and widely ramifying society, Henri Duveyrier has recently given an account. Its operations are of importance to civilization, not merely from the relation of this order to existing religions, but from that which it bears to the efforts being made by civilized nations to develop the dark continent, and explore its geographical and other mysteries. The success of the religious propaganda which the society represents menaces not only projected explorations, but the very existence of established colonies and international traffic. It is believed that to their instigation is due the melancholy fate of many African explorers of late years, among whom may be mentioned Dournous Dupéré, Beurmann, Von der Decken and his party, Col. Flatters, Capts. Masson and Diarnous, Dr. Guiard, Béringer, Roche, Mademoiselle Tinné, Sacconi, and others. If the present crusade in the Sudan be not wholly due to their machinations, it has at least been actively assisted and impelled by individual members of the society, and guided by the blind fanaticism which is its rule of conduct. The favorite motto of the head of the order declares Turks and Christians to be equally offensive, and doomed to an equal and simultaneous destruction. Their monasteries and influence extend from Morocco to Arabia, and from the Mediterranean to Mozambique, and govern two or three millions of peo-