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THE MISSION OF CAPTAIN ROUDAIRE IN TUNISIA, AND THE INTERIOR SEA

(pages 273-276)

p273 M. E. Roudaire, staff captain, attached to the general staff of the War Ministry, arrived in Tunis on February 13 with M. Baronet, civil engineer, M. Cormon, painter, etc. These men belong to the new mission entrusted to this distinguished officer, on whose name attention has been fixed with interest for almost four years.

The 23rd of the same month, after having completed the final preparations for his expedition, M. Roudaire embarked with the personnel of his mission, to which he added, in Tunis, an interpreter and a secretary, M. Leon Fleurât, brother-in-law of M. Paul Soleillet, the Algerian explorer. General Khereddine, Prime Minister of S.A., the Bey of Tunis, gave a very gracious reception to our staff captain, who, with the help of our consul general, has been provided with all the necessary facilities. Indeed, other than the interpreter who was placed at his disposal by the Prime Minister of the Bey, M. Roudaire is escorted by an oda-bachi (officer of the Bey) who will accompany him for the duration of his mission in the south of Tunisia. Orders were given to the various governors of Sfax, Gabes and the Djérid; tents and mounts have been gracefully granted to the mission, and finally the same hospitable measures have been taken for the return.

In Gabes, the starting point of his operations, M. Roudaire will find M. Chevarier, our vice-consul, a pleasant and courteous man whose long experience of this country will be useful to him.

The goal of the mission entrusted to M. Roudaire is the same as he has followed until now with so much success in Algeria; he proposes to level ('survey') gradually the extent of the country lying between Gabes and the Tuniso-Algerian border and to travel a circular route which will enclose the various Tunisian chotts so as to find himself, by the end of his research, at Gabes. The question of difficulties which could arise from the study of the Algerian chotts having been solved in a favorable manner, there is reason to

believe that the results provided by the account taken of the Tunisian chotts will be the same; and that finally, the interesting question of the "Inland sea" will happily be solved.

At present, the situation still involves some research: it is to this end that M. Roudaire obtained from the Minister of Public Education, a credit of 8,000 Fr. At this point it is appropriate to await the end result with confidence without being influenced either by the Report of the Italian Commission, or by the remarks of M. Fuchs. It is an error of our age to want to arrive at the result too quickly and to publish in haste writings which would certainly have benefited from more work. I believe that if M. Fuchs had guarded this itch that "we have to write everything" a little more and had taken time to make topographic surveys, he could have avoided the publication of a note which, all in all, has not proved anything because it tried too hard to prove.

The idea of the inland sea is old: however, like M. de Lesseps, M. Roudaire will have the distinguished honor of having resuscitated a great idea, modernized it and given it a body. Ten years ago, nobody doubted that in historical times there existed an inland sea going from Gabes to Biskra. This commonly accepted opinion was not discussed until M. Roudaire thought of confirming, by a levelling (topographic survey), the existence of this ancient sea and wanted to make it the basis of a practical application.

In 1872, he recognized that the chott Mel-Rhir has depressions reaching depths of 37 meters; he concluded from it the unquestionable existence of a sea; in December 1874, he accepted the official mission to perform precise surveys there, in the area of the Algerian chotts. A credit of 10,000 francs was then voted by the National Assembly on the proposal of M. Paul Bert, a member of the Institute, and the Geographic Society placed at the disposal of M. Roudaire a sum of 3,000 francs. Among the members of the mission, appeared in particular M. Châtelier, a student of engineering in the mines. This name reminds me of a remarkable article of the *Republique Française* (September 28, 1875) of which I transcribe here a passage of the utmost importance:

"M. Fuchs had entrusted to the mining engineer of the mission directed by M. Roudaire one of the aneroid barometers which had been used at Gabes.

For one month this aneroid was compared several times per day with a mercury barometer and the irregular variations of this aneroid sometimes exceeded four millimeters which in the calculation of the altitude had given an error of from 40 to 50 meters at least. ”

Thus, the barometer with which M. Fuchs made his observations in Gabes, this barometer with the help of which he wanted to contest the values p274 of the levellings made in Algeria, the barometer was a simple aneroid barometer prone to error like all its type, and it was precisely by chance that this barometer fell into the hands of the Captain Roudaire who was able to check it!

But let us not anticipate: very soon, I will return at greater length on the article from the *Republique Française* and on the note of M. Fuchs.

The principal goal that M. Roudaire pursued on his first mission in Algeria, “was to study the project of an inland sea while determining gradually, the perimeter and depth of the basin.” The survey began from the point of Chegga and was made constantly for four months at ranges from 120 to 150 meters. From December 1 to April 12, M. Roudaire and the officers of his mission levelled a line of 650 kilometers by ranges from 120 to 150 meters. The sea to be created being approximately 370 kilometers long and 50 to 60 kilometers wide, must have a surface of 10,200 square kilometers including 6,000 square kilometers in Algeria and 10,200 square kilometers in Tunisia. This last area located in Tunisia will be the object of study of M. Roudaire, who reckons to complete it in the space of approximately four months.

The depth of the Algerian basin, surveyed as it was known to be higher, varied “in the central parts between 20 and 27 meters” and it is advisable to note that if the sea regained possession of its old bed “none of the oases of Souf would be drowned.” It is useless, for the rest, to pause here to consider the advantages which would result from executing this project; I restrict myself to the topic material to the work.

The survey in Tunisia to which captain Roudaire will deliver himself will have the advantage of checking the operations made in Algeria in 1874 and 1875: it will be performed with the same care, the mission being equipped with two mercury barometers, five aneroid barometers, a hypsometer, two

sextants, stop watches, an ozonometer, a pluviometer, many thermometers, a theodolite and especially two excellent spirit levels. Did M. Fuchs, whose note fixed for a moment the attention of the erudite world, have the luxury of these instruments? It is known that he had only a theodolite and two aneroid barometers. One of these barometers, reputed the best, is precisely the one that he had entrusted to M. Chàtelier and that he himself had operated it with the assistance of M. Roudaire! Moreover, the chief of the mission to the chotts had with him, in Algeria, various officers with the help of whom he could easily manage to operate it properly; in Tunisia, he is also followed in particular by a civil engineer with whom he will establish all his calculations. If the resources of the state education budget had been less restrictive, M. Roudaire would have laid out for more personnel: but he had to bend to the circumstances. Failing these geodesic operations, the astronomical observations will provide M. Roudaire with a precise base, while his critic M. Fuchs worked from a restricted space and had the help of only two aneroids. The latitudes and longitudes must be obtained precisely by M. Roudaire who will also not neglect to study any anomalies in the magnetized switches; this will be to us an additional guarantee of the precision of his operations; the more precision, the more easily it will be to convince.

Dr. F. Garrigou of Tarascon, the author of a remarkable book entitled *Prehistoric Man* (“*L’Homme préhistorique*”), unlike some, did not visit the south of Tunisia, but nevertheless, on the word of Shaw, Greenville and the old authors, he does not hesitate to say that the Sahara was the bed of a sea in the post-pliocene era. Sir Charles Lyell (*The Age of Man - l’Ancienneté de l’Homme*) is also affirmative and here is how he expresses it:

“In the époque immediately prior to ours, this immense depression was the bed of a sea, that is to say in the post-pliocene era. There are parts of this desert close to the NE limit (below Biskra) that are now below the level of the Mediterranean sea, other vast portions are covered with shells of a recent species of which one of most abundant is *Cardium Edule*.” It is in the area of the Algerian and Tunisian chotts that it is appropriate to place this sea which today has disappeared and been replaced by lakes that are dry in the summer and fill during the winter. “The natives identify under the name of chotts or

sebkhas the muddy depressions covered with salt deposits where the water is present only during a few months of the year.”

The Algerian chotts explored and surveyed by M. Roudaire are the following:

Chotts Mel-Rhir; Merouan; Moggreddin; Bedjeloud; Sidi-Radouan; Sellem; Beni-Kleb; El-Touan; O-Oghah; Tunidgin; Mouïa-Tafelah; Hadgela; Bou-Chekoua; Mouïa-Tadjer.

These make up three large chotts to which the natives had given various names, according to the side from which one examines them.

In Tunisia, the mission will have to survey, from Gabes to the border of Algeria, the large chott El-Fejej called also Sebkh-Faraoun (the lake of Pharaoh) and the chott El-Djerid.

“This is the famous lake Triton of antiquity, says M. V. Guerin (Hérodote mentions a river called Triton, emptying into the lake of this name and in the middle of this lake, the Island of Phla... Ptolemée instructs us that the Triton river had its sources in the mountain Onselaton (**Ουσαλειτον ὄρος**) and that it formed lake Libya (**Λίβυα λίμνη**), lake Pallas (**Παλλας λίμνη**) and lake Triton (**Τριτωνις λίμνη**).” This, then, is the large chott Djerid which, according to its parts, is called in turn chott El-Rharsa, chott El-Djerid, chott El-Melah, Sebkh-Sebaki, Sebkh-Faraoun. Such are the various ancient and modern names of the Tunisian chotts to be explored by the mission of M. Roudaire.

By attentively studying the basin of the chotts and the ancient authors who wrote about Africa, M. Roudaire acquired the conviction that the Algerian and Tunisian chotts formerly communicated with the Mediterranean and formed an interior gulf called the great bay of Triton. The precise studies made in Algeria fully confirmed this opinion. The survey to be made in Tunisia will thus only corroborate it.

The reading of Herodotus proves, for the rest, as is evident, that the large lake of Triton was in communication with the Mediterranean and that the small Syrte formerly formed part of this large lake along with the Algerian chotts and chott Faraoun. The island of Djerba which was located in the small Syrte during antiquity carried the name of Meninx, Prachion and also Lotophages, while the Island of Phla was, according to the ancient authors, constantly

placed in the country of Nefzaoua; in particular it is the well established position of this Island of Phla which has confirmed the existence of an inland sea, of which only the gulf of Gabes is today the only part in existence. The islands of Kerkena, located much higher, were called Ceraina formerly; they never belonged to the large gulf of Triton, represented by the Little Syrte, Sebkhah-Faraoun and the Algerian chotts.

Ptolemy, Pomponius Mêla, Scylax, Plini, etc, in ancient times; Shaw, Grenville, Lyell, Doctor Garrigou, M. Levasseur of the Institute, M. Bourguignat, M. Hennoll, M. Henri Duveyrier, M. Charles Martin, M. Dubocq, etc, in modern times, confirm the existence of an inland sea formerly called the large gulf of Triton; Arab traditions say that where the salty undulations of the chotts extend, where animals often disappear, swallowed by the ground, when they leave the beaten path, there, I say, these Arab traditions say that a sea formerly existed there; also, today, indigenous poems still sing about certain oases in the south of Algeria saying that they formerly were seaports.

The straits which in antiquity connected lake Triton to the Little Syrte, that is to say the gulf of Gabes to the chott Faraoun, probably led to a small river located a day's walk above Gabes and at present called Wadi-el-Akarit by the Arabs: "By studying the chart of the Regency of Tunis by M. Pricot of Sainte-
p275 Marie, chief of the staff squadron (2), where the movements of the ground are marked with all the details that are found in completed surveys, one is struck by the depression that connects the mouth of the Wadi-el-Akarit with the point or head of the chott Djerid; it is obviously there that the old communication channel existed (1)," following a direction shown by many points in the whole extent of the territory of the Regency of Tunis. The coast which goes from the mouth of the Ouad-Akarit to Rass-Kapendiat almost rigorously following a straight line seems to be only the prolongation of this depression, which, on the basis of the Wadi-Akarit leading to Sebkhah-el-Fejej, formerly constituted the channel of communication of sea waters with the Triton gulf. Parallel to this direction the following features are aligned: the Kerkena Islands, the peninsula of the Cap Bon, etc., on the along the major part of their distance, the two main arteries of Tunisia, Medjerda and the Wadi-Meliane, as well as the peaks of the principal mountains surrounding Tunis (Djebel-Ressas,

Hamмам-el-Lif, Djebel-Zaghouan). By seeing the marked geographical relief so clearly in the mountain ridges and basin depressions, and this general direction which coincides precisely with the direction assigned by M. Roudaire for the old channel, one cannot deny that this last line indicates a passage in immediate agreement with the general features of the region. One understands easily how this old communication channel could be closed over time; the line of the coast, which we now mention, changes direction, indeed, at the mouth of Wadi-Akarit and turns at a right angle to pass to the south of Djerba; a current skirting the coast, as always occurs on the shoreline, deviates at the mouth of Wadi-Akarit and its speed being slowed down, the immediate consequence was the deposit of silt and sand. It's probably thus that the sand and the silt have come to fill the entrance of the gulf, leaving the inland sea isolated and becoming dryer little by little over time.

The communication of the gulf of Gabes with the Tunisian chotts through Wadi-El-Akarit, is closed little by little by the formation of an isthmus due to the action of the currents of the gulf of Gabes. Many deposits of stones, sand, and silt have accumulated with time at the entry of the bay of Triton; consequently, the current of waves decreased, little by little the water dried up in the large bay, chotts were formed, the constant evaporation increased steadily and when the sea water was completely stopped by the sand bars, the bay of Triton disappeared imperceptibly through multiple causes, including the contracting of the channel, sand, winds, the tide, evaporation, etc. Formerly, for example, Tacapa (Gabes) had a seaport which is today stranded and on land; boats arrive at this city by the Wadi Gabes, which is used as a seaport. Procopius, who lived into 565 before Christ, writes that, in his time, the sea advanced inland every day, and that in the evening it withdrew and that the navigators could there enter and sail there during the day. M. Fuchs says to us well that "the constitution of this powerful barrier is very complex, that the sand there plays only an accessory role," but he does not give us any geological information based on a study following the coast between Kasr-Ezzit and Kathena, that is to say, to the north and south of Gabes. He could meet "alternating layers of quartzose and ferruginous sandstone," at some

point, without which this observation does nothing to disprove the presence of an old communication channel from the large lake Triton to the gulf of Gabes.

The channel dug to connect the sea to the chotts should have an average length of 20 kilometers; however, the basin to be flooded in Tunisia and Algeria being, as I said, 16,200 square kilometers with the depth varying between 15.20m and 27 meters, it would take approximately two years for the water to reoccupy their old bed, taking account of evaporation and the infiltration.

p276 Up to this point, other than the ordinary detractors, M. Roudaire has only found two adversaries opposing him. The Congress of Geographical Sciences of Paris (August 1875), provided him with the opportunity to answer separately the objections raised on one side by M. Fuchs and on the other side by the Italian Commission. At the beginning of his note on the isthmus of Gabes, M. Fuchs acknowledges only having had at his provision two aneroid barometers; he adds then that the "measurements of heights obtained by him could not have had the precision of those which result from a geodetic and topographical survey." Thus, M. Fuchs whose science and high intelligence are known and appreciated by everyone, recognizing this absolute truth and knowing well the value that can be placed on the aneroids, believed it sufficient to provide itself with two aneroids to make studies on a subject where a variation of a millimetre represents an error of ten meters. Ten meters it is the depth wanted for ships of a certain tonnage. One sees then how a millimetre more or less is significant under these conditions. The aneroid barometers which all are prone to a difference of one or two millimetres are useful to measure mountains; but, they become completely insufficient to perform a levelling, even by approximation. M. Fuchs who can not be unaware of these observations, would at least have to provide a hypsometer and to tell us what use he made of his theodolite.

However, at Wadi-El-Akarit, M. Fuchs having, on one side, observed with two aneroid barometers an altitude of 50 to 60 meters, and M. Châtelier, on the other, having recognized that one of these barometers, entrusted to him by M. Fuchs, gave a minimum error of from 40 to 50 meters, one can consistently approximate zero where M. Fuchs has noted an altitude of 50

meters. A little above Wadi-Akarit, he measured 30 meters of altitude, which would give on the contrary a certain depth. Do I still insist on the lack of sensitivity of the aneroid barometers and on the many errors that they can make? (1)

For those who would admit with difficulty the error made by the aneroid barometers of M. Fuchs, I will recall, quoting the *République française*, “that all the comparisons were signed by the mining engineer and are at the disposal of those who would like to take note of it.” Consequently, in these circumstances, what value can be given to the altitude of 20 to 25 meters found in the Sebkhah, below the Wadi, by M. Fuchs?

If “there had never been direct communication in ancient times between the Mediterranean and the Saharan depression (2),” what then can be made of the opinions of Hérodoteus, of Pomponius Mêla, Scylax, Lyell, etc. What can we make, then of the Island of Phla which cannot correspond to Gerba, but only to the country of Nefzaoua?

As for the recent survey of the isthmus of Gabes, this is a question to study and that M. Fuchs hardly had time to survey: He generalized instead of being devoted to a meticulous work between the Wadi-Cehîr and the Wadi-El-Melah.

“It would have been required”, says M. Fuchs, “to annually introduce into the depression approximately 15 billion cubic meters of water by the channel of communication.” However the article of the *République française* above mentioned proves that the one can introduce in one year 53 billion for only the chott Mel-Rhir, while, naturally, the evaporation taking into account.

The honourable aforesaid engineer writes, on one side, that the salts deposited on the ground would exert a harmful influence on the healthiness of the neighbouring areas, and on the other, he says that he does not doubt the happy consequences of the project. How to reconcile these two opinions?

Lastly, he observes that the water in the channel will only be able to have a maximum speed of one meter: I will recall on this subject that thanks to the tidal bore which would occur in the trench once initiated, and thanks also to the tide of Gabes, the water would be able on the contrary to acquire a speed of 4 meters. A channel of 25 meters would thus become sufficient. As for the

length of 60 kilometers to give it, according to M. Puons, before deciding we should wait for the summary of work that M. Roudaire will undertake; and it is advisable to notice that M. Henri Duveyrier only assigns this channel a length of 18 kilometers.

Right now is not the time to calculate the millions of cubic meters to be removed for the boring of the isthmus, this is not the question. It is very different. Did the inland sea exist: yes or no? Let us content ourselves to wait with confidence the result of the mission in Tunisia and not worry for the moment about either the capital, or the excavation work; let us remain in the scientific domain; on the day that M. Roudaire produces the result of his studies, we will be able to discuss around a definite text.

To M. Correnti, president of the Italian Geographical Society, M. Roudaire answered the Congress by arguments drawn from material facts: "At the request of M. Roudaire who wants to be informed about the nature of the surveys carried out by the Italian Commission, M. Correnti declares that he does not yet have sufficient data and that he must limit himself to point out the conclusions formulated by the Italian Commission." M. Correnti, whose high science and love of truth are above any suspicion, is perhaps unaware that the Italian Commission did not have a theodolite. Did it have a spirit level? It did not receive any levelling data because only two members were on the spot and they stayed there only five days. For the rest, it was impossible for him to tell the Congress anything, since its delegates in Gabes did not have benchmarks established on the peaks; moreover, in five days, two operators could not make enough astronomical observations.

M. Fuchs and Italian Commission only traversed a small part of the ground to be explored: so the results obtained by them cannot have an overall value.

I make a point of recalling here that the Italian Commission travelled to Tunisia at the expense of Baron Dr Castelnovo, a deputy in the Italian Parliament and personal doctor of the King: it is to this generous and bright Patron that science owes this expedition. He could only sponsor it and contribute to its funds. If he had been able to inspire them by his eminently right and impartial ideas, we would by now have a work based on surveys. This is why M. Correnti, the illustrious president of the of Italian Geography

Society, brought to the platform of the Congress of Paris only a simple opinion.

To return from there to M. Roudaire, I will point out that his mission in Algeria proved: *the existence of an ancient inland sea going from Gabes to Biskra, and the clear possibility of immersing the basin of the Algerian chotts.*

It remains for him to continue the triangulation surveys in Tunisia, to seek the specific entry of the sea below Gabes. When he has surveyed the depressions of the ground between Gabes and the Algerian border, his mission will be complete and the scholarly world will be able to discuss a serious plan, the difficulties of execution, etc. The sanction of the Congress encourages M. Roudaire to continue his studies in Tunisia.

“Mathematically, scientifically, the remarkable work of the mission of the chotts showed that there exists, in the south of Tunisia from Algeria a vast basin located below the Mediterranean which can, consequently, be transformed into an interior sea.” Such is the the most recent opinion, that of M. Levasseur, of the Institute. Impartial men follow M. Roudaire by their own choice; they await impatiently the time when they will know “mathematically” the complete results that will be achieved by him for geography and to the scientific glory of France!

Evarist de SAINTE-MARIE.

Tunis, February 29, 1876.

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