

On camelback: René Chudeau (1864–1921), Conrad Kilian (1898–1950), Albert Félix de Lapparent (1905–1975) and Théodore Monod (1902–2000), four French geological travellers cross the Sahara

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Abstract: From 1920 to 1990, these brave geologists travelled through the Sahara from Mauritania to Libya and from Algeria to Niger. During these hikes across thousands of kilometres, often in very difficult conditions, they were able to trace the main features of the geology of these desert regions, they established stratigraphical sections of the main sedimentary provinces, discovered volcanic and eruptive complexes and drew geological maps of large areas.

Today, helicopters, four-wheel-drive vehicles, satellite observations and global positioning systems allow people to visit the most remote regions of the Sahara safely; however, geologists, naturalists and explorers like Chudeau, Kilian, De Lapparent, Monod made the most of their observations and discoveries thanks to two essential auxiliaries: the camel and the goatskin bottle.

The portraits and the principal contributions to the geology of the Sahara of these four pioneers are presented here with maps of their itineraries.

The immense desert countries of the Sahara were first crossed by nomads travelling for trade. The most famous Islamic traveller was Abou Abd Allah Mohammed Ibn Battuta (1304–1377) who, at 22 years old, left Tangier to explore the World, the Middle-East, Asia and finally Saharan Africa. Leaving Morocco on 18 February 1352, he went to Niger and returned two years later to Fez. His was the only description of a crossing of the huge desert produced during the Middle Ages (Rouch 1958). It was not until the 1550s that Leon the African, another Muslim traveller (who converted to Christianity) produced his descriptions of Africa.

The first great crossing of the Sahara made by a European traveller took place in 1825 and 1826 by the Englishman Major Alexander Gordon Laing. Leaving Tripoli, he arrived in Timbuktu on 18 August 1826, but he was murdered on the way back (Maugham 1961; Monod 1977). The following year, the Frenchman René Caillé (1799–1838) crossed the Sahara from south to north via Timbuktu. On the east side of the Sahara, in Tripolitania, Denham, Oudney and Clapperton left Tripoli and journeyed to Chad lake from 1822–1825; then the German Heinrich Barth, accompanied by the geologist Oterweg, joined the James Richardson expedition in 1850 and travelled to Tripoli, Agades and Kano; of the three companions, only Barth returned from this tour in autumn 1855. Barth was the first to make geological observations and to note the presence of granites and sandstones in the central Sahara. Other such intrepid explorers

included the French Henri Duveyrier (1840–1892), who from 1859 to 1862, visited the borders of the Southern Tunisia, of Tripolitania and Algeria, and in 1864 published a memorable work *Les Touaregs du Nord*, the first part of which was devoted to physical geography and to geology. In 1864, the German explorer, Gerhard Rohlfs (1831–1896), crossed the Sahara from west to east from Morocco to Tripolitania.

The French conquest of the city of Algiers in 1830 marked the beginning of the scientific explorations of the Sahara in the south of Algeria. Geological studies started in 1844 and were led according to the pacification of the Southern territories and were focused on two large projects: the creation of a large inland Saharan sea and the building of trans-Saharan railway.

The inland sea of the Sahara

Due to Captain Roudaire's instigation, military men, business men and adventurers rushed to undertake a mammoth project: to open a passage between the Mediterranean sea and the region of the 'Chotts' of South Algeria and Tunisia. This region constitutes a large depressed area south of the Atlas mountains that is below the sea level; the promoters hoped that digging a canal from the Gabes gulf would create a large inland sea, that would be fertile and prosperous area, in addition to quietening the nomadic and quarrelsome populations (Letolle & Bendjoudi 1997). This project, supported by Roudaire and Ferdinand

de Lesseps, the famous promoter of the Suez Canal, was particularly useful to the interests of speculators but it was completely unrealistic; this arid region was sparsely populated and the supporters of the project, against the advice of the geologists, such as Pomel (1877), had not considered the existence of a barrier not far from the coast, the Gabes threshold, that had to be crossed. They were also ignorant of the role of evaporation and of the precipitation of the mineral salts which undoubtedly would have transformed the Inland Sea of the Sahara into a giant salt marsh. Nevertheless from 1850 to 1875, the idea of an Inland Sea nourished passionate controversies and discussions. In 1905, the famous novelist Jules Verne published a story inspired by this project (Verne 1905).

In contrast to this French project, a British one was proposed, to create an inland sea near the West African coast, not far from Tarfaya. In 1877, the Englishman D. Mackenzie settled in a fortress called Victoria; however, the Reguibat nomads murdered him in 1880 and the project never succeeded.

The trans-Saharan railway

The idea of linking Algiers to Niger by a railway crossing the Sahara from north to south generated a project as utopian as that of an inland sea. Colonel Flatters was in charge of the study of the layout of the future line. He set out with a party of soldiers and engineers to study its feasibility but during its second expedition, the party was killed by the Touareg on 16 February 1881 after reaching the southern edge of the Hoggar mountains. The nomads, having fed the explorers poisonous dates, cut the throats of nearly all the members of the expedition (Decraene & Zuccarelli 1994). This tragedy had enormous repercussions in France; there is a monument inside the Montsouris Park in Paris.

This drama, and the rebellion of the members of the Ouled Sidi Cheikh tribe in the west of Algeria (from 1864 to 1883) brought a halt to exploration and research. These started again in 1898 with the Foureau-Lamy mission who succeeded in reaching Chad after crossing the Sahara and making several geological observations and collecting some fossils (Foureau 1904–1905).

Flamand made the first great synthesis of the geology of the south of Algeria (Flamand 1911). Flamand explored the Algerian Sahara up to In Salah as a geologist, under the protection of a military column of 140 men of the camels' corps, but with the desire to lead a peaceful and scientific expedition. However, after an ambush, the column, under the orders of the captain Theodore Pein captured the city of In Salah by force on 28 December 1899, breaking the promise made to

Flamand by the military commander. This event caused a serious dispute. Following the return to Algiers, there was a duel between Flamand and Pein, fortunately without dramatic consequences for the two antagonists (Decraene & Zuccarelli 1994). The law of 24 December 1902 established the autonomy of the South Territories and a geological survey was founded with Flamand as deputy director. In 1911, the latter published an comprehensive volume entitled: *Recherches Géologiques sur le Haut Pays de l'Oranais et le Sahara (Algérie et Territoires du Sud)*.

René Chudeau (1864–1921)

In 1904, the geographer E. F. Gautier asked a young 40-year-old associate to join him, a geologist, who had graduated in natural sciences. At the age of 26, René Chudeau had been in charge of lectures at the University of Besançon before being removed from his position abruptly by the University council who disapproved of the life he shared with a suspected prostitute. Chudeau tried to join Gautier at Timimoun in May 1905. The project to establish a telegraphic line between In Salah and Timbuktu led Chudeau to go to the south and to cross the Sahara from Zinder and the Chad Lake. He returned to France by Bamako and Dakar in Senegal 18 months after his departure having covered distance of 7500 km which he had walked without an escort. He mapped the districts he crossed, made a geological survey and took numerous observations (Bourcart 1925). Chudeau discovered the first dinosaur bones in Niger at the bottom of the Tiguidi cliff, south of Agades. He published the results of his work in two volumes—a synthesis full of new geological observations, the first of which was written in collaboration with Gautier: *Le Sahara Algérien* and the second written alone: *Le Sahara Soudanais*.

Fascinated by Africa, Chudeau started again in 1908 for Mauritania and in 1909 travelled in the Timbuktu region. At the end of the same year, he crossed the Sahara again from north to south with the commission of the trans-Saharan railway; he returned in 1913 and 1914 to Timbuktu and visited the Taoudenî basin, discovering unknown ancient volcanoes. In all his trips Chudeau walked a total of 18 000 km through unexplored countries of the Sahara (Fig. 1) (Chudeau 1907*a, b, c, d* 1909). Chudeau demonstrated the presence of Cretaceous rocks in the south of the Sahara which are widely represented in the north, and that the former, lower Cretaceous rocks are overlain in the Zinder region by Upper Cretaceous successions. He was interested in the Quaternary deposits and in actual geological phenomena such as the formation

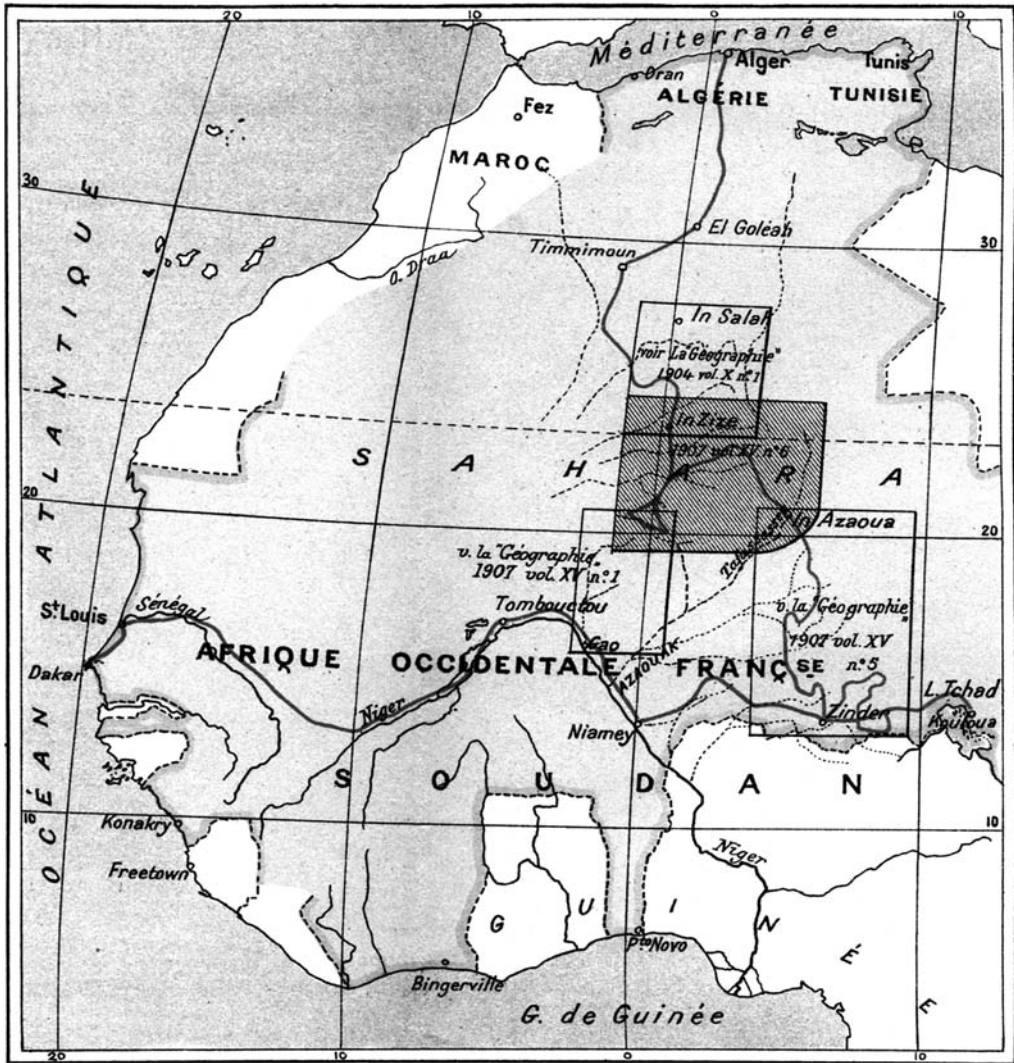


Fig. 1. The itineraries of René Chudeau through the Sahara (after Chudeau 1907a–c).

of dunes, the patina of the rocks, and in processes of aeolian erosion.

Back in Paris, Chudeau was obliged to accept a very modest job as a consulting engineer at the industrial bank of China. The bank subsequently went bankrupt and he was dismissed. Chudeau died miserably and alone. Ironically the day after his death, he was elected to a position at the Muséum National d'Histoire Naturelle, the institution where his collections remain to this day.

Conrad Kilian (1898–1950)

François Theodore Conrad Kilian was born on 25 August 1898 at the Château des Sauvages, near

Lamastre in the Ardeche, France. His father, who lived in Strasbourg, was of Huguenot extraction and had an older Irish ancestry and links with Cuvier's family. His father was Wilfrid Kilian a great specialist of alpine geology and a member of the Academy of Sciences. Conrad was educated late under the tutelage of Charles Deperet in Lyon. In October 1921 he was engaged by a businessman living in Constantine (Algeria) who wanted to find the legendary locality of the emerald layer of the Garamantes, the first inhabitants of the Sahara. Kilian was employed as a prospector and embarked on his survey in the company of an older warrant officer of the camel corps. The emeralds were in fact green feldspars,

amazonite, and after many incredible mishaps, Kilian, who was abandoned by his military companion, completed his exploration of the Tassilis des Ajers and of the central Hoggar. He developed a clear and excellent understanding of the main features of the geology of the central Saharan massif and of its aureoles. He discovered graptolitic shales *in situ* and realized that the Tassilis could be divided into two distinct units. The internal Tassilis he regarded as being 'pre-Gothlandian' [Silurian] comprising Lower Ordovician sandstones, whereas the external Tassilis consisted of upper Devonian sandstones. They were separated from each other by Silurian shales containing graptolites. Looking for a clear unconformity between the sandstones at the bottom and the crystalline basement rocks, Kilian also demonstrated that the basement was Precambrian and not simply pre-Silurian. The presence of a conglomerate allowed Kilian to separate this Precambrian sequence into two series (which he named Suggarian for the base and Pharusian for the top). These significant discoveries made by a young geologist who was only 22 years old at the time were submitted in 1922 to the Academy of Sciences in the form of a short note entitled *Aperçu général de la structure des Tassilis des Ajers* and then again to the International Geological Congress of Geology in Brussels in 1925 in a paper entitled *Essai de synthèse de la géologie du Sahara sud-constantinois et du Sahara central*. The information that these contained was so new

that Wilfrid Kilian, Conrad's father asked a practised geologist, Jacques Bourcart, to verify his son's logs! (Bourcart 1924).

Fascinated by the Sahara, Kilian returned again in 1926 (Fig. 2), when he crossed the desert on a white camel dressed like a Touareg, he was preceded by a squire carrying a banner, and proclaimed himself as sovereign explorer (Boissonnade 1971). During this trip he made numerous discoveries; he established the existence on the Saharan platform of a 'Continental intercalaire' containing fossil reptiles and fishes, a sequence situated between the marine upper Carboniferous (Namurian to Gzelian depending on the region) and the marine Middle Cretaceous (Upper Cenomanian), a concept still used today (Lefranc & Guiraud 1990). It was also Kilian who defined a 'Continental terminal' of Upper Cretaceous and Cenozoic age.

Kilian explored the confines of the Italian Fezzan and Algeria, in a no-man's land where he discovered unknown mountains that he named Monts Doumergue; he offered these to France and caused a diplomatic crisis. Back in France he published details of his fieldwork and prepared the two first sheets of the International geological map of Africa, the second being entirely his own work (Bourcart 1951; Furon 1955).

Kilian was rewarded with the gold medal of the French Geographical Society and he was invited to London in May 1932 by Sir Francis Rodd to deliver a lecture on his Saharan explorations to the

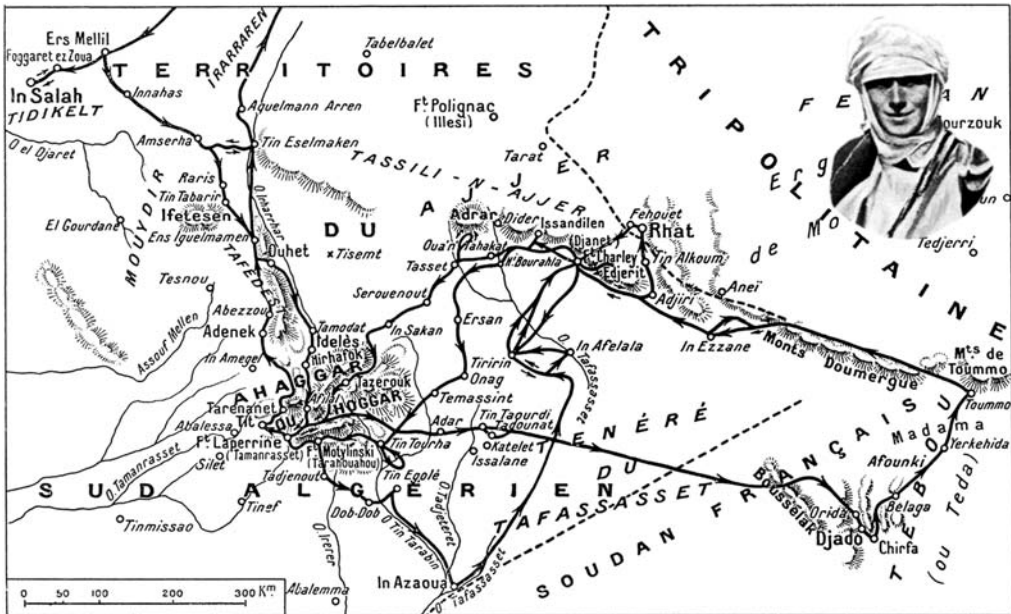


Fig. 2. Portrait and itineraries of Conrad Kilian through the Sahara (after *L'Illustration*, 1929).

members of the Royal Geographical Society. At the end of an intense and brief life, he was worn out by emotional disappointments, and by political and administrative wranglings in France over his opinions for the delimitation of the borders between Chad, Libya and Algeria (these took place against the background of intense prospecting for the first time for oil in the region). Kilian died in a mysterious and strange way in a hotel in Grenoble on 30 April 1950. He was found covered with blood and hanged at the espagnolette of his room window. There is uncertainty surrounding the circumstances of his death; some people feel that it was suicide, but others think he was murdered.

Albert Félix de Lapparent (1905–1975)

Albert Felix de Lapparent was born at Mont-Dieu in the Ardennes on 9 September 1905. His grandfather, Albert Auguste de Lapparent was a geologist who had founded the laboratory of the Catholic Institute in Paris in 1876 and became perpetual secretary of the Academy of Sciences in 1907. His uncle, Jacques de Lapparent was a well-known petrographer and mineralogist who taught in Strasbourg and Paris;

Albert Felix de Lapparent was ordained a priest in 1929. Following family tradition, he then engaged in geological studies and prepared a thesis on the sedimentary geology of Provence between Var and Durance. For this thesis he was awarded the Cuvier Prize of the Academy of Sciences in 1939. While continuing his geological work in France, De Lapparent, began, following the suggestion of the great Saharan geologist Nicolas Menchikoff, to study the stratigraphy of the Mesozoic Saharan basins. In 1946, he began a long period of exploration of huge monotonous regions travelling by camel. He undertook these trips with one or two guides, three or four camels and little food and endured conditions that were described as torrid during the day and icy during the night (Bordet 1977).

De Lapparent gave a detailed account of the stratigraphy of the Gourara, of Touat and Tidikelt. He began to collect vertebrate bones discovered during his Saharan trips, and he immersed himself in the study of the dinosaurs of the Sahara so he could develop a better understanding of the stratigraphy of the Continental Intercalaire. He travelled through the Sahara eight times (Fig. 3): southern Tunisia in 1951 and 1952; Tamesna (Niger) in 1953; Niger (Agades and Zinder) in 1954; Chad (Tibesti, Ennedi and Borkou) in 1955; Algeria in 1959; Hoggar, Edjelé and Fort Flatters in 1958 where he was the first to interpret the geology of the Edjele region where later the first oil field

inside the Algerian Sahara was discovered. I was lucky to be able to invite him to Niger in 1966 and to go with him to the Tademaït plateau in Algeria in 1970.

In 1960, de Lapparent published a memoir devoted to the dinosaurs of the Continental Intercalaire of the Sahara (Lapparent 1960), a memoir which marks the starting point of the studies on the terrestrial vertebrate faunas of the Mesozoic of the Sahara. He was the first to discover the bones of a giant crocodile in the cuttings of an underground irrigation canal (called a *foggara*) in Aoulef, South of the Tademaït. This crocodile was named in 1966 *Sarcosuchus imperator* by de Lapparent's niece, France de Broin and by the present author. *Sarcosuchus imperator* the skull of which is 170 cm long, measured 11 metres in length and is the biggest crocodile to have been found so far.

On Christmas Eve 1948 de Lapparent almost lost his life in the Sahara desert when he was travelling in the Azaoua region on the borders between Tunisia and Libya. He fell from his camel and dislocated his shoulder. His guide then roped him onto the back of his camel and hurried to Fort Polignac, a trip that still took several days! de Lapparent was then taken by car to Rhat, but he still had to wait three days before being taken by aeroplane to Tunis where he was finally operated on. He never fully recovered from this mishap and remained partially paralysed for the rest of his life.

All the archives and field notes of A. F. de Lapparent are today preserved in the Geological Institute Albert de Lapparent in Cergy Pontoise near Paris in France.

Théodore Monod (1902–2000)

Théodore Monod was born in Rouen on 9 April 1902. He was descended, on his father's side, from five ministers. He began to visit the Jardin des Plantes and the Museum National d'Histoire Naturelle in Paris when he was five years old. He wrote his first paper *Une relation zoologique et botanique d'un voyage dans le Midi de la France* in 1914 when he was only 14 years old.

Initially, Théodore Monod was tempted to study theology, but finally he chose natural sciences, obtaining his Master's degree from the Sorbonne in 1921. He was awarded a scholarship in the Museum National d'Histoire Naturelle and was elected as assistant at the laboratory of fish and colonial animals. After his first trip to Mauritania, Théodore Monod didn't embark on the boat back to France but preferred to travel to Senegal overland on camel back. From that time onwards, his research centred on two areas: both

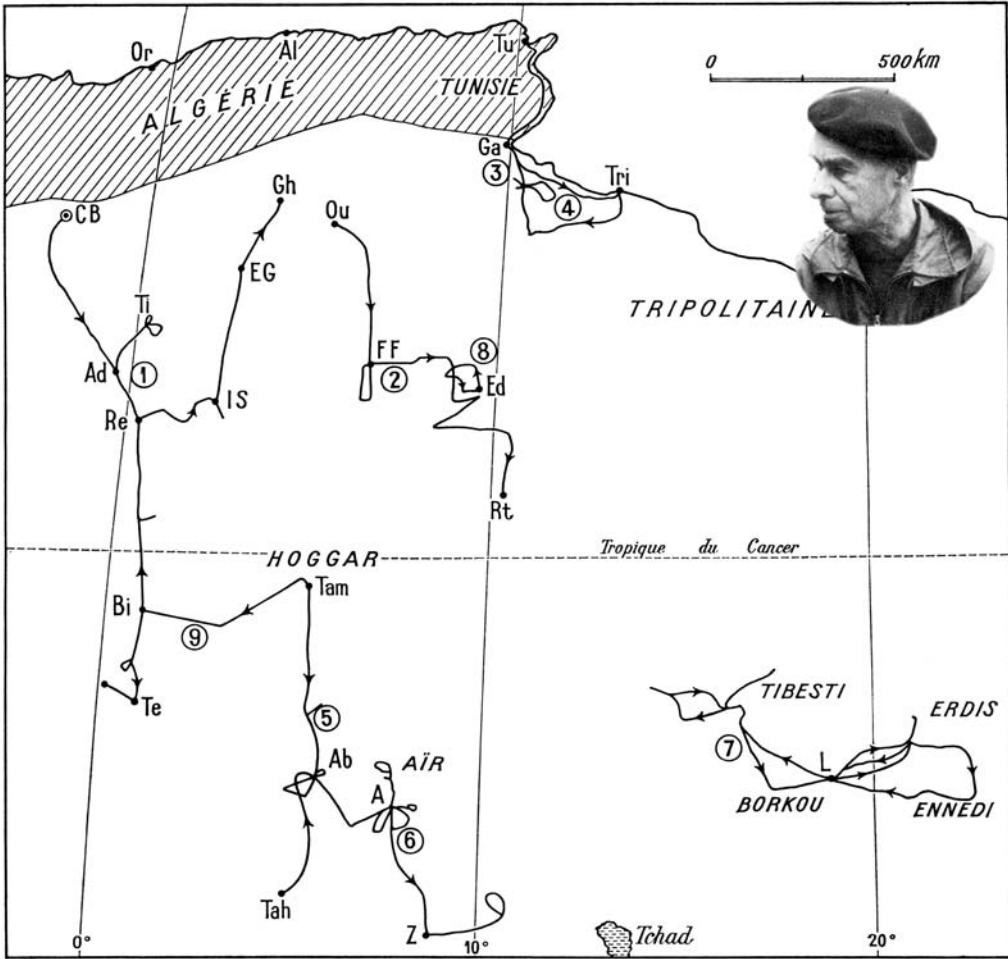


Fig. 3. Portrait and itineraries of A. F. de Lapparent through the Sahara (after Lapparent 1960).

'oceanic' (the vertical marine that yielded fish and crustaceans) and the horizontal sandy deserts in which he found rare treasures in the arid environments. Switching research between these two different environments, from the sea to the desert, from the desert to the sea, from one ocean to the other, was the idea of Théodore Monod, and so the pattern of work continued until his death at the age of 95 years. Théodore Monod crossed the Sahara in all directions, mainly on foot, in severe conditions, with some companions and few camels (Fig. 4).

In 1927, Théodore Monod participated as a naturalist on the Augieras-Draper expedition, organized by the French Geographical Society, and crossed Africa from Algiers to Dakar via Hoggar. In 1938, he was asked to manage the Institut Français d'Afrique noire which had just been

established in Dakar, and he made this institution (which still exists today as the Institut fondamental d'Afrique noire) a remarkable centre for scientific research in Africa. He was Director of this Institute for 26 years until 1964. During the Second World War he patrolled along the borders of the desert between Chad and Libya, during which time he was elected as Professor of the Museum National d'Histoire Naturelle and Director of the laboratory of fisheries. After the war he divided his time between the exploration of the Sahara, undertaken during long and intrepid camel trips, mainly in the Majâbat al-Koubrâ on the borders of Mauritania and Mali, and the exploration of the Atlantic Ocean. For the latter he participated in the first dives of the bathyscaph of Professor Piccard. This was whilst working in the laboratories in Dakar and Paris.

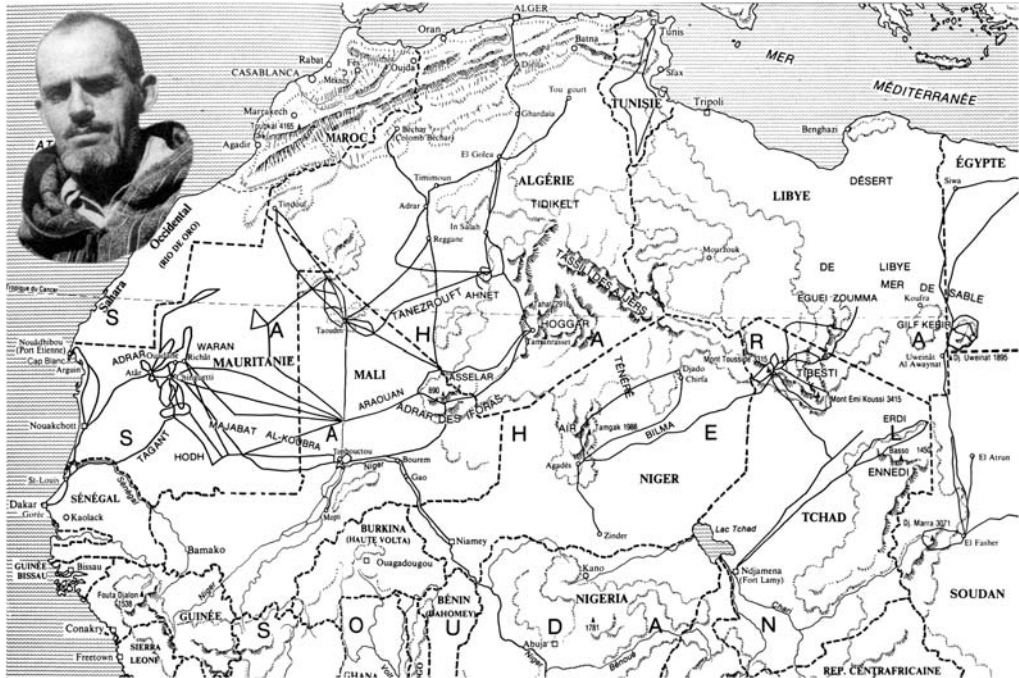


Fig. 4. Portrait and itineraries of Théodore Monod through the Sahara (after Monod 1937).

Théodore Monod was also an excellent Saharan geologist and palaeontologist: as early as 1930, when he was doing his military service as a second class cameleer in the camel corps, he discovered an intermediate series between the Precambrian and the Palaeozoic of the NW Hoggar (Monod 1931–1932), which he named purple series and which became famous, because it illustrated the first known example of Panafrican molasse. These were an extraordinary accumulation of sediments that were derived from an enormous mountain chain, as high as the Himalaya, but now eroded. He then studied the cliffs of the Mauritanian Adrar, describing its stratigraphical succession, and reported on Precambrian stromatolites, (calcareous masses with laminar structures that result of the consolidation of fine mud by blue algal filaments associated with bacteria). He had a passionate interest in the concentric complex of the Richat in Mauritania which he had discovered in 1934. This was a strange ring-shaped geological structure, composed of Precambrian sediments and containing siliceous rocks made of primitive unicellular micro-organisms. In 1934, he also discovered Silurian graptolitic rocks in the Tassilian aureoles of Ahnet, and soon afterwards in 1937 wrote an account giving a synthesis of the structure of the West Sahara. His findings are valid today and

are still used on all the recent geological maps. Following these studies he discovered Carboniferous plants in the Westphalian of Taoudeni, and Devonian faunas with goniatites and fusulinids in the erg Chech.

Although a man of science, Théodore Monod was also a humanist (Taquet 2002). Throughout his life, he fought for a more fraternal world and for a humanity that was finally humanized. He was also a talented writer and knew how to make his geological knowledge and scientific questions more accessible, explaining for example the geological formation of the Sahara by way of a cookery recipe (Monod 1937) and publishing books such as *Méharées* or *L'Hippopotame et le Philosophe* with which he became very popular. He received the gold medal of the French Geographical Society, the gold medal of the Royal Geographical Society and the gold medal of the American Geographical Society. He was commander of the Legion d'honneur, commander of the National Order of Senegal and commander of the Merite Saharien.

Conclusion

Today, helicopters, four-wheel drive vehicles, satellite observations, global positioning systems allow

anybody to walk in the most isolated parts of the Sahara. However, there are still some dangers inherent in these immense desert spaces and travellers still die of thirst every year in the Sahara.

But as the computer replaces the geological hammer, the motor vehicle replaces the camel and the aluminium can replaces the goat skin, it is right to pay tribute to some of the pioneers, to those geologist travellers, who at enormous cost, covered thousands of kilometres, hiking or on camelback for weeks or months, in order to collect samples, to survey outcrops, to draw maps and to trace the main lines of the geology of the Sahara.

References

- BOISSONNADE, E. 1971. *Conrad Kilian. Explorateur souverain*. France Empire Ed., Paris.
- BORDET, P. 1977. Albert F. de Lapparent (1905–1975) Notice biographique. *Mémoire Hors-Série de la Société Géologique de France*, **8**, 7–18.
- BOURCART, J. 1924. *Un voyage au Sahara. Note préliminaire sur les résultats géologiques de la mission Olufsen au Sahara*. Publication du Comité de l'Afrique française.
- BOURCART, J. 1925. René Chudeau (1864–1921). Notice nécrologique. *Bulletin de la Société Géologique de France* **4**, **25**, 449–467.
- BOURCART, J. 1951. Conrad Kilian (1898–1921). Notice nécrologique. *Bulletin de la Société Géologique de France*, **6**, 303–312.
- CHUDEAU, R. 1907a. D'Alger à Tombouctou par l'Ahaggar, l'Air et le Tchad. *La Géographie*, T.XV, **6**, 261–336.
- CHUDEAU, R. 1907b. L'Air et la région de Zinder. *La Géographie*, T.XV, **6**, 321–336.
- CHUDEAU, R. 1907c. D'In Zize à In Azaoua. *La Géographie*, T.XV, **6**, 401–420.
- CHUDEAU, R. 1907d. Excursion géologique au Sahara et au Soudan (Mars 1905–Décembre 1906). *Bulletin de la Société Géologique de France*, **IV-7**, 319–346.
- CHUDEAU, R. 1909. *Le Sahara soudanais*. Colin, Paris.
- DECRAENE, P. & ZUCCARELLI, F. 1994. *Grands Sahariens à la découverte du 'désert des déserts'*. Denoël, Paris.
- FLAMAND, G. B. M. 1911. *Recherches géologiques et géographiques sur le haut pays de l'Oranais et sur le Sahara (Algérie et Territoires du sud)*. Rey ed., Lyon.
- FOUREAU, F. 1904–1905. *Documents scientifiques de la missions saharienne (Mission Foureau-Lamy) d'Alger au Congo par le Tchad*. Masson, Paris.
- FURON, R. 1955. Histoire de la Géologie de la France d'Outre-Mer. *Mémoires du Muséum national d'histoire naturelle*. Nlle série, série C., Sciences de la Terre, T.V.
- LAPPARENT, A. F. DE, 1960. Les Dinosauriens du «Continental Intercalaire du Sahara Central». *Mémoires de la Société Géologique de France*. (Nouvelle série). Mémoire **88A**.
- LEFRANC, J. P. & GUIRAUD, R. 1990. The Continental Intercalaire of northwestern Sahara and its equivalents in the neighbouring regions. *Journal of African Earth Sciences*, **10**, 27–77.
- LETOLLE, R. & BENDJOUDI, H. 1997. *Histoires d'une mer au Sahara. Utopies et Politiques*. L'Harmattan. Paris.
- MAUGHAM, L. R. 1961. *The Slaves of Timbuktoo*. Longman, London.
- MONOD, T. 1931–1932. L'Adrar Ahnet. Contribution à l'étude physique d'un district saharien. *Revue de Géographie Physique et de Géologie Dynamique*. T. IV. fasc. **2**, 107–150; fasc. **3**, 223–262; T.V, fasc. **3**, 245–297.
- MONOD, T. 1937. *Méharées*. Je Sers ed. Paris
- MONOD, T. 1977. Le dernier voyage de Laing. 1825–1826. *Bibliothèque d'Histoire d'Outre-Mer*. Nouvelle série, Travaux, **2**, 1–126.
- POMEL, A. 1877. Le projet de mer intérieure et le seuil de Gabès. *Revue Scientifique*. 2nd series, **19**, 433–440.
- ROUCH, J. 1958. L'Afrique. In: ROUCH, J. (ed.) *Histoire universelle des Explorations*. Nouvelle Librairie de France, F. Sant'Andrea Paris, **4**, 155–187.
- TAQUET, P. 1997. Au temps des crocodiles mésozoïques sahariens. In: BILLARD, R. & JARRY, I. (ed.) *Hommage à Théodore Monod naturaliste d'exception*. Muséum national d'Histoire naturelle. Archives, 57–72.
- TAQUET, P. 2002. La vie et l'œuvre scientifique de Théodore Monod. In: *Académie des Sciences et Institut de France*. Discours et Notices biographiques. T.V, 181–186.
- VERNE, J. 1905. *L'Invasion de la Mer*. Hetzel. Paris. [New edition Cérès, 2003].