SAHARA: CROSSING THE WESTERN DESERT

John Parkins

During March of last year I was one of a party of twenty who made an east to west crossing of the Western Desert of Egypt. We started near the border with Libya and 'oasis hopped' in 4x4 vehicles to Luxor, see map, Fig 1. The journey took eight days, sometimes spending two nights in the same oasis to explore in more detail certain parts of the desert. The focus of the journey was archaeological, cultural and wilderness adventure but the geology was so evident and accessible that it was possible to appreciate much of it and to recover specimens. It is this aspect of the journey the article will review.

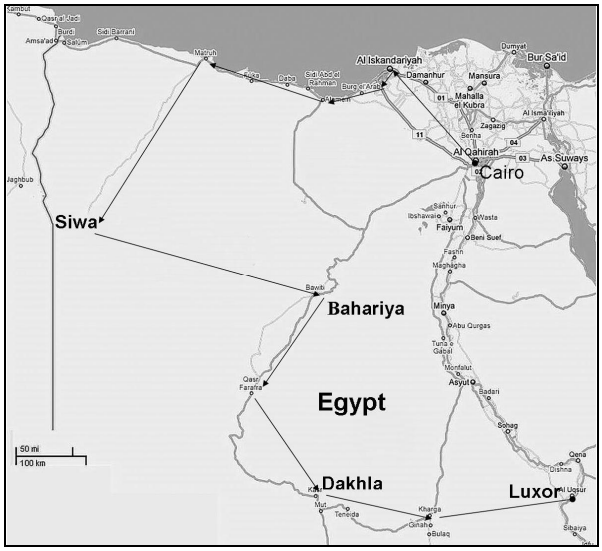

Fig 1: *Map of Egypt showing the journey from Cairo to Luxor via the Sahara desert*

The overall geology of the part of the desert we travelled is fairly straightforward, consisting of a sandwich of three layers. The basement complex consists of igneous and metamorphic rocks, the earliest of which are extremely ancient. This phase finished around 500Ma. The central layer is the Nubian Sandstone. This extensive layer is of Late Cretaceous age and includes the aquifer. Following directly on from this is the top layer, a series of limestones, sandstones and shales that continues well into the Tertiary. The limestones include significant deposits of white limestone, or chalk. This top layer represents various transgressions of the Tethys Ocean that lay to the north. Erosion, particularly in wetter times, has cut through this top layer, sometimes completely, and created the depressions for which this area is noted. One view holds that they represent the canyons and valleys of two great river systems. The depressions vary greatly in size and depth. In the smallest it is possible to see the complete encircling escarpment; the largest, the Qattara Depression is 298 km long by 145km wide, 186 miles by 90 miles, and between 60 and 134 metres, 192 and 428 ft, below sea level. It is within these depressions that the main oases are found and, with water more readily available, the main settlements. Increasing salinity of surface water is causing problems in some oases, Siwa for example is edged with extensive saline lakes and it was strange to see a lesser flamingo in the desert.

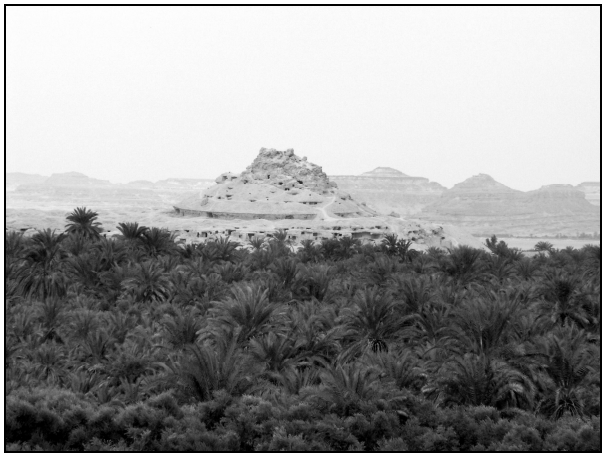

Fig 2: *Siwa Oasis*

Siwa Oasis was our starting point for the crossing, see Fig 2. It sits on a floor of Eocene limestone some 17m below sea level with escarpment walls of Miocene limestone. Our first day's journey would take us 400 km, 250 miles, eastwards to Bawti in the oasis of Bahariya. From there the inner oases are linked by good roads but there is none on the Darb Siwa, the ancient caravan route, described as 'deep desert', that runs between the Qattara Depression to the north and the Great Sand Sea to the south. Two previous tracks have been laid down, packed rock, tar sprayed, but the desert has reclaimed much of both and what

remains is often ruinous. The journey would take twelve hours, mostly off track. We visited two deserted oases during the day; El Areg and Bahrein.

Fig 3: *Entering the Qattara Depression. The car gives scale*

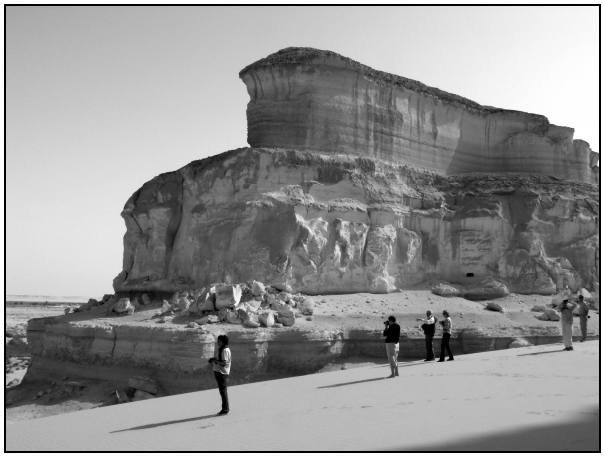

Fig 4: *El Areg. Note rock cut tomb*

El Areg, fig 4, sits in the southern edge of the Qattara Depression, Fig 3. In her book on the Western Desert, (see references), Vivian notes that whilst a good 4x4 will have no problems getting in, the same is not true about getting out and that it is not a place for the novice or a lone vehicle. The escarpment, which she describes as 'formidable', once negotiated leads to the sandy, scrub-dotted floor. In places, this is extremely soft and can be just a crust of sand over water. The sheer walls, orange, buff and chalk white, create a spectacular landscape. Erosion and sand blown from the plateau above has formed extensive piedmont slopes which, if met across the direction of travel can form major obstacles. We were to discover this later in the week. The lower part of the escarpment wall is chalk and some beds have dense concentrations of *Nummulites*. The surface was also strewn with them, making collection easy. Echinoids were also recovered.

A further fifty kilometres across a surface white with chalk fragments and countless numbers of *Nummulites* brought us to Bahrein Oasis 'of the two lakes', one saline and the other 'a treacherous trap'! In contrast to El Areg, a flat gently sloping limestone surface ended in a short drop to a sandy floor. Here were some of the most interesting specimens of the whole journey, Fig 5. In a single extensive bank were concretions eroded out of long-gone beds, most probably of chalk. Unbroken specimens were spherical or more complex variations of the same. Broken simple forms had a bull's-eye pattern of light and dark bands. There were endless complex variations on this. The light bands tested positive for limestone and the darker were chert. Much debate throughout the rest of the week brought no conclusions as to how they had formed. *Nummulites* were also present and Nummulitic chert was collected.

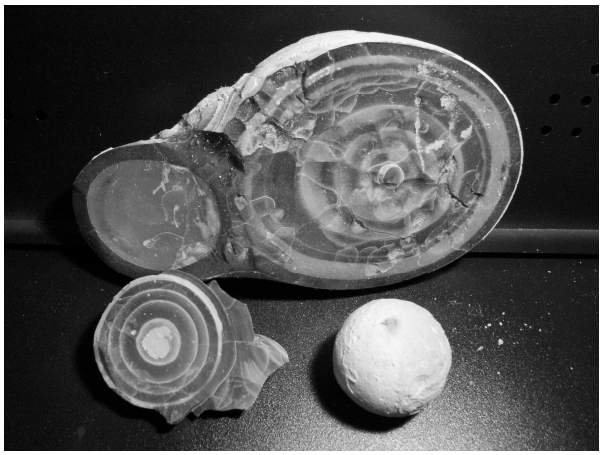

Fig 5: *Nummulitic chert*

There followed five and a half hours of hard driving eastwards to Bahariya Oasis where we spent the night in the town of Bawti. Shortly after arriving we experienced total power failure and, with it, the water supply but we also ate Berber style at the house of one of our drivers. The Bahariya depression is surrounded by a high escarpment, the lower part of which, together with much of the floor, is of Cretaceous Sandstone. The upper walls include Eocene strata, Oligocene basalt, and dolomite. The view from our hotel was of a vertical wall dark with extensive deposits of shale, Fig 6. As in every oasis we visited there was superb archaeology. Of particular note here were exhibits from The Valley of The Golden Mummies and painted tombs of the 26th Dynasty.

Fig 6: *View from the hotel in Bahariya*

The depression has a north-south orientation and is 94k, 58.7 miles, long and it was southwards we headed towards Farafra. Almost at once one enters the Sahara Sud, The Black Desert. The sandstone of this area is rich in iron and hydrothermal activity has converted much of it to iron quartzite. The iron is present in sufficient quantities for it to be mined commercially. From here it is taken by dedicated railway to smelt works near Giza. Thin plates of ironstone, ablated smooth by erosion, ring when struck. Our route south was dotted with isolated conical hills capped by this black, erosion resistant material, remnants of which darkened the sloping sides, Fig 7. The intervening desert surface was also black with a surface coating consisting of small fragments of ironstone and basalt. Here, as elsewhere, I collected specimens and one of a total of nine sand samples. Gaining the plateau to the south once more, the colours of the landscape lighten and black disappears to be replaced by white, an intimation of what lies ahead.

Fig 7: *Conical hill*

Standing sentinel to the Farafra Depression is the Crystal Mountain. Here huge deposits of calcite have been emplaced, interleaved with the host rock. Besides the beds exposed in situ, the desert floor is scattered with considerable quantities of loose crystals. We were to stay two nights in Farafra to enable us to spend a whole day exploring The White Desert. The White Desert is one of the great sights of the world and it was only in retrospect that I was able to consider it purely from the standpoint of geology. In cutting down through the plateau, erosion has created a series of free-standing monuments which have become progressively smaller over time. Near the escarpment wall mesa-like blocks of plateau are isolated by valleys that widen into the depression.

Further away these blocks are smaller and form inselbergs. The erosive process continues producing monoliths, fields of humps and finally a flat plain. This bald description gives no indication of the true impression made upon first sight. Below a darker cap, the walls of the depression are cut through Lower Eocene white limestone resting conformably on upper Cretaceous Khoman Chalk. This creates a landscape of dazzling whiteness under an intense blue sky. In places, sand introduces a third colour in varying tones but for much of the area there is a duochrome perspective. Our first stop was in the field of inselbergs, Fig 8. Towering above us, they seemed like icebergs in a frozen sea.

Fig 8: *Inselbergs*

From here we made for a more remote part of the desert. This proved quite difficult, the final obstacle being a huge bank of very soft sand that took some time and several exciting attempts to

climb. Continuing on foot we were soon walking on a hard chalk surface towards high cliffs, white at the base phasing upwards into sandstone, Fig 9.

Fig 9

Around us were scatters and drifts of black 'gravel'. These originated as iron sulphide both in pyrite and marcasite forms, now blackened by exposure. Very common were tubes up to a finger thickness with irregular outer surface and a radial crystalline section; one specimen recovered is a double joined tube. Other forms include spheres and amorphous blobs. Locally a much prized form is 'star'; a flat or curved top surface retains some crystalline form whilst beneath, specimens taper to a point. Also of interest were pieces of limestone and hard chalk that had been baked and abraded to a high polish. This had created the typical 'desert varnish' and small concave pits that covered the surface.

This part of the White Desert is one of the most beautiful places I have seen; it is also hostile. Although still March, and not yet midday, the temperature was around 45degC, 115degF. The surrounding whiteness reflected both heat and dazzling light. There was no shade. For this reason we spent the hottest part of the day at a small watering hole outside the White Desert on one of the traditional caravan routes, Fig 10. Here, in contrast, the surface was covered in fist-sized rocks, very testing for the cars. Two camels were refuelling, the first we had seen since leaving the coast as the donkey is the preferred animal in the oases and in Siwa they far outnumber motor vehicles. The afternoon saw us back amid the whiteness, this time to the most famous area, the monoliths. It was here that we were to spend the evening. A base was established on a broad flat area close to the monoliths and we were free to wander within sight of the cars. Here erosion, well on with its work, has reduced the high walls of the plateau to isolated monuments, some of spectacular form that have been given fanciful names, Fig 11. As evening approached the westering sun turned the whiteness pale yellow and then through a range of deepening shades, golden, rose, red, purple and finally a deep violet grey. That evening we ate under a clear velvet sky and a crescent moon. The brilliant starscape was so crowded that it was difficult to locate even the major constellations.

Fig 10: *Watering Hole*

Fig 11: *Eroded rock 'monuments'*

The next morning our journey continued towards Dakhla Oasis and the town of Qasr Dakhla, shown on fig1 as Kasr. Not long after starting out we came to the Mirage Desert which we crossed. Once again the Sahara produced a landscape unlike any previously seen. The Mirage Desert is

an area of flat, level sand compact enough for the vehicles to leave hardly any tracks. Under a lens the sand grains are perfectly spherical and of even size and colour. There is nothing angular nor any dust or other foreign material. It is this particular circumstance that helps to create the mirage. The illusion began soon after entering the area. The distant escarpment appeared to be an archipelago standing in shallow sea and the further we travelled the stronger the effect became. Once near the centre, we appeared to be on an island surrounded by water. One of our cars, apparently travelling in the middle of a river, created an inverse reflection beneath itself, Fig 12. Photography was extremely difficult as viewfinders were rendered useless by the intense light; it was just a question of point, shoot and hope.

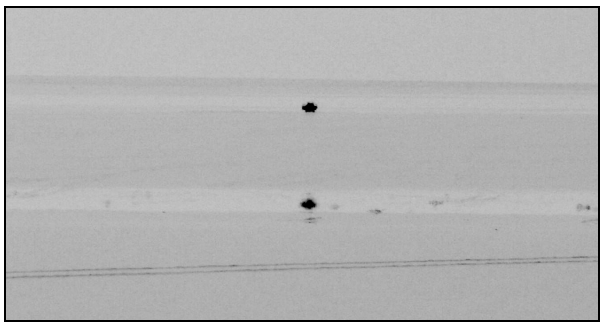

Fig 12: *Mirage: car and its reflection*

From here to Dakhla and onward to Kharga, the focus of the journey was archaeological and cultural. We visited temples, painted tombs, a sixth century Christian cemetery, Islamic sites and villages whose architecture was still much in the style of their pharonic ancestors. Meeting local people was a great pleasure. In Kharga Oasis, the Temple of Amun-Re at Hibis is a rare example from the Persian Period. Built of sandstone, it displays Petra-like patterns and contains a cartouche of Darius I still coloured. The dangers of crossing this desert are reflected in one of the events of the Persian conquest. Arriving at Thebes around 525BC, the Persian King Cambyses determined to seek legitimacy as pharaoh from the Oracle of Amun at Siwa, a particularly sacred site, or, failing that, destroy it. To this end he dispatched an army, of probably five thousand, westwards. At Kharga they rested and re supplied. They then continued westward into the desert and were never seen again, the entire army vanished. This story, read as a boy and never forgotten, was part spur for my journey. Still today the Darb Siwa, (Bahariya to Siwa,) is not easy and is strictly controlled. It can only be travelled west to east and with permission. There are a series of police checkpoints partly for security and partly in case of non-appearance. All were friendly and welcoming and at one, reached during a particularly featureless part of the journey, the ground was thickly scattered with fossil bivalves.

At Kharga a day was set aside to visit two 6th century Roman forts, southern outposts of the Byzantine Empire. The circular route included two more outstanding landscapes, the second of which was quite an adrenaline ride. Reaching the first fort, Qasr Ain Umm Dabadib, involved traversing the Abu Muharnik Dunes by means of a narrow corridor that weaves between massive sand dunes. If the zig-zagging is kept within reasonable bounds, the distance is 35-40km and takes around two hours. A deviation from the route on either side leads into massive dune fields and is to be avoided at all costs. Soon after leaving Kharga isolated barchan dunes appeared, low elegant forms with long tapering horns. Gradually the dune frequency increased until, interlocked and piled high, they towered above us.

Fig 13: *Dune field*

The view from the highest showed the dune field spread to the horizon in all directions, receding in ever diminishing waves, Fig 13. Sand samples from dune lee faces were generally of a smaller grain size than elsewhere and included flour sand. This suggests an element of grading in avalanche laminae. Samples from the flat interdune surface contained a high percentage of grit, semi- or sub-rounded. The majority rock type was quartz but examples of sandstone and limestone were also

present. A few dark inclusions may relate to rock types seen in the Black Desert and to mafic specimens seen later in the day. Beyond the dune field was a flat sandy plain strewn with dark rocks and bordered by an escarpment of Palaeocene and Eocene Limestone. Not far from the dunes we entered the dried up bed of a former lake. Wind blown sand had eroded the lake bed sediments into yardangs, or 'mud lions', humped forms aligned with the prevailing wind direction, fig 14. Intervening areas contained thick deposits of gypsum crystals. All those examined were heavily eroded. At first, indistinguishable from the background escarpment but coming into focus as we approached it, was the fort, Fig 15. Once it guarded fertile land but now, with keep still at full height, outworks shattered and surrounded by a carpet of potsherds, it looked desolate. A small clump of palm trees and tufts of dry scrub are now the only life.

Fig 14: *'Mud lions'*

Fig 15: *Ruined fort*

The route to the second fort, Qasr Al Labeka, was the most difficult and exciting section of the whole crossing. Long fingers of the escarpment reach into the plain and have eroded into a labyrinth of stony hills. Vivian, page 97, describes this as the most fascinating and one of the most beautiful off-road journeys in the Western Desert, one that will test the mettle of any driver and vehicle. She is right! Her advice that if fifty tracks go left and four right, follow the fifty or, like the four, you will end up in trouble, is well-founded. The route includes dunes, high dark interlocking hills, boulder-strewn narrow passes, steep climbs over saddles at alarming angles and very sudden changes of direction. At times it felt as if the car must have crampons on the wheels. Initially the way is across open plain with isolated dunes that give way to low, dark, solitary hills. These increase in frequency until the main bulk appears as a solid wall barring any progress. I found it impossible to see any break in them but our drivers were unerring in finding a way. Mostly from the oases, they had shown throughout the crossing that they have a great understanding of the desert, whatever the terrain. Much of the fort at Labeka still remains. There is also a ruined Ptolemaic temple and Roman tombs, some still with coloured walls. Nearby a row of circular well-like structures – vents - are the visible signs of one of the two underground aqueducts that brought water from the nearest oasis, quite an engineering feat, Fig 16.

Fig 16: *Vents marking line of aqueduct*

These may be Roman but resemble examples extant from the Middle East, so could be earlier. One man has cleared a section of one of them and created a small garden in the midst of an arid landscape, testimony to the power of water. Specimens of basalt in the form of Pahoehoe Lava were recovered, evidence of former volcanic

activity. Shortly after leaving Labeka, an 'interesting' incident involving the car I was in meant an unscheduled stop at a high point before an escarpment-backed dune field. This quiet time facing a beautiful, untouched landscape was very special, Fig 17.

Fig 17: *Untouched desert landscape*

After a second night at Kharga we set off eastwards towards Luxor on the last leg of the crossing and were soon in sand country. Here the sand stretched in a wide gently sloping expanse, quite unlike the heaped labyrinth we had crossed the day before. It was a final chance to enjoy the particular tranquillity that such areas offer. Returning to the cars along my solitary set of footprints, I found that the earliest of them were already blurred in outline by tumbling sand grains. Soon there would be no trace of our passing. The way into the Nile Valley from the plateau descends gently between slowly rising walls. In one place, massive sand dunes were draped from the plateau down the full height of the escarpment face in long sinuous curves, Fig 18.

Fig 18: *Massive sand dunes*

At our final stop, further on, the base of the escarpment wall, Fig 19, was of a soft white limestone/lime mud. The beds contained large numbers of a small gastropod preserved as an internal mould, similar in appearance to the earlier Portland Screw from the U.K. A few bivalves were also present. From here the route continued its descent to the Nile Valley, or, as it felt at the time when compared to the vastness of the desert, the Nile Linear Oasis.

Fig 19: *Escarpment, the Nile valley near Luxor*

The Sahara is vast and beautiful. We threaded a narrow one-thousand-mile journey, south from Mersa Matruh then east from Siwa, with, on each side, a seemingly endless expanse. The journey presented a constantly changing landscape, always geologically interesting, sometimes breathtaking, great beauty alternating with what seemed like hours of flat featureless terrain. Mile after mile of flat monotonous desert, stretching on both sides to a low horizon would eventually give way to a spectacular landscape that dwarfed our convoy. Even the apparently featureless areas, however, have continual and subtle variations of form, texture and tone that change with the changing light. The escarpments present an endless variety of colour from black through browns, reds, gold, oranges and yellows to pure white. All is beneath a high sky of intense blue that pales towards a multicoloured sunset. Whatever the view and wherever we were, walk a few paces from the cars and one was alone with the desert and an absolute silence, save, for the sand which sometimes whispered in the low wind passing over it. This was a very special journey.

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Photographs by John Parkins

My thanks to Linda Drummond-Harris for Fig 1 (J P)

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CROSSING THE WESTERN DESERT
REFERENCES

Richardson D. & Jacobs D. The Rough Guide To Egypt. Penguin. Current edition
Most general guides give scant attention to the Western Desert. This one has one hundred pages and is a good starting point.

Sampsell B. A Traveller's Guide to the Geology of Egypt. American University in Cairo Press. 2003. An very good introduction to the whole country.

Silliotti A. The Oases. American University in Cairo Press. 2007. A brief introduction to the main cultural features.

Vivian C The Western Desert of Egypt. The American University in Cairo Press. 6th printing 2007. An excellent and comprehensive record of all aspects of the Western Desert, both natural and cultural.

MAPS

Most maps ignore the Western Desert and concentrate on the Nile valley. Once again the Rough guide is the exception, producing an excellent general purpose map of the whole country. Scale 1:1.125,000 ;1 inch: 17.8 miles; 1cm: 11.25 Km

AFTERWORD

Herodotus was the first to tell of the Lost Army of Cambyses. A modern Herodotus is Wikipedia, both to be read with equal caution! Vivian, pp 148-9 has an authoritative account. She sorts fact from fiction and discusses options as to what may have happened.

Those still very young at heart should try 'Biggles Flies South' by Cpt. W.E.Johns

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90 YEARS OF GEOLOGY: COLLECTIONS and RECOLLECTIONS

Horace Sanders

The South Staffordshire coalfield is a horst, defined by two roughly parallel faults aligned N and S which brought up the Westphalian coal measures above the Trias on either side. It has an area of some 180 square miles extending from just west of Birmingham on the east, to Stourbridge on the west and reaching to Stafford and the Potteries in the north. It became known as The Black Country; deservedly from the grime and pollution of intense coal mining, iron smelting, forging and rolling in the late 18th and the 19th centuries.

At one time there were six huge blast furnaces producing cast iron from iron ore. At night the reflected glow on the clouds from them was spectacular. Although the name still persists, e.g. The Black Country Geological Society, the region is mainly one of commerce and medium to light industry, becoming almost as green as the surrounding areas on Triassic sands and clays.

I was born in 1910 just inside the eastern boundary fault not far from Birmingham and may therefore claim to be a Blackcountryman, especially as my working life has been with metallurgical processes. Geology determined the development of the area, providing iron ore, coal and clays suitable for the high temperature furnace linings, and limestone, essential in the blast furnace, where it combines with silicate impurities in the ore to form a slag. This floats on top of the molten iron and can be tapped off.

Geology for me began when I was eight, with my grandmother taking me to Dudley on the tram. In the castle grounds she showed me pieces of rock with impressions of shells, corals and other curious objects; explaining in simple terms what they were. I insisted on taking them home.