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THE SAHARA IN 1915.

By FRANK R. CANA.

THE exploration of the Sahara has been carried on, mainly by the French, with persistent energy during recent years. At the same time European control, not only of the Sahara itself but of the surrounding regions, is causing many changes in the social and economic conditions of the desert. The moment is therefore opportune for making a survey of the physical features of the desert in the light of the latest investigations, and at the same time for considering the altered conditions of the inhabitants, their changing modes of life, the possibilities of economic development, and means of communication. In dealing with a subject so large many details must necessarily be omitted, but the references given will enable the reader to study the questions more fully.*

The old notion of the Sahara as a boundless waste of shifting sand—a dried-up ocean-bed below the level of the sea—persists in many minds, and is fostered by tourists whose only knowledge of the desert has been gained by a visit to Biskra. This notion owed its rise to very natural causes. Approached from Egypt or the Barbary States, the only directions from

* In the *Encyc. Brit.* (11th edit.) there is a general survey of the Sahara, as known down to 1910, largely from the pen of Mr. E. Heawood. To the list of authorities there given and the books and journals cited in the following pages may be added: A. Knox, 'The Climate of the Continent of Africa' (Cambridge University Press, 1911); Sir H. H. Johnston, "A Survey of the Ethnography of Africa," *J. R. Anthropol. Inst.*, 1913; W. A. Cannon, 'Botanical Features of the Algerian Sahara,' Carnegie Inst., Washington, 1913; Captain Martin, "Reconnaissance de la région sud et ouest de l'Erg Ighidi," *B.S.G. d'Alger* (1913); Max Montbel, "Nos marches Sahariennes," *Quest. Dipl. et Col.*, vol. 37 (1914); Marco Roselli, "Colla colonna Miani. La regione e le vie fra Murzuk e Ghat," *Riv. Coloniale*, 1914; G. Cora, 'Dottor Gherardo Rohlf's viaggio da Tripoli all' oasi di Kufra,' Milan, 1914; E. d'Almonte, "Ensayo de una breve descripción del Sáhara español," *B.R.S.G. Madrid*, 1914 (with separate maps). For the most recent maps consult the monthly lists in the *Journal*.

which it was approached by civilized man until recent times, the Sahara does present almost everywhere a waste of sand, and much of it shifting sand. Moreover, when the Atlantic coast of the Sahara was made known by Portuguese navigators, that too, from Morocco to Dakar, was found to be continuously lined with sand-dunes. It is true that the Moors knew that there was, in the western Sahara, something else than sand, but their knowledge was either forgotten or not shared by the Christian nations, and the earlier of modern travellers in North Africa, using the Sahara merely as a corridor to the Sudan, did little to dispel current notions about the desert. In a phrase still remembered Lord Salisbury as late as 1890 echoed popular belief in describing the Sahara as consisting of "light soil." * Three years later appeared Henri Schirmer's brilliant monograph *Le Sahara*, which gave a summary of all that was then known concerning the desert, already proved to be of very varied relief and to contain mountain ranges and plateaus of enormous extent.

The size of the Sahara is indeed hardly realized. It covers approximately 3,500,000 square miles and is not much inferior in area to the continent of Europe. Though sand extends over probably 700,000 square miles, rocky plateaus and not sand-dunes are the chief characteristics of the desert. If a generalization be attempted, the Sahara may be described as a great tableland scored by the beds of dried-up rivers, diversified by mountains and depressions, and fringed by a deep belt of sand west, north, and east. Southward there is generally an intermediate zone between "the desert and the sown." The higher plateaux and the mountain ranges occupy a central position and extend across the Sahara north-west to south-east. This elevated region is sometimes spoken of as the bridge connecting the Mediterranean lands with Central Africa, the means by which early man spanned the desert. It is hardly a continuous bridge and there is scant evidence of its use as a means of communication in historic times. It had by then probably served its purpose.

The Central Sahara.—The mass of mountains and plateaux of the Central Sahara formed largely of Archean rocks, consists of two distinct systems linked by minor heights, and of a couple of isolated highland regions. The main elevated mass is a great squarish block of plateaux and mountains lying due south of Algeria and Tunisia. The chief sections of this mass are the plateau of Tademayt, the Tasili † Asgar, the Muidir and Ahnet plateaux, and, south of these, the Ahaggar or Hoggar Mountains. The Ahaggar Mountains alone cover an area as large as the Alps, but their highest points are not much over 8000 feet; some are

* Lord Salisbury was speaking, as it were, agriculturally, comparing the Sahara—which he had just acknowledged as in the French sphere—with the rich lands of Nigeria, secured for Britain as the results of the efforts of Sir George Taubman Goldie. French wits amplified Lord Salisbury's phrase into "Light soil in which the Gallic cock can scratch."

† Tasili = a Berber word for a high plateau.

volcanic. Further south and east, running in a north-west and south-easterly direction, are the Tibesti Mountains. The Tasili Asgar which extends eastward as far as Ghat is connected by a low chain, the Timmo range, with the Tibesti Mountains.* The two isolated highland regions mentioned are those of Aïr or Asben † and the Adrar Iforas, respectively south-south-east and south-south-west of the Ahaggar Mountains.

In all this region there is comparatively little sand, the chief dunes lying between Aïr and Tibesti. This sand area contains the oasis of Bilma and is traversed by the caravan route from Tripoli to Lake Chad. There is also an area of sand-dunes between Adrar Iforas and Aïr. A third region of sand—stationary dunes in part fixed by the growth of plants and shrubs—lies between Aïr and Chad, and the north and north-eastern shores of the lake are surrounded by sandhills. But though free from great masses of sand-dunes the Central Sahara is extremely forbidding. The mountains rise from and, save on the north, are bounded by level and almost lifeless tablelands. A French mission in 1912 travelled for thirteen days from the Ahaggar mountains towards Aïr without finding a watering-place. These void regions—with large areas of bare rock—are known as Tanezruft, a Berber word signifying their inhospitable character. They consist of rocks of the Devonian and Carboniferous ages.‡ The rivers, which from the southern versant of the Ahaggar ran south and at a recent geological period joined the lower Niger, are now dry. Somewhat more favourable conditions prevail on the plateaux and mountains on the Aïr highlands. Between the granitic and sandstone hills, are wooded hollows and extensive pasture lands, and though Aïr has no perennial rivers the watercourses are filled during the rainy season (August to October). South of Aïr the borderland between the Sahara and the Sudan is now less productive and more desert-like than it was when first visited by Europeans. Though the desert here seems to be encroaching upon the plains of Nigeria, this may be due not so much to natural causes as to the agency of man: political disturbances leading to insecurity and less cultivation and the cutting down of trees, inducing climatic changes.§

None of the other high plateaux and mountains are as fertile as the Aïr highlands, but the ravines which score their sides contain wood and

* For Tibesti see *infra*.

† For Aïr see C. Jean's monograph 'Les Touraeg du Sud-Est: L'Aïr,' Paris, 1909, and Captain Nieger in *La Géographie* for 1914. Captain Nieger writes: "South of the valley of the Tesellamen [a wadi which goes west from the Aïr highlands at a point north of Agades] one has quitted the Sahara. The rains are regular."

‡ A description by a recent English traveller of the Tanezruft is given in Captain Hayward's 'Through Timbuktu and Across the Great Sahara.' London: Seeley, 1912.

§ When the Anglo-French boundary between the Niger and Lake Chad was first defined in 1898, it was believed—from the reports of travellers—that the fertile region extended further north than it was found to do. Since that date (1898) the frontier has been taken further south, to give the French a route to the lake in non-desert country.

pasture lands. There are still rivers in the Ahaggar Mountains which contain water for months and even a perennial stream; thus the Ahaggar has sufficient fertility to support several large Berber (Taureg) tribes. At the foot of the mountains, which usually rise from the plain in well-marked escarpments, are found oases of date-palms (*e.g.* Silet) and a fair supply of water. When the railway from Algiers skirts the Ahaggar Mountains there may be an opportunity for development, but

the prospect is not very bright. Muidir and the other plateaux are in no better case than Ahaggar; Tademayt, for example, is very poor in water.

The Algerian and Tunisian Sahara.—The region between the southern slopes of the Atlas range and the mountains and tablelands of the central Sahara contains typical examples of the sand-belts which stretch bow-like across the Sahara and form its northern zone, and also of the most famous of those shats or depressions which gave rise to the idea that that part of the Sahara might be flooded by digging a canal from the Gulf of

Gabes to the nearest depression.* The Shat el Jerid lies temptingly close to the Mediterranean for such an operation, and west of it lies the next largest shat, that of Melghir. The shats are, however, nothing but large, shallow and marshy salt-pans. As to the sand-belts, these are the famous western and eastern Ergs. The eastern Erg reaches almost, but not quite, to the Mediterranean, a steep scarp, the Jebel Nefusa, Gharian, etc., marking here the bounds of the Sahara.† Eastward the Erg is bordered by one of the most desolate districts of the desert, a tableland of red-coloured rock, the Hammada-le-Homra. The Hammada forms the "back blocks" of Tripoli.

It is in the region between and north of the western and eastern Ergs that the French have undertaken considerable irrigation work. It contains shats, oases, and wadis, and supports a comparatively large population. Here are found several towns—Biskra, El Aghuat (Laghuat), and Ain Sefra, close to the Atlas, and Ghardaia, Tuggurt, El Wed, El Golea, and Wargla, further south. All these lead to routes across the desert; that by Ghardaia and El Golea to a passage between the western Erg and Tademayt; that by Tuggurt and Wargla by the Wadi Igharghar (Ir'err'er) direct south. Between Ghardaia and El Golea lies the M'Zab region scored by ravines running east to west. These ravines are filled after storms in the Atlas with torrential streams, which produce abundant verdure. But the sands of the western Erg constantly gain on the plateau, so that the fight to preserve the oases is unending.‡ South of El Golea moving sand-dunes from the Erg are stretching across to the flank of the Tademayt Plateau and have in places reached the escarpment.

The Wadi Igharghar, reached from Tuggurt and Wargla, is a great trough which cuts the eastern Erg into unequal parts. Formerly a mighty river rising in the Ahaggar Mountains and emptying in the Mediterranean, the wadi is now not only dry but is being blotted out by the action of the Erg. It is already obliterated in part, for the problem of fixing the moving dunes by planting desert flora is here apparently insoluble, as the region is waterless. Between Tuggurt and Ahaggar by this route the only (relatively) abundant supply of water is at Témassinin, in the Hammada-el-Tingerat (a westward continuation of the Hammada el Hofra) and 56 miles east of the Igharghar. At Témassinin, where the French have a post (Fort Flatters), the water is in a deep basin and is useless save for its immediate locality. Artesian borings in this region have failed to find water. The exceedingly difficult nature of this country

* In reality the area which it was proposed to turn into an inland sea covered little more than 3000 square miles—less than half the size of Wales.

† North of the Jebel the coast lands of Tripoli are low and sandy—a little desert with several oases, as is clearly seen on any large-scale map. Eastward of the Jebel the desert-with-oases character of the coast continues. The greater part of Tripoli must be regarded as a semi-fertile region of the Sahara.

‡ For example, Captain Nieger, writing in 1913, recorded that in the M'Zab country, fifteen years after they had been erected the telegraph posts between Ghardaia and El Golea were nearly buried in sand.

has led to the rejection of the proposal to take the trans-Saharan railway by El Aghuat, Ghardaia, and El Golea, and to the rejection also of the more seductive proposal to take it through the Wadi Igharghar.

The main route from Algeria to the Central Sahara is found west of the western Erg. Here, coming from the Atlas, the Wadi Zufana runs south-west and is joined by the Wadi Gir from Morocco. The combined wadis form the Saura, often after rain in the Atlas an imposing river. The Saura leads to the oases of Gurrara and Tuat and to the broad valley—Tidikelt—which separates Tademaït from Muidir and Ahnet. In Tidikelt is the well-known outpost of In Salah. South from In Salah the Sahara is without towns, until Agades in Aïr—800 miles distant—be reached. Whatever, in favourable conditions, may be done to ameliorate the sandy regions,* the hammada and tanezruft appear irreclaimable.

The Western Sahara: Mauritania.—For at least 2000 years there has been a route across the Sahara from the Niger to Morocco, and there was and is a close connection between the Moors and the Western Sahara. From the Senegal to Agadir, behind the coast dunes, is a belt of uplands rich in pastures and constantly traversed by tribes, Berberized-Arabs and Arabized-Berbers, whose affiliation is with the north; and between the Senegal and the Niger there is a considerable intermediate zone, the Sahel Sudanese. Here Walata, an ancient place, which stands on the border of the Sahara, has been superseded by its younger rival Timbuktu, conveniently situated as the meeting-place of the camel and canoe. The part of the Sahara which lies west of the meridian of Timbuktu, north of the intermediate zone and south of the Moroccan Atlas, contains two very dissimilar kinds of country. The Igidi desert in the north is a continuation of the sand-dune belt, while in the centre is the Juf, unexplored and apparently uninhabited. Though the Juf is probably little else than a waste of sand its exploration should settle some questions of considerable interest to geographers, geologists, and ethnographers. With it should go a detailed examination of the country between the Juf and Tuat. The theory advanced by MM. Gautier and Cortier that the Messaud (which is the lower course of the Saura of Tuat) ran into the Juf, which also received the waters of the upper Niger, remains unproved. The region between Tuat and the Juf has been traversed several times by French military parties since Gautier's and Cortier's books were published in 1908, but nothing appears to have been made known to throw light on this interesting problem.† On the east the Juf is bordered by a sharp line of cliffs and here in the subsidiary depression of Taudeni are the most famous salt-mines of the Sahara. In 1912-13 tribesmen from the Moroccan Sahara raided as far as Taudeni; a party which fled from the

* That is, districts, chiefly old river-valleys, where the soil is good and where water is most abundant. At In Salah, for example, one artesian well yields 880 gallons a minute.

† See on this point the *Journal*, vol. 38, pp. 460, 461.

French into the Juf was never heard of again and is supposed to have perished miserably of thirst.

If the tanezruft and dunes between Tuat and the Juf have been neglected, the region which extends to the Atlantic west and north of the Juf has been explored and even in great part brought under European control. Mauritania, as the French have named that part of the Sahara in their sphere, forms one natural region with the adjoining Spanish protectorate of Rio de Oro, and includes the "belt of uplands rich in pastures" mentioned at the beginning of this section. On the north it links up with the Moroccan Sahara. The description of Mauritania given by Lieut. G. Schmitt in *La Géographie* in 1913 * holds good, but details have since been filled in. The name Adrar, much more common in this than in other parts of the Sahara, gives the clue to the general character of the region, for Adrar is a Berber word for uplands.† It is a great tableland of Archean rocks overlaid by sandstone and cut by many wadis. It contains small wooded regions and areas of cultivation as well as rich pasture lands. Sand-dunes of cruciform shape, rare in other parts of the Sahara, are found here. At Idjil is a well-known salt sebkha from which salt is still exported to Senegal. Though water is—for the Sahara—plentiful, and southern Mauritania supports large herds of cattle, sheep, and goats, there are no permanent streams. Hydrographically, the region consists of closed basins both of ancient and recent date. M. Chudeau ‡ notes that the wadis which descend from Adrar Sotof run inland instead of seaward, and that further south other wadis have cut their way across high ridges. It is difficult to understand why the rivers did not take the easy route to the Atlantic.§ M. Chudeau conjectures that the existing contours are recent, which would accord with certain botanical and zoological data, and he concludes that it is probable that the separation of the Canary Islands from the continent does not go back to a remote epoch. The hinterland of the region between Cape Bojador to the Wad Draa is still only sketchily mapped, but it is also tableland (here called gaada), and is probably better provided with pastures than the uplands further south. It is the home of the Reguiebat and Tekna tribes, the great raiders of the Western Sahara.||

* See the *Journal*, vol. 42, p. 77.

† French writers distinguish the chief *Adrars* thus: those in Mauritania as Adrar Maure; the Adrar of the Iforas as Adrar Nigritien; the Adrar of Tuat as the Adrar Algerien.

‡ *Rens. Col.*, January, 1912.

§ The most southerly wadi—excluding very short coastal streams—to go seaward is the Seguia-al-Hamra (to the south of Cape Juby).

|| Valuable information concerning these tribes and their pastoral riches is furnished by M. P. Marty, who also gives particulars concerning the Walad Delim. The Walad Delim occupy the coast from the Bay of Arguin to the Seguia-al-Hamra. They, or rather a tributary people, the Imraguen, are fishers, and trade with the Europeans and Africans at Port Étienne and Villa Cisneros. Port Étienne, near Cape Blanco, dates from 1908, and is beginning to prosper. It is frequented by Breton

Moroccan Sahara.—The Wad Draa* in its lower course has now, by Franco-Spanish agreement, become the definite southern limit of Morocco, and the Moroccan Sahara is taken to be the country south of the High Atlas from the mouth of the Draa to the Tuat oases. It is little known, but it is a land of promise as it contains three rivers which are never completely dry. These rivers, as they descend from the High Atlas, turn south-west and make for the Atlantic, though of the three only the Draa reaches the sea. The other two are the Ziz and the Gir. The Ziz is economically the most important as it forms the beautiful oasis of Tafilalet, the first resting-place in the desert on the way to Timbuktu from Fez. In it are the ruins of the once famous city of Sijilmessa. The possibilities of cultivation on an extensive scale in the Moroccan Sahara are great if the regulation of the water it receives was carried out. "The flooding of the Saharan wadis . . . is somewhat irregular. The streams, however, in their passage through the Atlas, traverse successive plains and ridges, cutting deep gorges in the latter, and it would appear that the construction of dams to regulate the flood waters would present no unusual difficulty."† The French engineers, now that Morocco is a French protectorate, may be trusted to do what is possible.

The Libyan Desert and Tibesti.—Recent additions to the knowledge of the Eastern Sahara have been made chiefly along its southern border from Lake Chad to Darfur and in the adjacent mountainous zone (Tibesti, Borku, Endi). These additions are of peculiar interest as the work of the last five years has opened up countries almost unknown. The Libyan Desert, which fills so large a part of the Eastern Sahara, remains unexplored. No Europeans, save Rohlfs and his companion, Dr. Anton Stecker, have penetrated into the heart of the desert. Rohlfs' journey was in 1879 and was confined to a direct route from the Mediterranean to Kufra and back. Mr. Oric Bates‡ and Herr E. Banse§ have recently produced monographs dealing with the Libyan Desert, and we are indebted to Mr. W. J. Harding King|| for personal exploration and for gathering up such native information concerning the inner desert as is available. The fringe of it which contains the oases parallel to the Nile is fairly well known,¶ and the impression which this eastern part gives

fishermen, and since 1912 companies have been formed to deal with the catch. Villa Cisneros is the capital and port of Rio de Oro. There the Spanish officials trade direct with the Imraguen ('Les Tribus de la haute Mauritanie,' *Rens. Col.*, 1915).

* In the Arabic of Morocco wadi becomes wad.

† Mr. Alan Ogilvie in *Geogr. Jour.*, vol. 39, p. 566. This paper by Mr. Ogilvie gives other information concerning the Moroccan Sahara.

‡ 'The Eastern Libyans' (with map). London (Macmillan), 1914. The information given does not deal with events later than 1911.

§ In *Petermanns Mitteilungen*, March, 1914 (map).

|| "The Libyan Desert from Native Information," *Geogr. Jour.*, vol. 42, p. 277.

¶ Consult the geological and topographical reports on the oases issued by the Public Works Dept., Cairo, and for Kharga see also H. G. Beadnell's 'An Egyptian Oasis.' London (Murray), 1909.

seems applicable to other regions of the Libyan Desert. It is a vast plateau partly consisting of bare limestone and rugged sandstone, with crystalline rocks outcropping, but immense areas are covered with sand-dunes, crescent shaped in the north, longitudinal in the east. In the centre are the oases known collectively as Kufra, and a few other oases give a practicable route from Wadai and adjacent regions in the south to Egypt, Cyrenaica, and Tripoli. On the north-west of the desert are the oases of Fezzan and Aujila; on the north-east, towards Egypt, lies Siwa; south-east absolute desert extends to the Nile. On the south-west, towards the Tibesti Mountains and the lower heights of Borku and Endi, there are a number of oases. All these oases, as far as is known, are deep depressions in the plateau, and they derive their water, as far as has been ascertained, from a bed of porous sandstone which underlies a large part of the desert. The Libyan Desert is marked off sharply from the Nile valley by limestone cliffs, and the Libyan Plateau, which extends north of the desert to the Mediterranean, is of limestone formation.

One of the most interesting of the statements made to Mr. Harding King by his native informants was that the dried-up bed of a once great river traverses the centre of the Libyan Desert.* This river-bed is called the Wadi el Fardi, and is said to have been fed by streams rising in the Tibesti Mountains, and to run north by Kufra to Siwa. There, near the southern edge of the Libyan Plateau, it turns east, and, it is to be supposed, reached the Nile somewhere about the head of the Delta. Had this wadi been fed from such inexhaustible reservoirs as supply the Nile we should have seen another Egypt piercing the heart of the Libyan Desert. There has been no such proved change in historic times in the climatic conditions of the Libyan Desert† as would account for the drying up of the wadi, nor is there reason to suppose that the ancient Egyptians knew of another Nile on their western flank. Yet the reality of the Wadi el Fardi is probable. The orography of the Eastern Sahara almost seems to demand its existence.

The thorough exploration of Tibesti may throw light on this problem, but it would need tropical rains to produce water enough to keep alive such a river as the Wadi el Fardi. Since the capture of the Senussi stronghold of Ain Galakka, in Borku, in November, 1913, knowledge of the topography of that region and of Endi (Ennedi) has been completed in its main outlines, and Tibesti has also been visited. The result is that we now know that no large river flows from those mountain regions either towards the Libyan Desert or in any direction. Other interesting

* "The Libyan Desert from Native Information," *Journal*, vol. 42, pp. 277.

† There has been some change in climate in the Eastern Sahara (see *Journal*, vol. 38, p. 464), but in respect to the Egyptian oases and other regions, the increasing desiccation may result from the abandonment of the struggle against nature waged by the ancient Egyptians and the Romans, whose water-conservancy measures the Arabs and Turks neglected.

points have been decided. There is facing the Libyan Desert a continuous escarpment from Tibesti to Endi. General Largeau in his report on the occupation of Borku speaks of his troops marching at the foot of an escarpment about 100 feet high, "prolonging the mountains of Tibesti to their junction with those of Ennedi." * Writing of Borku Captain Ferrandi, who took part in the expedition, tells of a wind-eroded rocky backbone separating series of oases. On the plateau leading from Faya to Guro,† an oasis south of the eastern slopes of Tibesti, "the vegetation at the water-holes fights with tenacity against the sand, but it has to do with an adversary which knows neither fatigue nor repose"—an adversary which had, when Captain Ferrandi passed, already half buried all the trees. Desert conditions are not so severe in Endi as in Borku. Endi is described as a plateau of soft sandstone subject to extremely powerful erosion by wind and water. Besides fantastically fashioned rocks and stretches of sand there are numerous fertile valleys—valleys carved out of the plateau by rivers which after the winter rains carry a good deal of water. Some of these rivers flow for over 100 miles. In the rainy season large lagoons are formed in their clayey reaches. Alligators and moufflon are unexpected examples of the fauna of the country. Though Endi be itself a land of comparative plenty the streams which come down the northern side of the plateau (the chief of these are called Murdo and Nicaulé) end almost at the base of the mountains.‡ Yet northward as far as 20° N. there are numbers of scattered oases, some thorn scrub, and scanty pasturages sufficient to maintain a nomad population. This is the home of the Bedayet—a tribe classed as Sudanese, but probably of Berber-negro origin.

There is only a small area of fertility in the Tibesti mountains. Commandant Lofler, in his expedition to Tibesti in 1913-14, covered much the same ground as that covered by Nachtigal—his only European predecessor in that country—in 1869. That the two routes so nearly coincided had this advantage: it was possible to ascertain what alterations had taken place in the intervening forty-four years. Nachtigal drew a pleasing picture of the fertility of the Zuar valley (on the western side of the Tibesti massif). Commandant Lofler, who reached Zuar in December, 1913, found that the district had greatly altered. Rains had failed and everywhere was seen a picture of aridity. The tamarisks, palms, and, more rarely, thorns which marked the course of the river had been stripped of all foliage, save in their higher branches, by the animals which could not find sufficient herbage for their needs. The people were poor and few in numbers. Cultivation had not ceased, wheat, maize, and tobacco being raised in small patches in the ravines. Small lakes

* *Rens. Col.*, June, 1914, p. 315.

† At Guro is the kubba of Senussi el Mahdi, who died in 1902. It is a large white rectangular building.

‡ "L'occupatin du Borkou et de L'Ennedi," *Rens. Col.*, December, 1914.

containing fish were found in these ravines. The main impression of this the north-western part of Tibesti was of a dying land. Early in 1914 Commandant Lofler received orders to occupy Bardai, the chief settlement in Tibesti. He crossed the mountains with his convoy of 600 camels by a route north of and lower than that taken by Nachtigal. Lofler went by Urr (Warr), 4600 feet; Nachtigal by Tarso, 7200 feet.

Lofler occupied Bardai in July, 1914, the Tibbu chieftain who had opposed the French taking to flight. The Tibbu were either unable or unwilling to get a force together strong enough to oppose the unbelievers. Bardai is an oasis in a wadi of the same name which runs north-west and south-east at the base of the mountains. The oasis is some 2 miles long; through it flows a ribbon of water. Besides the date-palm it produces cereals and vegetables. Ravines which cut their way through the massif to the wadi Bardai were also found to have small oases and petty cultivation—nothing more. The anonymous writer in *L'Afrique Française*,* who supplies the scanty particulars of the Lofler expedition, comes to this conclusion: "Tibesti presents itself as a massif of entirely denuded rock, life being concentrated in the depth of the ravines near the water." Captain Ferrandi, who had opportunities of gaining information at Guro, but did not himself enter Tibesti, says that between Bardai and Guro are the valleys of Osa, Zumuri, and Yebé. These, with Bardai, form "the rich and peopled region of Tibesti," all else being sterile. We await the result of the further exploration of the country. Some traveller may find a dry wadi which, if followed, will lead on to the (equally dry) Wadi el Fardi.

Lake Chad and the Bahr el Ghazel.—From Lake Chad to Endi the zone between the Sudan and the Sahara (now a French possession) is becoming more arid. This zone, much of it level plain, is scored by the bed of the Bahr el Ghazal (Soro)† of the Chad system. The problems connected with this bahr have not yet been solved. Captain Vignon, in 1911–12, traced its course as far east as a depression, Wayta, leading to the plain between the hills of Borku and Endi.‡ According to native reports the Ghazal, avoiding the hills of Endi, goes on eastward, and contains in its unexplored (as in its explored) parts good watering-places, cultivated areas and pastures. Captain Vignon had not the means of taking accurately the levels of the bed of the Ghazal, but he believes that the slope is eastward. The wadis which join the Ghazal west of Borku have also an eastern slope. The theory that the bahr was a tributary of Lake Chad rising in the Tibesti Mountains is discredited; but that does not tell us what the Ghazal is. Its bed has yet to be traced to its end (or beginning) and its levels have to be

* For August–December, 1914.

† This Bahr el Ghazal must not be confused with the Ghazal river of the Nile system.

‡ "Le Réseau Hydrographique der Pays Bas du Tchad," *Rens. Col.*, April, 1914.

ascertained. Those who have seen in the bahr a possible explanation of the mediæval stories of a Niger-Nile connection may be tempted (probably without justification) to make the Ghazal run from Wayta to join the Wadi Hower, a wadi which, according to native reports, reaches the Nile near Dongola. As Mr. Harding King points out, the very existence of the Wadi Hower is doubtful.

Captain Tilho has shown * that from Lake Chad eastward to Fant-rassu the Bahr el Ghazal channel is a simple prolongation of the lake. The surrounding country is flat. Chad was at one time a much larger lake than it is now; † as it contracted it may well have developed a system of backwaters and river-like arms such as now mark the Nile in its course between Victoria and Albert Nyanzas. Of this contraction the Bahr el Ghazal may be a witness; its western part marking, as Captain Tilho suggests, an arm of the lake, its eastern part being a true river-bed whether effluent or affluent.

It will be seen that the chief remaining problems of Saharan topography are concerned with its former river-systems. The existence of so many dried up water-channels of large size is conclusive as to an abundance of water in the Sahara at some period, and in the case of the Bahr el Ghazal at least the drying up is "recent." ‡ Without entering into the question as to whether there have been over the desert as a whole marked climatic changes § in the past two thousand years, it is certain that the Sahara fulfils nearly all the conditions stated by Prof. Gregory in his paper contributed to the discussion on deserts at the British Association meeting in Melbourne in August, 1914: "Deserts are most easily produced and least curable where the rainfall is low, the temperature is high, the wind is strong, and the country consists of a plateau where there is an easy drainage to the adjacent lowlands." It is with regard to drainage that perplexities exist. Part of the Central Sahara drained to the Gulf of Guinea, while the drainage of the Libyan Desert was to the Mediterranean by the Nile Delta; but the Chad is an inland basin where desert conditions are encroaching, and, as we have seen, the Juf is regarded as having been the centre of another closed drainage area. The other

* 'Documents scientifique de la mission Tilho.' Paris, 1910-11. The facts established by the mission are summarized in vol. 2, pp. 601-613.

† Students of African hydrography are aware of the extraordinary changes in the area of the lake since it was first visited by Europeans in 1823. The supposition that it had a large surface of deep water and was comparable to the lakes of East Africa gave rise in the eighties of last century to the "race for Lake Chad" between France, Great Britain, and Germany. It proved to be valueless as a highway. The question as to whether there has been any permanent decrease in its area within the last twenty years is scarcely settled, though for years at a time the northern part has been dry.

‡ See the evidence brought forward by Captain Tilho in *La Géographie*, December, 1913 (*Journal*, vol. 43, p. 441).

§ That particular areas have become, since the beginning of the Christian Era, more arid has already been stated.

conditions named, low rainfall, high temperature, and strong winds, appear to have prevailed against the parts played by Lake Chad and the Juf.

In considering pastoral and agricultural possibilities it must be accepted that as a whole the desert conditions of the Sahara are not curable. The indications which may be given as to the development of the land in favourable areas will, however, best follow some account of the inhabitants of the Sahara, political developments, trade, and means of communication. On all these factors land-industries depend.

PEOPLES, POLITICS, AND TRADE.

The majority of the inhabitants of the Sahara are of the Libyan stock known as Berbers. There is not sufficient evidence to dogmatize with respect to the neolithic race which first peopled the Sahara: the supposition that the Western Sahara was, as late perhaps as the time of the foundation of Carthage, an agricultural land richly watered and a negro domain remains a supposition. The Berbers have been in the Sahara as far back as can be traced definitely. In the south they have mixed considerably with the negroes. The only other race strongly represented is the Semitic, the result of the Arab conquest of North Africa. In Mauritania and the Sahel Sudanese Berbers and Arabs have largely intermixed and have produced the "Moorish" tribes of the Western Sahara. There is also in these "Moorish" tribes a negro strain derived partly from times when the Walata region was more fertile and was (it is supposed) thickly peopled by Sudanese.* Between the Niger and the Nile, along the intermediate zone, there is a mixture of races in which the dominant Berber or Arab strain is very markedly crossed by negro blood. The original inhabitants of Air were negroes (Hausa), and an affiliation with Egypt is traced in certain of the non-Berber peoples of that region. The Tibbu or Teda of Tibesti may be classed as Berber negroids. Many Bedawin tribes in the Eastern Sahara claiming Arab descent are really of Hamitic stock, as are also several of the "Arab" tribes of Nubia, Kordofan, etc.

The Berbers in the Sahara, as in the Barbary States, have in the main preserved their racial purity and their pre-Islamic polity. This is worth noting on economic grounds, for the Berber, unlike the Arab, is, wherever circumstances permit, a tiller of the ground. The Arabs have in two respects, however, made their mark on all the Berber tribes—they have imposed their language † and their religion on all North Africa. All the dwellers in the Sahara are Mohammedans, ‡ and especially in the Eastern Sahara.

* There is some evidence that this area—a typical intermediate zone—is again becoming more humid. See Prof. Gregory's paper in the *Journal*, vol. 43, p. 299, and the authorities there cited.

† The Berber tongue is still very largely used, but Arab is the general vehicle for speech and writing.

‡ Some tribes on the borderland of the Sudan are pagan and among those tribes the French wisely discourage Islamic propaganda.

large numbers are members of the Senussi fraternity, a sect which has shown much hostility to European influence and has contested foot by foot the advance of the French in the district east of Lake Chad.*

As to the population of the Sahara only of those who dwell in the Egyptian oases and the Algerian Sahara are there accurate census returns. In the Egyptian oases, including the Fayum, there are about 160,000 inhabitants (the last census was in 1907); in the Algerian Sahara there were 494,000 in 1911, including 9000 Europeans (French, Maltese, Italians, Greeks). All the rest is simple estimation. The French authorities give 222,000 as the population of Mauritania and 800,000 for the rest of the Western and Central Sahara. There may be 100,000 in the Moroccan Sahara and 50,000 in Rio de Oro. For the Eastern Sahara, inclusive of Tripoli and Cyrenaica but exclusive of the Egyptian oases and Tibesti, Borku and Endi, 1,180,000 was Mr. Oric Bates's estimate in 1912; for Tibesti, Borku and Endi 250,000 appears a generous allowance. This gives in round figures a total of 2,250,000, and it probably exceeds the real number. If the Fayum be excluded, and it may well be considered part of Egypt proper, and also the city of Tripoli with its 60,000 inhabitants, we get as the population of the Sahara something under 2,000,000, of whom nearly a fourth is found in the Algerian Sahara. The majority of these 2,000,000 people are nomads, but the nomads are more dependent on sedentary settlements, *i.e.* towns, than might be thought. Fixed centres are essential for their existence; to these they have to resort for their markets and their news and everything which connects them with the outside world. Saharan towns—which have a population of from 2000 to (rarely) 10,000—are either agricultural settlements in large oases or are on the routes to and from the Sudan and the Mediterranean; often a Saharan town fulfils both conditions. We have already named the towns in the Algerian Sahara. The other chief towns in the Sahara are Ghadames and Ghat on the Tunisian-Tripoli frontier; Murzuk in Fezzan, Bilma (between Murzuk and Lake Chad), Aujila and Siwa on the inland route from Tripoli to Egypt; Jof in Kufra; Bardai in Tibesti. In the Central Sahara Agades in Air has already been mentioned, and Taudeni the most important place on the route from Tafilalt to Timbuktu. In the Sahel Sudanese Walata, north-west of Timbuktu, is of much less importance than it was formerly, but it is a French administrative post. Between the Niger and Lake Chad is Zinder which, however, may be regarded as in the Sudan rather than in the Sahara. The life of the nomad is confined as a rule to the regions around these centres; in the rains he will go as far afield as he can get pasture for his camels and his horses, but when the pastures dry up he returns to the oases. In the more arid regions

* Neither has the Senussi policy looked with much favour on the Turks. The fraternity has played a part in opposition to the Italians in Tripoli and Cyrenaica—on material as well as religious and political grounds—but it has preserved a friendly neutrality towards Egypt and the Government of the Anglo-Egyptian Sudan.

he keeps to the tracks along which small oases and *hattiahs* lead to the larger settlements: *hattiahs* are halting-places where grazing may be had, but, usually, no water.

The chief commodities of the Sahara are the date palm, the camel, and salt. The milk of the camel is the common drink throughout the Western Sahara.* Raiding is or was a pastime and pleasure. The favourite object of the raids was a rich caravan carrying merchandize, slaves, and eunuchs (for the harems of the East) from the Sudan to the Mediterranean. At such towns as Ghadames and Timbuktu the nomad got and gets the products of the Sudan and the Barbary States and also goods imported from Europe. The conveying of the caravans afforded employment to a number of these nomads. The Berber tribes, besides cultivating the soil wherever opportunity offers, have a few primitive manufactures, such as the weaving of woollen garments and the making of carpets of goat and camel hair.

European Influence on the Life of the Saharans.—The preceding brief and inadequate sketch of the traditional manner of life of the desert dwellers shows that in many respects it was incompatible with Western ideals and would be modified when the Sahara came under European control. The changes in the customs of the Saharans are due to two causes: (1) the enforcement of "law and order" in the desert itself, and (2) the economic changes wrought by the establishment of European authority in the lands bordering the Sahara. To-day the whole of the North African states are in the hands of Europeans, while France and Great Britain between them hold the Sudan from Cape Verde to the Red Sea.† Only in Darfur has a native Sudanese government in touch with the Sahara any real authority, and Darfur is a tributary state of the Anglo-Egyptian Sudan. This European control of the Sudan and of the Barbary states means, in the first place, the suppression of the slave trade. After other routes had been closed slaves were still smuggled to Morocco from the Western Sudan, and small consignments went from Wadai, Tibesti, Borku, and Endi across the Libyan Desert to Cyrenaica and Tripoli, where with the connivance of Turkish officials they were disposed of clandestinely. This trade was not large in recent years but it existed. In 1909–10 the French conquered Wadai, in 1912 the Italians seized Tripoli and Cyrenaica, in 1913–14 Borku and Endi were occupied by the French. The establishment of a French protectorate over Morocco in 1912 was followed by the suppression of the slave markets in that country. Thus the Saharans have been deprived of one means of livelihood; they can neither buy nor convoy slaves. There has been an even greater interference with their legitimate trade. Until the belt of primæval forest which stretches across

* P. Marty, *op. cit.*

† Germany had a small share of the Sudan around the south of Lake Chad. This she has lost.

the Western Sudan was pierced the trade of the Sudan went either north to the Mediterranean or east to the Red Sea at Suakin,* while the commerce of the Barbary States with the Sudan had likewise to go across the desert. The first efforts of the French and British to trade with the Sudan by the Gulf of Guinea had little effect in the Sahara. The case was altered when the French brought a railway from Senegal to the middle Niger and opened a route to Timbuktu from the west, and the British built railways from Lagos and the lower Niger to Kano. From Senegal to Lake Chad trade has for some years now increasingly followed the safest, cheapest, and (though a minor matter) the quickest routes—those to the south and west. The people most affected by this deflection of trade from the Saharan route—in addition to the nomads who either plundered or guarded the caravans—were the merchants of Murzuk, Ghat, Ghadames, and Tripoli. The Tripoli-Chad-Kano route had been for over a century the most famous of all the caravan routes across the desert, surpassing in importance that from Timbuktu to Fez. The wars of Rabah, Zobeir Pasha's ex-slave, who conquered the Chad countries in 1891-93, rendered the route insecure, and when order was restored and Northern Nigeria came under effective control the merchants of Kano and Bornu had begun to look to the Gulf of Guinea as the proper outlet of their commerce. The trade of the French East Nigerian territory is also encouraged to take the southern route. Zinder is recognized as a commercial dependency of Nigeria. These facts and the war between Italy and Turkey in 1911-12 almost killed the caravan trade on the great Saharan highway. The French in Tunisia and the Italians in Tripoli, with reason, believed that the trade might be revived and measures which may have led to success were being taken † when the outbreak of the war in Europe was followed by serious revolts against Italian authority. The result has been that the Italians have withdrawn for a time from Fezzan and Ghat. In the Sahara they now hold only Ghadames. The prospects of any great revival of trade with the Sudan across the Sahara are not encouraging. It must be remembered that only goods of considerable value can pay the cost of transport, especially since the most valuable form of currency—slaves—is no longer available.‡ Ivory, ostrich feathers, leather goods, gold-dust always paid for transport; yet the annual average value of the

* The building of a railway from Kordofan to the Red Sea tends to emphasize this west to east inclination, yet, owing to greater prosperity, Sudanese trade with Egypt *via* the Nile has increased and not decreased.

† The *Primo Maggio*, an Italian journal published in Tunis, poured scorn on the results obtained—three caravans in two years; a few thousands of ostrich plumes, a few hundreds of elephants' tusks, and skins of animals, all in transit for England or Germany!

‡ Slaves, cheap in the Sudan, were employed to take the other merchandise across the desert, and they themselves fetched good prices in the markets of North Africa.

caravan trade brought to Tripoli for the forty years ending 1901 was but £114,000.

There are, however, the wants of the Saharans to be supplied; cottons, tea, and sugar are in constant demand. There is no reason to despair of creating a trade with the desert peoples which shall take the place of the transit trade from and to the Sudan.* The suppression of raiding and inter-tribal fighting will ultimately tend to an increase of productivity and trade in the inner Sahara (as it has already done in the Algerian Sahara), for if the raider cease from raiding he must turn his hand to some other employment. In the present transitional stage it is undeniable that life for the Saharans has been made harder and more drab. The increase of means of communication and the safety of travel will have their effect on future generations.

This question of internal security has been practically solved by the French whose sovereignty is now unquestioned over the greater part of the Central and Western Sahara. The only other European power there with territorial possessions is Spain. In the protectorate of Rio de Oro Spain has a seaboard with one good harbour and a hinterland of limited extent but considerable potential value. At present Spanish authority is not effective save at a few places on the coast, and the adjoining Moroccan Sahara is still in fact outside French jurisdiction. But nearly all the tribes in Mauritania have, after hard fighting, acknowledged French sway. (Important chiefs hitherto hostile made submission at the close of 1914.) More remarkable perhaps is the rapidity with which, since the conquest of the Algerian Sahara was completed in 1901 by the occupation of Tuat, the Taureg of the Central Sahara have been brought into friendly relations with France. The pacification of Tripoli and its hinterland by Italy is postponed owing to the Great War, but unless the Senussi should make a great effort it is not likely to be delayed much beyond the close of the war. The Italian annexation of Tripoli solved one question which, in the opening years of this century, promised to give trouble—the extension of Turkish authority in the Central Sahara and the Libyan Desert. Turkey is no longer an African power, her last political link with the continent being broken in December, 1914, by the proclamation of a British protectorate over Egypt. There remains the settlement of the boundaries of the Italian sphere, a settlement which affects French and British (Egyptian) interests. The exact frontiers of Libya (as the Italians style their North African possessions) is a matter of some importance, involving the control of the routes to the Central Sahara and the possession of the Kufra oases.† The solution of this question will help materially in the pacification of the Sahara, for the

* See *infra*, "Possibilities of the Land."

† See "Egyptian and Sudan Frontiers," by F. R. Cana, *Contemporary Review*, May, 1914, *L'Afrique Française*, May, 1914, and *Rens. Col.*, April, 1914.

tribes on the debatable borders will thereafter be made amenable to one power or the other. Meantime France has already found a congenial means of employment for some of the tribesmen she has tamed. The policing of the Sahara is confided to the men who but lately were the disturbers of the peace. The meharist companies (men mounted on swift riding-camels) led by French officers do their work effectively. A considerable number of Berbers from the Sahara are, too, fighting to-day in France in the ranks of the Moroccan and Algerian regiments. They have carried their aptitude for war to Europe, and have shown a degree of discipline which has won the direct commendation of General Joffre.

MEANS OF COMMUNICATION.

Something has been done to render travel on the chief caravan routes less arduous. Thus the French have a post at Bilma on the Kano-Tripoli route, and there are fixed stations between Zinder and Agades and from the Senegal to Mauritania. These routes are regularly policed by meharists and the water-supply has been improved. All that can be done by these methods will be done, and it means much to travellers and all who use the desert to be able to travel without fear of being plundered and with less risk of dying from thirst.* Caravan tours across the Sahara may well be organized by the tourist agencies in a not distant future. Meantime the opening up of the desert by railway has begun.

Railway projects in the Sahara are of two kinds: (*a*) those intended for a local and circumscribed purpose; (*b*) those which look forward to the junction of the railways of the Barbary States and Egypt with the Sudan. Some of the lines in class (*a*) will eventually become part of system (*b*). We may take first the lines built for special or local reasons. These have so far reached their greatest development in the part of the Sahara east of the Nile.† The well-known rail and river route from Cairo to Khartum is a trans-Saharan route. Egypt is but a long oasis in the Sahara and the Nubian Desert is as much part of the Sahara as is Mauritania, and is much more arid. But the railway from Halfa to Khartum was built for military and political reasons and from its situation east of the Nile has little influence on developments over the rest of the Sahara. The railway from Atbara (on the Halfa-Khartum line) to Port Sudan on the Red Sea is also a purely Saharan line. Its purpose too is local, to get the products of the Eastern Sudan by the quickest route to the world's markets. Neither the Khartum nor the

* A recent picture of the Tripoli-Chad route is given by Hanns Vischer in 'Across the Sahara from Tripoli to Bornu' (London, 1910).

† The Sahara is often regarded as ending eastward at the Nile. Geographically incorrect, this is a convenient boundary for many purposes. In France the tendency is to exclude the Libyan Desert from consideration when dealing with the Sahara. These distinctions arise chiefly from political causes.

Red Sea railway was built to serve the deserts across which they run. They do not even pass through any oases.

Of local railways west of the Nile in the Sahara there are two or three. Kharga, "the Great Oasis," has been linked by rail to Cairo since 1908. This is a type of the local lines which serve oases sufficiently fruitful—or capable of being rendered sufficiently fruitful—to make it worth while to encourage trade with the outer world. Going westward from the Nile valley the only railways built which penetrate the Sahara are those starting from Algeria. A beginning has, however, been made by the Italians in Tripoli. From Tripoli city a line has been planned to go south to Murzuk in Fezzan. Good progress had been made with the first section, to Gharian, but work on the line was suspended in the spring of this year in consequence of the spread of the revolt which broke out in Fezzan in September, 1914.

The Algerian Sahara has two railway systems. One line from Oran crosses the High Atlas by Ain Sefra and continues south-west by Figig to the oasis of Colomb Becher. This line though built for military reasons is however commercially valuable. It leads to Igli and the fertile oases of Tuat. The continuation of this railway from Colomb Becher by Igli along the Soura valley to Adrar in Tuat has been decided upon. The French trans-Saharan railway, when built, will pass through Adrar, so that the Tuat line will become of double importance. The second railway in the Algerian Sahara is that which from Constantine crosses the Aures Mountains to Biskra where for several years it ended. Biskra stands at the northern end of the caravan route to Tuggart and Wargla, a route which passes through several oases. It is a region where there are many possibilities of development and it was regarded until the last few years as the probable line which the trans-Saharan railway would take. The Algerian Government some time ago decided that in any case the Biskra railway should be continued to Wargla and the first section—Biskra to Tuggart—was begun in 1911 and opened for traffic in May, 1914. This section is 124 miles in length, is of metre gauge, and cost £380,000. As illustrative of the topography of this region it may be mentioned that this railway in its short course passes through six oases, several stretches of bare desert, skirts the salt-encrusted Shat Meruane (the western arm of the Shat Melrir), and crosses the Wadi Jidi—which is subject to violent and dangerous floods—by a bridge 300 metres (nearly 1000 feet) long. The chief oasis served is that of the Wadi Rhir famous for its date palms.* One of the intermediate stations, near to the Shat Meruane, is named Kel el Dor (the Rock of the Turning Back). This name preserves the memory of a legend that here a Roman legion from Timgad advancing towards the Wadi Rhir turned back stricken with fear at finding all their weapons completely rusted. These old legends

* For fuller details of the line, see *L'Afrique Française* for May, 1914.

have their value, and when tourists flock to Tuggurt (preparations for their reception are being made by the erection of hotels with all modern conveniences), a halt at Kef el Dor and an excursion to the Shats will be part of the programme. A branch line westward (53 miles long) up the Wadi Jedi to Walad Jellal has been surveyed, while the main line will pass by the oasis of El Kadir to Wargla which will be 105 miles by rail from Tuggurt.

Half a dozen routes have been suggested for the railway which, since the occupation of Timbuktu in 1894, has been ardently desired by the French colonial party. In February—September, 1912, Captain Nieger was at the head of a mission which made a careful survey of the ground and the route he suggests seems likely to hold the field. The line he has traced runs south-east from Adrar in Tuat to El Aulef at the western end of the Tidikelt oasis (whence a branch line might go to In Salah). From El Aulef the railway would traverse the wadis—where water can be got by artesian boring—between the Ahnet and Muidir plateaus.* Thence turning more directly south the line would keep west of the Ahaggar mountains and on to the oasis of Silet with its numerous date palms. From Silet the route is over the Tanezruft south-east to Agades in Air. At two places—In Guezzam and In Amauel—in this dreaded Tanezruft, which Captain Nieger took forty-two days to cross, there are however inexhaustible supplies of water, and at a third place, Tinrerho, there is a supply which could be much augmented by artesian borings. Rounding the south of the Air highlands the railway would go by Zinder to Lake Chad, skirt the northern end of that lake and reach its eastern side. Its further connection with the Congo river did not concern Captain Nieger. It will be seen that the line suggested aims at reaching Central and not West Africa. The connection with West Africa is proposed to be made by a branch which would leave the main line south-west of Silet and traverse the western side of Adrar Iforas. It would reach the Niger at Tosaie (below Timbuktu), that spot having been chosen as there the river can be fairly easily bridged. An alternative route which would keep east of Adrar Iforas and strike the Niger at Gao was surveyed. The connection of Morocco with the Sudan could be made should the Nieger proposals be adopted by building a railway from Fez to Tuat.

The surveys of Captain Nieger, Captain Maurice Cortier, the second in command, and other members of the expedition showed particularly how level is the general surface of the Saharan tableland and how free its surface is from sand-dunes. Captain Nieger reported † that along the whole route he suggested from Tuat to Lake Chad—including the branch

* Alternatively the line might keep west of the Ahnet plateau.

† 'La Mission d'Études du Chemin de Fer Transafricain,' *L'Afrique Française*, 1913, p. 5; 'Résultats scientifiques d'ensemble de la mission du Transafricain,' *La Géog.*, 1914, p. 73.

to the Niger—important embankments, cuttings, and moving sand are avoided; the railway, he says, encounters no serious obstacle and over the greater part of the route it is simply a question of fixing the sleepers and laying down the rails. In one place between Air and Lake Chad the line would have to cross a sand-belt of fixed dunes partly covered with vegetation and only 22 miles across. The length of the line from Colomb Becher to Lake Chad would be 1700 or more miles—about four times as long as the line from Halfa to Khartum. Of the practicability of building such a railway there is no doubt; the question is one of utility. It would not in any event attract the trade of West Africa to take the long land journey by rail when the markets of the world can be reached more easily and cheaply by the sea route; still less likely does it seem that it would attract the trade of the northern Congo regions. It would however have strategic value and it would bind together the French possessions in North, West, and Central Africa. Perhaps the strongest reason for its construction is that nearly two-thirds of the proposed Algeria-Chad route will be served by railways in any case. Political and economic reasons combine to cause the French to carry the Colomb-Becher line to Tuat, and the same reasons will cause the linking up of Zinder with Agades in the north (and Kano in the south). That being the case there will remain only the gap between, say, Adrar in Tuat and Agades. This gap of about 800 miles is the precise region where the railway can be most easily and cheaply made, and if only for the sake of symmetry and completeness the gap is likely to be bridged.

There are other reasons why the Lake Chad end of the line will be built. The effective development as well as peaceful control of the intermediate zone between Lake Chad and the Nile is best assured by rapid means of communications. At the eastern end a beginning has been made by the building of the railway from Khartum to El Obeid in Kordofan, and at the Chad end a few miles of rails have been laid down by the French. It requires, indeed, no gift of prophecy to foresee the day when a railway will stretch from Dakar to Port Sudan fed by branch lines north and south.

Another east and west trunk-line which has direct connection with the Sahara is in the making—the railway which will run parallel to the coast of the Mediterranean from Tangier to Alexandria. From the Gulf of Gabes eastward to Egypt the coast lands, if not part of the Sahara, have a Saharan character. A railway along this section of the coast until recently seemed a thing of the dim future. The aspect is now altering. Some year or two ago the French began to extend the Tunisian railways from Sfax to Gabes, and these railways are now to be continued to the frontier of Tripoli, while a line inland from Gabes to capture the trade of Ghadames is proposed.* The Italians, besides the line inland to Fezzan,

* The French are endeavouring to open up a new "through" caravan route from Gabes to Lake Chad, skirting the western frontier of Tripoli. It will pass by way of

are also building coast lines both east and west from Tripoli city. The western line, which was completed as far as the oasis of Zauia in October, 1914, will link up with the Tunisian lines. The eastern line will in time reach the Egyptian frontier at Sollum. A section of this eastern extension has been begun independently, the Italians having determined to connect Benghazi and Derna by rail as soon as possible. The first little section of $12\frac{1}{2}$ miles eastward from Benghazi to Benina was opened in September, 1914. Something also has been done from the Egyptian side. The ex-Khedive, Abbas Hilmi, convinced that there was a profitable trade to be done with the Bedawin of the Libyan Plateau, built a line (since bought by the Egyptian Government) westward from Alexandria to Bir Fuka (120 miles). Thus fragments of the line which will form the eastern section of the Tangier-Alexandria trunk railway are in existence. They should help in the restoration of prosperity in Tripoli and Cyrenaica and branch lines may aid in creating industries and trade in the hinterland.

An extensive telegraphic system has been established in the French Sahara and some small use has been made of motors. Wireless telegraphy stations have been erected at Timbuktu, Colomb Bechar, and Port Étienne.

POSSIBILITIES OF THE LAND.

Regarded from the point of view of the contribution it may make to the world's wealth the Sahara does not seem a promising field. Yet it possesses one thing for which there is a great and apparently increasing market—dates. There are many millions of date-palms in the Sahara; millions more might be grown, and the Sahara dates are unequalled in quality. The difficulty is in getting them to market, and such railways as that recently opened to Tuggurt give the needed facilities. Information given by Commandant Godefroy—who both surveyed and built the Tuggurt line—with regard to the production of the Rhir oases may be given as typical of the work carried out by France in the Algerian Sahara generally. In 1856 the Rhir had 200 wells and 339,000 date palms. In 1914 there were over 800 wells and nearly 1,500,000 palms. Since the French occupation the production of dates had nearly quadrupled and was in 1914 some 30,000 tons. This was accomplished before the railway gave the people of Rhir the chance of putting their dates on the market. This year it was anticipated that 8000 to 10,000 tons of dates, worth about £16 a ton, would be exported from Rhir, and with the coming of the railway the area of plantation can be very largely increased. Commandant Godefroy estimates that the Rhir can produce for

the oases of Janet (near Ghat), Jado, and Bilma. A copious supply of good water was found by boring at a spot 19 miles south of Ghadames. The first caravan left Gabes in April, 1913. This route, should it be much used, will diminish the importance of the Chad-Tripoli route.

exportation dates worth nearly £500,000 yearly. Already some French colonists have acquired palm groves. This example of what can be done in one oasis must serve to indicate what is being done in many others. When all the oases in the Moroccan, Algerian, and Tunisian oases are brought to full productivity and given easy means of access to the North African ports, the date industry should attain proportions as large as any demands made upon it. More distant oases can also be made more flourishing and thus able to support a larger population—all needing European goods.

The date palm is rightly called the monarch of the Sahara, but it has subjects. A great variety of fruits—peaches, grapes, oranges, figs, and the more hardy apple, etc.—are grown in the oases and there are possibilities of a valuable export trade in them. Moreover, a large range of crops from wheat and barley to rice and durra can be grown. These will not become exports, but if all the chances of cultivation were seized the Sahara could support a much larger population than it now does. Two things are requisite for the cultivation of the oases to their fullest capacity—water and security of tenure. The French are providing both. Besides the sinking of artesian wells, the usual method of getting new supplies of water in the oases, surface irrigation works are being undertaken in Tuat where there is a large supply of river water.

Another source of sylvan wealth is afforded by the gum acacias. These are found in oases but chiefly in the intermediate zone bordering the Sudan. In these regions too are found the ostriches whose feathers have for centuries been one of the chief articles of Saharan commerce. There is no reason why ostrich farming in this “strip of herbage strown” should not become very valuable. In Mauritania many of the uplands appear to be suitable for stock-raising on a large scale and Port Étienne and Villa Cisernos afford convenient harbours for their export. The thousands of camels, asses, goats, and sheep possessed by certain tribes proved the existence of large areas of pasturages. The present trade in hides and skins is obviously capable of material expansion. Probably esparto might be cultivated here as it is in the Algerian plateaus, and Mauritania with its harbour of Port Étienne seems to deserve to be supplied with a railway system.

Although the Sahara may be the least curable of deserts actually the area where increased cultivation of the soil is possible and would be profitable is large. It cannot well be less than a tenth of the whole area—say 350,000 square miles, or something less than the combined area of France and Spain. This would include the Sahel Sudanese, the intermediate zone mentioned several times already. There appears to be no sufficient climatic reasons to prevent Fezzan, the Zinder district, the Aïr highlands, and the Walata valley recovering the prosperity they formerly possessed. The region of the Middle Niger—the backwaters and lakes which extend westward of Timbuktu—could at comparatively little cost

be placed under irrigation.* Means could in all probability be found for restoring to cultivation large areas between Lake Chad and Borku. In the bed of the Bahr el Ghazel wells already exist and their number could be increased by boring. Efforts to regenerate the intermediate zone are, naturally, likely to take second place to the development of the richer regions further south, but work in that zone has the recommendation that it will form a protection against further encroachment by the desert.

As to mineral wealth the Sahara is rich in salt. Phosphates, potash, and soda are found; the great beds of phosphates exploited in Algeria and Tunisia lie on the Saharan border. There is a regular export of potash from Air to Nigeria. Gold and precious minerals were mined by the ancient Egyptians in the hills facing the Red Sea and gold-mining on a small scale has begun again in the Nubian Desert. Soda in large quantities is obtained from the Natron lakes west of Cairo, from the Chad district and other regions. Petroleum-bearing strata are believed to exist. But the mineral resources of the Sahara are practically unknown, though the belief that they are great is probably well founded.

When all has been done for the economic development of the Sahara which is possible, when France, Great Britain, and Italy between them maintain peace throughout its wide extent, when a population ten times as numerous as it now is finds in it means of support, the desert will in outward aspect be little altered. It will remain a land of immense solitudes and boundless horizons, of strange dead mountains and dry riverbeds, of verdant oases, waving palms and ever-receding mirages—a land of heat and thirst, of rock and dune, in which the tents of the nomads and the caravans of camels will leave a more lasting impression than the lines of steel which bind it anew to the outer world.

EARTHQUAKES IN GREAT BRITAIN (1889-1914).

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DURING the twenty-six years considered in this paper the total number of known earthquakes is 357. The average annual number is thus 13·7, or slightly more than one a month. The annual number, however, is extremely variable. No year was entirely free from earthquakes, though in each of three years (1897, 1899 and 1914) only one earthquake is recorded and in each of three others (1895, 1902 and 1913) only two. Some years were unusually rich in earthquakes, 18 shocks being felt in 1908 and 1909, 19 in 1891, 20 in 1892, 21 in 1910, 23 in 1901 and 1906, 26 in 1890, and 74 in 1912.

The more important earthquakes as well as many of the slighter

* See 'Haut-Sénégal-Niger. Géographie Economique,' by J. Meniaud. Paris, 1912.