

## **The Aftermath of French Nuclear Testing in Algeria**

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### **Editorial**

From the 3<sup>rd</sup> to the 19<sup>th</sup> of November, 2007, Bruno Barrillot had the opportunity to accompany a French television team (M. Larbi Benchiha, director and journalist on France 3 West and M. Hervé Portanguen, cameraman) to Reggane, in the heart of the French Sahara, where, in 1960 and 1961, the first French atmospheric nuclear tests took place. Needless to say, their presence hardly passed unnoticed!

In Algeria, the emergence of the political will to take responsibility for the consequences of the Saharan nuclear tests has taken forty years. At the request of the Algerian government, an expert assessment by the IAEA (International Atomic Energy Agency) was made in 1999 on the Reggane and In-Eker sites. Then in February 2007, the Algerian government went further by organizing, in Algiers, an international colloquium “on the environmental and health consequences of the nuclear tests,” followed by a visit to the In-Eker site, where underground tests occurred. The government later authorized this second visit to Reggane.

The French government has seen fit to provide the Algerian government with placement maps of anti-personnel mines buried during the Algerian war. Moreover, in Polynesia, site rehabilitation and medical tracking have been initiated by the Ministry of Defense. Is it not time now for complete transparency and for the French government to begin negotiations with the Algerian government on this painful page of the history of Franco-Algerian relations in order to agree on concrete actions of “rehabilitation” and “reparation”?

### **Visit to the French Test Site of Reggane in the Algerian Sahara**

Today, civilian airlines do not go directly to Reggane. One must first travel to the small town of Adrar, 1200 kilometers south of Algiers, and then take the asphalt highway which goes uninterrupted over 160 km to Reggane. Between Adrar and Reggane, palm groves, true oases of green in the immensity of the ochre sand, succeed each other. All along the way, one is aware of the official policy of “bringing the desert back to life”: small palm trees have been planted at regular intervals and are watered, drop by drop, by an efficient system. The palm groves are supported by an ingenious irrigation system, the

carefully maintained result of ancestral practices. These underground canals—the “fogaras”—give life to this mineral universe. Through the generations, the inhabitants have learned to preserve water as a great wealth. At a time when the developed world is beginning to understand the necessity of safeguarding this indispensable resource, the ingenuity of the palm grove “gardeners” should be an example.

Nonetheless, the small city of Reggane, only a village in the 1960s, is developing into a city of 10,000 inhabitants. The need for water is felt acutely, and the traditional “fogaras” cannot meet the needs of modern urbanism. The supply of groundwater, subsisting from ancient times when this region was green, is considerable. There are gigantic operations to exploit this source of water. They are on-going, but it will probably be necessary to teach the new generations to manage and preserve this wealth. When there is relative abundance, it is too easy to forget the frugal ancestral practices. It is evident that this environmental education remains to be done.

### *Reggane Plateau: A Huge Military Base in the Middle of the Desert*

Beginning in 1958, the French authorities built here, around 10 kilometers from the small palm grove of Reggane, a military base capable of accommodating almost 3000 people with all the infrastructure necessary for the nuclear experiments planned for 1960.

According to testimony gathered among the local population of Reggane, the construction and the installation of the military base were effected arbitrarily. Contrary to what happened a few years later for the installation of the Pacific Experiment Center where the atolls had to be “ceded” to France by the Polynesian authorities, France considered herself to be the owner of the Sahara territory.

A single concession was made to the natives: the use of local labor, necessary in order to support the young French conscripts who were unused to such hostile territory as this desert. According to Mohamed Belhacen, an inhabitant of Ti-Taourirt, who was employed for three years by the military, the French wanted “to give work to everyone.” So they hired laborers by turn from the settlements; they were the “Working People of Lower Touat”, the PLBT or “Pelos,” a slightly pejorative name. So far as we know, no list by name of the PLBT was made by the French authorities. Payment to the PLBT was apparently made hand to hand, without real pay slips. However, the worker had to put a finger print on a card when receiving his pay. Today, that obviously means that no pension will be given to these workers. Mohammed, who subsequently worked in the Creusot region of France, had no official record of his three years of work at the Sahara Military Experiment Center (CSEM), the official name of the Reggane base, for he had received no pay slip.

The approach from the route below, leading to the entrance of the CSEM, reveals a flagrant lack of respect for the environment. Hundreds of metal barrels, probably for asphalt, have been abandoned there, probably since the 1960s, in a large space surrounded merely by barbed wire. Continuing on, we could imagine, from this desolate spectacle, what we were going to find.

Since 1966, the Algerian army has had possession of the Reggane Plateau. According to present-day Algerian military authorities, the buildings constructed by the French are not today occupied. We could not verify this because, here no more than in France, does one visit a military base, especially with camera in hand! But we were authorized to visit the former installations of the Atomic Energy Commission (CEA) below the Reggane Plateau cliff.

*Direct from the Observatoire des Transferts d'Armements*

**The French Nuclear Tests, in Brief**

The Four Atmospheric Atomic Tests in Algeria

Date	Name	Firing method	Power
13/02/1960	Gerboise bleue	100-meter tower	40-80 kt
1/04/1960	Gerboise blanche	surface	< 10 kt
27/12/1960	Gerboise rouge	50-meter tower	< 10 kt
25/04/1961	Gerboise verte	50-meter tower	< 10 kt

--Between 1961 and 1963, 35 explosive experiments with “plutonium balls” in shafts were carried out near ground zero of *Gerboise rouge*.

--From November 7, 1961, to February 16, 1966, 13 underground shots were made on the In-Eker site in the Hoggar mountains, also in Algeria.

--In Polynesia, France carried out 193 nuclear tests on the Moruroa and Fangataufa sites (46 atmospheric and 147 underground).

*The CEA Zone of Reggane*

The CEA occupied an immense platform backed up to the cliff. There remain a few stripped out buildings whose interior installations have been “recovered” or “pillaged.” Most were built with asbestos panels that swing in the desert wind. The water purification station of Reggane Plateau and of the CEA zone are down below, abandoned. Residence and recreation buildings for the personnel were constructed with harder materials and have better resisted the passage of time. The fuel tanks that probably fed the power and air-conditioning plants appear to be intact, protected from corrosion by the intensely dry climate.

Overall, the platform is a desolate sight. Despite the ochre desert sand that inexorably covers and then uncovers the remains—electric cables, scrap metal, tubes, and water

pipes are strewn over several hectares of earth—I find here the same tangles of abandoned cable found on the beaches of the Hao atoll, another scene of the post-nuclear

disaster, the latter in Polynesia. It is difficult to attribute a “paternity” to this open-air trashcan; evidently, the platform installations were not dismantled according to the rules at the time of the French departure in 1966. But the anarchical destructions and salvages were apparently carried out by Algerian military units that occupied the sites afterward, as numerous graffiti indicate.

We were greeted by local officials with unexpected consideration. After the necessary introductions and customary conversation, we were “guests” and treated as such. The journalists encountered no problems; the people speak uninhibitedly before the camera. It should be said that the Algerian producer greatly facilitated contacts. We much appreciated the presence and the comments of M. Aberrahmane Lahab, a physics teacher at the Reggane lycée and vice-president of the “13 February 1960” association, named for the date of the first French nuclear test at Reggane.

On several occasions, we shared the traditional meal in two *zaouia* whose sheiks are moral and religious authorities of the region. During a farewell meal, I presented to the sheiks and to the civilian officials—the mayor and the head of the Reggane *daira*—shell necklaces made by the women of the Tureia atoll in Polynesia, symbols of the necessary solidarity between the populations who, although separated by 20,000 kilometers, were closest to the French nuclear explosions in the Sahara and in Polynesia.

Obviously, the visit to the Hammoudia test sites was made under military escort, with officials sent from Algiers, including M. Ammar Mansouri, who observes the follow-up of the Saharan tests in the name of the Moudjahiddine ministry, and M. Gérard Aïssa Ruot, an Algerian by adoption and a veteran of Hammoudia in 1961. Without the determination of the Algerian government to bring to light the consequences of the French Saharan nuclear tests, it is evident that we could not have made this report. In the name of the duty of remembering that we all, Algerian and French, owe to future generations, we express our gratitude.

B. B.

The main part of the CEA base remains to be discovered. The cliff reveals the entrances of fourteen subterranean galleries of impressive dimensions, the more so because they seem to have been built to last. The entrances closely resemble those of old railroad tunnels, carefully framed by fitted stones. Here in the open desert is the trace of specialists recruited among the coal miners of northern France. Some of the entrances are already obstructed by sand that piles up against the wall of the cliff. But several are still accessible through the opening of an enormous metal gate.

At the openings of the tunnels, whose interior coating is astonishingly well preserved, one sees shafts for electricity, ventilation, and air-conditioning. The width is great enough for the passage of a vehicle. The one we visited goes straight into the cliff for about two hundred meters and ends against a wall that must have been built to block laboratory entrances. To the side, another, narrower gallery must joint the other tunnels. M. Ammar Mansouri, who accompanied us, explained: “We have no map of the CEA’s underground installations. We know only that they assembled bombs in these laboratories and that they analyzed samples gathered by aircraft in the radioactive cloud, as well as objects, animals, and plants exposed at some distance from ground zero, and probably samples taken from the crater of the explosion after the underground blasts of In-Aker. Are there still dangerous wastes underground and installations that are still contaminated? We do not know. That is why we have left everything as is, pending more information.”

### *The Hammoudia Base, at the Edge of the Firing Range*

The entire day of Friday, November 16, was dedicated to visiting the ‘firing range.’ From Reggane, one must travel around sixty kilometers across an extremely arid desert. We did not spot the slightest palm tree or the smallest tuft of dry grass during this journey, which can be made only by four-wheel drive vehicles. At the time of the tests, a tar road did link the Reggane Plateau to the forward base of Hammoudia located a few kilometers from the firing range. But before leaving in 1966, the French destroyed this road, so that today only desert nomads can find their way there using landmarks known only to them. For us, the Algerian soldiers’ GPS, duly programmed with the geographical coordinates of each firing, was most useful.

The old forward base of Hammoudia is located on a modest height a few meters above the surrounding desert flatness. The buildings—there was even a pool!—described by the veterans who lived there were razed; the concrete foundations remain. They probably pushed everything over the slope with bulldozers and dispersed the rubble, the scrap metal and the fuel barrels that are strewn over the earth without the slightest trace of rust or corrosion. Down below, barely covered by the sand, what was a soccer field is clearly visible. For Gérard Ruot, who lived on the site during his military service and built the pool there, it is very sad. “Why did they destroy everything?” It was certainly wasteful, but it is hard to imagine a use for such a base in the middle of the desert, which would have necessitated colossal maintenance expenses. The destruction was necessary also in order to avoid leaving very visible landmarks close to a firing range which would be dangerous for many decades. Still, it should have been dismantled properly, which certainly was not the case!

The destruction of the Hammoudia base has not prevented intrusions. Our knowledgeable Algerian companions show us the outlines of a temporary encampment used as a base by desert “pillagers’ to recover metals and other objects abandoned or hastily buried. Since the dryness preserves everything perfectly—even after 45 years—it is easy to imagine that kilometers of copper wire from both the base and the firing range have been melted down and reused for other things.

## *The Firing Range of the Four Gerboise*

In a few minutes by car from Hammoudia, one reaches the entrance to the firing range. As for the mountain of Tan Affela at In-Eker, the Algerian government has decided to enclose the zone, notably around ground zero, of the *Gerboise bleue*, *rouge*, and *verte* tests, which were rather near each other. The *Gerboise blanche* firing was done around ten kilometers to the south of the *Gerboise bleue*. This Friday, November 17, a team of laborers was placing metal posts for the future fence, which is to extend over twenty kilometers.

At the place indicated by the GPS for *Gerboise bleue* are found pieces of twisted, scattered metal; they are probably remains of the tower, one hundred meters high, where the bomb was placed. A short distance away is a concrete bunker with obstructed openings, probably used for cameras observing the explosion. Gérard Ruot says that he saw this bunker in 1961 covered with a lead facing that must have been removed—and reused! by “pillagers” ignorant of the contamination risks. But what is most striking around this *Gerboise bleue* ground zero is the soil covered with black fragments of vitrified sand. It is difficult to estimate the extent, but the fragments must be scattered over several hectares of an ochre-colored sandy area. When it barely touches the vitrified sand, the Geiger counter spits out the maximum: its counter is saturated. This place is definitely unhealthy.

After taking a few pictures, we get back into the vehicles and go toward *Gerboise rouge* and *Gerboise verte*. There we find an immense concrete blockhouse, low in height but some tens of meters long. It was apparently a bunker sheltering a battery of cameras from which one photo from that time has been passed on to me by a veteran. Today, sand has accumulated against the walls so that the openings are no longer visible. Several other blockhouses, in the form of pyramids, lined up for a long distance, have no evident openings. What was their role during the explosions? I have no idea, because up to the present, there is no veteran’s testimony or even a photo.

Another mystery: large metal vats are there, surrounded by tens of concrete balls about the size of soccer balls, scattered at random. Were they projected by an explosion? The report of the International Atomic Energy Agency (1) notes that experiments (explosive) on plutonium balls were carried out near ground zero of *Gerboise bleue*. But the balls we see today are not plutonium! We have no testimony on this point either. So a description will have to suffice, with the hope that witnesses may come forward to throw light on the matter.

Around the ground zero points of *Gerboise rouge* and green *Gerboise verte*, one finds rather little black vitrified sand. Why? It is doubtful that these explosions, although less powerful than *Gerboise bleue*, did not produce the same effects. Was the vitrified sand gathered and stocked somewhere in a trench? Have the sands covered everything up? It is true that here and there one spots little mounds that could be trenches. Obviously, that day, we had no way of verifying.

There were other surprises in store for us at the *Gerboise blanche* site. After about ten kilometers of a sandy track, we came upon some intriguing objects easily visible from a distance. They turned out to be three heavy metal cages, as intact as if they had been placed there the day before, containing the cadavers of two animals, probably goats. The bottom of each cage was made of a sheet of asbestos placed on metal bars. The cadavers were dried out, but the skin was almost intact! Witnesses confirmed it: we were in the presence of animals that were put some distance from the explosion and were supposed to be collected later to be analyzed to measure the biological effects of a nuclear explosion. Obviously, these three cages were “forgotten,” for reasons unknown. But it was a fascinating discovery after more than forty-six years!

Another surprise: there is nothing at the *Gerboise blanche* ground zero. It is known, however, that this explosion was at the surface. We found no trace of a crater. The IAEA report (p. 9) mentions that it was later filled in and that the residual radioactivity is in material buried a few meters under ground zero. The only things visible are some fragments of vitrified sand here and there. For the people with us, I did a little experiment to identify the potential danger. On the black fragments, the Geiger counter registered the maximum, but a few centimeters away, on the “normal” ochre sand, the counter fell back to barely discernable levels.

In my opinion, the danger is there: these honey-combed black fragments have already attracted and probably will attract the curiosity of possible visitors. These black desert stones, loaded with tiny pieces of plutonium, could very well be transformed into pendants or souvenirs of the Sahara. Probably impressed by their number at *Gerboise bleue*, I had not dared handle one. Here at *Gerboise blanche*, my curiosity won me over. Putting a piece in my hand, I realized that it was both very fragile and very light. So it is very likely that the winds have blown the vitrified sand to distances difficult to calculate. Ignorant of the risks, a craftsman or a maker of souvenirs could very easily inhale or swallow radioactive black powder while cutting or polishing a fragment.

### *The Concerns of a Doctor at the Reggane Hospital*

Our journey continued with a visit to the Reggane hospital. The equipment is comparable to that of any local French hospital. There is even a scanner, we were told. Pressed for time, we spoke with a doctor who has been practicing here for around ten years. “For some time now, we have been finding an abnormal number of thyroid problems which were previously unknown. When we diagnose any kind of cancer, the patient is sent to Algiers where he must be treated. Since we have few medical records, it is difficult to do any serious studies. So we care for people.” The anxiety of the Reggane doctor is similar to that of the Pacific islanders whose patients are evacuated thousands of kilometers from home and family to be treated. In such conditions, the hope of a cure is often hypothetical. “We would like to be able to do preventive care,” said the doctor. “But we do not have the means. And yet, I think that our people who have undergone the fallout from aerial tests should be given particular medical attention.”

In the course of interviews and discussions, the Reggane inhabitants reveal some anxiety. With little information about the nuclear risks, they all attribute the sterility of date palms or the decrease of harvests to the nuclear tests. Why have the “fogaras” dried up? It is the nuclear tests again. There are certainly causes for these popular observations, but no precise study has been done. Suffice it to say that a reality underlies these observations: dates, like the water of the “fogaras,” are the base of the daily existence of the Saharans, and the least upset in this area cannot escape the notice of the palm grove “gardener.” As if it were an echo, I hear the same things said about the poisoning of fish—the only protein source—at Mangareva.

### *Some Legitimate Questions*

Water is a vital resource in the desert. This obvious fact was probably as striking at the end of the 1950s as it is today in this arid region of the Sahara. How can it be that the military authorities who carried out huge projects to supply abundant water to the Reggane and Hammoudia bases—there were even swimming pools, not to mention the numerous decontamination showers all the veterans talk about—did not even think about providing the same benefit to the local populations?

In those years, France had a law setting working conditions that it applied specifically to “metropolitan” [continental French] civilian personnel employed at the Sahara sites. Why was there this discriminatory non-application to the Algerian workers?

In French Polynesia, a few years later, they built blockhouses at Tureia to protect the population and “Pantz shelters” at Mangareva, at Totegegie, at Reao, and at Pukarua. All of these inhabited islands are one hundred to five hundred kilometers from Moruroa. How does it happen that nothing was done to protect the populations of Reggane and the surrounding settlements? Reggane is only sixty kilometers from Hammoudia! No doubt, the carefully calculated wind direction will be used to answer this question...

Why is there this distortion in the statements on “dismantling” of the Saharan sites carried out in the “best conditions,” when the opposite is evident at In-Eker, Reggane, and Hammoudia? Why do the French officials base their statements on the report of the Parliamentary Office of Evaluation of Scientific and Technological Choices (2) when neither of the two authors has ever set foot on the Saharan sites?

In a “File for Presentation of Nuclear Tests and their Follow-up in the Sahara” distributed in February, 2007, by the Ministry of Defense (3), there is no mention of biological tests on animals at the CSEM of Reggane, but only of tests on materiel and equipment. Why this omission belied by witnesses and now by on-site photos? Would it be embarrassing in high places to mention biological experiments? Transparency on the biological research carried out in the context of the nuclear tests is all the more necessary because, in 2007, allegations on the voluntary exposure of FLN [National Liberation Front] prisoners to the aerial blasts are still being made by Algerians.

Why is it that the IAEA report (pp. 20-23) mentions measurements of dosage output at ground zero of the *Gerboise* blasts (between 2.7 mSv/h and 0.1 mSv/h for *Gerboise bleue*), whereas we measured dosage outputs up to one hundred times greater on the vitrified sand pieces at the same places? Did the IAEA make measurements where it knew it would not find much? Why did it minimize the danger of this vitrified sand in its recommendations (p. 32)?

The IAEA report makes no mention of contaminated materials buried on or near the test sites. Why this lack of transparency, especially since a French expert from the CEA [Atomic Energy Commission] participated in the IAEA mission? Would it be embarrassing to learn that some of these materials may have been, as some witnesses say, gathered by “pillagers” ignorant of the danger?

--Bruno Barrillot with Larbi Benchiha and Hervé Portanguen  
Translated by Robert M. Davis

1) IAEA, Radiological Conditions at the Former French Nuclear Test Sites in Algeria, Preliminary Assessment and Recommendations, 2005. Can be downloaded at [www-pub.iaea.org/MTCD/publications/PDF/Pub1215\\_web.pdf/](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1215_web.pdf/).

2) Christian Bataille and Henri Revol, “Les incidences environnementales et sanitaires des essais nucléaires effectués par la France entre 1960 et 1966 et éléments de comparaison avec les essais des autres puissances nucléaires, report of the Parliamentary Office of Evaluation of Scientific and Technological Choices, National Assembly, no. 3571, 5 February 2002. Available on the site [www.assemblee-nationale.fr/](http://www.assemblee-nationale.fr/).

3) Available on the site [www.defense.gouv.fr/](http://www.defense.gouv.fr/).

### **Recommendations**

The measures for closure taken by the Algerian government are necessary and welcome, but can be only preliminary. It is probably impossible to prevent human intrusions onto these old test sites, and even less so dispersion by wind of some contaminated materials. Measurements of the radioactivity of the four *Gerboise* sites could be made by means of the techniques already used on the Hao atoll [in Polynesia]. Mapping of the gamma radiation of soils could be done using a detection device placed on a helicopter and by taking soil samples and core samples from suspect areas. (1) If need be, cooperation with the French government could be sought. Once the mapping of the radiological situation of the firing field is accomplished, it would probably be possible to assemble and stock the radioactive elements thus detected in an appropriate site to be constructed on the firing field or nearby.

We do not have precise information on the location of burial sites for materials contaminated after exposure to the *Gerboise* firings. We do have photos of some burials (e.g. *Vautour* aircraft, metals) proving that such activity took place. By referring to

information given by the Ministry of Defense to Polynesian authorities concerning the nature, the sites, and the dates of disposal of contaminated wastes, it should be possible to obtain the same kind of information for burial operations effected on the former Saharan test sites. Within the framework of Franco-Algerian relations, the question of mapping of these burial sites should be brought up. The objective is to secure the sites and to regroup wastes in conformity with the norms of international regulations.

We support the legitimate demand of Algerian authorities who wish to obtain the plans [maps] of CEA [Atomic Energy Commission] underground installations beneath the Reggane Plateau military base. A comprehensive plan for environmental rehabilitation of the CEA site should also be proposed.

In view of actions undertaken by the French government in French Polynesia, notably the “tracking of the health of former civilian and military workers at the Pacific experiment stations and of populations living or having lived near to nuclear experiment sites” (2) and in response to suggestions of hospital authorities in Reggane, the establishment of a health tracking mission for Algerians having worked on the Saharan test sites and of populations living or having lived near to nuclear sites should be negotiated between the Algerian and French governments.

So that they might benefit from the same rights as the Polynesian personnel who worked at the Pacific Experiment Center, we recommend to the Ministry of Defense authorities the establishment of a list of all local personnel recruited to work on the Saharan test sites.

The French government should respect requests for information and for access to nuclear test archives from Algerian authorities. The latter base their claims on the fact that most of the French nuclear experiments were carried out after Algeria became independent, and they judge that this fact gives them a right to know what was done on their own territory.

1) F. Fouret, W. Delahaye, C. Musa, *Evaluation radiologique du grand motu nord de l'atoll de Hao*, DSCEN, November 1999.

2) Convention no. 161-07, Republic of French Polynesia, 29 August 2007.