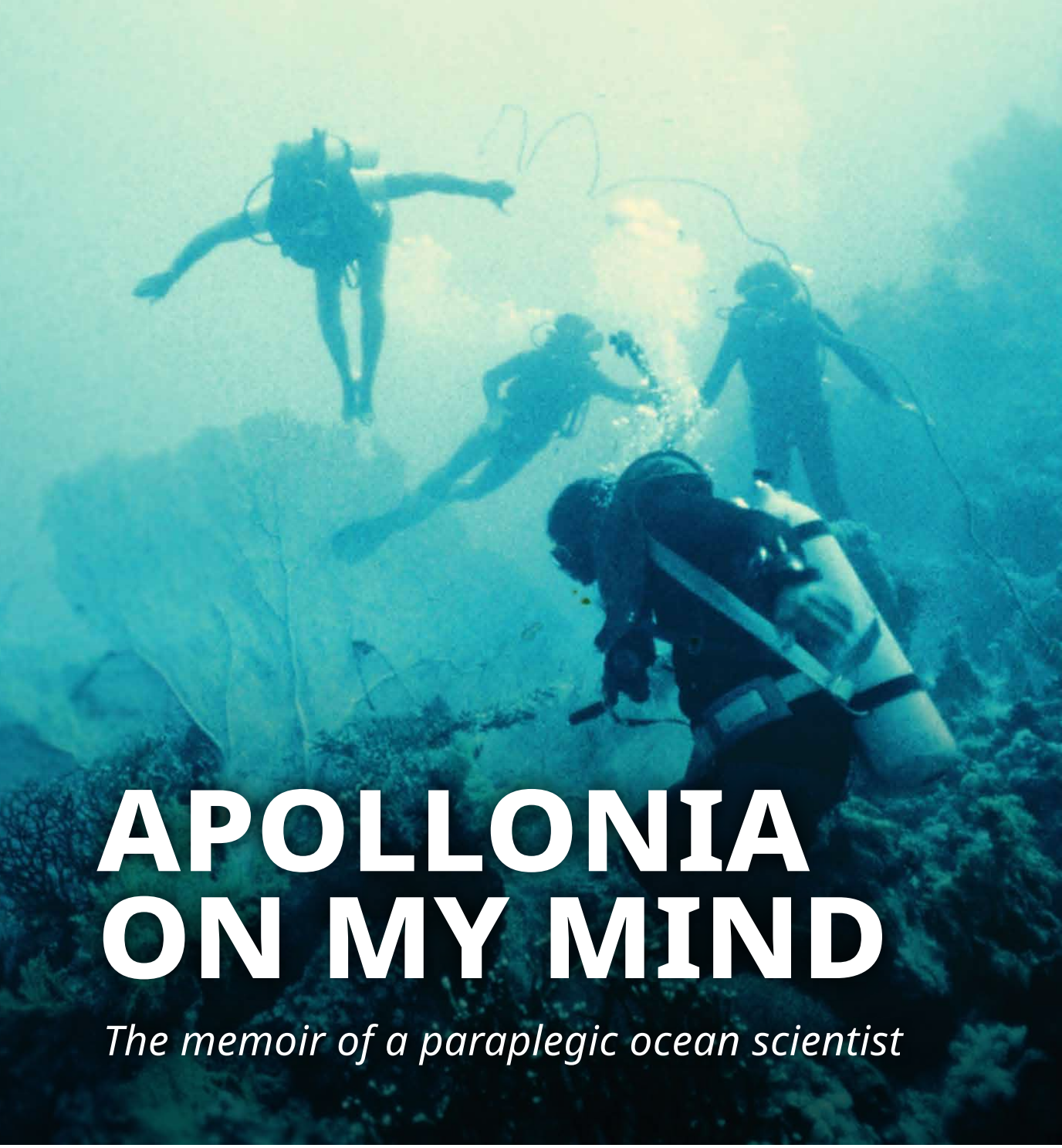

APOLLONIA ON MY MIND

The memoir of a paraplegic ocean scientist

NICHOLAS C. FLEMMING

HONOR FROST FOUNDATION

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Apollonia on My Mind

Sea spray drifts over me and I shiver in spite of the African sun. Clad in swimming trunks, I crouch on the ridge of a high wall of solid rock from which I stare down into the sea, and try to understand the mind of a Greek king over 2500 years ago. Another wave rises out of the Libyan Sea, curling over to crash in clouds of foam. I am thinking.

Why was this island off the coast of Libya sculpted this way over one hundred human generations ago? I must watch and think. Be patient. A human mind created this carved shape for a purpose.

A wave crest rears and plunges with a roar into the lagoon as the engulfed air explodes upwards into jets of blue-green with glinting flecks and dark shadows that break into white spray. The cloud of salt spume drifts against the cliff face of the island.

The blue-black water sucks back again from the ridge that separates the lagoon from the open sea. I watch the straight smooth rock, exposed and slimy in the brilliant sunlight. Watch the water rise and plunge again, falling, falling, and the spray rises, but the island behind the ridge on which I am perched stays dry. Is this what he intended 2500 years ago? To protect the island with its precious buildings that were full of weapons and stores and, above all, to protect the war galleys?

When the ancient city of Apollonia was being built in about 600 BC, a weather-beaten battle-hardened man, probably a Phoenician sailor-turned-engineer, told a Greek king that if his slaves cut the rocks just so, and just so, his city would last for ever and defy Poseidon and all the storm-gods of the sea (Fig. 1.1).

The king ordered slaves, sponge-divers, and murex-purple-shell-divers to excavate the rocks as planned. They toiled and struggled in the surf day after day while they worked underwater holding their breaths for several minutes on each dive. The gang-masters exhorted them without mercy. How many divers drowned in the task? How did they cut solid rock more than 2 m (6 ft) deep in the water using only bronze tools and abrasive powder? They succeeded in cutting a trough 70 m (231 ft) long and several metres wide, deep into the bedrock, leaving a low residual rock barrier on the seaward side, and creating a vertical artificial cliff face on the island. The water-filled trough ran along the whole of the outer face of the island.

The result was a carved island-fortress protected from storms by this artificial wave-trap, creating a work of technical art and cunning as inspired in its way as any statue of marble. On the sheltered side of the island, away from the open sea, facing the harbour and the city centre, were ten slipways for storing the king's lightweight fighting galleys

In: Flemming, N.C., 2021, *Apollonia on my Mind. The memoir of a paraplegic ocean scientist,* 19-60. Leiden: Sidestone Press.

Figure 1.1. Much of the ancient city of Apollonia, Cyrenaica, lies submerged in the bay shown here between the theatre and the rocky islands, 250 m off the modern shore.

Figure 1.2. West Island at Apollonia where the author sat on the top of the rock wall which appears dark at the back of the island. The tops of the slipways are easily visible, as is the network of low walls under the sea in shallow water close to the beach. The gap between the submerged block forts and the channel to the eastern harbour is on the right margin of the picture.

when they were hauled out of the sea to prevent weed growing on the hulls. That way they stayed light, smooth and fast. They were only launched for military conflicts or at times of tension for training. This feat of harbour engineering was the Phoenician's masterpiece. His was the art of turning the destructive power of nature against itself to produce a safe haven for human activities in a fortified coastal city (Fig. 1.2). He had forced the natural physics of the waves to destroy their own forward momentum. They dissipated their energy within the artificial lagoon. The war galleys were safe. Perhaps the king paid him well for his work.

Unfortunately, after a thousand years, nature played an unexpected trick. Earthquakes wrecked the city by dragging the harbour and the islands down into the sea. Then the biggest waves overtopped the rubble breakwaters and cruised across the wave-trap so that they struck too fiercely on the rock walls. The wealth and grandeur of a commercial port city were destroyed in minutes. Multi-storey buildings cracked as masonry fell into the sea. Sailors and dock workers, slaves and merchants, scrambled for the high ground on the islands, or fled to the towers of the city wall that did not collapse. Broken houses and warehouses, fallen columns and roof tiles, roads, statues of marble, coins and pottery are now beneath the sea in the 25 hectares (62 acres) between the islands and the mainland. The abandoned remnants are exposed to the force of storms. This rock wall where I sit makes the last partial defence against the waves. Plate tectonics shows that Africa is moving slowly towards Europe, crushing the Mediterranean Sea, and that process has already crumpled the earth's crust, taking the city of Apollonia down nearly three metres (10 ft) deep. The calculations of the Phoenician engineering genius have come to nothing.

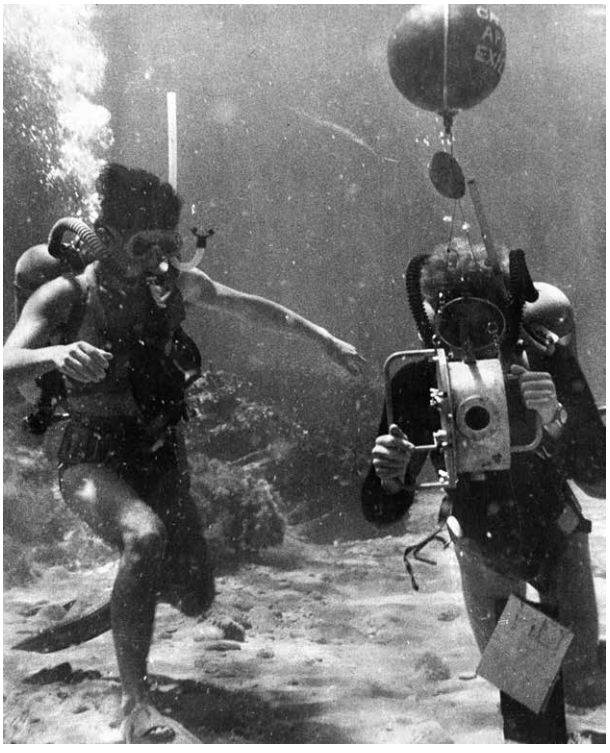


Figure 1.3. Martin Minns (left) and the author working on the ruins of Apollonia. Note my Formica drawing board hanging on a string.

Figure 1.4. Looking down from the cliff top on the West Island at Apollonia, Libya, into the artificial wave-trap cut by divers and engineers about 2500 years ago. The ridge of rock just visible beyond the white water has been created by cutting the trough between it and the cliff. The waves break in the trough, and do not attack the cliff. The town has sunk about 2 m into the sea, so originally the wall of the wave-trap would have risen 1.5 m above still water level.

Behind me, between the island and the Libyan shore of Africa, divers were swimming on programmed tracks, placing their survey poles on the corners of the drowned buildings of the lost Greek city. For the past three weeks our team had been diving every day, searching wide-eyed, peering through the haze that cloaked the ruins of Apollonia (Fig. 1.3). On shore, Nick Wood, the survey architect, was hunched over the plane table and telescopic alidade plotting the divers' positions. Day after day, blasted and bleached by salt and sun, we created a map of the city under the sea, street by street, wall by wall, quays and docks. We did that in Libya back in August 1958.

We made the first-ever scientifically accurate map of an underwater city anywhere in the world. The divers each day swam over collapsed buildings as we sought to interpret the strange shapes of the ruins and to understand the motives of the people who lived there.

Sixty years later, I can zoom down with Google Earth to focus on the yellow-grey rocky island off the coast east of Benghazi, finding the wall where my 21-year-old body crouched while my eyes burned and burned into the waves, searching for the truth. But the modern aerial photographs show that something has changed, because that great rock wall has gone. Simply vanished. It was solid sandstone, 2 m thick, 5 m high, and 20 m long (7 x 17 x 66 ft) linking two high massifs of rock. It effectively joined together the two halves of the island at a constant height, so as to protect the city of Apollonia from the storm waves that the north wind brings in across the Libyan Sea. It was the second line of defence against the sea, after the wave-trap, and a necessary part of the military defence of the city.

Every surface of that island had been quarried, cut, carved, sculpted, shaped for a human purpose, as surely as Michelangelo released a human body from its block of Carrara marble. The residual barrier of cut rock just offshore from the cliff and extending parallel to the seaward side of the island (Fig. 1.4) forced the waves to break and plunge into the pool, from which the water escaped sideways. The precious warships, food stores, sails, ropes, spare masts, shipwrights' tools, barrels of pitch, sheets of copper and lead, oars, weapons and the garrison of troops were safe and dry. The island was once the focus of marine and military trades, with a constant noise of workshops, the smell of freshly cut wood or molten lead, the creaking of rigging, ropes, and oars, the clang of hammers. Now the defences are shattered. When the city subsided deep into the water, the waves began to strike directly against the island and against the rock wall, until late in the 20th century a roaring storm cracked the wall and tore the solid stone from the bedrock, sending huge slabs tumbling. Hundreds of tons of rock crashed into the torrent. Smashed chunks of rock were driven like pebbles by the colossal waves. The island broke in half so that jagged stone blocks as big as cars rolled into the city and crunched to a halt on the slipways where the Greek war galleys had once been safe. Now the ocean breakers surge over the wave-trap, re-gathering their momentum so that the white-crested surf streams across the broken island into the former city centre. *Sic transit Apollonia.*

* * *

I first heard of Apollonia while I was a member of a diving club in London in the summer of 1957. The British Sub Aqua Club London Branch held its training sessions once a week in the evening at the Marshall Street Baths, near Holborn. I joined the club after finishing my National Service with the Royal Marines in February 1957, and I converted my service diving training, breathing pure oxygen on closed circuit, to civilian air-breathing equipment quite quickly. Once I had become familiar with compressed-air sports diving, I took a diving holiday in Greece (Chapter 4) and started thinking of how I could use intelligent observations under water as a means of scientific research when I would start at Cambridge University the following October.

The BSAC-Club members were a lively and idiosyncratic bunch, amongst whom I soon noticed an energetic young woman who seemed different from the others. She was already an excellent diver. Her name was Natalka Czartoryska, although she had anglicized it as Natalie Pater, and four years later, in 1961, I married her. As the divers scattered to pubs and apartments after an evening's pool training, Natalka suggested that we have coffee with a friend of hers, Judy Jordan. Coffee and coffee-bars were still a post-war social novelty.

We sat round the low coffee table gossiping about the diving world and the latest films from Jacques-Yves Cousteau and Hans Hass. The film *The Silent World* had been a sensation in cinemas that year, with images of divers carrying flaming magnesium torches under the sea. Diving was a fabled frontier that had the magic to take you out of the grey routine of post-war London. There was an irrational buzz with no limits to the imagination. Technology solved problems. Judy's husband, John, was a professional cameraman for film productions who specialized in aerial photography from helicopters and light aircraft. I asked him about his most recent work.

John described his contract for the British Army in Libya where he had been filming from a helicopter at a bathing beach used by the Army for rest and recreation. It was a village called Marsa Susa, east of Benghazi. He mentioned that you could see ruins on the seafloor, with more ruins on the beach, including many standing columns. I quizzed him for more details, but he could not provide any information, apart from the name of the ancient city, Apollonia, and the postal address of the officer who had arranged the contract.

The next day I posted a letter to Captain D. Forrow, Royal Engineers, at British Forces Post Office Tobruk. The reply ten days later sparked my imagination. Forrow confirmed that there were walls and square stones to be seen over a wide area underwater. He even included a very rough sketch of the places between the mainland and the two islands where most of the drowned buildings seemed to lie. My mind teemed with questions and doubts.

Was it possible that the story was pure imagination, a fantasy, and the supposed ruins were just debris, fallen stones and natural rocks? What did the supposed ruins look like under water? Were they really square? Why were they under the sea? Could a diver draw them or measure them accurately? Could I enlist a team of divers to make a map of the underwater city? That would take time. How would such a project raise funding? Would sculptures or tombs have survived the inundation? The Atlantis legend distorted rational planning, and I knew that accurate surveying under water would not be easy or romantic.

At the start of the Michaelmas Term at Cambridge University in October 1957, I found two other freshmen with diving experience, Bill Hemmings and David Fagan, and together we started a new diving club which we called Cambridge University Underwater Exploration Group (CUUEG), which still thrives. I toured the college notice-boards sticking up typed Gestetner-duplicated announcements inviting members for the new club. As the winds from the fens attacked the trees, and leaves accumulated in soggy drifts in the streets, the black-gowned undergraduates scurried between lectures clutching piles of books. I persevered with recruiting would-be divers. There was so little time. I was studying mathematics, physics, chemistry, and metallurgy in the Natural Sciences Tripos (the broad category of science exams) but my extra-mural activities distracted from lectures and course-work which I often started after midnight. The colleges were quite tolerant of a wide range of talents in those days, and academic dedication was not essential. The so-called “well-rounded individual” was still accepted. Some of my contemporaries at Pembroke College were very well-rounded indeed.

Richard Adrian, a don in Corpus Christi College, helped us to write a constitution for the club, since the university rules required a don to supervise the finances. When we had elected the Club Chair and Secretary, we were ready to start training our recruits. Richard was a flamboyant, elegant and cultured junior don, driving around Cambridge in a gorgeous pre-war Bentley Lagonda. His rooms were decorated with sophisticated abstract paintings in muted colours. He was a cellular physiologist whose later career was extremely distinguished, and he became a Fellow of the Royal Society, Master of Pembroke College, and Vice Chancellor of the University of Cambridge. During that Michaelmas term, at a Club committee meeting in Richard’s rooms in Corpus, I proposed a diving expedition to the underwater city of Apollonia. From my experience in the Royal Marines, combined with Bill’s diving experience in the Royal Engineers, I was

sure that we could devise a method of mapping an area as big as a whole city under water. Bill was a keen photographer who developed his own photographic negatives, had already experimented with a simple underwater camera, and was teaching himself to develop colour negatives. His skill in the sea would be a great help.

The treatment of underwater archaeology on feature films and television documentaries at that time stressed the melodramatic discovery of Roman and Greek shipwrecks in the Mediterranean. There were frequent long upward-tracking shots of divers rising in plumes of bubbles towards a bleached-out sunlit surface while clutching a huge teardrop-shaped amphora. This cliché did not help us, as there was seldom any reference to serious collection of measurements, documentary photography, or mapping. Divers had recovered statues and amphorae from several wrecks between 1900 and 1956, but the goal was always to find objects of artistic value. Plotting the positions of finds within the wreck was approximate, with the simplest measurements by tape when required. In some shipwrecks divers had made measurements of the surviving hull timbers before raising them, but a whole underwater town of tens of acres would need a different strategy. Nobody had ever attempted to make a precise archaeological map of the seabed on this scale. I would have to apply a mixture of science with my military experience to find a way to do it. I also became fascinated by the concept of the ancient port and its operations. For two years I had worked with the sea in the military, and then on the Rhine in Germany, and I wondered how the same activities were carried out 2000 years ago. How were sailing and oared ships docked or loaded and unloaded by hands alone?

During the Michaelmas term, Martin Minns, a fellow undergraduate at Pembroke College, and I did the background archaeological reading, after which I wrote to potential sponsors, in the style that had proved so successful for the Cambridge Explorers and Travellers Club. Adventurous travel was very much in the news. It was part of the post-war explosion of ideas and impulsive experimentation. Martin was the grandson of the distinguished late Professor of Archaeology Sir Ellis Minns and, although he was reading for a degree in English, he was naturally a keen amateur archaeologist. He was also an excellent swimmer. Many potential sponsors thought that the project was too ambitious for undergraduates. Eventually the Royal Geographical Society, the British School at Athens, the Department of Classical Archaeology, and the *Sunday Times* agreed to support us with grants of equipment and money. Various companies supplied stores, or reduced their prices for us, including Kodak film, and Bell & Howell Ltd who made movie cameras. The De La Rue Company provided numerous sheets of Formica, a new plastic surface for kitchen counters, which we had found was ideal for writing on underwater, while ICI provided a crate of newly invented plastic bags of various sizes as an experiment to find out if they were useful. They asked us to report back on the ways that we used the transparent bags, as they were not sure how to market them.

I wrote to Richard Goodchild, the British archaeologist who supervised antiquities in Libya, which the British had freed from Italian occupation during the war, and he suggested that we could find cheap accommodation and store sheds for our gear at the Dolphin Hotel in Marsa Susa, close to the ruins of Apollonia. The British School at Athens agreed to transfer an air compressor that they had been using in Crete for our use in Apollonia. A few weeks later Goodchild was in Cambridge to give a lecture to the Department of Classical Archaeology. This chance was almost too good to be true.

Professor Jocelyn Toynbee invited me to attend the lecture where I would have the opportunity to meet the speaker at the sherry party afterwards. Goodchild was a large cheerful man who immediately confirmed my idea that there was plenty of original research to do under the sea at Apollonia. He gave me contacts in the Libyan Embassy in London and the British Consulate in Benghazi, and assured me that he could grant a permit for our work under water.

* * *

Greek explorers from the volcanic island of Thera, otherwise known as Santorini, landed on the coast of Cyrenaica, in the eastern part of Libya, in the 7th century BC. There is evidence from Minoan pottery in Cyrenaica, and Egyptian pottery in the Aegean, that regular contacts across the eastern Mediterranean already existed in the earlier Bronze Age, but settlement and foundation of a permanent Greek colony only occurred later. Herodotus narrates the account of the expedition that founded Cyrene in 631 BC, a story that is confirmed by a 4th-century inscription found at Cyrene. Over-crowding of the island of Thera provided the main motive for the expedition, which was steered towards its eventual destination by the usual cryptic advice of the Delphic oracle.

After several abortive attempts at settlement by the Greeks over a period of about six years, local Libyans led them to the position of Cyrene, and encouraged them to settle there. From the Greek point of view the high rainfall in the mountains of the Jebel Akhdar was an advantage. Cyrene grew and prospered, acquiring ruling status in the five cities of the Pentapolis during the Hellenistic period, and was absorbed under Roman colonial rule in 96 BC. Apollonia was the port of Cyrene. After a turbulent history of revolts, wars, and periods of improved prosperity, Cyrene declined in the 3rd century AD. After AD 395 Cyrene was ruled from Constantinople, within the eastern half of the Roman Empire that we know as Byzantium. Earthquakes are common in Cyrenaica, and a large one in AD 365 destroyed many cities in Crete and Libya, including Cyrene, and caused a tsunami in Alexandria. After steadily declining security and attacks from barbarians from the south, the cities of the Pentapolis in Cyrenaica fell to the Arab invaders from the east in about AD 642.

The prosperity of Apollonia rose and fell with that of Cyrene for many centuries, but it continued to grow in the Byzantine period when Cyrene was in decline. It even acquired the status of capital of the Libyan Pentapolis in the middle of the 5th century AD, but in spite of the city's substantial fortifications, the Byzantine governor abandoned Apollonia when it was attacked by the Arabs.

Cyrene is in a beautiful location at a height of 520 m (1700 ft) in the mountains, with distant views down a succession of terraces to the coast 5 km (3 mi) away. Since the wealth and luxury of the city, and the grandeur of its temples, depended upon trade and agriculture, especially exports of the mysterious drug silphium, Cyrene needed a secure port on the coast. Mediterranean trade by ship at this time included grain, olive oil, honey, wine, raw glass, perfumes, garum (fish paste), henna, leather, almonds and other nuts, dyed cloths, ingots of unprocessed metals, timber, bronze tools, faience plaques, scarabs, saffron, ivory, and occasionally jewellery and precious metals such as gold or silver. Apollonia was a natural focus for south-north trade across the Mediterranean, and was also the safest port between Alexandria to the east and Leptis Magna and Carthage to

the west on the North African coast. Its prosperity benefitted from this coastwise trade, including products from the Middle East, and possibly even pearls from the Red Sea.

Each element of trade used containers, usually jars or amphorae of various sizes and shapes. Thousands of fragments of these containers exist amongst all archaeological remains in the Mediterranean, and divers have found many shipwrecks stacked with hundreds or even thousands of unbroken amphorae. The management of trade and cargoes for ships requires specialist buildings and restricted areas in a port where products of high value await embarkation or dispersal inland. Record keeping was essential. Bureaucracy goes back a long way: written or inscribed tallies and records of production, trade, deposits, loans, and debts existed on clay tablets for many centuries, perhaps millennia, before anyone started to write down poetry, moral thoughts, or legends such as the glorious *Epic of Gilgamesh*. A busy harbour needs official, locked store rooms, bonded warehouses and armed guards even in a time of peace. The risk of theft and looting or avoidance of taxes was ever-present, as it is today. Guards were always alert for possible threats to peaceful trade. The slipways protecting the warships were probably roofed with timber, and the risk of fire or deliberate arson was a military security threat. For all these reasons the buildings around a port would have proportions and shapes that were uncommon in inland cities. Above all they were large, strong, defensible, and probably embellished with symbols of their importance. Mapping these unique structures was the challenge we faced as we planned our expedition during the winter 1957-58.

Research in the university library and the British Museum Library revealed that the first attempt at making a map of the underwater structures at Apollonia dated back to a book published in 1827, in which Captain F. W. Beechey of the Royal Navy published a very passable sketch map with three of Apollonia's most prominent submerged buildings (Fig. 1.5). The stimulus for mapping the Mediterranean coastline and shallow seas in

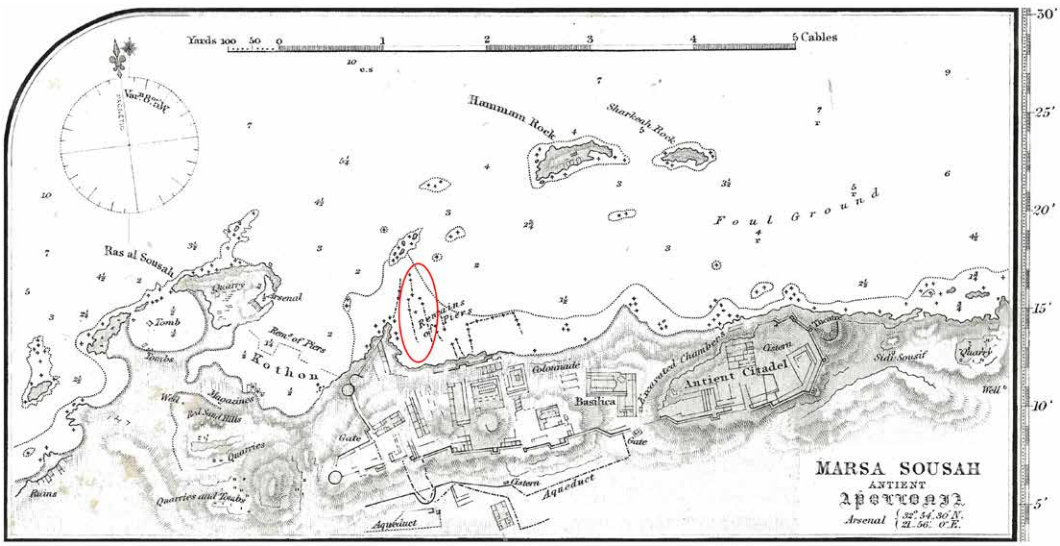


Figure 1.5. In 1827 the Royal Navy Captain Beechey surveyed the coast of what is now Libya, and made this map of Apollonia, showing some walls in the water. The building shaped like a two-pronged fork, circled in red, is quite accurate. Most of the buildings under the sea were not discovered or mapped at this date. This map is copied from chart 241, dated 1861.

the early 19th century was Britain's ongoing naval rivalry with France. Royal Navy captains had a classical education, and many of these surveys produced supplementary volumes describing the antiquities found on the shore, with careful correlation between the ancient historians and the surveyors' modern findings. In the true spirit of Enlightenment science, the same captains noted that coastal port structures from the ancient world were sometimes uplifted high above the water, or sometimes deep beneath the waves. Sailors looked down through glass-bottomed buckets, a trick used by fishermen, to observe and sketch buildings on the seabed.

My military diving experience provided the skills needed to measure and accurately map such a large area of buildings under the sea. We also needed to link the measurements of each submerged building to a baseline on shore and then join that consistently to a matching survey on land. But the most obvious survey tool, a theodolite that measures angles numerically, would be expensive, difficult to maintain in a rough environment, and prone to damage.

Nowadays, in 2020, with GPS and laser rangefinders, it is hard to imagine the difficulties we faced. Nick Wood, studying architecture, proposed that we used a more robust instrument called a telescopic alidade instead of a theodolite. He suggested a straight baseline along the shore marked with poles at intervals of 30 m (100 ft) measured by surveyor's tape. At each point we could position a survey tripod table, and sight through the alidade that rested on the drawing paper, giving the exact bearing relative to the baseline to a diver holding a pole on the surface of the sea over the wall to be fixed. The telescope of the alidade stood on a metal base with a straight edge that could be used to draw a line directly onto the map exactly parallel to the telescope itself. If this was done from two stations on the baseline, with the baseline already drawn on the otherwise blank map, any position out to sea could be fixed. We would need to repeat this routine for each point which would be marked by holding a coloured pole over the designated structure on the seabed. In practice we would fix ten or more points from one station, and then repeat all ten from a second baseline station, as this would be more efficient. With corners and junctions of walls fixed on the map, divers could then fill in the details of wall thickness, block sizes, and orientations of cut blocks, writing notes on Formica sheets. They could also sketch in details such as fragments of pottery, fallen columns, cuttings in the rocks, and lead dowels. When Nick Wood transferred these sketches to paper, the drowned city would live again.

Ranging poles marked in coloured 20 cm (8 inch) bands would provide rigid measuring rods under water for distances of a few metres, while a standard wooden or metal carpenter's rule would measure blocks with an accuracy of a single centimetre. In 1958 there was no such thing as a plastic tape with which we could measure distances underwater, while a normal surveyor's canvas tape would stretch and shrink in the water, and probably rot after a few days. Martin was brimming with ideas for fancy gadgets, and we adapted equipment, such as the chest-mounted reels of cord I had used in the Royal Marines Special Boat Service for beach profile surveys. Martin and I then constructed a chest-mounted reel, supported by a harness of canvas straps, holding 50 m (164 ft) of rust-proof copper wire used for the aerials of battle tanks marked with coded tapes inserted every metre. It looked clumsy, but it worked perfectly.

Photography and filming were a fundamental part of our plan. Our underwater still camera, loaned by the British School at Athens, was a Leica 35 mm with a 50 mm lens,

which was a rather narrow angle on land, and gave an even narrower field of view when you take into account the refraction of light under water.

Bell and Howell had given us generous terms with the 16 mm spring-wound movie camera that held 30 m (100 ft) reels of film. With this I could shoot several minutes of action at a single loading of the camera, shooting at 24 frames per second. The 15 mm wide-angle lens gave broad images under water, and reduced the need to adjust focus between shots since it would be in focus from close-up to almost infinity. Colour-correcting red Wratten filters helped to recover some of the colour which is lost in the blue of the underwater world. The only 16 mm colour film available was Kodachrome ASA10, which meant that the lens aperture would have to be wide open most of the time to collect enough light under water. But because of the short focal length, the pictures would still be in focus because of the good depth of field. This was the best photographic documentary system we had under water. It is very difficult to obtain a wide view picture in shallow water, and it was not until ten years later that Nikonos and Calypso Phot produced a wide-angle underwater lens for use with 35 mm still cameras.

The university engineering laboratory helped by designing an underwater case for the Bell and Howell camera. At that date the idea of filming underwater was still wildly exotic, so my request caused considerable surprise. Professor Baker could see that the challenge would be valuable to some of his staff, and they offered to make the case for us at cost. The cadmium-plated case they designed had the camera mounted securely with screw-clips onto a thick circular steel base, with the controls coming through the base in penetrations sealed with rubber O-rings. The camera could be easily lifted off the base-plate for adjustment or loading film reels.

The other half of the case was like a large saucepan that fitted over the camera, and had a circular glass-plate porthole in the side that lined up with the lens. The “saucepan” was bolted onto the base-plate by a dozen hefty screws with wing-nuts, and was sealed again by a large O-ring (Fig. 1.6). Everything was easy to handle and looked strong.

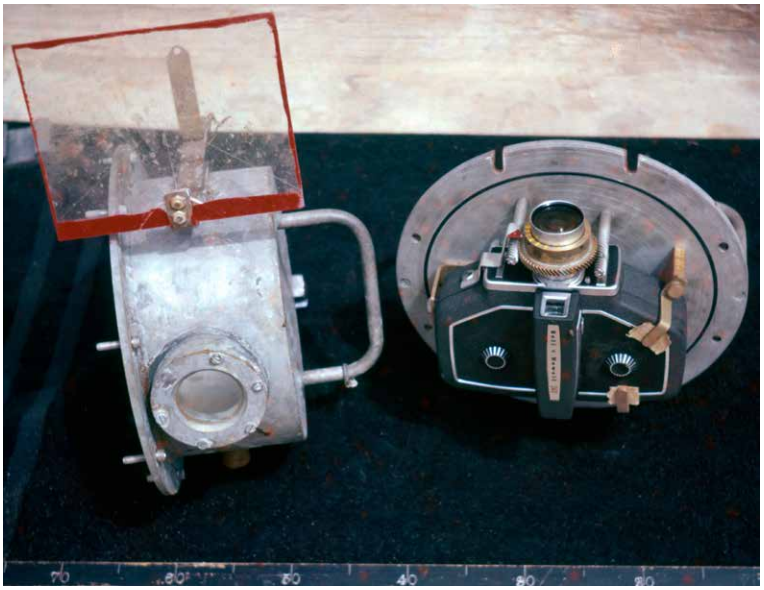


Figure 1.6. The underwater movie camera case, made in the engineering laboratory at Cambridge, disassembled to show the internal arrangement. The external view-finder is designed to match the wide-angle lens that is shown in the picture. The scale bar is in cm.

We took the camera in triumph to the Leys School swimming pool to test a roll of film. It worked perfectly, but the engineers had been so clever in making the "saucepan" a tight fit around the camera that they had neglected to calculate the effect on its buoyancy. It was so heavy that it was impossible to swim with. We postponed a solution to this problem until the end of the academic year in June.

* * *

During the early months of 1958 our potential expedition team members learned to understand and respect each other's skills. Those who were new to scuba diving developed confidence in their own ability under water, and trusted their buddy divers. It is essential when diving that you can rely on your co-diver. By the spring we had a team of ten. In the Easter vacation the CUUEG members spent a week diving in the sea around Portland, on the British south coast, where we experienced open sea conditions and some deep diving to 30-50 m (100-165 ft).

We tried to recruit an undergraduate archaeologist to the team, but failed, in spite of strong encouragement from Professor Toynbee. In that absence, Nick Wood, our architect draftsman, had the most archaeological experience, with Martin's added dedication as a strong amateur. Further members included myself, Richard Adrian, Bill Hemmings who would specialize in still photography and biological sampling, and Richard Windred who was studying chemistry and was interested in the psychology of diving; then Dick Longbottom and David Fagan both studying medicine; Richard Everington reading English, and Natalka Czartoryska who worked part time at the Natural History Museum in London. With four Richards in the team, we had to rely on abbreviations and nicknames. We needed time at the beginning of the summer vacation to test equipment. A departure for Libya at the end of July would enable us to dive with the best weather and wind conditions on the Libyan coast.

During the spring, Martin and I continued the background archaeological investigations, and I bought charts of the Libyan coast from J.D. Potters, at 142 The Minories, just behind the Tower of London. Much-lamented, Potters, which had probably sold charts to Joseph Conrad, closed in 2002 after centuries of service to the merchant mariners of the world.

Back home in Chiswick after the end of the Easter Term in June, preparing for departure in six weeks' time, I finally tackled the problem of the heavy movie camera. Richard Everington and I obtained permission to scuba-dive in the public pool at Chiswick in the early mornings before it was officially open so that we could test the camera itself, and the range of measuring and surveying gadgets, drawing boards, and tools that we had devised. Some worked, some didn't. The fresh morning stillness in the vast pools prompted clear thinking. The camera and case weighed more than 4.53 kg (10 lb) when under water, which was fine while you were standing on the bottom of the pool, but you could not swim with it. We shot some reels of colour film to test exposures and the filters while I tried to think of a buoyant device that could compensate for the weight.

The only lightweight strong sphere that I could think of was a metal ball-cock float like the one in a lavatory cistern. I calculated that it would have to be about 35.6 cm (14 inches) in diameter to give the lift required: more than twice the diameter and nearly

ten times the volume of the usual ones in home lavatories. I hoped that factories and big buildings used cisterns with ball-cocks of large size. I went up to the Chiswick High Road to visit the biggest plumber's shop.

"You want a copper ball-cock 'ow big?" gasped the man at the counter.

"Er, about 14 inches diameter," I repeated nervously.

"Nothing like that 'ere," he said. "Perhaps you'd get it at Johnsons in Westminster Bridge Road. Big firm, they are."

I took the Underground to Westminster. At Johnsons I had a similar exchange.

"The only people that could supply that would be the big wholesale plumber at 120 King's Road in Chelsea," said the salesman after recovering from the shock. "Really big industrial company. That's your best bet."

Arriving in the King's Road I searched for number 120, and when I found it I saw the proud sign in huge golden letters across the pale-blue shop-front: "Thomas Crapper and Co. Sanitary Appliances by Appointment to Royalty". It was logical.

"I need a fourteen-inch copper ball-cock, please," I said to the salesman, feeling more confident this time.

"Fourteen and a half inches is the nearest standard, Sir."

"That's fine,"

The salesman returned from a distant store shelf and dumped a large gleaming copper sphere on the counter.

"That'll be 17 shillings and sixpence," he said sharply. He had the professional's contempt for a non-plumber.

I left happily with my prize.

At the Chiswick swimming pool, I suspended the camera below the copper sphere and found that it was now a couple of pounds too light. A few bits of lead tied below the sphere made a perfect balance, and the whole array had the unexpected and delightful advantage that the camera was now held tautly between the buoyancy of the float and the weight below it, so that it was always steady in the water. It did not wobble or twist when I was swimming with it. The buoyant float acted like an inverted tripod for steadiness. I painted the slogan "Cambridge Apollonia Expedition" in bright yellow on the ball-cock (Fig. 1.3).

* * *

The journey to Apollonia by way of Benghazi required driving across Europe to Sicily, where we would board the ship *Città di Livorno*, crossing to Benghazi in three days at sea, followed by a further day for the drive to Apollonia. Sandy May, a Canadian friend, had lent us his Volkswagen van for the drive from Dieppe to Syracuse in southern Sicily. The whole trek to Apollonia would take 11 days. Nick Wood, Richard Everington, and Bill Hemmings departed early for excursions in Europe, and we arranged rendezvous to pick them up on the way south. In the days before mobile phones a series of rendezvous like this was risky, and if they failed the expedition would have to proceed with people missing. David Fagan, Dick Longbottom, and Natalka Czartoryska would travel to Syracuse by train a week after the main party and take the next ship to Benghazi.

On Tuesday, 29th July, I drove the bundles and crates of gear to Newhaven in a hired van, leaving them in customs bond at the docks. Two days later I met Adrian, Martin, and Richard Windred at Victoria station. The crossing to Dieppe was uneventful and Sandy was full of cheer and welcome as we loaded the gear into his van. There was the conventional hysterical screaming row with the French customs and the bank-bond officials who inspected my papers and doubted that Barclay's Bank had the credit-worthiness to compensate for the risk of our selling all the gear in France. We left Dieppe, driving off in high spirits, and at midnight we said goodbye to Sandy in Paris. We drove all night, and through the next day, down that big road in the middle of France that is like driving through wine labels. Near Fréjus, we parked in a quiet spot by the sea at sunset, cooked a meal on the Calor gas stove, and slept on the ground in our sleeping bags.

As we headed south through France and along the coast through the Alpes Maritimes the roads became narrower and more tortuous. The heavily burdened Volkswagen was slow, and we took turns driving, making for long days on the road while the non-drivers chatted or slept amidst the baggage. We became addicted to that hypnotic Mediterranean blue that was so novel to us then.

After the Italian border at Ventimiglia, we spent the third night on a hill above La Spezia, from which we watched a spectacular display of fireworks launched from barges in the bay. The reflections of the soaring rockets gave us a two-for-one. Next morning, we drove on quickly. I parked the bus at 0945 where we had agreed to meet Nick Wood by the leaning tower of Pisa in the main square. We climbed the tower. By the time we came down Nick was waiting for us, suntanned and cheerful, looking very Italian. To escape the heat of the city we drove to the sea nearby for a swim, driving back to check the tower at every hour, but Richard Everington and his Lambretta scooter were missing. We left without him.

Because of our late departure from Pisa, we had to drive all night, arriving in Rome at two in the morning. Barefoot and wearing shorts and singlets, we wandered around the great architectural monuments in deep shadows with the silence broken intermittently by brief lectures from Nick. I remember standing beside an isolated huge marble foot that must have been part of a statue to make Ozymandias jealous. (The colossal foot, accompanied by its anatomical twin, is now exhibited in the courtyard of the Capitoline Museum. It was a fragment of a gigantic seated statue of Emperor Constantine). We drove on all night, trundling the next morning into the outskirts of Naples. Mist hung over the bay concealing Vesuvius, Sorrento, and the islands.

We drove through heavy traffic to the seafront on Viale Anton Dohrn where the Stazione Zoologica, one of the oldest marine stations in the world, occupies the centre of an extensive scrubby tropical garden. Bill Hemmings welcomed us at midday, beaming with the successful results of his studies of Mediterranean species. We loaded his kit bag into the long-suffering Volkswagen, spent the afternoon in Pompeii, and continued south under a clear sky with Vesuvius rampant. I slept for the next part of the trip, waking in some befuddlement to find the bus stopped at dusk in a field near some Greek temples. There were two perfect temples close by, and a third a bit further back parallel to the road.

With no training in archaeology, I was surprised and baffled.

"Nic, we have to visit the Greek temples of Paestum," explained Adrian. Nick Wood agreed. So we piled out of the bus, vaulted a fence, and trooped across the grass. The red

sun was sinking already into the sea and the last rays shone through the ribs of the black temples like the vision of the Ancient Mariner.

There were no houses nearby, no tourists, and no traffic on the road. There was almost complete silence, although the sea was just a mile distant. We climbed onto the ruined platform or crepidoma of the Temple of Hera, the most complete of the temples, and admired the extreme bulging curves of the fluted Doric columns. Every column was still intact and in place. Nick Wood explained that they had been built about 500 BC. The architraves and entablature were almost complete, although there were no decorative sculptures. I could see no other ancient buildings or ruins of a town, although parts of the ancient city do survive. The three exquisite temples dominated the fields in neglected grandeur.

It was the beginning of my love affair with Magna Graeca, Great Greece, that continued for many years. In this part of southern Italy there were so many prosperous Greek cities in the centuries before Roman power absorbed them, that the whole region was known as Great Greece. Constantine Cavafy wrote a bitter-sweet poem about Poseidonia, the original Greek name for Paestum, in which he imagines the Greek citizens of the once-cultured and sophisticated city bewailing their humiliation by the barbarians of Rome. As Rome triumphed, so the Greeks continued clumsily celebrating their own half-forgotten ancient festivals. The cities such as Sybaris, Croton, Poseidonia, Tarentum and Syracuse produced a wealth of music, mathematics, geometry, physics, sculpture, architecture, trade, and engineering that paralleled the achievements of mainland Greece and the Aegean. Anecdotes about the outrageously decadent luxury of Sybaris were a staple of comic Greek story-telling, and the town gives us the modern word “sybarite”.

With every mile that we travelled south of Paestum the road became steeper and more twisted with hairpin bends and narrow bridges over dry gorges. Sometimes the narrow road clung to the cliff above the sea, and sometimes it plunged inland skirting behind a particularly resistant mountain peak. We rolled at sunset into the ferry port of Reggio di Calabria where the dock-hands weighed the Volkswagen and could not believe that it was twice the weight they expected, even without the six passengers who stood by and watched. As the incoming ferry unloaded its cargo we saw two heavily barred railway coaches carrying imprisoned bandits being shunted off the ship into a siding on the mainland. We crossed on the ferry from Reggio to Messina, spending the next night in the hills of Sicily. We had been advised by the ferry captain to beware of bandits, and, since we were not sure that the train-load we had seen was a clean sweep, we slept with spear-guns and diving knives close to hand.

* * *

The last miles of southeastern Sicily took us through sun-baked mountains and coast roads, round the curvaceous cone of Mount Etna, through the industrial port towns of Catania and Augusta, and finally into the magnificent ancient city of Syracuse, famed as the colony that defeated Athens and precipitated its final collapse as a Mediterranean power. The main port is the Porto Grande where fleets of hundreds of Athenian triremes and galleys had been trapped and destroyed in desperate battles at close quarters. We found the modern port jetty, where the well-worn passenger-freighter *Città di Livorno*

was berthed, tied up to bollards on the dockside. I negotiated with a nearby garage-owner to leave the Volkswagen in a lock-up shed while my companions unloaded our gear and stacked it beside the gang-plank

I heard shouting, laughter, and rapid tooting of a motor horn. Richard Everington had put-putted into the dockyard at full speed in a cloud of dust, exhausted, begrimed, with smoke belching from the over-heating scooter, and a wide grin above his wind-blown beard. We parked the scooter with the Volkswagen and settled down to a yarn-swapping evening meal before embarking at eight o'clock. Richard had missed the last rendezvous at Pisa by an hour and had followed us down the whole length of Italy a few miles behind us.

The *Città di Livorno* was a cargo vessel that carried a few passengers, but the food was good. On the planked deck we acclimatized to the sun, while we checked our stores documentation, and revised the survey procedures, plans, and logistics. The ship stopped for an afternoon in Grand Harbour, Valletta, Malta, and we arrived in Benghazi on the morning of the third day, with a strong onshore wind making a choppy sea. The breakers smashing over the harbour wall, the yellowish haze over the dull-coloured city, and the apparent lack of life combined to give a down-trodden and uninspiring impression. Things changed quickly. A gang of red-hatted Arabs and Africans gathered on the quay as we came alongside where they unloaded our equipment onto a donkey-cart. We trekked across the dusty cobbles to the customs office, in which a smart African officer chalked our baggage with customs code marks and then we were ushered out through the wire gates into the town. We loaded everything onto a hired minibus and refreshed ourselves at a hotel, before driving eastwards for Apollonia with an Egyptian driver.

Libya at that time was ruled by King Idris and the country was beginning to modernize, while the British Army provided security. During the Second World War the territory of Cyrenaica changed hands several times, and derelict army vehicles and thousands of munitions still littered the countryside and the shore. By 1958 the main streets of Benghazi were lined with large European buildings, many built by the Italians. The roads were wide and filling with cars as we drove away from the port. Between the road and the sea, there was a large grove of palm trees with a shanty town of corrugated-iron and cardboard shacks packed around the trunks of the trees.

We drove through the foothills, across numerous dry waddis spanned by military girder bridges, and up into the Jebel Akhdar, the Green Mountains. In those days the modern village next to ancient Cyrene, Shahat, had only a single street that was shaded by whispering eucalyptus trees where it twisted between the low white shops. Surrounding the village, dotted amongst the trees, were the magnificent ruins of temples, columns, ancient market places, baths, stone sports tracks, and theatres, sprawling over graded terraces and slanting down the mountainside. The scale was almost unimaginable. Beyond these were the scattered remains of the suburbs of the once-great city, half-buried in sand and overgrown with trees and thorns.

The road from Cyrene to Apollonia descended the Jebel in a series of hairpin bends bordered on either side by hundreds of Greek and Roman tombs in the form of miniature houses carved into the cliff. As we rounded a curve in the hills the view of the coast emerged below us with a chain of headlands and islands slanting away from the shore to the east, sheltering little bays and harbours. The late afternoon sun was behind us, and the sun-gilded islands were cast into heavily moulded relief of brightness and black shadow

against a hazy sea. Modern Apollonia, the village of Marsa Susa, was a cluster of neat houses just to the west of the ancient port, and the poorest members of the community still lived amidst the ruins of the ancient city that have remained on dry land.

The street into the village opened into a beautiful little square where palm trees and all manner of greenery flourished, with occasional bursts of red flowers. The Dolphin Hotel, which had been converted from the original Italian post office, was run by Captain Spencer, a retired British Army officer, who briskly indicated where to stow gear and showed us the various bedrooms, which would need to be shared in twos and threes. Natalka would have a small room for herself when the second party arrived. Gratefully, we washed and showered and unloaded the equipment. Captain Spencer was astonished at the quantity of cylinders, tripods, cameras, the inflatable boat, and boxes and bags that piled up in the shed. He advised us to employ a *gaffir* or caretaker to watch over it.

After a British-style meal, I wandered out towards the ruins to size up the lie of the land. The sun had set long ago, but there was a bright moon and I easily followed the path into the ruined city. Though the wind had dropped after a recent storm, the rollers still came in with a constant rumble of noise, and the hulks of the islands were riding a sea of phosphorescent white. I walked along the bank above the beach where I saw how the masonry walls broke off into the sand and surf. On my right were the silhouetted columns of the Eastern Christian basilica, two rows of smooth marble, spaced on a mosaic floor. I stopped walking. I looked out again at the lines of breakers sweeping in, over the submerged city, and felt the sorrow of loss. So much had gone already and would never be retrieved. A helpless sense of the destructive power of earth and sea sobered my adventurous anticipation. What could we rescue from that desolation in just four weeks?

I returned slowly to the Dolphin Hotel.

* * *

Preparation for the first day in the hot climate required us to think both of the time to do the most work that would avoid the heat of the day, and how to manage our own health and diet. Early in the morning we tidied and checked the stores before breakfast. Before starting work in the sea, we rubbed olive oil on our bodies, and donned T-shirts to wear even while swimming. We planned to eat plenty of salt with meals, while always drinking plenty of water. The temperature at midday was 32° C (90° F). Although nobody knew then about the risks of skin cancer, and acquiring an oak-like tan was thought to be both healthy and virile, we had enough sense to know that burning lobster-red was not a good idea.

From the work-sheds and store rooms that we used opposite the hotel we could see ruins close by on the extreme west of Apollonia, outside the city proper. Standing in the shallow sea, there were the skeletal remains of a tomb carved out of the solid rock. On the beach on the opposite side of the village the waves had split open a massive circular tower, and shattered blocks projected from the remaining segment overhanging the water. The land surrounding the village was almost bare and sparsely cultivated. Where the 300-ton cargo ships of Imperial Rome once docked to load cargo after cargo of wheat, the peasant farmers now scraped a living from soil which they no longer irrigated.

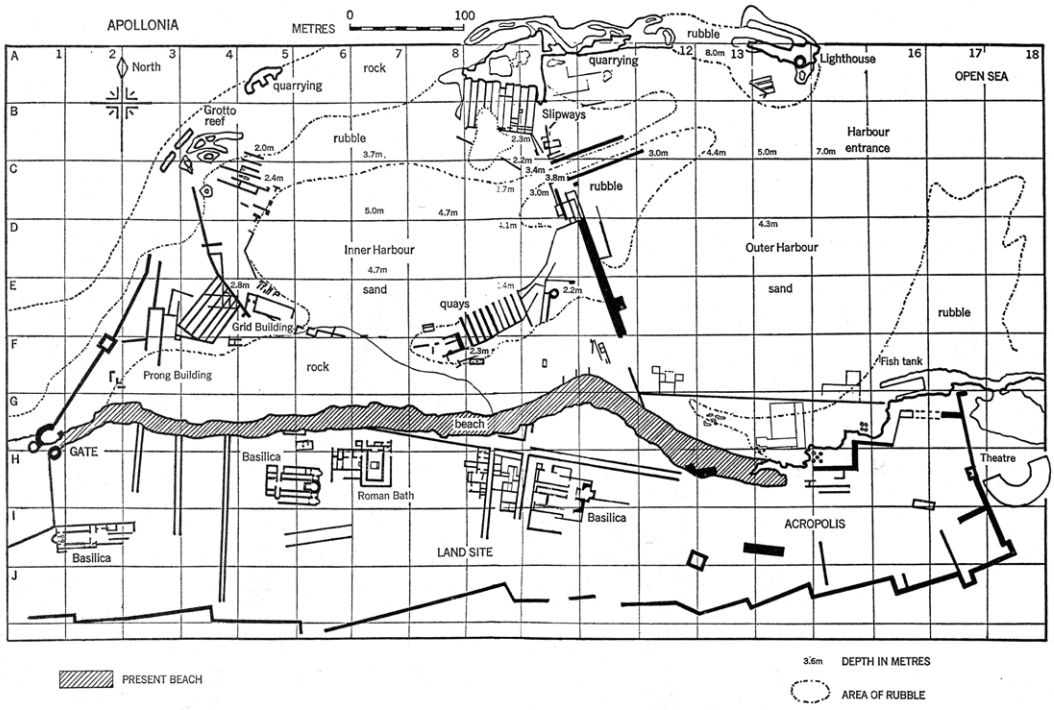


Figure 1.7. The complete map of the underwater city made by divers in 1958 and 1959. The hatched strip is the modern beach, so everything south of that is on land, and everything north of it is under the sea, except for the islands.

After a hefty breakfast prepared by Mrs Spencer, Nick Wood and Dr Adrian went out to find the best position for the survey baseline, while Richard Windred and I started the air compressor. We checked the purity of the air and charged two diving cylinders. The others were experimenting with swimming over the ruins for the first time using masks, fins, and snorkels, and carrying plastic sketching-boards. Richard and I soon followed them. We walked through the broken circular tower which was the western city gate, from which we could see the external city wall running inland about 200 m (650 ft). It then turned to continue its serrated path more or less parallel to the shore as far as the acropolis and theatre at the eastern limit. The wall was part of the great Hellenistic defence system, but most of the buildings visible within it were Byzantine Christian. The structures in the sea might turn out to be of any date between 635 BC and AD 600.

We climbed down the rubble slope, donning our masks as we scrambled over the fallen blocks, then waded into the water over the submerged foundations of the tower. I swam out, gazing with fascination down into gloom where I saw the foundations of a broad stone wall overgrown with a short fringe of green and brown algae, more like moss than seaweed. The stones were laid lengthwise across the thickness of the wall, known by archaeologists as “headers”, and they rose only one or two courses above the surrounding rubble. Upper parts of the building had collapsed around the lower walls, protecting them from further erosion. I thought that many small objects must be buried. I curved out over the wall into the deep water to the west, and saw a steep slope of rubble plunging into the blue; on the inner side I found more low walls, almost covered

by the tumbled masses of square blocks. This was the western limit of the city. There were defences here, both against the sea and against attack from warships.

I reached a low, square building 100 m (325 ft) from the shore, which had three complete walls, and in one place the masonry rose to within inches of the surface. The long swell waves swirled and boiled over the stonework, driving clouds of bubbles down into the clear water. A fat mérou, a slow-moving, rock-dwelling grouper, lay motionless in one corner, gazing from beneath a fallen block. I swam slowly round the building, drawing its outline on the Formica plastic board, first the wall which joined it to the shore, and then other walls leading off from it towards the unknown. I followed the faint traces of a thin wall eastwards into the city until it met a cross-wall. I sketched the junction and swam left. The morning passed with the constant hiss and slap of water over my ears and the ever-expanding vision of buildings emerging from the blue before my eyes.

By midday I had outlined a fork-shaped building with two prongs towards the shore, which we later called Prong Building (Fig. 1.7 grid square E.3), and immediately east of this, a complex tangle of walls overlapping one corner of a series of long parallel structures which we called the Grid Building (Fig. 1.7, E.4). I swam back to the beach, and over lunch we put our drawing boards together to compare notes. Some areas of ruins were so confused that it would require several days of careful tracking and sketching to sort them out before we could start the main survey with accurate measurements.

The sea was calming down, although the residual swell from the windy day before was still stirring up some flecks of sand amongst broken fragments of weed. The largest and best-preserved buildings were in the shelter of the islands, where the other snorkellers had found walls ending in solid masonry towers reaching almost to the surface, causing the swell to pile up and break into surf over the ashlar blocks. We gave more names to the biggest buildings which reflected how they were found, who found them, or some token of their construction and position. Amongst them were “Bill’s House”, “Tyre House”, “West Island Slipways”, “Five Silos”, and “Nine Quays”. The reef to the west of the city, “Grotto Reef”, where we could see the entrance to a submerged tunnel, was exposed to incoming ocean waves that were very dangerous, even in the relatively calm weather. We were not able to swim near it. Also, the water there was so full of bubbles that it was difficult to see much, and sharp rocks would suddenly loom up in front of you.

This preliminary sketching occupied most of the team for the first week. Each sector of the town had to be drawn with an unambiguous set of shapes and corners, disregarding the true lengths and distances, but sufficiently accurately that anyone with the sketch could identify each corner or junction for later precise fixing. With a diver in the water having a similar copy of the sketch map as the surveyor with the alidade table on shore, we could make fixes of agreed points in logical sequence without mistakes. Nick Wood had unpacked his drawing board, T-square, rolls of linen-backed drawing paper, and drawing instruments in readiness. During this first week Dr Adrian found that Mrs Spencer had been running an informal medical clinic for the villagers, with the result that his professional skills were soon engaged every morning working together with her.

In four days we had familiarized ourselves with much of the city and we had set up the baseline on shore. The line was 810 m long (2657 ft) and marked every 30 m (100 ft). It started by the Main Gate in the west and finished by the Greek Theatre in the east. We were ready to start the accurate survey, while sketching still continued in the far corners

of the underwater town. Work progressed well, but our discoveries showed that the scale and architectural complexity confronting us were daunting.

Underwater archaeological mapping has made great advances since 1958. Where the seabed structures are large masonry blocks or concrete buildings with rectangular corners and plane faces, the use of high frequency multibeam sonar can produce reliable preliminary outlines to be checked by divers. Where the walls of buildings have collapsed into surrounding rubble, or where uncut stones have been used like dry-stone walls on land, the human eye of the diver is necessary from the start. Even with modern Total Station laser rangefinders reflecting off poles equipped with reflecting prisms and automatic data logging, somebody has to make the preliminary sketch map so as to define the recorded points, and this phase of mapping underwater cities continues to be laborious. The only system that might speed things up and enable faster surveys is the use of robotic automatic vehicles that simultaneously take overlapping stereo-photographs while recording position by GPS (Chapter 6).

* * *

Every morning for the next few days, after collecting our kit, we walked through the scorching heat of the village to the beach, dressed only in swimming trunks and T-shirts. Bill Hemmings and Richard Everington took aqualungs and underwater cameras, Nick took the alidade and plane table, while the rest of us carried swimming-gear, Formica plastic sheets, ranging poles and tripods. This procession caused much amusement, and Arab children who called everyone "Johnny" always accompanied us. They often helped us carry things. Every morning we passed the same donkeys, camels, and chickens scratching and rolling in the thick red dust. On arrival at the day's survey base, Nick

Figure 1.8. Nick Wood working with the telescopic alidade on the tripod, positioned on the West Island. The yellow arrows permit the tripod to be put in exactly the same place on different days. Nick is viewing a diver in the sea holding a coloured ranging pole, like the one in the background.

set up the plane table while Martin, Richard Windred, and I swam out to sea with the ranging poles. Using duplicate copies of the preliminary drawings, drawn on Formica, it was easy for the swimmers to position themselves over 20 or 30 points in turn, while Nick took the bearings on the same points and signalled when he was ready for us to move (Fig. 1.8). We took two or three hours to fix 30 points in this way, and when Nick wanted to cool off in the water, somebody would take his turn at the plane table. The children taught us to count in Arabic and how to say a few polite phrases, but we never got very far, finding it easier to talk to the older students who often visited us, and who usually spoke excellent English. They were very interested in our work as we explained the principles of triangulation to them, which they easily understood.

Sometimes I would sit on the rocks of the West Island, or on the beach, redrawing my plans or transferring them to paper, and gaze out over the water to where the tiny figures of swimmers cruised back and forth, hesitating and turning with slight splashes as they followed the elusive walls flickering in the refracted sunlight below them. Each day the snorkel swimmers swam several miles as they stationed themselves over one key point after another. When we landed on the island we beached the dinghy on the trireme slipways cut by the Greek colonists 2500 years earlier. Just east of the slipways (Fig. 1.7 B.9) was the entrance into the harbour basin, guarded by the two solid towers which we called the Block Forts (Fig. 1.7, C.10).

The towers of the Block Forts rose massively from the sandy floor and broke off just at the sea's surface, so that in the slightest wind or swell the waves broke white with foam (Fig. 1.9). South of the Block Forts was a maze of walls that was proving most intractable. We swam over the area in a collegiate shoal, trying to identify every stone, checking and cross-checking, and discussing our different drawings. A colossal wall nearly 10 m (30 ft) thick stretched from the shore near the Great Basilica (Fig. 1.7, H.10) to the southern Block Fort, near which were numerous small rooms, one almost complete and with a door space. This was the only area of the city where kelp grew thickly, and rank brown fronds of laminaria concealed the details. The massive wall separated the inner harbour basin from the bay to the east, forming a section of the military defensive walls of the city. Swimming westwards, we followed the curved

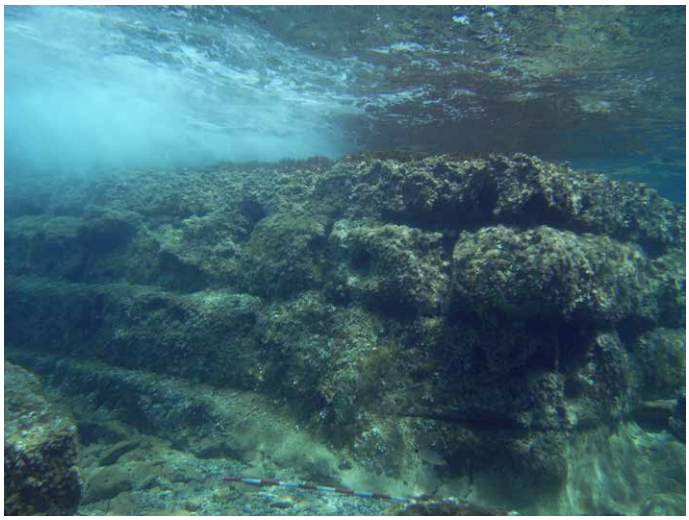


Figure 1.9. Southern Block Tower, guarding the channel between the two harbour basins, showing the stepped-in courses of ashlar masonry (Photo Carlo Beltrame).

wall that led round the inner harbour to the nine parallel buildings which we dubbed the Nine Quays (Fig. 1.7, E.9), and the foundations of a round tower (Fig. 1.7, E.10). By repeated observations, discussion, and redrawing, we eventually eliminated most of the ambiguities in the original sketches.

As the survey progressed and the map grew larger, we discovered more rock cuttings that looked like slipways by the East Island. We also found that the galley slipways on the West Island had buildings right on top of them, which was very odd; and below the end of the slip was a large wall that would have prevented the entry of any ships. The city had been rebuilt over time so that we were seeing stratigraphic superimposition of buildings from different periods, one on top of another. There were also the foundations of a house on top of the Grid Building in the southwest corner of the harbour; and overall there seemed to be two generations of buildings, one defining a circumference about 20 m (65 ft) nearer the centre of the harbour than the other. At some date the harbour basin had contracted, or the sea level had dropped. We found fragments of amphorae everywhere, and several whole pots and jars embedded in the black earth below the sand. Miraculously, after a storm had shifted the sandbanks on the seabed, we found the arm of a large marble statue which we raised and gave to Richard Goodchild. The discovery confirmed that in its heyday Apollonia had been decorated with fine sculptures. We searched for hours for the rest of the body, but had no luck.

Every evening after dinner we discussed the progress of the work. Nick Wood confirmed that the accuracy of positions measured from the baseline to buildings in the sea was consistently of the order of 20 cm (8 inches); although on one occasion he found an error in the day's work, and we had to repeat it. After a week we planned to extend our activities. Bill had shot several rolls of black and white film which he had developed successfully, so that he was ready to start shooting colour under water. He had also been collecting biological samples which he stored in the transparent plastic bags. Nick Wood had moved his architect's drawing kit to the peace of a beach hut, where he had plotted all the survey points to date. He suggested that we should start measuring wall thicknesses and block sizes the next day. The time was also right to start filming movie, using the West Island as our base.

Next morning, with a stack of aqualungs, tripods, boards, poles, and towels piled into the inflatable boat, Nick perched on the top and rowed cautiously across the calm sea to the island. His loyal following of Arab children stood wide-eyed and bereft on the beach for some time, then ran away to find other amusement. Dave, Dick, Martin, and Richard Windred swam after the boat and helped Nick with the surveying, while Bill and Natalka collected zoological specimens, and Richard Everington and I prepared the underwater ciné-camera. Adrian was by now committed to helping Mrs Spencer running the surgery for the local population, and could not be with us in the mornings. By eleven, when we gathered on the hot, rocky slopes of the West Island, the sun was burning down on the dead calm sea. We planned to shoot a film series of the different stages of surveying around the Block Fort towers, and we discussed the exact sequence of shots as we fitted our aqualungs. I plunged into the water first, and briefly tested the motor of the underwater movie camera. Some wrasse swam towards me, their mosaic colours shimmering in the green light, and I slowly brought the camera into position and shot a few feet of film. The divers were on their way, and the fun was soon fast and furious. There were six divers in the water in front of the camera, with Bill

gliding around the outskirts of the group taking still pictures. On either side of us the flanking towers rose up to the surface, and the floor of our stage was carpeted with the building stones quarried from the islands by the Greeks and Romans. While we were swimming in this mysterious and peaceful setting, we felt periodically the sharp clang and pressure-shock of underwater explosions. Arab divers were blasting for scrap on a wreck just along the coast. We hoped that they would not come too close.

One morning I was finning luxuriously over a curious area of superimposed buildings dating from different periods, when I saw a fisherman's rowing boat about 50 m away, with dark figures waving to me. I could not make out whether I was meant to approach or keep away. But as I guessed that they were bombing fish, I thought I would rather be in their boat when the big bang came than anywhere in the water. I swam towards them and climbed into the stern of the boat. A tall, handsome, one-legged African stood amidships, handling the oars, with his stump-leg propped on the thwart. In the bows sat two Arabs, gazing into the water. The first wore only trunks and was still wet and shiny. He gripped a glass-bottomed bucket with his good hand, while his other hand, which had three fingers missing, was curled painfully on the side of the boat. His friend held a homemade bomb, constructed out of sardine-tins filled with the explosive from shells, and he too had the fingers of one hand missing. The whole crew seemed very happy, and the big African smiled at me as he turned the boat this way and that, but nobody talked as they waited for the fish. There was a long, slow swell coming into the bay, on which the boat rose and fell silently, rocked occasionally by the gentle creaking movement of the oars. They could find no fish, so I thanked them for considering my safety, and they smiled again as I dropped back into the water.

* * *

The slipways were amongst the most perfectly preserved features of the whole city, since they were in the lee of the West Island. You could lie in the shallow water gazing down the parallel sloping walls and imagine the slender bow of a galley nosing onto the central runner of the slip after a long voyage. Then the shouting and heaving as the vessel was hauled, dripping and weedy, into the heat of the sun, before being pulled up under the wooden roof, to be scraped and re-caulked. Now the slips were completely submerged, and littered upon them were fragments of columns, rubble, and three-inch shells from the wrecked ammunition ship nearby. At the top end of the slipways was an excavated work space or storage area carved out of the island, with rock-cut doors leading into hollowed-out caves, from one of which steps led up onto the top of the island. There had probably been a watchtower up there. This would have given advance warning of attack from the sea. The fortification of the West Island confirmed both the military and commercial importance of Apollonia.

We had anticipated that parts of the city might be covered in deep sand so that we would need a powered device to excavate down to the building stones. Martin and I had constructed a small airlift consisting of 3 m (10 ft) of sections of rigid pipe that slotted together, with an air inlet welded into the side near the lower end. Injecting high-pressure air at this point would create an upward flow of water mixed with bubbles that dragged in more water, and sucked up the sand. An aqualung cylinder strapped onto the lower end of the pipe provided the air supply. We took this out in the dinghy and

lowered it to the east of the Nine Quays to test it. I forced the bottom end of the pipe into the sand before turning on the high-pressure air. Plumes of muddy sand shot out at the top, as I dug a small pit. Soon the pipe had cut through the sand layer and was resting on packed mud and stones. The machine worked well, but after further exploration, we realized that the ruins projected above the sand almost everywhere, so we did not use it often.

As the map grew, it began to reveal how the city reached its present state. The West Island slipways were Greek, similar to those at Piraeus, being just wide enough to hold triremes. Thus they were probably built in the earliest period of the city's history, in the 5th century, and should indicate the level of the sea surface at that time. If boats are to be pulled up a slip, the water must be deep enough at the bottom for the keels to rest on the slip, and it must be long enough for the boats to be dragged high and dry. From the dimensions and slope the water level had risen by just over 2 m (6 ft).

The slips were 6 m (20 ft) wide and 40 m (131 ft) long, with the top just awash and the foot submerged by 2.8 m (9 ft 2 in), making a gradient of 4 degrees (Fig. 1.10). The centre of each slip was depressed relative to the sides, so that it had a shallow V-shaped cross-section, with thick walls dividing each slip from its neighbours. These walls, which were cut out of the solid rock, were 75 cm (2 ft 6 in) thick, and stepped irregularly as if to support a masonry wall of rectangular blocks above, or perhaps wooden pillars and a roof. No blocks were found in position, and it is possible that the large patch of rubble overlying slips three to five contained the remains of some fallen walls, or that they were removed deliberately before the later buildings overlying slips six to nine were built. Polybius, in his description of the sack of Carthage, mentions slipways with storage chambers above them and a column at the foot of each dividing wall. The slips at Piraeus seem to have been separated by rows of columns, but the columns at Apollonia all lay on slips six to eight, suggesting that they were relics of the overlying buildings rather than the slips themselves.

Slips three, four, five, seven, and eight had central runners, each about 5 cm (2 in) high, varying from 30 cm (1 ft) wide at the top to just over 1 m (3 ft 4 in) at the bottom (Fig. 1.10). Slipway two had a more complex runner with a slot in it, presumably to take a timber beam to provide a safe skidding surface. Later work on slipways at other ports, and literary study, show that the stone cut slipways were probably the foundation for wooden skids with supporting frames to prevent damage to the fragile hulls.

Even with the lower water level, there would still be a depth of a few metres in the gap between the West Island and the Grotto Reef. Since the prevailing wind is from the north-northwest, so that there is often a heavy sea from that direction, the harbour would have been almost useless unless that gap had been blocked up. This had been done at other Greek harbours, and it seems very likely that there was a dyke or mole connecting the reef and the island, especially as we found large quantities of rubble in this area. The need for the early construction of this dyke was also dictated by the large number of people frequently working on the West Island: soldiers, guards, watchmen, shipwrights, and the crews of the galleys would need to go back and forth easily to the main city on foot. The dyke connecting the Grotto Reef and the West Island also formed part of the defensive perimeter.

To account for the buildings over and beyond the foot of the slipways, and for the inner ring of dockside buildings, it seems that the level of the sea surface dropped at

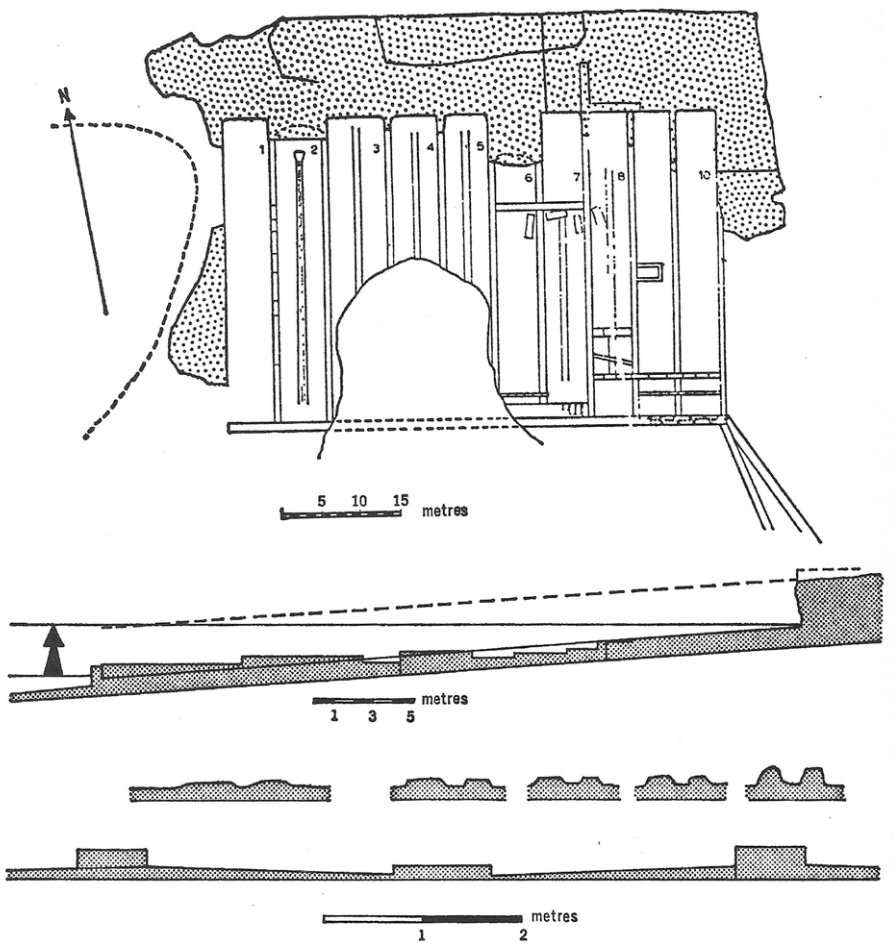


Figure 1.10. The ten slipways at Apollonia probably had wooden skids fitted into the central runner to prevent damage to the galleys when they were hauled out of the sea, and the whole complex may have been roofed in. Sand and stones cover slipways 3-4-5, and walls of a later date have been constructed over the slipways, when they were disused. The lower drawings show the slipways in profile and cross-section.

some time, or that the land uplifted. It is likely that the lowering of the water occurred, or became serious, during the Roman period. A sequence of earthquakes could account for first an uplift followed by a major subsidence. In later years I spent a great deal of time studying the interaction of earthquakes and global sea level change (see Chapter 6), but in 1958, sitting right beside the puzzling ruins, we did our best to decipher the cryptic clues with no established science to guide us.

* * *

We soon became acquainted with a team of Arab divers who were spending a season at Apollonia. They lived on the modern concrete jetty beneath a canvas shelter supported by oil drums. They had cushions to sit on and a radio for entertainment, and they would

have been very happy had it not been for the bends, or decompression sickness. The wrecked ammunition ship that they were cutting up for scrap lay at a depth of 24 m (80 ft). They used old-fashioned standard helmet gear, with a large copper helmet and baggy leather suit provided with compressed air by a long hose from a pump on the surface. After dives of many hours, they were in the habit of surfacing without stops. As a result, one man was groaning in agony on a heap of rugs while his companions comforted him by singing, waiting for him to get better before they continued their work. We tried to explain that the pains would not occur if they dived for a shorter time or stopped on the way up. They would hear none of it.

"It is the will of Allah," said the afflicted one. "All divers die young. My father died at 27. I will soon be dead. It is the will of Allah."

Meanwhile, during Mrs Spencer's morning surgery for the village, Dr Adrian's medical treatment of the wife of the captain of the Arab divers had been so successful that the grateful skipper offered to take us out in his boat any time we wished. I asked if we could use his boat to dive for a short while in the open sea to a depth of 60 m (200 ft). The Hydrographic Office charts, combined with the Arab's local knowledge, enabled us to anchor a mile offshore at the correct depth, where I organized a sequence of buddy diving pairs supported by standby divers who had not dived. I wanted to see what the seafloor was like at this depth, checking for rock outcrops. The charts showed a flat gravel seabed, but one could not expect detail in such a remote area.

The sea was so unbelievably clear as we plunged "into the blue" that there was almost a feeling of vertigo when you looked down as if floating in the air. We descended rapidly down a vertical shot-line. The colder water at depth shocked our skin as we finned downwards, and gradually the darkness of the seabed loomed below. It came into focus as ribbed undulating gravel, with a few fish looking startled by our arrival. Huge elephant ear sponges were dotted about like gooseberry bushes, and I cut some chunks and stuffed them into a plastic bag. We had no wetsuits and, at this depth, where the sun could not warm the water, we felt the cold badly. I scooped a sample of the gravel into another bag, and after a few more minutes I signalled to ascend, coasting slowly upwards, conscious of the need to be careful, to save air for decompression stops. We used the British Sub Aqua Club decompression table, which demanded a series of progressively longer stops, starting at 20 ft (6 m), and then 10 ft (3 m), before reaching the surface.

We hovered at the 20 ft stop where we rested, hanging on the shot-line which was secured to a buoy on the surface. Since stops are usually boring, I gazed around in all directions, trying to find something to pass the time. The water at this level seemed to be cloaked in a translucent film, like a horizontal sheet of gauze that stretched away to infinity. The water above and below the film was pure and clear. Sunlight filtering down from the surface was reflected back from the film like headlights of a car bouncing back from fog, although the film was so thin that we had not noticed it at all during our descent. It was only visible when you were very close to it and you looked at it at a very oblique angle, almost parallel to the film itself. Even more puzzling was the fact that the film undulated with long slow waves a few inches in height that travelled at a crawling, creeping velocity, like a movie being shown in very slow motion. I was familiar with the idea of a thermocline, an interface where warmer water lies on top of cooler water with a sharp temperature change at the boundary, but I never expected to see one in the flesh. The discontinuity in density caused by the change of temperature had created

a catchment on which falling dust and plankton had come to rest, making the layer visible. This visibility also revealed the internal waves that travelled slowly on the interface. That decompression stop was not boring. I had made my first observation of physical oceanography. The Arab divers watched with incredulity and mirth as we held onto the anchor rope, just flapping our fins slowly, doing nothing, easily visible from the surface. Finally, we climbed back up the diving ladder and, after other buddy-pairs had dived, returned to shore, where we thanked the captain of the boat for his time and help.

In the next two days we surveyed and fixed the location of all the corners of the Nine Quays (Fig. 1.7, E.9), confirming that there was an unbroken chain of scattered buildings from the quays to the Grid Building, thus completing the circuit of the southern border of the ancient harbour. The quays are not closely similar to any structures in other harbours, either ancient or modern, but can only have been used for the berthing of slender ships, either civil or military. The 6 m width of the slipways on the West Island would have been sufficient for vessels with a beam of 4-5 m (13-16 ft), but the spacing of the quays is only 3.5 m (12 ft). Whether this is the maximum beam of the largest vessel, or whether only multiple smaller vessels were berthed at the quays, is not certain. The dock spaces between the quays are 25 m (82 ft) long, and if the ships were this length, they would have had a length-to-beam ratio of about 7:1, which is high for a cargo boat, but very likely for a fast boat built more to be rowed than to carry a large sail. From the rough rule that a stable rowing boat draws one-third to one-quarter of its beam, these boats would have drawn less than 1 m (3 ft). The function of the quays has been much disputed in subsequent years, but I stand by the proposal here, which seems the best explanation. This point is discussed more fully in Chapter 11.

We continued the underwater survey of Apollonia by mapping the walled channel which led into the harbour from the east. Straight walls, spaced 14 m (46 ft) apart, stretched 65 m (213 ft) northeast from the Block Forts. The sides of the channel contained fallen rubble, which sloped down to a sandy floor. The channel was partly silted up, but was 4 m (13 ft) deep at the inner end, sloping to 6 m (20 ft) deep at the outer. The top four courses of the Block Forts were each inset from the course below by 10-15 cm (4-6 in), so that the buildings tapered slightly (Figs 1.11, 1.12). The tops of the Block Forts were completely flat, with no suggestion of a superstructure or peripheral walls. Maybe they supported wooden towers. The small square building just south of the southern Block Fort had a door in its eastern wall opening onto the area of rubble (Fig. 1.7, C11), where one or two foundations were visible.

Sitting on the sandy floor of the channel and looking up, you could imagine triremes with bronze rams at the bow passing slowly overhead, blotting out the sunlight. They might be carrying soldiers returning from a patrol where they had searched for pirates. Armed guards on either side of the channel lowered the heavy chains between the block forts that closed it to unauthorized vessels, and the triremes rowed over to the slipways.

For the first time we were able to approach the Grotto Reef and fix its limits (Fig. 1.7, B.4). We left one man on the island to guard the equipment during lunch, where he was surrounded by Arab boys throwing unexploded shells about in trials of strength. The afternoon was exceptionally calm. Four of us swam out to the reef accompanied by the dinghy, after setting up the surveying alidade on the West Island from which Nick surveyed the prominent corners of the reef.

We found a long boomerang-shaped lobe of bedrock curving round the outside edge of the city to form its northwest corner. The outside face of the rock was cut into vertical planes,

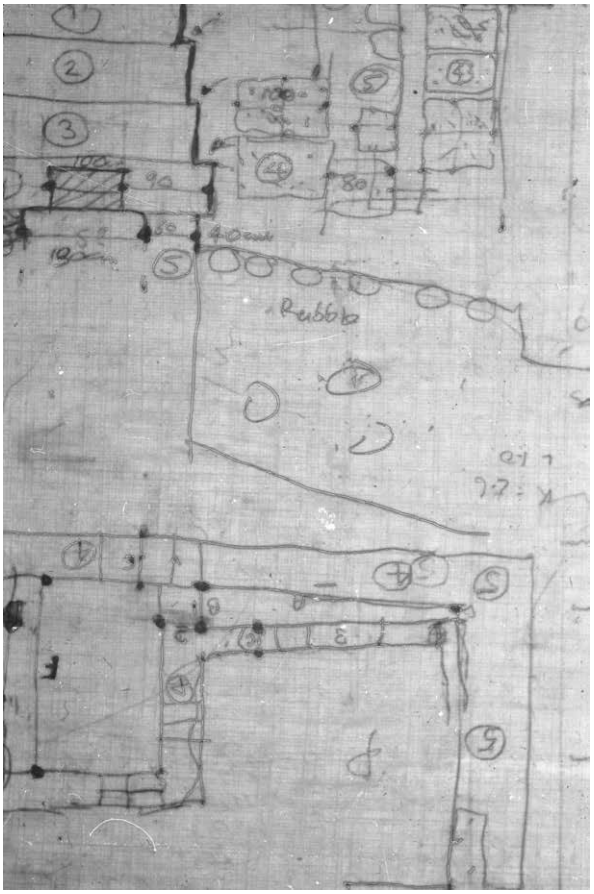
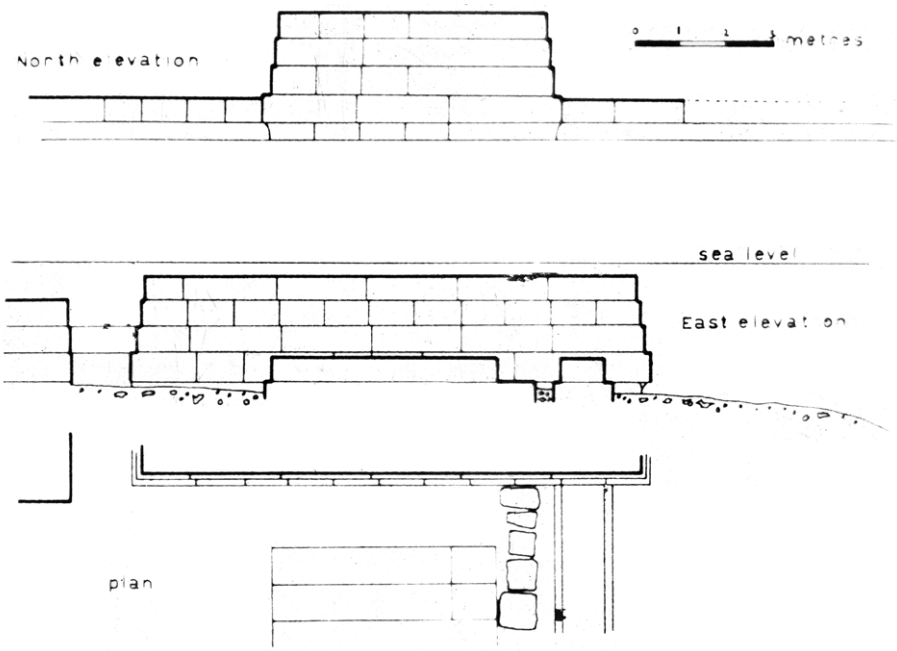


Figure 1.11. A drawing made under water of the southern Block Fort showing the stepped-in courses of ashlar masonry. This gives an idea of the level of detail that was recorded in 1958-59 for the main well-preserved buildings. The architect's rendition of this is shown in Figure 1.12.

Figure 1.12. Nick Wood's accurate survey drawing based on observations by divers working round the southern Block Fort, and photographs. The two fort bases were on the south and north sides of the channel between the two harbour basins. The channel could have been closed with a chain for defence.



and the upper surface broke the water at a few points. Outside the main block there was a second series of planar rock walls parallel to the first, separated from them by a channel 10 m (33 ft) wide. It was like a recessed road with a solid rock fortification protecting it on the seaward side. The most extraordinary feature was a tunnel cut right through the main block, some 17 m (56 ft) long, 2 m (7 ft) high, 1 m (3 ft) wide, and with a perfectly flat floor and flat roof. The rock roof was just below the surface of the water. This tunnel was one of the most beautiful and impressive remains of the city. At the inner entrance facing into the ancient harbour, there was a great overhanging slab of rock projecting like a dark porch, with the waves rippling gently on top of it. Inside, the straight walls and flat floor were menacingly dark, but in two places the roof had cracked, admitting silver wedges of sunlight that illuminated the drifting plankton like dust in a curtained room. Pale-pink diaphanous fish clustered against the ceiling, trailing transparent fins. I swam slowly through the darkness until, at the outer end, the tunnel opened into a small courtyard or chamber, from which a wide doorway led beneath a slender horizontal beam carved from the solid rock into the channel or roadway beyond (Fig. 1.13).

Swimming under that roof of the tunnel where the soldiers of the city had once marched through to stand guard on the outer defences was the moment when I felt most powerfully the haunting presence of the dead. The sense of identity with the original users of the shortcut through the rocks onto the sea wall was visceral. We measured the internal dimensions of the passage with the 2 m (7 ft) rule, and the outside with the 50 m (164 ft) wire. Apart from these crude measurements, this exquisite structure has

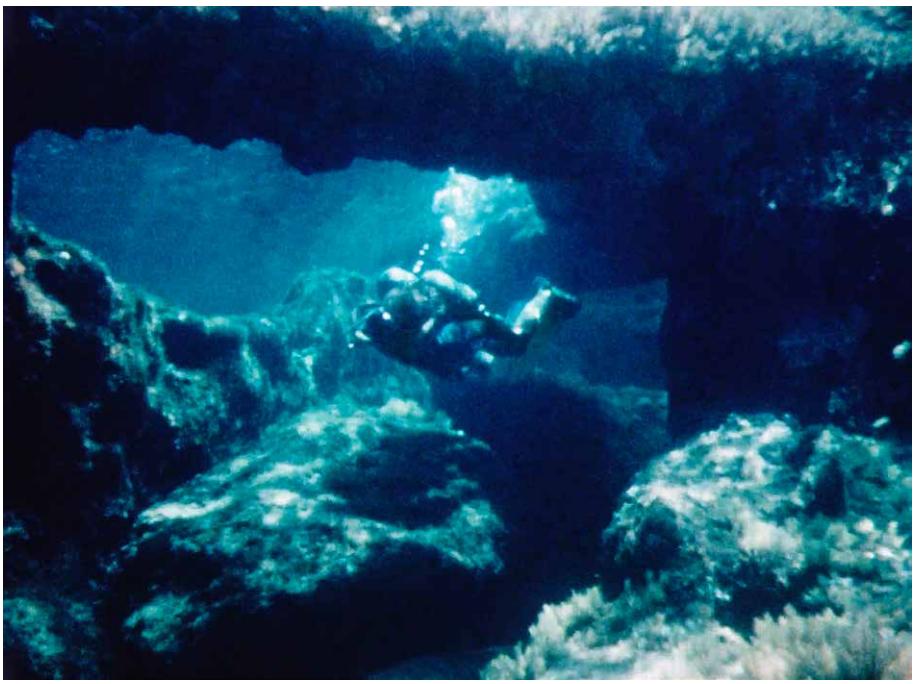


Figure 1.13. This blurred image is a still taken from the 16 mm movie shot at 24 frames per second. It is the only existing record of the rock-cut arch at the outer end of the tunnel through the Grotto Reef. The diver has swum through the roofed tunnel that ends in the dark shadow on the right-hand side of the picture. This has all been destroyed by storms or fish-bombing since 1959.

not been drawn or measured in detail, and the only record of it is the 16 mm movie. I copied the film onto DVD in the 1990s, and in 2020 I had the original Kodachrome film digitised at high resolution direct onto solid state hard disc memory. In 1958 there was no time to measure the tunnel precisely, draw the roadway, or photograph the beautiful arch at the outer end: nobody anticipated that it might be almost impossible to dive at Apollonia for decades to come. French divers who photographed the reef in the 1980s found that much of the roof had been smashed by the waves, or perhaps by the fish bombers. Professeur Claude Sintes, to whom I sent a copy of the DVD, said that most of the tunnel or corridor and the arch had collapsed.

* * *

During our last days at Apollonia the weather was bad with the north wind first bringing waves roaring over the Grotto Reef, before swinging round to the south so that the sky was red with dust. The divers worked singly or in pairs measuring block sizes or patches of masonry that had proved too small or isolated to be surveyed from the shore baseline. These were fixed in position by trilaterating measurements using the 50 m (164 ft) wire from known fixed points. Many buildings had collapsed so completely that only further excavation could possibly reveal their former shapes. On the last full day of diving and snorkelling, Martin found that a rectangular excavation under the sea just close to the acropolis was a segmented tank. It was almost certainly a fish preservation tank, or *piscina loculata*. This discovery was exciting, but also frustrating, since there was no

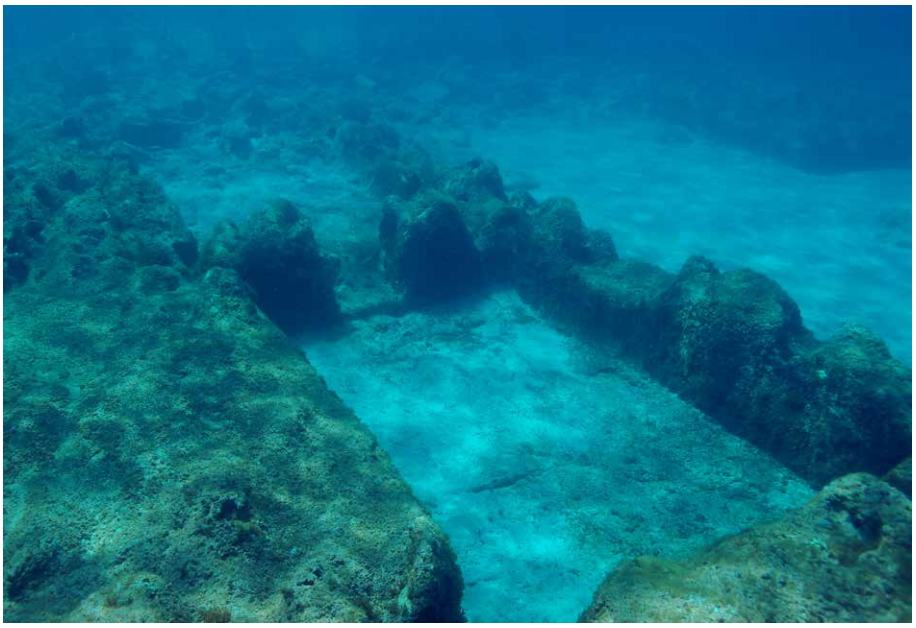


Figure 1.14. Martin Minns found rectangular submerged tanks at the east side of Apollonia on the last few days that we were there in 1958. The tank was divided into sections by internal walls, and we concluded that it must have been a fish-tank, or piscina loculata used by the Romans for keeping different species of fish in different compartments (Photo Carlo Beltrame).

time to measure it accurately (Fig. 1.14). The Romans had perfected ways of keeping sea-fish living in protected pools, but we knew nothing of the details.

We were exhausted by the work, the heat, and countless abrasions and small cuts on our hands, feet, and legs that did not heal because of the constant exposure to salt water. These sometimes became infected, in spite of the application of mercurochrome – an old fisherman's standby – or, in extreme cases, magnesium sulphate paste, which were the only treatments available in our medical kit.

We had avoided siestas during the four weeks at Apollonia, but tried to use the hottest hours of the day to do work in the stores, repairing equipment, filling air cylinders, drafting the maps and drawings, writing reports, or developing films, minimizing the risk of sunburn. We developed minor attacks of dysentery or "gippy tummy", but luckily nobody was badly affected. Dr Adrian had departed to visit friends in Tripoli a week before the end of the work at Apollonia, so that we no longer had his expert advice. David Fagan had brought some new sulpha drugs to test for a pharmaceutical firm, but we found that they made people drowsy and lethargic, which was dangerous if you were snorkelling or diving. Instead we relied on kaolin clay or charcoal to control the dysentery. An occasional visitor during our work was Dr Wolfgang Berka, who, in his capacity as Doctor to King Idris, drove a pale-blue Mercedes which unfortunately had a big dent in it where it had been kicked by a camel. Wolfgang suggested that the infected cut on my foot would benefit from an injection of penicillin, which he administered over a drink of pastis at the Dolphin Hotel.

The mapping of Apollonia was so clearly unfinished. It dawned on me with frustration and sorrow that I had been naïve to even think of finishing such a task in four weeks. In probability it would never be finished. Brigadier Martin arranged for some army trucks that had been conducting exercises nearby to transport us back to Benghazi, where we were entertained with a refreshing and light-hearted reception party at the British Consulate. With heroic feelings of achievement somewhat restored we boarded the *Città di Livorno*, returned to Syracuse, reclaimed the Volkswagen minibus, and drove back across Europe

As soon as we were back at Cambridge, Nick Wood, Martin Minns, and I set about thanking sponsors, recording details from numerous notebooks, documenting, and tidying the records and maps (Fig. 1.15), while Bill developed and printed the still photographs and sorted his biological specimens. The 16 mm film had turned out quite well, requiring me to spend many hours squinting at a small illuminated editing screen, winding the film through by hand, and cutting it into short lengths, before sticking the good segments together again in a logical order to make a presentable story. Editing was an absorbing skill, but the smell of the adhesive cement was overpowering.

One result of our mapping was to show the horizontal erosion of the coastal ruins at Apollonia since the survey by Beechey 130 years earlier. Comparing Figures 1.5 and 1.7, you can see that the circular western gate tower was securely on dry land in the 1820s, with a solid triangle of land stretching about 100 m (325 ft) to seaward along the western city wall, up to the square tower in the city wall near Prong Building. The sea had eroded away this area by the time we arrived in 1958, although the foundations of the broad outer city wall had survived on the seabed. This maximum erosion on the western side of the city confirmed the damaging effects of the northwest wind and storms. Other parts of the beach and shallow ruins are better protected by the refraction effects of waves obstructed by the island barriers on the seaward edge of the city. The term "Foul

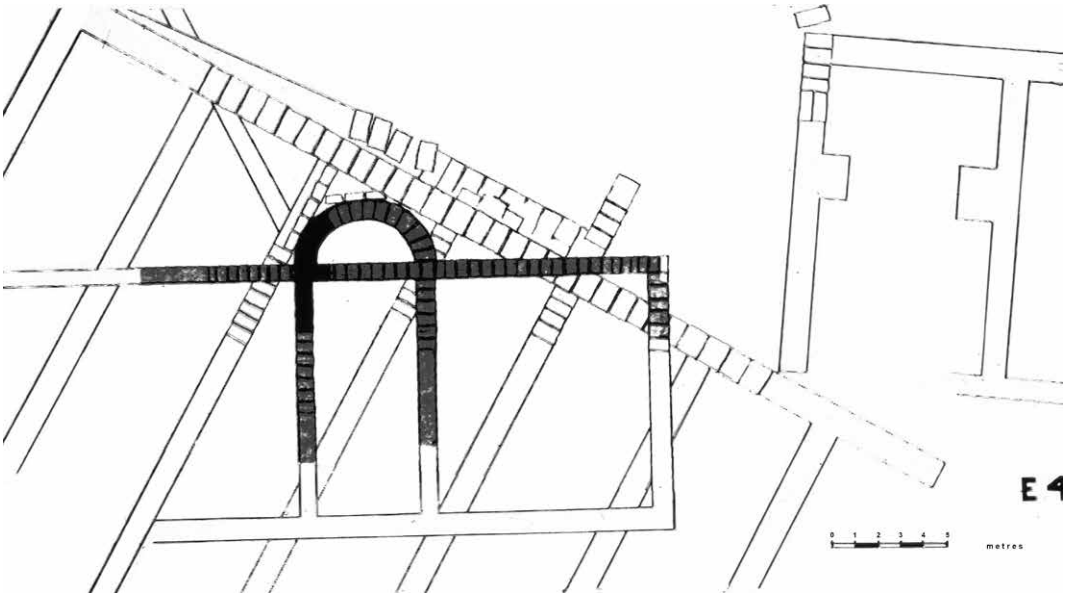


Figure 1.15. One of the most complex pieces of stratigraphic evidence at Apollonia. There are four layers of superimposed buildings of different dates, culminating in the small apsidal building using smaller ashlar blocks at the top. The shading of the walls of the apsidal building indicate one course of masonry, two, or three and more courses intact. The successive phases of use of the buildings suggests that the diameter of the inner harbour contracted at one stage.

Ground" is applied to most of the underwater city area, this being the navy term for a seabed that is likely to snag your anchor and make it difficult to recover.

During that autumn I tried to establish whether the submergence of Apollonia was due to local earthquakes or a global rise of sea level in the past 2500 years. I thought that this would take a few days. (Sixty years later we are still working on the details of an accurate answer to that question. See Chapter 6). I visited the National Institute of Oceanography at Wormley, Surrey, where, after a day with the experts, they provided the classic answer that "It could be a bit of both". I learned that global sea level could change due to the heating and expansion of the sea itself, or to melting or freezing of the polar continental ice sheets. The knowledge that sea level really could change over the whole planet started a train of thought that motivated me for the rest of my life.

The Director of the Royal Geographical Society, Laurence Kirwan, invited me to give a lecture on our team's work at Apollonia, to be presented in the spring of 1959. I gave the lecture, illustrated with slides and a short excerpt of the underwater film, which provoked many eager questions afterwards. Sir George Deacon, Director of the National Institute of Oceanography (NIO), came up to the lectern and said very quietly, "If you ever need a job, please apply to me." I was informed later that I was the youngest person ever to give a public evening lecture at the RGS, and so far as I know, this is still the case.

I wrote an article that was published in the *Geographical Magazine*, followed by short articles for the house magazines of several of the sponsoring companies. After that I settled down to study the Natural Sciences Tripos at Cambridge with renewed energy.

* * *

During the winter we worked over the results of the expedition, finding, to our irritation, that the deductions we made from our map would need further fieldwork to confirm. Was there a lighthouse on the East Island? Was the rectangular tank really a *piscina loculata*? Was there a further breakwater enclosing the eastern harbour basin? What were the accurate depths in the centres of the harbour basins? What was the relationship between the great port and the neighbouring small ancient towns along the coast? Did they all trade independently with Rome, or was produce transported coastwise to be concentrated at Apollonia, for transfer into larger cargo ships?

But there was no plan to return to Libya.

A few weeks before leaving for a project in Sicily in July 1959, I found the opportunity to arrange a second visit to North Africa as a result of the repeated generosity of the Royal Geographical Society, the British Academy and *The Geographical Magazine* Trust Fund.

Our diving team that left Sicily for Libya at the end of August 1959 was six people, including some old-hands from Apollonia 1958, and some excellent new members. The core team was myself, Martin Minns, and Natalka Czartoryska; the new divers were Martin's younger brother Jonny, John Dick from Cambridge University, and a wonderfully energetic Australian named Hugh Edwards. Although I have not met Hugh again since 1959, I have followed his career in Australia, noting that he became a successful writer who was awarded several literary prizes. Hugh was an expert on Australian shipwrecks, but he enjoyed the novelty of an underwater Greek city, which he has mentioned several times in his later writings. He had a sharp eye for detail and was an invaluable member of the diving team. Machines loved Jonny. The most battered outboard or rusty compressor would purr to life instantly when he touched it.

On the morning of September 3rd, the twin domes of the Italian Catholic Cathedral of Benghazi crystallized out of the early mist on the horizon, and we carried our gear onto the deck of the *Città di Livorno* for unloading. There was a small compressor, an outboard motor, four aqualungs, two underwater cameras (one still, one ciné), plus a mass of personal equipment and odds and ends. We had no boat of our own, but one of the sailors on board assured us that his friend Nino of the fishing vessel *Freccia Nero*, who would be in Benghazi, would be delighted to lend us a dinghy, so I gave him a large bottle of Marsala wine and hoped that this would help him to find Nino.

We cleared customs quickly. By chance we met Richard Goodchild in the street, and he arranged for us to stay in an unused school building in Marsa Susa. The main party set off in a bus with all the equipment, while I stayed in Benghazi to collect the dinghy from Nino's fishing boat in the harbour the next day. I contacted the Royal Army Service Corps who told me that they had a patrol of two Land Rovers and a 3-ton truck going east, on which they would take the dinghy and one or two people. That evening, as the air cooled from the heat of the day, I sat at a café in the square calculating the odds on getting any useful work done in only ten days at Apollonia so late in the season. We were committed to make a map of Phycus, an unsurveyed town west of Apollonia, to confirm the positions of the submerged rubble moles around Apollonia, and to do a plan of Martin's fish tanks, all in so short a time with only a slight chance of good weather.

I accompanied the army lorry next morning to the dockyard, where Nino had some hands ready to load up the dinghy. We drove out of the docks, met the Land Rovers at

the Turkish Fort in the foothills of the Jebel Akhdar, and drove on to Barce and Cyrene. We arrived at Apollonia in the early evening, where, to the west, the ranges of hills were blurred by the glare of the setting sun.

We started work early next morning. Martin was continuing the detailed measurements of the submerged *piscina loculata*, his all-absorbing task. The *piscina loculata* is a fish storage pool divided into compartments connected by channels controlled with sluice gates, each compartment containing different varieties of fish (Fig. 1.16). The technology is described in the Roman literature of Columella and Vitruvius. (Archaeologists have documented and measured many ancient fish tanks on the Adriatic coast of Italy since 1960, and in a few in other parts of the Mediterranean). Continuous circulation of fresh seawater is assured by synchronizing the opening and shutting of the main sluice gates with the small Mediterranean tide, so that water flows in and out, keeping the tank fresh (Fig. 1.17). The Apollonia tank was cut out of the solid rock at the foot of the acropolis, so that, diving from the rock platform at the water's edge, you plunged straight down to the bottom of the pool, where you could see the dividing walls projecting from the sand and rubble. The water was about 3 m (10 ft) deep here, and so clear and still that Martin could work for many hours without an aqualung, measuring and writing on a board the minute details of the tank's construction.

Hugh went to the extreme eastern end of the city, where he was searching for remains of a sea wall or breakwater, while John and Jonny took the dinghy to make depth measurements all over the ruins and the central harbour basin. One great surprise was the discovery that some of the huge ashlar blocks of the southern Block Fort had been slightly dislodged so that the fresh smooth surfaces with no weed on them projected free. What could have caused them to move? Was it storms, or possibly fish bombers? The implications were worrying. How long would Apollonia last if this was typical damage in one winter?

The time had come to find and explore the ruins of Phycus, the next known Greek town to the west. The Army provided two Jeeps for Natalka and me to make the journey along the coastal dirt track. We drove westwards until we reached Ras Aamer at mid-morning, where we found a team of Arab divers at work on the remains of a wartime wreck, which they had started to cut up the year before. The tangled mass of rusty steel lay against the rocks in 9 m (30 ft) of water with the swell waves breaking slowly over it, disappearing into the gaping holes in the deck to reappear as great plumes of spray. The divers used standard Siebe-Gorman helmet gear, a hand pump and oxy-acetylene cutters. At this depth there was very little risk of bends.

Shortly before midday we reached a stretch of the coast where a line of small dome-shaped hills bordered the sea, clustered around a deep-blue inlet that opened to the northeast. Strange rectangular shadows betrayed the overhangs of rock-cut tombs. We came to a stop on the crest of a hill and looked across the ashlar walls and bits of column which scattered the slopes and projected from the sand. The rocky shore was honeycombed with the hollows of ancient tunnels and tombs.

We climbed out of our seats, took pencils and pads, and started to draw rough plans of the hill and buildings on it. The shore itself was the most important and here we found a submerged shelf fringing the headland, only about 60 cm (2 ft) underwater, with depressions about 3 m (10 ft) deep incised in it, connected to the open sea by narrow channels. The rock headland was about 9 m (30 ft) high with a series of broad straight-

Figure 1.16. Diver examining the small channels connecting the separate tanks of the piscina loculata found by Martin Minns at the eastern end of the submerged city. Fresh seawater could flow through the tanks, driven by the small Mediterranean tide, and the flow was regulated by perforated stone grilles and sluice gates (Photo Carlo Beltrame).

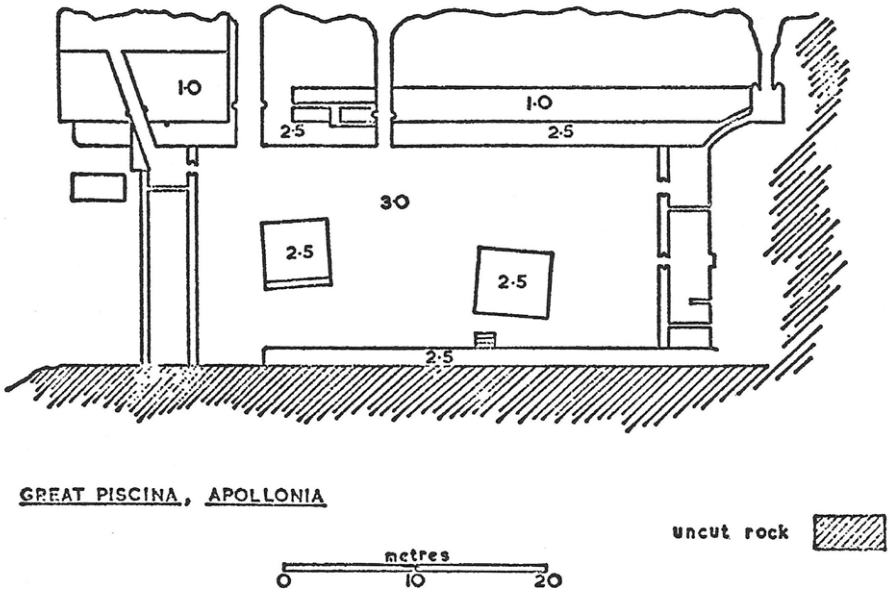


Figure 1.17. Map of the Roman piscina loculata. Note the separate containers for fish of different species and the channels connecting the tanks to the open water. The numbers show the depth in metres. The relative sea level change must have been a bit more than 2.5 m, so that the walkway around the tank was dry.

Figure 1.18. Phycus is an ancient town 30 km west of Apollonia that had never been mapped or excavated beyond preliminary sketches. A network of rock-cut chambers and submerged roadways are incised into the cliffs, flooded by seawater. The ancient town has sunk into the sea by about 1.0-1.5 m.

sided cuts through it, with the flat floor almost like a roadway, but submerged beneath the rippling wavelets coming in from the sea. From these "roadways", rock-cut doors and windows led into tomb chambers, each with alcoves and niches for monuments or votive relics (Fig. 1.18). It is unlikely that the carved "roadways" were just quarries. You don't quarry 10 m down into the rock when you can cut blocks at sea level just nearby. The "roadways" have vertical sides, with openings into chambers with rectangular windows, which all had a purpose, though it is now difficult to understand.

Close to the sea, in places where the rock rose only a few feet above the water, we found evidence of successive cutting of channels, tunnels, silos, and storage tanks, since one cutting would sometimes slice straight through another. Many of these chambers looked as if they had been partly filled with concrete, but closer investigation showed that it was a natural formation of blown sand and chemical salts from the sea, cemented together by sunlight and evaporation. The network of tanks probably formed a storage depot for oil, freshwater, grain, fish, oysters, crayfish, and so on for supplying the ships which called at Phycus in the Byzantine period in the 4th and 5th centuries AD, but many of the features that we found still defy explanation. The produce stored here may have been for transport to Apollonia before assembling in larger cargoes. We swam round the headland, tracing the seaward limits of the walls of the tanks, collected a few pieces of amphorae, and left in the early evening. We drove through the decaying village of El Haniyah, then climbed the hairpin bends to the summit of the Jebel and returned to Apollonia by the mountain road.

Phycus was submerged by about 1.0-1.5 m (3-5 ft), so the earthquakes that had dragged Apollonia beneath the sea may have shattered towns for many miles along the coast of Cyrenaica. Or had the sea level risen also? (See Chapters 6 and 11 for the answers).

* * *

We were outrageously lucky. For the next few days, a gentle east wind blew. It was so soft that it did not stir the water to cloudiness, but was sufficient to cause a slow movement of sand from the eastern limits of the ruins of Apollonia onto the part that we had mapped the year before. The result was that many ruins were revealed in the area of the city that we knew least about, and we worked there furiously for fear that the conditions would change. We discovered a continuous broad band of rubble projecting from the sandy bottom in a depth of 9 m (30 ft) leading out to sea from the acropolis almost to the East Island. At the outermost end there were many enormous rectangular blocks of stone littered about the bottom, with smaller blocks of white marble between them. Knowing that the Greeks were quite capable of building a sea wall in this depth, we concluded that there had been a mole here enclosing a second harbour, and that there had been a guard tower at the end of it. Storm waves had progressively flattened the piled rubble of the mole to leave only the present broad scatter on the seabed.

Although the gap between West and East Island was deep enough for a channel, there was so much rubble lying at the bottom that it seemed that this too had, at some date, been blocked up, so that the real entrance to the port was between the East Island and the newly discovered Eastern Mole. Hugh was certain that the gap between the islands had been blocked and was less than 6 m (20 ft) deep. He was so sure of this that he volunteered to be tied by 20 ft of rope to a large rock and dropped over the side without an aqualung. Luckily we checked the depth first and found it to be 8 m (25 ft), but clearly it had not been used as the port entrance channel.

While we were in England, Sir Mortimer Wheeler, a famous archaeologist of the time, had examined our 1958 map, and had suggested that we search the East Island for the remains of a lighthouse. The sides of the island were all artificially quarried, cut plumb vertical, so that it was very difficult to land. Martin climbed the cliff with a rope which he used to haul up the cameras and surveying instruments from the boat. On the top we found a wide circular foundation partly of curved blocks, part cut from the solid rock, which projected from the cliff like a bay-window on the south side: the lighthouse had been here. As we stood on the lighthouse foundations looking shorewards towards the acropolis, we could see in the depths of water the dark shadow which marked the end of the Eastern Mole. We had discovered the true entrance to the eastern port of Apollonia. This was where the cargo ships entered to load up with hundreds of tons of grain to feed Rome. The narrow channel between the block forts then led further into the inner basin with the slipways.

There were only two days to go. We had achieved all we had set out to do except for finding ruins on the island chain immediately to the west of Apollonia. And still the weather held. Hugh and John spent a morning swimming westward from island to island down the coast, while the sun rose vertically into the sky, but they had to return, defeated, across the scorched red earth. To compensate for this unlucky start to the day, the afternoon provided a succession of surprises. Most of the divers were working

on last-minute measurements, photography, and gap-filling, but Hugh was nowhere to be seen. By mid-afternoon we finished filming and swam back to the shore, where we found that Hugh had just emerged from the water. He was sitting on a large square stone, looking very pleased with himself.

"What have you been doing?" I asked abruptly. I was irritated because I felt that he had been slacking. But I knew that he must have found something exciting, so I tried to conceal my feelings. He jumped up from his seat, revealing it to be a wedge-shaped chunk of carved sandstone with three large holes cut in it through the narrower end.

"Just look at this, boys!" he shouted. "The finest Greek anchor you ever saw. It's better than any we found in Sicily. An absolute beaut."

"Where on earth did you find that?" I asked.

"I was just cruising along the little square building near the Nine Quays when I saw the corner of a stone sticking out of the sand. It had a hole drilled in it, so I guessed what it was. It was less than 10 ft down so I went and got it out. It was a honey. The trouble was it was so goddam heavy that I couldn't swim with it and had to walk along the bottom, dump it, come up for a breath, and then go down and get it again. I'm shattered."

The journey of 100 yards had taken him quarter of an hour before he was able to sit down on the anchor, exhausted but happy.

Figure 1.19. Hugh Edwards found this ancient Greek stone anchor lying on the bottom of the harbour at Apollonia and, since he had no scuba gear with him, carried it onto the shore by walking along the bottom holding his breath.

"Too bad," I said. "Shattered or not, you're going to do it all over again for the cameras. It'll make the funniest picture for years."

We whistled for the dinghy, and Jonny rowed it over. I was getting into the boat when Jonny prodded me and spoke in a hurt voice.

"Haven't you noticed anything?" he asked. I was puzzled. "This," he said, and triumphantly held up a slab of lead with a slot in it. "A Roman ballast weight. The plumb-line landed slap on it. I was looking to see that the line was straight, and there it was. Too easy." This was a wonderful find, but Jonny was cheated of his glory by the excitement over Hugh's anchor as we stowed everything into the boat. Sure enough, Hugh, staggering along the sandy bottom, hugging the great lump of stone and half falling over his fins, was a splendid scene for the film, but he found it too tiring to be funny (Fig. 1.19).

In the evening, after measuring some foundations which had just been uncovered by the sand in the surf zone, Natalka and I returned to the house to find the others already sitting down to start dinner. I was sitting down myself when Martin got up, walked to the corner of the room and said dramatically, "Hugh has done it again. Meet our new friend." He pulled a coloured towel away from a chair, and there was the gleaming white marble head and torso of a smiling faun. I was too astonished to say anything, so Martin provided the details. Hugh had been helping him finish measurements in the

Figure 1.20. Hugh Edwards was diving in the Roman fish-tank when he found this small marble statue of a faun. It was more than half-buried in the sand and gives an indication of the decorative surroundings that originally embellished the fish-tank.

fish-tank when he had glimpsed the head of the statue half concealed by the sand under the edge of a large boulder as he swam across with a measuring rod. Together they winnowed away the sand and raised the statue to the surface (Fig. 1.20). I began to see that the ancient fish-tank had been an ornamented pool with statues, possibly shaded by vines and awnings. It had been a place to relax in pleasure as much as a store of fresh food. Watching fish hover and glide is always soothing. The prosperity of Apollonia had enabled some people to live well.

We drank to the success of Hugh's wonderful eyesight, feeling very pleased with ourselves. But our luck had not run out yet.

A friend of ours, the Arab school teacher, came in to say that he had found something that might interest us, and he asked for a pencil and paper. We provided him with a large sheet of paper, on which he drew a map of Apollonia and the islands nearby to the west, explaining that he and some friends had been swimming around one island where they had found ruins which disappeared down into the water on all sides. He pointed awkwardly, as if he was afraid that we might not be interested. I assured him that this was marvellous news, that we were extremely grateful to him. The next day we were due to leave, and a truck driver from the village had offered to take us back to Benghazi if we were prepared to travel overnight, sleeping on top of his cargo beside our dinghy. First thing in the morning we drove with an Army Jeep along to the school teacher's new island where Martin took a camera in an underwater case, drawing boards, pencil, and ranging poles and swam over to it, while the rest of us returned to base to pack. In the afternoon we re-enacted the discovery of the marble faun statue for the movie camera.

The island that Martin sketched and photographed contained several large tanks cut deep into the rock, and there were numerous fallen curved blocks that must have formed an arched or vaulted roof over a huge storage tank. The roof had collapsed into the tank, and many of the blocks were set in the congealed natural cement that we had seen at Phycus. The carvings, cuttings, tanks, and silos descended into the water on the flanks of the island. At the time when the sea level was lower, when the port of Apollonia was thriving, the island would have been the tip of a rocky promontory joined to the mainland, but there was no sign of a settlement or ruined habitations. This was a depot purely for storing produce and supplies in the short term for transfer to coastwise shipping. From there agricultural products were transported to Apollonia for the great sea-crossing voyages to Rome or Athens. It is easy to imagine a few small ships lying in the shelter of the headland while their crews carried the amphorae or sacks into the holds.

At 11 o'clock that night we said goodbye to our friends who had helped us so much, and the lorry in low gear roared up the steep hill to Cyrene on the Jebel. We arrived in Benghazi at dawn, where we returned the dinghy to Nino's fishing boat and boarded the *Città di Livorno* once more.

* * *

In 1959 we had been lucky with the sea state and had discovered extraordinary things, but there was so much still to do, so many features of the ancient city that remained inexplicable. We had begun to reveal the decoration and luxury that beautified the working façade of the city, but it would take years of diving excavation to do justice to such a vast and unique complex. There were few clues as to how the great port really

functioned, and there were many buildings that had no parallel in land-locked cities … or indeed in other known ancient ports. How were they used? Fallen shards, debris, coins, tools, glass, lead, bones, statues, anything buried amongst the stones and tiles would help to reveal their purpose. How was the annual transport of thousands of tons of grain to Rome managed? How were the huge grain ships loaded with their cargo? What were the phases of building and abandonment as the sea level changed and the half-ruined city evolved over the centuries? There was nowhere else to go for the answers which all lay under the sea. We scattered at Syracuse and took our different ways back to England.

The marble faun had been given to Richard Goodchild as a valuable antiquity for curation in the museum at Cyrene, but he said we could keep the stone anchor, so I had slung a rope through the end hole and somehow between us we carried it like a suitcase across Europe. Lillywhites, the famous sports store on Piccadilly Circus, exhibited our finds and maps from Apollonia in its street-front display windows, but I had a memorable experience afterwards trying to travel on the Underground train carrying the heavy stone anchor on its loop of rope. I was told by a porter that it was too dangerous for other passengers. Rather surprised and disgruntled, I trudged with it to the next station, and boarded the train there.

In addition to the main map that Nick Wood had drawn, he had also prepared larger scale drawings of the multi-layer stratigraphy of the Apse building over the Grid Building (Fig. 1.15), and the staggered layers of ashlar masonry of the southern Block Fort (Fig. 1.12). These were probably the first accurate drawings of ancient underwater masonry anywhere. We took it all as routine work as the project morphed into the stages of drafting reports, writing lectures, and thanking sponsors. But the achievement is worth noting, both for the accuracy of the measurements by the divers, and the careful draftsmanship of Nick Wood.

The *Sunday Time*s ran an illustrated feature on Apollonia, while I published academic articles and reports. Bernard Eaton, the editor of the British Sub Aqua Club magazine, *Triton*, ran a feature that emphasized the diving itself, to encourage amateur archaeologists. I gave lectures and showed the 16 mm film at meetings of the club and at an international diving conference in Barcelona in 1960. In the world of marine archaeology, I was known for a year or two as the man who had mapped Apollonia in the first scientifically controlled mapping of an entire underwater city.

The techniques and systematic wall-to-wall thoroughness that we had applied were innovative and ahead of their time. Every corner of a building was either triangulated from the baseline on shore, or trilaterated from two known points on the seafloor. Furthermore, every member of the team dived. Underwater archaeological projects before this date had employed naval or salvage divers to work on the seabed, supervised by an archaeologist on the surface. Trained minds did not observe the seabed directly. Unknown to me at the time, Professor Nino Lamboglia, in Italy, had instructed sailors to apply a grid of fixed tapes, 10 x 12 m, with 1 m spacing (33 x 40 ft with 3 ft spacing) over the shipwreck at Spargi in 1958, the year we started at Apollonia. Lamboglia described his innovation as "… to initiate this new experiment in the history of underwater archaeology … and to test the co-operation between archaeologists and free divers." He still saw the grid of tapes as a way for non-academic divers to report their observations to the archaeologist on the surface.

Within a few years, shipwreck archaeology, by a process of evolution and diffusion, adopted as standard the use of fixed rigid grids laid over the wreck throughout the survey and excavation on the seafloor, fixing every artefact and key point surveyed into position in three dimensions. Gerhard Kapitän developed the techniques in Sicily. Peter Throckmorton, Honor Frost, and George Bass carried out meticulous surveys of shipwrecks on the coast of Turkey, followed by excavation, while other groups in Germany, France, Italy, and Israel applied rigorous survey techniques to submerged ruins. A team from Imperial College London, led by John Woods, mapped a deepwater wreck off Xlendi Reef, Gozo, Malta, in 1961, at a depth of 60 m (200 ft), from which they raised many amphorae under controlled conditions. A team from the USA led by Bob Marx surveyed and excavated parts of Port Royal, Jamaica, in the late 1960s.

An accurate map, whether of a wreck or a city, is the basis for the next stage of interpretation and selective excavation. I expected that having demonstrated the extraordinarily good preservation of the great city of Apollonia, showing the unique complexity of the unusual structures round the harbour basins, professional archaeologists would seize any occasion to continue the work for years to come. We had created the opportunity for original archaeological research by other people. I was happy for them to take the lead. But in Britain there was no professional reaction, and the initiative passed to French divers decades later (Chapter 11).

I also had to obtain my degree in Natural Sciences. I loved the sense of historical time passed and passing, the visceral contact with cultural roots, and I savoured the indulgence of desolation and decay in remote places, but my professional and intellectual focus became the change of sea level, the changes of climate, and the occurrence or absence of earthquakes. The intense memories of those days at Apollonia faded into the background, although a key piece of logic had stuck in my mind. I realized that there were hundreds of ancient ports around the Mediterranean coast, every one of them potentially containing enough remnant structure to tell me about the changes of sea level during its history. It seemed possible that mapping hundreds of sites would reveal for the first time how earthquakes had been distributed around the Mediterranean coast for thousands of years, how much the ground had moved up or down, and whether the global sea level had changed in the past 2000 years. My life progressed in chaotic and unpredictable zigzags from one chance opportunity to the next. Life was exciting and producing new sensations and experiences all the time, so that the mapping of Apollonia, which had started in my first year as an undergraduate, came to seem almost a juvenile escapade.

11

Requiem for Apollonia

After 1959, as the years drifted or scrambled by, I never expected to see Apollonia again. The thought never occurred to me.

The young Colonel Muammar Gaddafi, so absurdly good looking, used his support in the army to overthrow the government of Libya in 1969, expelling the king, and the remaining British troops. His subsequent smuggling of heavy weapons to the IRA in Northern Ireland, the shooting of policewoman Yvonne Fletcher in 1984 outside the Libyan Embassy in London, and then the Libyan sabotage of the Boeing 747 that crashed on Lockerbie in 1988, confirmed that Libya was a hostile state. As he became older, and in spite of claiming to live frugally in a Bedouin tent, Gaddafi's appearance became increasingly raddled and dissolute, accompanied by weirdly eccentric behaviour. Libya was out of bounds for decades.

In 2001, I received in the post one of those travel brochures that shows the Sydney Opera House, the Taj Mahal, and the Rose Temple at Petra in Jordan apparently visible simultaneously without leaving the deck of your cruise ship. I was about to throw it away when I saw a more serious brochure behind it from Cox & Kings Travel, offering tours of Libya. Prime Minister Tony Blair was cultivating Muammar Gaddafi at the time, so that the tourist attractions of the great classical cities of Libya became a fresh product for the more enterprising travel agencies.

Cox & Kings restricted the archaeological tours on offer to the obvious cities of Tripoli, Sabratha, Leptis Magna, Cyrene, and home again. The internal journey from Tripoli to eastern Libya was by direct air flight. Other trips included escorted southern desert drives into the interior Sand Sea.

There was a footnote saying: "Customized tours requesting to visit other sites can be arranged at prices to be agreed."

My mind went into a rapid buzz. Jay had accompanied me often as a full team member on expeditions in very rough countries, sometimes with the added risk of finding that the local people carried guns. Our children were in their late teens and would be useful on a rugged trip in a hot country. Why not try to negotiate a family holiday driving along the whole coast of Libya, starting at Sabratha in the west near the Tunisian border, looking at coastal ruins all the way, and ending up at Apollonia? There was no harm in asking since the worst outcome would be a simple "no".

I wrote to Cox & Kings, proposing the family holiday trip along the coast, making a party of four tourists, explaining also that, having mapped Apollonia many decades

In: Flemming, N.C., 2021, *Apollonia on my Mind. The memoir of a paraplegic ocean scientist,* 427-470. Leiden: Sidestone Press.

ago, I would like to view coastal ruins along the shore, snorkelling or swimming over the underwater buildings. I promised to report all observations, finds, drawings, and photographs to the Libyan Antiquities authorities. I also agreed to accept continuous supervision from an expert appointed by the Libyans.

Cox & Kings Travel said they would have to consult their associated agency, Dar Sahara Tourist Services in Milan, which resulted in silence for a few months. After a polite reminder, they asked me to provide a complete itinerary, suggesting ruins that we wanted to swim over, number of days along the track, towns where we could stay overnight, and number of days staying at Apollonia itself, or nearby in Cyrene, or El Beida, or Shahat. Using the Barrington Atlas of the Greek and Roman World, publications of the British Society for Libyan Studies, and all the sources I could find, I sent a proposed itinerary, illustrated with maps and charts. I purchased guide books and modern maps from Stanfords in Long Acre near Covent Garden.

Several procrastinating letters and reminders followed over many months. Then in spring 2003, we struck gold. The Dar Sahara Agency in Milan had arranged with Sukra Travel in Tripoli and Bright Star Tours in El Beida, for two Toyota Land Cruisers to be driven by desert-trained expert drivers, allowing us to drive on beaches anywhere along the coast, accompanied by a senior archaeologist, and representatives of the Government. The tour would be most conveniently enjoyed in the first weeks in early September, starting precisely on 27th August. The itinerary was carefully spelled out, including the towns where we would spend the nights in hotels.

This was promising, but the accompanying letter from Cox & Kings carried an ominous warning. Reading between the lines of a letter which had been checked carefully by company lawyers, I deduced that they, Cox & Kings, could provide no guarantee as to our freedom to explore or photograph anything. We might be supervised by KGB-style police guards who controlled our every movement. We might have a wonderful family holiday, or we might feel like prisoners on parole. Cox & Kings could take no responsibility for what actually happened.

I consulted the family, who all agreed that it was worth the risk. As the price quoted by Cox & Kings was acceptable, I paid the whole sum up front.

In my usual way for planning coastal trips looking for underwater ruins (Chapter 6), I prepared files on each major ancient city, plus many small settlements, clipped maps together into A4 booklets and arranged everything so that we could enjoy the fun of swimming and snorkelling in utterly wild places, while finding any ruins that might be under water.

Suitably armed with Libyan visas, sun-cream, big floppy hats, rugged carry-on bags, masks, fins, and all the rest of our luggage for a trip of two weeks, we boarded the flight to Malta on 27th August. From there, after a break of a few hours, we flew with Air Malta in an almost empty aircraft to Tripoli, landing at sunset. Porters carried me in my wheelchair down the gangway steps, where I felt the daytime heat rising from the hot tarmac, although the sun was already on the horizon.

The Toyota Land Cruisers were parked next to a small group of men, from which a middle-aged man of kindly appearance came towards me to introduce himself.

“Good evening, Dr Flemming. My name is Moktar Hawel. I am the representative of Bright Star Travel, and I am in charge of your visit to Libya. You are welcome. I will accompany you throughout the trip. I think it will be interesting for all of us.”

"Thank you, Moktar, you have arranged a wonderful tour for us. We are looking forward to it. Can I introduce my wife, Professor Jay Kleinberg, and our children, Kirsten and Peter." Everybody shook hands. Moktar introduced us to Mr Abdul Hamid Abussaid, who was to be our archaeological supervisor. He was the retired chief archaeologist from the Ministry of Antiquities, a man of culture, wisdom, and philosophy as we discovered, whose help over the following weeks was essential to our success. He was an elderly, short, chunky man radiating a sense of calm. I guessed that he had suffered much and seen much suffering in his lifetime. Finally, we were introduced to the Man from the Ministry. We never learned his name, but he held the sheaf of security clearance papers that enabled us to pass through police and military checkpoints with minimum trouble. He had a pinched, miserable face and narrowed eyes but turned out to be friendly and helpful throughout the trip.

"You should meet also our two drivers," said Moktar, "who are from Sukra Travel. They are trained in desert driving, Ali, and Abdul." We shook hands. The drivers were both large, muscular men who exuded the authority derived from their command of the vehicles, rather like the captains of ships. During the first two days, while we were visiting the traditional tourist ruins of Sabratha and Leptis Magna, I detected that driving on tarmac roads was very much beneath their dignity.

The airport floodlights had come on by the time we loaded the gear into the Toyotas, with my wheelchair on the roof rack. We drove to the tower-block hotel by the port in central Tripoli. Jay and I were in one vehicle with Mr Hamid, the archaeologist, so that Kirsten and Peter were with Moktar and the Man from the Ministry in the other one.

Having checked in smoothly at the hotel, all negotiated by Moktar, we parted in the lobby. "I'll pick you up again at nine o'clock with a six-seater to go to a restaurant nearby," he said. Dinner the first night was somewhat stilted and formal. We sat together at a large table, but nobody quite identified the right verbal conventions or mutual respects. The meal itself combined European and North African dishes, with spicy Libyan soup, macaroni or couscous, main dishes of mutton or chicken, a range of vegetables, fruit, and sweet Arab cakes. Alcohol is forbidden in Libya, so we drank flavoured soda or non-alcoholic beer, which was quite good. Later we found that many small restaurants on the coast served fish. After returning to the hotel, we agreed to start with a trip to Sabratha, 68 km (42 mi) to the west, at nine o'clock the next morning.

* * *

In the morning sunshine, we drove west through many small towns and villages along the main coast road, bordered by typical Mediterranean arrays of concrete houses and shops of one or two storeys. Ancient Sabratha was a Phoenician trading station linked to Carthage, trading in the products from Africa to the south. By the 4th century BC, it was specializing in trans-Saharan trade. Carthage was destroyed by the Roman Scipio Aemilianus in 146 BC, after which, although the culture of the city was strongly influenced by the Greeks, Sabratha came under Roman influence, eventually being rebuilt and developed by the Emperor Marcus Aurelius and his son Commodus. Most of the large monuments that make the city so attractive today are from the Roman period, although there was serious destruction by earthquakes in the 4th century AD. The Roman theatre that was excavated and reconstructed by Italian archaeologists in the 1930s stands to a

height of three superimposed columns (forming, properly, the skene and proskenion), and dominates the city dramatically. The theatre could seat 5000 spectators and is the largest in Roman Africa. After 365 AD, Sabratha became Byzantine Christian, with a surrounding city wall from that period, before occupation by conquering Vandals. Justinian briefly re-conquered Sabratha in the 6th century.

We arrived at Sabratha in mid-morning. The ruins cover more than 21 hectares (60 acres) with well-preserved theatres, temples, the forum, baths, mosaic floors, a grid of streets, and many of the public features of a large Roman city. Our party of Mr Hamid, Moktar, one of the drivers, and the four family carried swimming-gear and cameras in bags as we zig-zagged through the astonishing ruins and reconstructions. Most of the paths were quite navigable for my chair, but the driver was always ready to help over steps and fallen blocks of stone. At the beach, I could see that the Temple of Serapis, Justinian's Basilica, and the Temple of Isis were close to the shore, with the ashlar foundations of the Temple of Isis being partly undercut by erosion (Fig. 11.1). Several streets and buildings, including baths, are cut off abruptly as if there has been a bit of land loss. An offshore reef of fossilized dunes was protecting the city from major storm attack, and the modern curators had tried to protect the beach in some places with concrete, but slight erosion was still taking place. Although there were some fallen blocks of masonry on the beach, and in the shallow water, the absence of any blocks beyond 2-3 m (6-9 ft) from the shore is evidence of no submergence.

It is a bit of a mystery as to why there are not more obvious harbour constructions, quays, docks, or warehouses at Sabratha. In 1966 a team of CUUEG divers led by Bob Yorke studied the underwater site and the offshore reef. They noted that drains and

Figure 11.1. At Sabratha, near the Basilica of Justinian and the Temple of Serapis. The ashlar walls of buildings break off at the waterline. The corners of the buildings have been eroded and collapsed into the sea. But the foundations of buildings do not continue into the water, and the masonry has simply fallen into the beach. The columns of the Temple of Isis are just visible in the background (Photo Jay Kleinberg).

gutters carrying water off the Temple of Isis seemed to be at the right height in relation to the present sea level. Aerial photographs show that a row of drowned fossilized sand dunes extends 8.5 km (5 mi) to the west, gradually diverging seawards from the modern shore. Much of this ridge is submerged, but it rises above the sea sporadically to create a chain of islands. A submerged rubble mole, just 30 cm (1 ft) below the sea surface, partially closes the gap between the islands opposite the west margin of the city. The ridge converges close to the present shore at Sabratha itself. Yorke's team found that the island immediately opposite the city had been covered in Roman concrete for a length of 180 m (590 ft), which had improved the shelter for shipping in its lee. Scattered blocks adjacent to the concrete suggested that there had been buildings on top of it. Bob's divers also found a triangular area of scattered columns and masonry massifs on the seafloor out to a distance of 100 m (328 ft), leaving a gap of only 40 m (130 ft) between the buildings and the concrete-covered island.

The overall effect showed that the citizens had built a few structures in a sheltered area between the island and the shore that could probably support the loading and unloading of ships. But it seems rather inadequate when the ability of harbour builders was so much more advanced already in the Roman era. Why nothing better? Why no docks or jetties for warehouses?

I turned to Mr Hamid.

"Is it acceptable for Jay, Kirsten, and Peter, to swim over the submerged area between the shore and the reef?"

"Yes, it is permitted."

The others kitted-up and I watched them snorkelling around the bay where Yorke had reported masonry blocks on the seabed. The tracks of the family's bright-coloured snorkels criss-crossed over the ruins, with occasional splashes as someone duck-dived to the bottom to inspect something or take a photograph. When they returned to dry land, they described seeing blocks, but not distinct walls, just a massif of close-fitted masonry. The photographs later confirmed this, so that it looked like a quay foundation, not a road or house. The upper courses had probably been pillaged when the harbour and the city declined.

There is no evidence for sea level change, but there are no accurate indicators, so that the error is potentially plus or minus 40 cm (16 in) in this case.

After the swim, we drove into the modern town for lunch. During the discussions both in the ancient city and over lunch, I sensed the continuous alertness of the Libyans as to how much help I needed, or did not need, but also a general sensitivity to our response to what we were seeing. Did I need help over a step? They always judged it correctly. Did we find the ruins impressive? Did we like the food? This concern was reassuring, but I also sensed behind it the possibility that they had suffered frustrating or humiliating experiences when their previous clients had sometimes treated them in a condescending or dismissive way. I made sure that nothing I said could be interpreted in this way, and no member of the family made that error. After lunch we visited the museum to see the breathtaking mosaic from Justinian's Basilica, which covered a huge floor area with myriads of motifs in hundreds of brightly coloured panels. The Roman antiquities of Libya are comparable to Rome itself.

Leptis Magna, 130 km (80 mi) to the east of Tripoli, was our main visit next day. This is one of the most perfectly preserved Roman cities anywhere in the Mediterranean.

Figure 11.2. At Leptis Magna the entrance to the city is celebrated with this magnificent arch, built to honour the Emperor Septimus Severus (Photo Jay Kleinberg).

Like Sabratha, Leptis was originally founded by Carthage, then greatly developed by Septimus Severus, in whose honour there is a magnificent arch as you enter the city (Fig. 11.2). The most expensive coloured stone for columns and construction was imported from all over the Empire. Unfortunately, by the later 3rd century AD the city was frequently subject to Berber raiding parties, but it was reinstated as a provincial capital by Emperor Diocletian. It was captured by Vandals in 439 AD, and, although brought back into the Byzantine Empire in 533, it was finally overwhelmed by the Muslim expansion along the North African coast in 647, after which it was abandoned.

The harbour at Leptis was and is magnificent in its grandiose ambition, perhaps over-ambitious, comprising curved docks and quays embracing a basin 350 x 300 m (1150 x 980 ft), with integrated mooring stones and bollards, backing onto roads and storage areas. One can imagine the sight and noise and smell of such a basin crowded with moored vessels carrying every conceivable cargo, including herbs, spices, and pickled fish. Thanks to freshwater springs in the region, the export of grain and oil to Rome was immensely profitable. In the harbour, the lowest mooring stones are 1.2 m (4 ft) above present sea level, while others at the back of the quays are higher up. A lighthouse tower marked the entrance to the basin on the western side. The harbour was constructed by digging out and widening the mouth of a small river now known as the Wadi Lebda. As so often in North Africa, the sand brought down by the wadi, perhaps assisted by wind-blown sand and migrating dunes, gradually filled in the basin, which had no natural flushing to the open sea. Today the harbour appears to be on dry land. The British, in the 19th century, removed 22 granite columns from Leptis, 15 marble columns, 10 capitals, entablatures, and sculptures which ended up as a romantic feature of re-invented “ruins” in the park at Virginia Waters, 30 km (19 mi) to the west of

Figure 11.3. Mr Hamid, our archaeological guide, explaining the entrance to the Frigidarium of the Hadrianic Baths at Leptis Magna. Kirsten, Peter, and I are listening carefully (Photo Jay Kleinberg).

London. But this pales into insignificance compared with the 600 columns from Leptis "donated" earlier to Louis XIV for his palaces at Versailles and in Paris. Notwithstanding the removals by Europeans in the 18th and 19th centuries, an astonishing number of magnificent buildings has survived.

Mr Hamid gave us an informative tour of the city (Fig. 11.3), concluding at the hippodrome and amphitheatre overlooking the sea. From there we climbed down to the shore and scrambled along the rocky coast back towards the harbour mouth. The crumbling remains of the city where it reached the shore had collapsed in places, scattering blocks and columns on the rocky wave-washed terrace, but there were no foundations or cuttings under water (Fig. 11.4). Since none of the buildings I could find gave a really accurate relation to sea level, the overall evidence from Leptis shows no relative change of sea level to within an error of plus or minus 50 cm (20 in).

During our tour of Leptis Magna, we had lunch at the nearby visitors' centre, where there was a small museum. One of the exhibits was a Palaeolithic handaxe, which made me conscious yet again of the paucity of prehistoric evidence from this coast. As the tour came to an end, Mr Hamid explained that there was one more surprise.

"You have to visit the villa of Sellin," he said. "I know it is not on the list you asked for, but it is impossible to pass it by."

After driving back westwards a few kilometres, the Toyotas bumped down a dirt road towards the sea, halting at the edge of a low cliff. Tiny waves, mere ripples, whispered on the beach. The sun was low in the sky, but there would still be another two hours of light. The domed baths of the single-storeyed Late Roman villa, surrounded by smaller rooms, walls, and gardens, were perched close to the sea as if the occupants wished to enjoy every mood of the seasons, storms, calms, bright mornings, and peaceful sunsets.

Figure 11.4. The rocky shoreline at Leptis Magna, below the cliff by the amphitheatre. Buildings very close to the sea have collapsed due to wave attack, but the foundations do not continue across the rock terrace, and there are signs of rock cuttings or quarrying on the terrace itself, but not under water.

With its domestic architecture, friendly family layout, exquisite mosaics and frescoes, built on the brink of a low cliff with the sea washing the beach below, the villa of Sellin is a perfect real-world example of that bucolic image that Diolé had imagined of the rich retired Roman citizen, sipping wine, at ease with the world. The garden itself is perfect beyond belief, with beds for flowers and herbs separated by small stone walls. Far more than at Pompeii with its many grand houses, I sensed the comfort and pleasure of ordinary domestic family life at the time of Roman prosperity. One has to remember that slaves did all the hard work around the house and on the estate lands surrounding it, but I hope that the owner of Villa Sellin was kind to his slaves.

The villa was only discovered under the sand and excavated in the 1970s. It had 20 rooms, a library with bookshelves, dining rooms, walled gardens, baths, and summer rooms that faced the gardens. The separate components were linked by a portico decorated with a rich array of mosaics depicting mythical events, intermingled with scenes from nature and decorative patterns. There are copious tritons, nymphs, plants, and birds, and wall paintings of gladiators. One scene shows a horse race in the circus at Leptis Magna.

* * *

As the sunset, we turned east again, to spend the night at Zliten, a small port town. Once we had driven east of Leptis, we were moving into terrain not normally explored by European visitors other than professional archaeologists and oil engineers. It had always been a difficult and dangerous coast, where there were no major Greek or Roman ports,

but just minor settlements and fortresses or defensive posts along the shore. The ancient coastal towns had been concentrated in the Three Cities around Tripoli (Greek: *tri* + *poli*, πόλη), and the eastern five cities around Cyrene, known collectively as the Pentapolis. In between was 700 km (566 mi) of wild coast with scarce freshwater springs, no good natural port or shelter, and very little vegetation. In many places, the dunes of the desert simply carried on down to the beach. There might be a few ridges of fossilized dunes, either just on shore or in the shallow water, then merciless blue sea to every horizon. The Gulf of Sirte was a devastating place to be shipwrecked.

While we had been at Leptis, over lunch in the restaurant linked to the big tourist site, Moktar had turned to me to ask some questions, rather nervously.

"The food here is quite good, I hope you agree, but as we drive east, spending more time on the beaches, and without big hotels and restaurants, would your family be prepared to eat food that we cook for you in the open? On the beach? It might be possible to find small cafés and eating houses, but I think this would be best. Would it be all right for you? We will buy fresh food in the markets each day."

Moktar was so apprehensive as he asked this question that I recalled my thoughts from our conversations at Sabratha. I sensed that he had perhaps experienced previous tour parties where some people had behaved arrogantly or demanded a standard of comfort, service, and European-style food, which obviously was impossible in the poorer parts of the country. On the other hand, maybe Moktar was just being very considerate and polite, as was his nature.

"That sounds perfect," I said. "We are all used to living outdoors, so fresh food cooked on an open fire will be delightful."

"The drivers are very good cooks. But they also make good salads, and we will buy fruit which we will wash very carefully. We should be able to buy fish sometimes. Can you eat goat meat?"

"I'm OK with goat," I said, "but my wife certainly cannot eat it. It would be OK sometimes, provided there is an alternative. Lamb would be better if you can buy it."

"That is very good," said Moktar. "I think you will find that Ali and Abdul prepare excellent meals, and we can make camp-stops on the beach as if we were in the desert. They will like that."

He was relieved that this negotiation had gone smoothly. When I told the family they were pleased with the new plans.

Zliten was a modest town with crowded, run-down streets near the waterfront, but avenues of palm trees in the main approach roads. It is now, after the civil war, one of the central assembly towns for migrants seeking to cross the sea to Italy. Already in 2003 there were small gangs of Africans sitting tired and exhausted in the dusty streets by the port, hoping that someone would provide a boat for their escape. The hotel had no lift and no bedrooms on the ground floor. Peter and Kirsten, ably assisted by Ali and Abdul, whisked me up the stairs after dinner, and as easily rolled me down for a dawn start next day. The friendliness of the hotel staff, the cheerful service in the restaurant, and the support of our guides were perfect.

The small archaeological remains that we visited on the long coast from Zliten to Benghazi do not merit description in detail but, to me, the names are magic: amongst others are Thubactis, Euphranta, Charax, Ad Palmam, Zacazama, Philaenorum, Boreum, and Euhesperides, that is Benghazi itself. For the next two days, we drove steadily further

east and south, where the desert became hotter and the few towns smaller and more desolate. The tarmac coast road was controlled at intervals of a hundred kilometres or so by fortified police or military checkpoints, with chains and other obstacles that could be raised rapidly across the road to stop vehicles trying to pass. At each checkpoint, the armed guards eyed us suspiciously until the Man from the Ministry went into their offices with his great bundles of duplicated forms. After a few minutes he would return looking very pleased with himself. After one such check he said, "Someone up there really likes you. I have never seen papers approved so quickly."

We had lunch on the beach (Fig. 11.5), in preparation for which even the Man from the Ministry busily took part. For most of these stops, the Toyotas were arranged with a screen stretched between them to provide shelter from the midday sun. The drivers now lowered the air pressure in their tyres and drove happily over soft dunes onto the beach sand, confident that their skills were really needed. We spent one night at Sirte, in a very smart modern building, which I think was intended as a conference centre. But the hotel restaurant was not functional yet, so that we ate the evening meal of fish at a seaside restaurant in the town.

The desert dunes became larger and more mobile as we drove south, with huge ridges of active sand blending into fossil ridges, either on the shore, or offshore, creating chains of small islands. Although the evidence was never totally reliable, erosion terraces, beach-rock, fossil dunes, natural lagoons, and archaeological remains all provided signs that there had been no change of sea level in historic times to within a general error of the order of plus or minus 50 cm (20 in). Mr Hamid quietly mentioned Muslim buildings and ancient sites from several hundred years ago, which we visited with real interest. He did not emphasize the fact that I had not included these on my list of places to visit,

Figure 11.5. Cooking on a remote beach in the Gulf of Sirte. The Man from the Ministry is preparing vegetables, while Kirsten, who has just been swimming, and Mr Hamid, watch with approval. The debris of plastic bags was a constant factor everywhere in Libya (Photo Jay Kleinberg).

but the point was well taken. They were not on the shore, but were well worth a visit, to get the sense of the development of this inhospitable region by the Arabs.

As we turned directly east at last near Ras al Ala, Mr Hamid drew our attention to an abandoned Italian prison camp by the beach. We had to drive a few kilometres from the main road towards the sea, but there, at the very southernmost and hottest point on the coast, devoid of any shelter or vegetation, were the unmistakable vestiges of a typical prison camp, with wooden guard stations and gun emplacements on rickety towers, miles of barbed wire collapsing into the sand, and sun-baked timbers and cracked planks projecting from the dunes. To imagine living in such a place, with prison treatment, bad food, and no medicine, struck terror into one's body. Mr Hamid explained quietly the various resistance bands and guerrillas that had fought against the Italians in the 1930s and '40s, and how they had been interned in this camp for many years. There was not a hint of bitterness or condemnation in his calm voice. How could he be so forgiving? The place haunted me all the more because of Mr Hamid's calm. I did not ask whether any of his relatives had been there, or even himself. He showed no rancour. His philosophical resignation and the acceptance of unpleasant human nature seemed an example of boundless tolerance. British, Germans, and Italians had stormed backward and forward for decades across his country, killing and bombing, but he seemed to show no resentment. I am sure he had strong views, but he did not think he needed to flaunt them.

For tens of miles on either side of the abandoned prison camp, the beaches stretched as pure white sand from horizon to horizon. Occasionally as we drove on the beach, we saw the rotting hull of a wrecked boat, and, where the fossil dunes provided a hard foundation, there might be a fisherman's hut, a few small boats drawn up on the sand, or some nets drying in the sun. The desolation was pervasive. The phrase "unspoilt beaches" does not apply to situations like this. The symmetry of white and blue was aesthetically attractive, but the sense of menace and risk was overwhelming.

* * *

We crossed oil terminal pipelines at Al Brayqa (El Brega), turning north towards the ruins of Boreum on a bold headland, and then to Benghazi for the night. Boreum was interesting because the main fort and major buildings were high on the hill overlooking the sea, but from that summit we could look down on many walls and foundations on the shore, though not extending under water. The hotel at Benghazi was the epitome of expensive appearance for its own sake, with countless mirrors, glittering fake-gold-plated frames and gewgaws, and chandeliers everywhere. It had a lift and comfortable bedrooms. In the foyer, a large video screen was displaying Gaddafi making a long speech, but the few guests did not pay it much attention. We were led to understand that nobody took such speeches seriously. Moktar explained that we had recently passed the anniversary of the 1969 revolution, and I recalled that some buildings in the bigger cities had been hung with complete wall coverings in retina-bashing green, accompanied by the slogan, "Another 34 years".

The next morning, Jay went for an early walk in the cool dawn air but was molested by a male passer-by. She was wearing a flowing dress, long sleeves, and a head-scarf, but was obviously European, which seemed to justify the attack. She screamed and beat the

man off. He fled from her strong reaction. Over breakfast at the hotel, Jay told Moktar, who reported the case to the police, but we heard nothing more. We were advised that in Cyrenaica, women had to be more careful and preferably chaperoned by a man, in contrast with Tripoli, which was much more European in attitudes and dress.

The Toyotas drove rapidly into the hills of the Gebel Akhdar, where the bridges that I remembered as rusting World War II military concoctions had been replaced with gleaming white modern suspension spans. We arrived in the late afternoon at Shahat, the modern town close to Cyrene, where we checked into our hotel. Moktar lived in Shahat, so he spent the next few nights at home with his family. Mr Hamid, I think, had a house there, or stayed with friends, and the drivers found accommodation elsewhere. The hotel had no lift, but the ground-floor saloon was busy with men playing backgammon and dominos. Whenever I appeared in the foyer, half a dozen well-built locals would leap to their feet and offer to drag me upstairs. This was very welcome and was executed with great humour and good spirits. Peter learned to play their games of dominos, but I am not sure anyone really agreed on the rules. The food was simple, but filling, with every day a choice of two soups: lentil soup and Libyan soup. The waiter was very punctilious at explaining the content of the soups, but after a day or two began to see the joke, and allowed us to choose from what we already knew. The hotel staff were kind and helpful at all times.

In the morning, fresh with sunrise, we boarded the Toyotas for the return to Apollonia. We curled past the hundreds of rock-cut tombs on the street that slopes down from Shahat and negotiated the hairpin bends as we dropped from one terrace to the next. At the final turn, the beloved view, so well remembered, opened before me (Fig. 11.6). Forty-four years disappeared into a time warp, and I felt as if I had never been away. The chain of islands far below, the village of Marsa Susa, the little fishing port, and, slanting away from the shore, the islands that enfolded the underwater city: how much would have changed? We descended the last hill and motored towards Susa, where the modest skyline was now dominated by the reddish-ochre monstrosity of a hotel of six storeys (Fig. 11.7). I cannot imagine that it is ever fully booked, or maybe nobody stays there at all. The village had expanded eastwards and inland so that the ruins on land and the Hellenic city wall were almost surrounded by modern houses.

Driving through the village, we arrived at the massive gate tower of Apollonia still poised as if it would fall into the sea. But it had not fallen. To the right-hand side we saw young Europeans sitting on a flight of steps with notebooks and drawing pads. The steps led up to a small building. We disembarked, to find that there was an ongoing excavation supervised by André Laronde, professor of Greek History and Director of the Institut d'épigraphie grecque at the Sorbonne, and this building was their dig office. Students pulled me up the hill to the building, where Laronde greeted me effusively. My poorly remembered French seemed to blossom again in response to this unexpected linguistic emergency, so that we were able to hold a brief, but fluent, scholarly discussion. Laronde professed great respect for my early work, but his own excavation was exclusively on the acropolis hill, not in the water. We exchanged business cards very formally, while we sipped our tea.

Our party then drove along the track at the edge of the cliff to the centre of the archaeological site, opposite the islands. The drivers rigged an awning between the Toyotas, spread rugs on the ground, and prepared coffee.

We were home.

Figure 11.6. Looking down from the terrace part way down the slope of the Gebel Akhdar over the coastal plain to the modern village of Marsa Susa, and, close to the right-hand margin, the two islands that mark the outer limits of the underwater city (Photo Jay Kleinberg).

Figure 11.7. The shoreline at Apollonia looking westwards to the columns of the Christian basilicas, dominated by the modern six-storey Hotel Al Manara. This tragic construction is typical of the neglect of the antiquities at Apollonia by the official agencies (Photo Jay Kleinberg).

We relaxed. The north wind breezed out of a blue sky, bringing the breakers piling over the Grotto Reef, churning over the Block Fort towers, and throwing spray high in the air around the islands. But the islands provided partial shelter so that the waves were less rough on the beach. After absorbing the landscape, trying not to notice the ghastly hotel, and relishing the pure sense of the great city under the waves, I suggested that we just get in the water for a token swim over the ruins closest to the shore, hoping for a calmer day later. Peter and Ali lifted me into shallow water, where I donned my mask and snorkel and started swimming towards the Nine Quays. Jay and Kirsten donned their fins to swim beside me. The low parallel lines of ashlar blocks, greeny-black through the cloudy water, were as strong and solid as forty years ago. There seemed to be more sand around the ruins than I remembered. Once again the sense of the past almost crushed me with its intensity. Two thousand years ago, these huge parallel structures were teeming with people, but what were they doing? I cruised slowly over other low walls, but the choppy water and poor visibility meant that I would have to postpone a serious swim. I gestured to Kirsten that we should head for the beach.

Returning to the shore, I warmed up in the sun while I discussed the ruins with Mr Hamid. The drivers, assisted by the Man from the Ministry, cooked a fine lunch of fish with vegetables and salad. Peter was sitting in the shade reading Jules Verne's *The First Men in the Moon*; Kirsten and Jay discussed cameras and photographs. We were still using Kodak reversal film in the Calypso Phot underwater camera. After lunch, Jay wandered along the shore towards the acropolis, climbing around it to look at the theatre on the far side. In 1959, there had been the short stump of a young palm tree growing in the middle of it. Jay reported that the palm tree was now full height and looked very healthy.

I felt at home, but the experience reawakened in me the dissatisfaction that had consumed me at the end of 1959: there was so much to be done. The whole city needed surveying and mapping to modern standards. The strange dockside buildings needed to be re-assessed in the light of what archaeologists had learned about ancient harbours in the past four decades. Acoustic mapping was needed, and a planned set of excavations in different parts of the city, with close-up study of details of construction. The sequence of buildings one on top of another, reflecting a thousand years of constant change, needed proper investigation and dating if possible. I didn't voice these concerns to Mr Hamid, but we did discuss the principle of doing more work underwater with Libyan archaeologists and students.

We spent some time on each of the next three days at Apollonia, while extending our exploration along the coast to the west, and enjoying guided tours of Cyrene, with explanations of each building by Mr Hamid. Where Sabratha and Leptis Magna are impressive in their grandeur, symmetry, and civic boastfulness spread out for all to see at a glance, Cyrene blends into the mountainside, hugs the landscape, and in its ruined state, is partially concealed by trees and patches of forest. The trees, which make the city so attractive, were planted by the Italians between the wars. The remains of temples, palaces, baths, theatres, markets, the agora, and sports stadium extend over a vast acreage, but one has to find each building by climbing and clambering over the uneven ground. The Temple of Zeus is fixed in my mind because the rows of huge standing columns are reflected in the towering pine trees growing close by on all sides, enclosing a grassy glade with the temple in the centre. On the undulating southern slope

Figure 11.8. Sculpture of a warship prow at Cyrene, showing upper and lower bronze rams for attacking enemy ships. Both rams made of stone have a trident 3-bladed structure (Photo Jay Kleinberg).

of the hill, parts of the city have been excavated, where the well-preserved ruins and reconstructed buildings overlook the steep descent of the Gebel Akhdar towards the sea.

There is a unique sculpture at Cyrene comprising a replica in stone of a warship bow showing two stone replicas of the cast bronze rams mounted so as to attack enemy warships, breaking their oars and staving in the planking (Fig. 11.8). This image helped my colleagues and I later when trying to understand the function of a bronze ram that had been found in the sea near Tobruk. Some archaeologists have used this stone model to understand how bronze rams were mounted and used, but since the assemblage of stones had been reconstructed by archaeologists, the argument is somewhat circular. The arrangement of the upper and lower rams exhibited at Cyrene, with a fair amount of cement padding, is what archaeologists expect, not direct evidence from the past.

* * *

Mr Hamid had an extraordinary knowledge of the small sites along the coast to the west that fascinated me so much. He was the perfect guide. There had been no road along the coast in ancient times, so each small settlement or depot had to communicate with its neighbours by sea when there was a heavy load to carry.

The ruins that we visited, from Apollonia westward, were the island that Martin discovered on the last day in 1959, Brak Nota, Sidi Amer, Phycus, an unnamed site, then Ausigda, and another unnamed island to the extreme west beyond El Haniyah. Martin's Island was just 3.7 km (2.3 mi) west of the ancient city, one of six just offshore, and you can see on Google Earth the rectangular tanks incised into the solid rock. We did not swim out to it on this trip, but the island was probably joined to the mainland when the sea level was relatively lower in Roman times.

Brak Nota is the modern name for a curious combination of an ancient site on the shore close to two huge, collapsed karstic dolina, which are now filled with freshwater. At low sea level, the groundwater dissolved out two vast underground caves, the roofs of which have fallen in to create lakes with a steep rocky edge. The closest of these lakes to the shore is only 200 m (650 ft) back from the beach, but it is so inconspicuous, concealed by bushes and tall reeds, that we had passed along the tracks several times without my seeing it. The ancient settlement was on a rocky ridge 5-10 m (16-33 ft) high projecting, as so often, almost parallel to the shore, and protecting a bay on its southeastern flank. Given the dominant winds from the northwest, this was a sensible location to choose for a small harbour with no additional breakwater. The crest of the ridge was covered in a maze of ancient olive presses, silos, tanks, and cisterns, suggesting a huge amount of storage for agricultural products. In the lee of the ridge, close to the sandy beach, there was a complete row of ashlar blocks just awash in the shallow water (Fig. 11.9). It was breezy on the day we visited, so the waves were breaking into a rolling surf 100 m (330 ft) offshore on the sloping rock. The run-up of the surf then sloshed up the slope to the edge of the ancient storage tanks. The sea must have been relatively lower when the storage spaces were being used. I sketched rapidly. As usual, we cooked lunch on a driftwood fire, while the snorkellers, Jay, Kirsten and Peter, searched the seafloor to check for any ruins that might be totally submerged.

Sidi Aamer, just over 9 km (5.5 mi) further west, consists of a Muslim shrine on one side of a gulley by the sea, and a Roman fortress tower, several courses high, on the other side. Mr Hamid said that there had been a fortified Roman village nearby inland. The gulley did not provide much shelter but could have been used to pull a boat alongside in those rare days of calm weather.

Figure 11.9. Brak Nota. At the top of the slope to the left are many rock-cut storage tanks, circular silos, and an olive press. They are splashed by the breaking waves. At the waterline, exposed to every wave, there is this line of well-fitted ashlar blocks. The settlement has submerged by about 2 m (Photo Jay Kleinberg).

* * *

Our visit to Phycus with Mr Hamid provided a very different perspective from my previous visit in 1959 (Chapter 1). My study since then of hundreds of ancient coastal ruins (Chapter 6), combined with the published reports by other archaeologists working on other sites, meant that I now knew which critical factors needed to be measured most accurately: quarry cuttings, road levels, storage tanks, salt pans, and so on. Phycus receives several mentions in the ancient literature as an active port in the 1st-5th centuries AD, although the original foundation is older, since pottery from the 4th century BC has been found on the site. The natural form of the bay provides shelter from the dominant northwest winds, but there are no remains of docks or mooring quays, and no artificial breakwater. It is difficult to imagine large grain-carrying ships being loaded here, even if the grain had been ferried out on lighters.

The orientation of my 1959 map of Phycus was slightly wrong, twisted too far anticlockwise. Correcting for this showed that the cuttings, submerged roads, and buildings are open to the water only to the northeast, with a massive, rocky barrier 6-10 m (20-33 ft) high protecting the city to the north and northwest where the dominant waves come from. On the day we were there in 2003, there was a very light wind, no white horses, and the waves were just the low swell left over from the day before. Kirsten and Peter measured the depth of the water at nine locations on the submerged roads, giving an average depth of 92 cm (36 in) at 12:30 pm. We put a marked stick and tape in a position where we could measure the water level every hour, to see if there was a measurable tide in the area. The mean sea level dropped 30 cm (12 in) during the next five hours. This seemed excessive as pure tide, which I would have expected to be only about 20 cm (8 in). A change of wind direction, barometric pressure, or wave action might have been acting in concert with regular tidal action.

We made a camp by the two Toyotas perched at steep angles on the high sand dunes that covered most of the ruined city. Kirsten and Peter climbed all over the rock cuttings, exploring the hidden chambers and rock-cut rooms. Jay climbed down the cliffs to take photographs. We ate lunch under a shade supported by two sticks of driftwood and explored the shoreline around the city afterwards. There were tanks cut in the rock on the waterline, some ashlar blocks, and many occurrences of “chocolate bar” criss-cross incisions from the extraction of quarried building blocks. Within the drowned road system, the rock-cut walls had a deeply incised solution notch at present sea level, with coralline algal growth and *trottoir* encrustations extending to about 1 m (3 ft) above the notch (Fig. 11.10). This suggests that the site has been geologically stable for a long time, several centuries, although it was submerged by about 1.5 m (5 ft), with an uncertainty of plus or minus 0.5 m (20 in) since the Classical period. During our exploration, Jay photographed some beautiful flowers growing in the sand, while Peter somehow tamed a most unpleasant-looking insect. We drove home after a good day’s work.

On another day we approached Ausigda, the settlement to the west of Phycus, by driving inland and travelling through the hills from Cyrene, before descending to the coast along the great Wadi Kahuff. Looking down into the valley from the road, we could see forests of huge pine trees growing at the bottom, which confirmed an ample supply of groundwater even at the end of summer. The mouth of the wadi spreads out into a

Figure 11.10. Phycus, west of Apollonia. Peter has been measuring the water depth in the cut channels that form roadways, now submerged. The stratification in the cut cliff shows the internal bedding structure of large sand dunes that have been turned to stone over tens of thousands of years (Photo Jay Kleinberg).

Figure 11.11. Campsite at Ausigda. The Toyotas are parked with a large sunscreen taut between them, and rugs and cushions on the ground in the shade. The drivers are cooking lunch while I work on my notes and sketch plans from the ruins. The Byzantine buildings are at the top of the sandy slope (Photo Jay Kleinberg).

broad delta of sediments, crossed by many braided channels, flanked by the extensive coastal plain on both sides.

The highest part of the headland at Ausigda, 15 m (50 ft) above sea level, was covered in ruins half-buried in the sand. Mr Hamid said that it had been a small Byzantine village. A church dating from about 500 AD stood on a secondary hillock, set back from the sea. Mr Hamid explained that the wide coastal plain from here to Apollonia was dotted with Roman settlements, with the buildings tending to be on small hills.

Jay and Kirsten ran down to the beach, sheltered as always from the northwest wind, and explored the seabed by snorkelling as far out as a small island. They climbed onto the island but found no cut blocks and no cuttings in the rock. I snorkelled in the shallow water, finding natural rock ledges covered in a thin dusting of sand.

We quickly discovered the body of a dead camel rocking gently in the surf a few hundred metres from our proposed campsite. But there was no smell, and nobody was going to use the seawater for anything but swimming. We kept as far away as possible and ignored it. The beach was quite flat, so the drivers arranged a classic back-to-back campsite with rugs and cushions spread on the ground (Fig. 11.11). I warmed up in the sun, writing notes and sketches, while the drivers and the Man from the Ministry cooked a lunch of lamb chops, peppers, tomatoes, and salad, followed by fresh fruit and ice-cold drinks. The ruins of the Byzantine village were very distinct where they protruded from the sand, but there were no cut blocks, either *in situ* or fallen, lower than a height of about 3 m (10 ft) above the sea. There was no evidence for subsidence or a rise of sea level, but the margin of error was such that one could not exclude a change either way

Figure 11.12. The end of the road. As the sun was almost setting, we reached this far west but had to turn back. I wanted to try and visit these islands, but it was too late. Google Earth shows a large rectangular storage tank cut in one of the islands. Very tantalizing (Photo Jay Kleinberg).

of about 1 m (3 ft). As I jotted down this rather vague conclusion, two gorgeous blue-spangled kingfishers flew low over the beach before settling on a rock by the headland.

We drove further west from Ausigda in the late afternoon, following a twisting coast road over red dust and gravel, through sun-scorched husks of villages with concrete houses, bravely decorated with plants in tubs and newly planted trees. The population of the coastal plain was increasing, with fresh-ploughed farms strewn with shacks and sheds in the open land, and villages beginning to sprawl with new buildings.

Eventually even the Toyotas had to stop amongst criss-cross goat paths, ridges of rock, and soft banks of sand and soil. There were several Roman dams across the wadis near the end of the track, with ruins visible on the far side of the valley. The islands offshore looked as if they had been connected to the mainland when the sea level was lower, and there was a straight line in the water that could have been a causeway. It was very tantalizing, but there was no time to swim or dive. We could probably have gone further, but it was late in the day, and the prudent drivers decided that we had to turn back. There were scattered small islands still further west, just black silhouettes against the calm white sheet of sea that reflected the glare of the setting sun (Fig. 11.12). I longed to go further to explore the islands, but I knew it was unwise. We returned to Shahat through the high hills of the Gebel. Checking on Google Earth years later, I found tanks cut into one of the islands that I had seen from the end of the track. One tank was a perfect large rectangle, just awash, so that in calm water it could be seen clearly, but in rough weather it would have been swamped by the waves. There must have been subsidence of a metre (3 ft) or more.

* * *

The number of closely spaced, small ancient settlements along the coast west of Apollonia became more and more astonishing as Mr Hamid took us to one obscure site after another, but every one was rich with buildings close to the water, foundations in the sea, and a host of storage tanks, silos, plaster-lined cisterns, and inexplicable cuttings and rectangular hollows, sometimes connected by cut channels. The volume of these storage spaces was out of proportion to the size of the settlements, indicating that they were designed to store trade goods for export, perhaps on behalf of a settlement or farms several miles inland. The hinterland was fertile; the hills of the Gebel Akhdar were also fertile, and Cyrene could not consume everything produced locally. Just the opposite: the wealth of Cyrene depended upon exports to Rome, Athens, and Ephesus, and the port for loading large cargo vessels could only be Apollonia. The chain of settlements from Ausigda to Phycus, Brak Nota, and Apollonia itself, including all the tanks on islands, such as Martin's Island first sketched in 1959, were probably assembly depots where produce was brought down to the shore for loading onto small vessels that sailed along from one depot to the next, transferring the oil, grain, nuts, and the drug silphium to warehouses in Apollonia. The Grid Building in the inner port at Apollonia makes sense in this scenario. On the other hand, the eastern harbour basin would have been capable of servicing and replenishing larger vessels, probably with loading quays on the east side of the great wall leading out to the Block Forts. Immense quantities of grain, oil, and wine must have been stored in warehouses in preparation for loading onto ships in the few months of late summer after the harvest.

The average spacing of the settlements that we visited west of Apollonia was less than 10 km (6 mi) along the shore, and there were several smaller inlets that might have served as additional mooring places for coastal boats. The hinterland of these settlements was the widest part of the fertile coastal plain. Further west is a gap of 25 km (15.5 mi) to the port of Ptolemais, which is comparable in scale to Apollonia, with a strong port construction providing shelter in all conditions. The coastal plain is narrow along this part of the coast. Study by diving teams over several decades, including meticulous work by Bob Yorke and David Davidson, shows that there are roads and foundations underwater at Ptolemais, indicating submergence of about 2 m (6 ft). In the opposite direction, to the east of Apollonia, there is a stretch of narrow coastal plain for 24 km (15 mi), with some small settlements but no harbours.

The rocky eroded shore throughout this area precluded beaching vessels as a method of loading and unloading safely. This limitation probably applied to the coastwise vessels as well as to the big grain carriers crossing to the northern Mediterranean cities. The average size for grain ships on the cross-Mediterranean voyage in about 200 AD was between 300 and 400 tons displacement. Many grain ships were smaller, and a few were as large as 1000 tons. The units of measure for grain were *modii*, with 150 *modii* making about 1 ton. Rome needed to receive 40 million *modii* of grain each year. But how the grain was stored on the ship is uncertain.

More than one thousand wrecks of cargo ships from the Graeco-Roman period have been found by divers in the Mediterranean, but not one of those that survives was obviously designed for carrying grain. They are mostly laden with hundreds or thousands of amphorae, presumably for wine, oil, garum, or other liquid produce, or nuts, or spices. In contrast, we know from literature and archaeological evidence in the big cities of the northern Mediterranean that grain was the principle south-to-north trade. How was it carried? Why have no grain wrecks been found?

The second question is easier to answer than the first. A ship full of hundreds of tons of grain, however it is stored (other than in amphorae, which have never been found to contain grain), will sink, if wrecked, and be carried to the seafloor by its weight of ballast. On the seafloor the grain will start to absorb water, it will suffer biological decay and microbial attack, while fish and other creatures will soon join the feast. As the grain is consumed or washed away, with no overburden of amphorae, the timbers of the ship will be exposed to bacteria, boring molluscs, and biological encrustation and algae, so that nothing will survive except possibly some bottom planks covered with ballast stones. As an archaeological target this is unlikely to attract attention, though the anchors and the contents of the crews' living quarters might provide some artefacts of interest.

Now for the first question. Anyone who has worked on a farm in a temperate climate will know that the need to protect harvested grain from moisture generates anxiety close to hysteria. Grain must not get wet, and it must not be moist when it is stored in bulk. Wooden-hulled ships, however well-constructed, and however well sailed at sea, will always ship some water onto the decks, and will always weep through the hull planking internally, however well caulked, so that some seawater accumulates in the bilges. The bilge-pumps fabricated from lead pipes and leather that divers have found on many ancient wrecks show that the ships were well-equipped to cope with this water, and the crews were presumably trained to use the pumps.

The problem is, how did they keep the grain dry while it was in the ship's cargo holds? Pumping out the bilges would prevent gross contamination of the grain with seawater, but a ship that rolls in a rough sea, or simply heels in the wind in a gentle breeze, would inevitably allow some spray or drops of bilge water to splash onto the grain if it were stored loose in bulk, or even in sacks. In sunny North Africa, storage in sacks would be cheap, logical, and safe. I imagine that the grain cultivated in Cyrenaica was, on calm days, loaded in sacks onto small coastal vessels at places like Phycus, Ausigda, or Brak Nota, for transport to Apollonia, where it was stored in the warehouses.

When the big cargo ships were ready for loading, slaves probably carried the grain in sacks onto the ship. Whereas photographs of amphora wrecks show the amphorae lying in direct contact with the planks and ribs of the hull, a grain carrier must have had an inner lining of small timbers tacked across the ribs, known as a spar ceiling, and then a layer of light planks to keep the grain away from the hull. By analogy with grain-carrying wooden ships in the 19th and even in the 20th centuries, there may also have been a further lining of canvas inside the spar ceiling, or more probably skins. Such inner timbers or planking have not been found on ancient shipwrecks, but, as explained above, a ship carrying grain, whether in bulk or in sacks, would rot away almost completely, so that is no surprise.

The spar ceiling and internal planking could be fitted temporarily to the inner surface of the ribs in the season when grain was being carried northwards. On the return journeys, the grain carriers often transported bricks or tiles as ballast, since these could easily be sold in North Africa. A shipwreck carrying bricks is not attractive to archaeologists, and although several have been found, they have not been excavated. It might be worth excavating one of these wrecks to see if there is an inner lining of planking to the hull that has been preserved by the overlay of bricks.

Marine archaeologist Stella Demesticha alerted me to a phrase in the Rhodian Sea Law, written about 600 AD but based on much earlier texts, that describes precautions to protect bulk grain:

> If a ship loaded with corn is caught in a gale, let the captain provide skins and the sailors work the pumps. If they are negligent and the cargo is wetted by the bilge, let the sailors pay the penalty. But if it is from the gale that the cargo is injured, let the captain and the sailors together with the merchant bear the loss....

This shows that sailors routinely used skins as a waterproof protection for grain, but applying them after a storm already threatens to spoil the cargo seems rather too late. The skins could only be applied as a top covering, while water accumulating and sloshing about in the bilge will inevitably damage the grain unless pumped out quickly. It would have been much safer to line the spar ceiling with skins before loading the grain.

This problem is not solved, but it worries me. There must be a simple answer. In the meantime, the largest trade cargo by volume in the ancient world has left no trace on the seafloor.

* * *

Moktar, whose family lived in Shahat, invited Jay and Kirsten to see their house and to learn about the design of houses where the men and women lived in separate quarters. One evening he also invited them to join a party for one of his nieces, who was preparing for a wedding. This party was not the wedding itself, but the bride-to-be and her female friends celebrating the forthcoming event, like a wedding shower. Jay and Kirsten returned with their hands beautifully decorated with designs in henna.

Next morning, the wind dropped at Apollonia so that our family could swim across the main area of ruins. The incoming swell was still heaving and surging with white surf over the Grotto Reef, so that we could not investigate it closely, but otherwise I could swim over all the buildings that I remembered so well. We swam as a family, zig-zagging back and forth over the Nine Quays, then along the major wall out to the Block Forts. The masonry of the Block Forts reminded me that so much of the ancient city must have been built with a defensive purpose. Ashlar blocks amongst the rubble of the eastern breakwater showed that the Hellenic city wall had continued along the breakwater to provide defence to the east. Even at the height of security of the Roman Empire, piracy was always a problem, so that military patrols were needed, with constant vigilance, lookouts, and watchmen.

I swam across the channel between the towers. Peter and Jay had already swum ahead to the slipways, but Kirsten and I were crossing between the towers when Jay turned back and photographed us (Fig. 11.13). We all swam over the gentle gradient of the slipways, but only examined the easternmost slips. If I had swum to the westernmost,

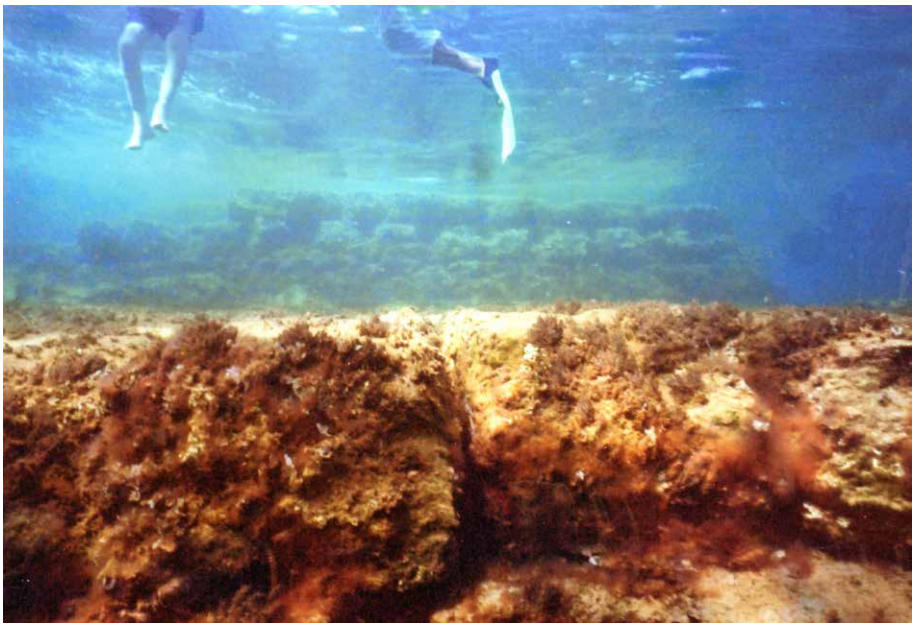


Figure 11.13. Looking across the channel between the Block Forts at Apollonia. The massive blocks in the foreground are the northern tower, with the southern tower visible beyond the divers. I am the diver without fins, and the other one is Kirsten (Photo Jay Kleinberg).

slipways 1 and 2 on the map (Chapter 1, Fig. 1.13), I might have discovered some surprises that would, in retrospect, have answered questions that arose later.

With sorrow, I turned back towards the city on land. Glancing through my mask splashed with water I scanned the columns of the basilicas standing so proudly on the shore. Those columns represented the last phase of Apollonia's active life, the Christian Byzantine stage, built high on the soil and ruins of earlier variants of the city's plan. Here, in the water, I was swimming over the earliest structures where they rested on the bedrock. Then back to the beach, and a tour west to look at the minor settlements under the wise guidance of Mr Hamid.

On the fourth day at Apollonia there was a bit of a breeze blowing, so that suspended sediment would make it difficult to see under water. I wondered if we could hire a boat to go out to the islands instead of swimming. I turned to Moktar, where we all sat under the shade between the Toyotas.

"Do you think we could hire one of the fishing boats, to go out to the islands?" I gestured to the little modern harbour close to the village where there were a dozen boats tied up to the jetty.

Moktar looked hesitant.

"I wish I could help you. There is nothing in the plan about boats. It would cost money, and I have no approval for that."

Moktar had been handling all the money throughout the trip, paying hotels, restaurants, purchasing fuel, and buying food in the markets.

"I have brought some dollars as a reserve, just in case. I am sure that the fishermen would accept dollars."

"But I don't know what a boat would cost. I am happy to do that, but I could not bargain properly with the boatman."

I handed Moktar a ten-dollar note.

"I am sure that if you offer the fishermen ten dollars, they will agree the time that they can provide us with the boat. I think an hour or two would be reasonable. I don't know the prices either, but it would be worth trying. I would be very grateful if we can land some people on the island today."

Moktar looked uncertain, but walked the few hundred metres to the jetty, and returned 20 minutes later smiling happily.

"One of the fishermen can take you out in his boat for two hours for ten dollars. He is very keen."

We drove to the jetty, where the drivers lifted me down into the small boat, in which I sat on my cushion without my wheelchair. Mr Hamid and the family followed. The outboard looked very battered and unreliable, but the fisherman was smiling, and off we went. The others brought their fins just in case.

In the shelter of the West Island, the fisherman brought the bow gently up to the rocks, so that everybody could jump ashore except me. We stood off in the boat, just stemming the waves, and watched the others clambering about. Peter soon emerged on the top of the island, having found the cave and storage rooms inside, with the rock-cut steps up to a watchtower on the summit. I called to Mr Hamid to come back into the boat and gestured to the boatman to go around the island. Mr Hamid explained what I wanted. The sea was choppy between the islands, but our little boat rode the waves smoothly, and we turned to cruise along the outside of the wave-trap, looking up at the

Figure 11.14. North face of the West Island. The wave in the foreground is breaking into the ancient wave-trap. The cliff face is completely artificial, being cut vertical by the same process of excavation and removal of rock while excavating the trough of the wave-trap. This vertical face made it difficult to attack the island from the sea (Photo Jay Kleinberg).

carved cliff on the north side of the island. It was splashed by the spray and mottled with encrusting algae (Fig. 11.14).

I tried to envisage the shape of the island before the excavation of the wave-trap. Suddenly I was staring straight through the cliff at the misty hills of the Gebel Akhdar on the mainland. My mind grappled unsteadily with the shock. I felt disoriented, like Alice tumbling down the rabbit hole. The cliff had become transparent, like a window. That made no sense. The cliff had disappeared. Not much more sense. I seemed to be looking through a window in the cliff at the distant hills. Still absurd.

I gestured to the boatman to stop and tried to explain my problem to Mr Hamid. When we looked carefully at the island we saw that a freshly broken rock surface gleamed palely on either side of a gap 20 m (85 ft) long, where the rock wall that I described at the start of Chapter 1 had been. The solid rock that I had perched on 45 years ago had vanished. The exposed surfaces at each end and across the base of the wall showed that it had been about 2 m (6 ft) thick. But where had it gone? And why? When?

Even stranger, I, who thought of myself as a trained observer, had been sitting on the mainland shore for several hours on each of the past three days looking towards the islands, and I had not noticed anything wrong. One does not expect hundreds of tons of solid bedrock to disappear, and, like the detectives in Edgar Allan Poe's *The Purloined Letter*, the missing element was so striking, so obvious, that I could not see it. Since it could not be true, I did not register the change in the profile of the island.

I did not feel humiliated so much as astonished and shocked. The human mind is very strange. We drove quickly around the west end of the island, turning in towards the submerged slipways. I called to Jay and Kirsten, both of whom had cameras.

"The wall has broken at the back of the island. Try to get pictures of the waves breaking across the island and the broken wall."

Jay waved that she had understood, so the boat backed off again while Jay and Kirsten both photographed the damage (Fig. 11.15). At dinner that evening, while consuming my second portion of Libyan soup, I pondered the strange occurrence of the missing wall. How rapidly was Apollonia collapsing under the attack of storms? Some years later, I was sent a picture of Apollonia in a winter storm, and it is astonishing that anything survives (Fig. 11.16).

* * *

The drive back to Benghazi next day was truly nostalgic. I had been privileged to enjoy a revisit to Apollonia, but would I ever return again? Once more I thought of finding archaeologists who could give the site the serious attention it needed under water. We stayed again at the plush, glitzy hotel in Benghazi, where we were the only guests. In the echoing, vaulted dining room, we sat at a large table, from which, halfway through dinner, the Man from the Ministry departed, perhaps to make a telephone call. He returned ten minutes later, and, seeing that Kirsten was sitting with her back to him, determined to creep up behind her and give her a surprise, perhaps by clapping his hands. With exaggerated contortions and facial expression, he tip-toed *à la* grandmother's footsteps towards Kirsten's chair. He failed to notice that in a hall surrounded by mirrors, his manoeuvres were not secret at all. Kirsten had been watching him carefully in the mirror and, when he was still a metre back from her chair, she whipped around and clapped her hands in his face. He jumped with surprise, before realizing the impossibility of his attempt. We all laughed at him, but he was not at all upset and re-joined us for the meal with good humour. As security officers go, he was pretty relaxed, at least in our company.

We covered the 900 km (570 mi) from Benghazi to Tripoli in one high-speed drive at full throttle, stopping only for security checkpoints and occasional food and drink. The road surface on the coast road is good, and traffic is sparse, although we did get stuck once behind a small pickup truck carrying two camels, whose long necks extending on either side blocked most of the road. As we approached Sirte, the wind began to drive the sand in swivelling streamers snaking across the road, and then the finer particles and dust were whipped up into the air in a small dust storm. The sun gleamed weakly through the clouds of dust, but the drivers assured us that this could not really be called a sandstorm. The storm lasted for several hours, but the density of dust was not so bad as to make breathing difficult, and the drivers were confident that the air filters on the engines could cope with the abrasion. I was reminded of the extraordinary work by Brigadier Ralph Bagnold who, between the wars, studied the movement of sand in the Libyan desert, writing his original and fundamental 1941 book, *The Physics of Blown Sand and Desert Dunes*. It is still a reliable reference work. Bagnold commanded the Long Range Desert Group in Libya during World War II, from which were born both the SAS and the SBS.

Figure 11.15. Jay Kleinberg photographs the broken wall that originally protected the West Island, both against military attack, and to prevent waves and spray washing onto the island. The ridge of the wave-trap is visible on the outside of the trough. The entrance to the storage caverns has half collapsed. Waves now wash right across the centre of the island.

Figure 11.16. Apollonia West Island in a winter storm, with waves and wind from the northwest. The effect of the broken rock wall is to allow the breaking waves to flow over the centre of the island (Photo Jean-Pierre Misson).

We stayed in the same grand high-rise hotel in Tripoli but enjoyed one last magnificent dinner at an excellent fish restaurant by the sea. The contemplation of the end of our adventure was surprisingly intense for all of us. Our support team of five Libyans were amongst the best people I have ever worked with. If I had tried to pick a team for the project, I could hardly have found people who would approach their efficiency, kindness, thoughtfulness, and quick responses to problems and emergencies. We exchanged many commitments and assurances that we would return to Libya soon, to conduct more research together at Apollonia. Many toasts of Libyan non-alcoholic beer were consumed emotionally.

On the final morning, as we prepared to drive to the airport in the six-seater van, Moktar quizzed me while the others did some last-minute shopping. "Please promise you will come back. This trip has been so interesting for all of us, and we have enjoyed your company. We must work together again. Your children are very unusual. They are so …" He struggled to find the right word. Finally he said: "They are not complicated." I knew that he did not mean that they were simple. Perhaps he was looking for words like not moody, or not temperamental. I think he had sensed, correctly, that in a stressful or demanding situation, both Kirsten and Peter just go for the practical solution first, and postpone any quibbles or complaints for afterwards, if they are necessary. They do not make problems for their own sake and always try to simplify and ease the situation in a conflict. Moktar certainly intended it as a compliment. Once more I wondered if he had had to cope with tourist families where the children indulged in mild, or not so mild, fits of complaint or tantrums. I owe many thanks to Moktar and the whole Libyan team.

* * *

Back in England, I wondered how best to protect Apollonia from further damage, and whether the original cause of the smashed wall had been storm waves or fish-bombing. Cyrene is a designated UNESCO World Heritage Site, which technically includes Apollonia as its port. But no effort has ever been made to use the UNESCO designation as a reason to protect Apollonia. I consulted Dutch engineers during one of my visits to the Koninklijk Nederlands Meteorologisch Instituut in Den Haag about the costs of a breakwater encircling the whole city to protect it from direct wave attack. The best approach was probably a submerged breakwater that, rather like the present function of the ancient wave-trap, would cause the waves to dissipate most of their energy several hundred metres outside the city limits. This could be a crude rubble construction, using blocks large enough to stay in position, which could be built for about €8-9M. At that time, there was a huge publicity campaign supported by Colonel Gaddafi for a project called "Green Mountain", which implied an investment of many millions of dollars into development of the Gebel Akhdar area, so that I hoped that protection of Apollonia could be added to the agenda.

During this time also, the BBC contacted me to consider making a film about triremes, and we discussed using Apollonia as the site, with the perfect slipways, and using the reconstructed ancient trireme *Olympia* as part of an elaborate documentary. It was attractive but too ambitious and came to nothing.

In 2008-09, Carlo Beltrame, representing an environmental research group in Venice, dived on Apollonia to assess the possibility of developing an archaeological

marine park, providing tourists with glass-bottomed boats that could travel over the city, allowing them to keep their feet dry while enjoying the ancient ruins. Such tours could have been combined with dive trails supervised by diving guides. The project was part of a general remit by the Libyan government for Evaluation and Conservation of the Cultural Libyan Heritage. I corresponded with Carlo about these ideas, which I supported, because I felt that the justification for protecting the ancient port properly would be improved if there was strong public interest, even providing a small financial return with the stimulation of local employment. Carlo's report assessed the visual appeal of each feature and target on the seafloor, showing also that, as the scheme was developed, there should be scope for research. I sent Carlo a digitized version on CD of the 16 mm film that we shot in 1958-59, and he has sent me some pictures which are used in this book. Again, we abandoned such plans as the political situation in Libya deteriorated in 2010-11.

Professor Claude Sintes, Director of the Museum of Ancient Arles, France, excavated at Apollonia between 1986 and 2003 as a member of the Mission Archéologique Française (MAF), in a series of projects some of which included diving. His work focused on the channel between the inner harbour and the east harbour and on the piscina, where his divers found part of a statue that matched the marble faun that we raised in 1959. French divers also found remains of a wreck in the eastern harbour and raised part of it. I sent Sintes the same CD I had sent to Carlo, and he also responded with several pictures of his work, but also with the comment that the Grotto Reef was, he thought, completely destroyed before he began work there. He also confirmed that the back wall of the West Island was broken already. This pushed back the date for the great wall breaking to a much earlier date than I had expected.

When Jon Henderson conducted the sophisticated, high-tech survey of Pavlopetri in 2008-09 (Chapter 6), we discussed the possibility of applying the same methods to Apollonia, which would, in the absence of more substantive protection, at least have documented the exact state of the remains at that date. Unfortunately, the civil war to overthrow Gaddafi started in 2011, which brought all such speculative ambitions to a stop.

* * *

I presented an illustrated report on our 2003 tour of the Libyan coast to the Society for Libyan Studies in the British Academy lecture hall in 2004. I showed a section of the 1959 movie, now on DVD, then followed with the original measurements that we had made on the sea levels all along the coast in the Gulf of Sirte. I stressed the need for new efforts to map and protect Apollonia from damage. In the following years, I kept in touch with Paul Bennett, the chairman of LibSoc, and with Claudio Vita Finzi, an old friend from Cambridge days, who also participated in the Farasan Islands project (Chapter 10). Vita Finzi has a strong interest in the climate change and sea level on the coast of Libya.

In 2007, LibSoc invited André Laronde to give a talk on his excavation of trenches on the acropolis at Apollonia, which I attended with interest and curiosity. The excavation revealed details of ceramics and coins in stratigraphic context, but Laronde made almost no mention of the underwater studies, although he did refer to my early mapping. He mentioned very briefly the MAF diving research in the 1980s.

As we were putting our coats on after dinner, Paul Bennett approached me in a chatty way.

"Nic, we have decided to return the Fitzwilliam Bronze Ram to Libya as soon as possible. All part of trying to re-establish friendly political relations, you know."

I gulped with astonishment.

"Ram? Bronze ram? I'm sorry, I did not know that there was any bronze warship's ram in England. Surely the Atlit ram in Haifa is the only one that has been found and published?"

"Oh no," said Paul. "This ram was found near Tobruk, off Wadi Belgammel, by British military divers in the 1960s. They brought it back to England and loaned it to the Fitzwilliam Museum in Cambridge. It's been stored in a basement archive there. The owner has decided that it would now be good to give it back to the Libyans, and I have agreed to arrange that at the diplomatic level."

"Wait a minute, Paul, please. Please. I must know more. I am not a "ship man", but I am sure that no nautical archaeologist or expert on ancient ships in the Nautical Archaeology Society even knows that this ram exists. The only warship ram ever published is in Haifa. If we send the Fitzwilliam Ram back to Libya, we will never be able to study it in detail again. We need several months to make proper scientific analysis of how it was cast, what it is made of, the alloys, how strong it is, how it worked, how it fitted onto the ship's bow, where the metal ores came from and so on. It will take time. We must have time. Please."

Paul hesitated.

"It's a bit sensitive. Of the people who found it, raised it to the surface, only one is still alive. The Fitzwilliam Museum has never been told exactly where it was found. It is now back in private hands, and I will have to ask the owner if he will agree to the sort of examination that you are suggesting. I'll try."

"Thank you, Paul. Thank you. Honestly, I think this is a unique chance to study an ancient bronze fighting ram in detail. It will never happen again."

Several months had passed when Paul told me that the owner of the bronze ram had agreed to it being examined scientifically before sending it back to Libya. I asked if I could see it before I started to contact the scientists who I thought needed to work on it. A few weeks later. Paul told me that the owner, Mr Ken Oliver, would be happy to show me the ram, and that he lived in a suburb of Southampton. This was an extraordinarily convenient coincidence, since the NOC is in Southampton, and I could request scientists from different groups at Southampton University to conduct the specialist studies.

In January 2008, I drove to Ken Oliver's house. Ken was a lean, active man, a retired teacher, older than me, and keen to ensure that the bronze ram was given a good home. He escorted me through to his kitchen where, on a metal display frame, the exquisite shape of the three-bladed ram dominated the room like a prima donna. It was impossible not to stare at it: 20 kg (44 lb) of solid bronze, cast in one piece, showing complexities of shape and decoration that demonstrated the skill of its makers (Fig. 11.17).

"The man who had it in his home in Cornwall died recently," said Ken, "and he left it to me in his will. The other two divers who found it died many years ago. Technically it was on loan to the Fitzwilliam Museum, but it really ought to go back to Libya."

"It is beautiful," I said. "Has Paul Bennett told you what we want to do before it goes home?"

Figure 11.17. The Belgammel ram: the bronze ram weighs almost 20 kg. The trident blades at the front would have been used to damage the oars on an enemy ship (Crown Copyright).

"Yes, and I think all the original finders would agree. But I think we need also to obtain permission from the Fitzwilliam."

Ken told me how the Belgammel ram was found by the group of RAF divers to which he belonged in the early 1960s. They found it in 24 m (80 ft) of water to the west of Tobruk, off Wadi Belgammel, 200 kilometres (124 mi) to the east of Apollonia. The discovery and lifting of the ram had never been published, and they did not reveal to the Fitzwilliam the position where it was found, not even the country. The find site, fairly close to Apollonia, provided a richness to the event that added to what we already knew about the use of warships in the area, both Greek and Roman. The Belgammel ram was smaller than the Haifa ram, and was clearly designed to fit above the waterline, not a massive battering ram to stave in the enemy timbers, but more probably to smash the oars. I imagined a small, armed patrol boat that assisted the Roman warships in the suppression of piracy along that important coast, where trade was so essential. Perhaps it had sometimes called at the port of Apollonia.

Ken lent me the files on the discovery, photographs from the date of discovery, and correspondence about the possible function of the small ram that he had in his records. I thanked Ken for the papers, after which I informed Paul Bennett and the Fitzwilliam what we intended to do. The museum agreed both to the return of the ram to Libya, and the study and sampling of the bronze, given ethical assessment by archaeologists.

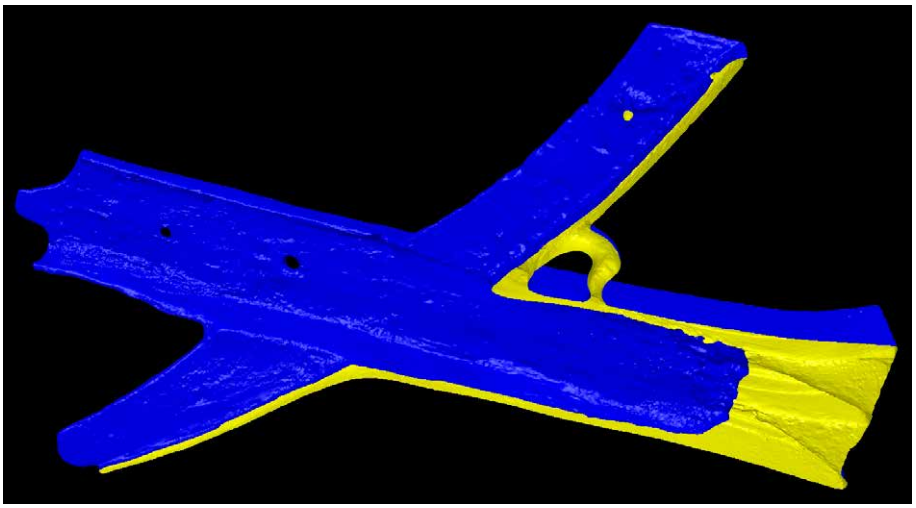
I recruited a range of experts who could subject the ram to several tests and sampling: surface non-contact digitizing using a laser scanner; reflectance transformation imaging using polynomial texture mapping and hemispherical harmonics; digital photogrammetry with dense surface modelling; structured light optical scanning; and X-ray fluorescence analysis. The experts examined its internal structure by X-radiography and 3-D X-ray tomography. Metallurgical composition was studied by micro-drilling and subjecting the nine samples to scanning electron microscope X-ray micro-analysis,

micro X-ray fluorescence, and X-ray backscatter. The organic materials and fragments of wood inside the ram were dated by radiometric Carbon-14, and an expert on ancient shipping estimated its age independently based on its design and decoration.

Paul Bennett and Ken Oliver joined our first meeting at the NOC Southampton. People responded dramatically to the sight of the mass of bronze supported on its frame, standing on the table. The alien shape with its aggressive trident blades forced everyone to stare at it. Eyes widened, gazes were fixed, jaws dropped, so that metaphors are not needed. We had to make a decision on the ethics of drilling for metallurgical samples. Bronze is an alloy of copper and tin, with possible additions of lead, and other impurities. From my days of undergraduate metallurgy at Cambridge, I knew that, when a complex alloy of two or three or more metals cools and the first crystals solidify, the residual liquid has a changed composition, so that the next crystals change to a different

Figure 11.18 a) This section through an X-ray CAT-scan of the uppermost blade of the trident on the bronze Belgammel ram shows intense porosity concentrated into the up-curved tip. This shows that the ram was cast on an upright position with this blade at the top (Crown Copyright).

Figure 11.18 b) Section through a 3-D X-ray CAT-scan reconstruction of the Belgammel ram. The thin curved material would fasten round the stem-post of the ship, while the wales were inserted inside the main cavity, terminating at the solid bronze at the front of the Ram. Note extreme variation of the thickness of the metal, which was cast in one piece (Crown Copyright).



mix. Since some parts of the ram were only a few millimetres (about 0.1 in) thick, and others 20-25 cm (8-10 in) thick (Fig. 11.18) the rate of cooling would vary, and thus the composition. Also, bubbles probably formed in the molten metal when it was poured into the mould, and the bubbles would rise to the top of the mould, depending upon the location of riser vents, revealing the position and orientation of the ram when it was cast. Ian Croudace, the geochemical expert, reported that he needed to take about eight or nine micro-drilled samples, each of only 50 milligrams (one five-hundredth of an ounce). After the position for the samples was agreed, we recorded that this was an ethically allowable programme, in view of the knowledge to be gained.

We started work on the Belgammel ram with the assumption that we had only a few months to complete the examination, but the diplomacy with the Libyan Embassy proceeded slowly for two years, so that we were never told to hurry up. Analysis of the micro-drill samples showed quickly that the alloy was high in lead, with an overall composition of 86.9% copper, 6.3% tin, and 6.6% lead. Isotopic analysis of the lead showed that it could have come from mines near Athens, but this is uncertain, because of the habit of re-melting and re-casting multiple lead or bronze objects. The most difficult part of the study was to shine X-rays through the thick 20-25 cm (8-10 in) parts of the bronze, to reveal the internal integrity, cracks, porosity, and concentrations of bubbles. Ian Croudace discovered that no hospital or laboratory in the Southampton region had an X-ray machine of sufficient power to even consider such a project. His contacts with scientists at MoD Aldermaston provided us with the solution we needed. In a concrete bunker with walls of unbelievable thickness, the experts there had an X-ray generating machine that fired beams of 6-10 million electron volts at targets on a rotating table. Using this device, we could shoot X-rays through the ram at many different orientations, building up a complete picture of its internal structure, somewhat like a medical Computer Aided Tomography scan.

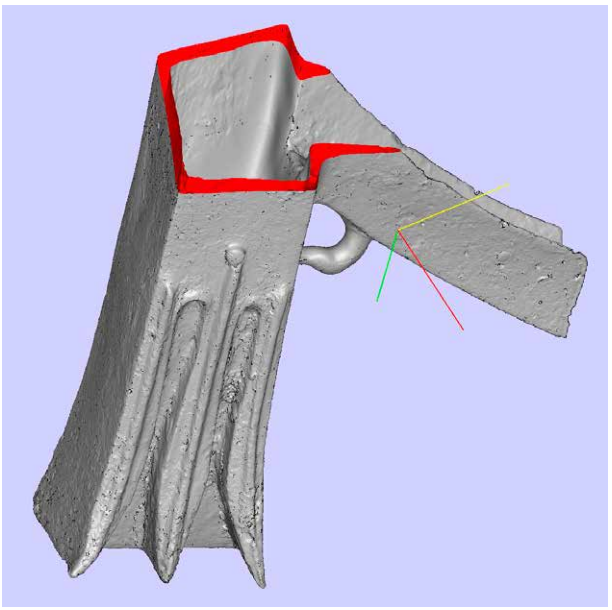


Figure 11.19. A cross-section cut through the 3-D reconstruction of the ram based on X-ray CAT-scan (Crown Copyright).

The security precautions were laborious but necessary. The outcome of the X-ray study was wonderful (Fig. 11.19), showing a porosity that would be regarded as unacceptable by modern standards, but which, by all reports, was quite common in ancient castings. The bubbles are concentrated in the tips of one of the up-curved blades, showing that this part of the ram was uppermost during casting. Consideration of the shape of the ram itself, the lack of seams, and the multiple curves, showed that it was cast in one piece, in a single pour, using the lost-wax process. This is the same process that was used by the ancient sculptors to make beautiful bronze statues like the Charioteer at Delphi. The technique was very highly developed in the ancient world and was apparently just as important in the realm of military technology as in art and aesthetics.

In May 2010, Paul Bennett and Ken Oliver travelled to Libya with the ram, where they were guests of honour in a ceremony at the National Museum that was so grand that Tripoli was bedecked with banners. We published the report on the ram first in an illustrated book which accompanied the donation in Tripoli, and then in the *International Journal of Nautical Archaeology*.

* * *

Mohamed Bouazizi, a Tunisian, burned himself to death in December 2010 out of despair at unemployment and a sense of the impossibility of change. This sad event started the spread of imitations and civil unrest in many North African and Middle Eastern Arab countries. The government of Tunisia fell a few months later, followed by elections, encouraging many observers and commentators to hope for a decline in dictatorships and a rise in responsive democratic governments throughout the region. The initial phase of optimism was dubbed the "Arab Spring", but it was soon followed by counter-attacks from governments, skirmishes, vendettas, suppression, and increased use of force in many countries. Only Tunisia seems to have survived without lapsing back into authoritarian or religious dictatorship.

Muammar Gaddafi's army marched on rebellious Benghazi in February 2011, prompting the expectation of an unrestricted massacre of civilians. The United Nations Security Council decided on 26th February to freeze the assets of Gaddafi and his inner circle and restrict their travel. On 19th March, a NATO force led by British and French intervened with aircraft, bombs, and rockets in support of the rebels. Various factions of rebels increased their attacks on Gaddafi's army, and civil war raged until October, when Gaddafi was captured and killed on the 20th, with Tripoli falling into the hands of the alternative government council on the 23rd October.

The destruction and suffering caused during the intense months of August to October were all the more agonizing to watch on TV, and in the press reports, because most of the battles were surging to and fro along the coast road that we had travelled in 2003. Every event, every picture of a shell-shattered town or village, brought back memories of the good people we had met in Libya, their kindness, generosity, and open-heartedness. Ironically, we returned the Belgammel bronze ram to Tripoli only a year before the city was bombed by the RAF. The survival or destruction of the ram was a trivial matter compared to the sufferings of tens of thousands of innocent people, but, as a matter of fact, the museum was not destroyed. I have enquired of the survival of the people we worked with, but have been unable to find out if most are alive or dead. Mr Hamid died of old age in 2017.

* * *

The academic publication of the uniquely detailed metallurgical and geochemical study of the Belgammel ram created some correspondence, including an e-mail from a Monsieur Jean-Pierre Misson. This began a long, friendly correspondence and, so far, one meeting, which has been surprisingly fruitful and constructive.

Jean-Pierre (JP), who was born in Alexandria, Egypt, had Belgian and English parents who stayed in Alexandria after World War II, so that his education was completed there. He speaks excellent Arabic, plus English, French, Italian, and possibly other languages. He trained as a telecommunications engineer, working from 1961-67 as a radio engineer on the microwave network in Libya, where his accommodation was in El Beda, not far from Cyrene. His spare time was often spent in the sea, swimming at many archaeological sites on the coast, frequently at Apollonia. He first dived with scuba tanks in 1963, getting his tanks filled with compressed air at the RAF base in Tobruk by the same people who later found the Belgammel ram. To record the ruins that he saw under water, he built a waterproof housing for a reflex 6" x 6" camera, which worked in shallow water, but also purchased a Calypso Phot 35 mm camera. He became completely obsessed with the details of the submerged buildings at Apollonia. Richard Goodchild showed JP a copy of the map that Nick Wood and I had prepared a few years earlier, which had been published in the *Geographical Magazine*, and in a book edited by Joan du Plat Taylor in 1965. JP annotated a copy for himself to use as guidance while he was diving regularly on the city.

JP's sharp eyes detected many small details of the construction of the Nine Quays and the slipways (Fig. 11.20). There were grooves and slots for dowels of lead or iron in several places. As our exchange of e-mails expanded, I noticed that some of the pictures

Figure 11.20. View along the Quay Number 2 of the Nine Quays. Each quay, which is 2 m wide, has an outer face of long blocks, while the internal space is filled with rubble and topped with rectangular blocks. There are no footings for a wall or pillars that could have supported a roof (Photo J-P Misson).

included the West Island in the background. To my surprise, the great wall at the back of the West Island was already broken away and missing in pictures from the early 1960s. When I discussed this with JP, he found pictures of colossal blocks of broken stone lying on the slipways (Fig. 11.21). They were lying on slipways 1 and 2, which I did not inspect in 2003. It appeared that the wall had already been smashed by 1963. The light-coloured fresh surfaces of the broken rock where the wall had collapsed were only relative to the heavily weathered rock around them. They had been exposed for at least 40 years.

One day, JP sent me a slightly blurred monochrome image of an aerial photograph of the underwater city which, he said, had been part of a survey started in 1959. Careful scrutiny of the image of the slipways 1 and 2 shows that there are large shadowy blocks lying on the seafloor. The photograph is too blurred to check for the existence of the wall itself, but this seems to show that the great wall was probably smashed in the winter of 1959, very soon after we left. Such an early date would also explain why nobody I spoke to in the village, and no archaeologists, recalled the event of the wall being broken. While this occurrence has now been more or less dated, the destruction of the Grotto Reef is less well documented, since nobody has examined it for many decades. Sadly, we are losing information as the city surrenders to the waves.

Figure 11.21. This huge block of stone used to be part of the rock wall that protected the West Island. The storms broke the wall and pushed hundreds of tons of rock onto the slipways. This block is about 3 m across. Smaller debris from the wall are visible in the foreground. These rocks were not on the slipway in 1958-59 (Photo J-P Misson).

* * *

One final postscript on factual research from Apollonia: one day in early 2016, I received an e-mail from my colleague Udi Galili in Israel, attaching a recent academic paper of which he was a co-author, describing geochemical analysis of the production of industrial quantities of raw glass in various ancient cities along the coast of Israel and Egypt. I was about to classify it as interesting but not important, when I glanced up at the bookshelf to the right of my desk, on which there was a chunk of raw bluish-green glass that the CUUEG divers had found in Apollonia in 1958.

In the first few years after the Apollonia expeditions, I did try to have the glass examined or dated by experts, but nobody could help. It might be any date from early Roman to late Victorian. Any ship carrying bulk glass to be used somewhere else could have dropped it.

Udi's paper persuaded me that it was worth trying again. I sent him photographs of the chunk which he copied to his co-author in Haifa, Yael Goren Rosen. Yael suggested that there was an expert on ancient glass at the Institute of Archaeology in London named Iain Freestone. I immediately wrote to Professor Freestone and took him the sample, which he agreed to date and analyse chemically. He was puzzled by the shape, which looked as if it had been broken out of shallow mould, but assumed that everything would work out when they knew the chemistry.

The dating of the glass places it in the in the 4th to 7th century AD, most probably 5th century, with a chemical composition that ironically, suggests that it was manufactured in another city called Apollonia, the modern Arsuf, in Israel (Chapter 6). I have dived at Arsuf several times with my friend Dr Yehuda Melamed. The late date surprised me, but it confirms the observations of Philip Kenrick that the port of Apollonia in Libya was still active and commercially viable in the Byzantine era. Any model of the earthquakes and earth movements that resulted in Apollonia being under water, as it is now, must include a stage of the harbour in the Byzantine period which was still usable (Fig. 11.22).

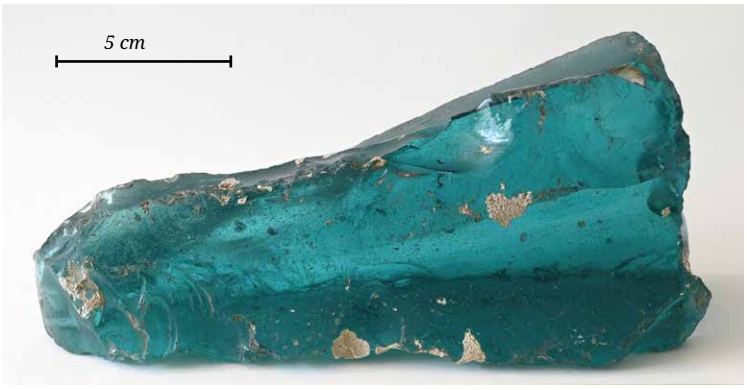


Figure 11.22. This chunk of raw glass was found by the divers in the inner port at Apollonia in 1958. It has been dated to the 4th-7th century AD, in the Byzantine period. The chemical composition of the glass, and the isotopes of contaminants, are typical of glass manufactured at the city of Apollonia in Israel, the modern Arsuf (Apollonia was a popular city name) (Photo Mike Tibbots).

* * *

Sixty years after the Cambridge team of divers made the first complete map of the underwater city of Apollonia, do we fully understand how the city evolved after its foundation, how it adapted to changes during the 1300 years of active life as a commercial and military port? How ships were managed? How warships were stored and launched? How bulk cargo was loaded? How valuable produce was stored and protected? And what happened during the further 1300 years after the port was abandoned? The quick answer to all these questions is still no, certainly not in a precise and reliable way.

As I have stressed many times, I am not an archaeologist. During the decades after 1959, I did not have any reason to observe or record the subsequent short visits to Cyrenaica by small research teams from other countries, nor to try to understand what was happening locally on the site. But I shall try here to fill in some of the gaps, and note what happened during those years.

There are two main factors that drove the changes at Apollonia: the effect of tectonic earth movements on the coast causing changes of relative sea level, and the cultural, political, and military changes in North Africa and the wider Mediterranean empires.

The people of the city responded to both. They could not avoid or ignore the changes of relative sea level that caused the harbour to contract, or flooded it and drowned other buildings. After such changes of sea level, the relative importance of certain activities in different parts of the town and harbour would change overnight. That is in addition to the destructive effects on buildings that may have occurred from the earthquakes. On a different timescale, the prosperity of Cyrene, the demand for trade from the great cities of the northern Mediterranean, shifting political alliances in the region, military and naval security, and raiding parties from the Arab expansion combined to force changes in priorities, increased defences, or required more warehouses, docks for larger vessels, and so on.

Modern maps of seismicity, combined with historical records of ancient earthquakes over the past 2000 years, confirm that there are two regions of intense activity on the Libyan coast, from Sabratha to Tripoli in the west, and from Ptolemais to Apollonia in the east. This fits exactly with observations of uplift and submergence, but leaves a question mark over the timing, and the possibility of multiple earthquake events.

In 1959, I noted that the walkway around the piscina is at present under 2.5 m (8 ft) of water. If the land uplifted so that the relative sea level was lowered sufficiently to make the walkway dry, with a bit of clearance, then the slipways on the West Island would have been entirely out of the water. All relevant evidence indicates that they should be submerged by about one-quarter of their length. Since the piscina is probably Roman, and the slipways are much earlier, this suggests that there was an earthquake or seismic event shortly before the year zero, that uplifted the city by about 50 cm (20 in). This is compatible with the circular line of buildings showing a contraction of the radius of the inner harbour, and existence of the buildings constructed on top of the slipways. It also explains a wall in square B9 (Fig. 1.7) that runs across the seafloor about 20 m (66 ft) beyond the bottom of the slipways, which would be nonsense if they were still in use.

On this evidence alone, we can speculate that there was a tectonic uplift on the order of 50 cm (20 in) at the time of the Early Roman Empire, which was followed by tectonic

submergence of the order of 3 m (10 ft) at an unspecified date, probably in the late Byzantine period or shortly afterwards. Such multiple stick-slip phenomena are quite common in the way that large faults yield to the stresses caused by plate movements. There is no direct evidence for this double movement at the other ports in the region, nor would one expect the displacement to be identical at all ports, but the final net subsidence is confirmed, or at least compatible, with the evidence at all the settlements between Apollonia and Ptolemais.

The post-glacial GIA (Chapter 6) component for Cyrenaica in the past 2000 years is close to zero, and the most recent calculation by Giorgio Spada from Urbino University shows that it is probably about 10 cm (4 in) at Apollonia.

This simple model therefore proposes three phases bounded by tectonic change: before the uplift; after the uplift; and then after the submergence which is both tectonic plus a small GIA component.

* * *

Almost 30 years after the CUUEG expeditions, the Mission Archéologique Français en Libye, led by Professor Claude Sintes, from the University of Arles, conducted a series of land-based and diving research projects, with some excavation by air lift suction hose between 1985 and 1998. Work on land at Apollonia continued under the direction of André Laronde until 2006. A diving team from the Department for Underwater Archaeological Research (DRASSM) of Marseille took part in the early years of the mission. They discovered two Roman wrecks in the eastern basin and excavated one of them, which they dated to the 2nd century BC. This pair of wrecks with amphorae dating to the later Republican period confirms the hypothesis that the external basin to the east, bounded by a massive rubble breakwater, was the main commercial basin for large cargoes. But the wrecks were not grain-carrying ships.

The DRASSM team also excavated a trench between the Block Forts at the entrance of the western harbour. The trench uncovered evidence that, between the 6th and 7th centuries AD, the entrance had been closed quickly with reused building material. The French divers' investigations at the Block Forts estimated a total change in sea level of 3.50 m (11 ft), with a slight variation for the small tides. They based this on indications of lithophaga, small molluscs that bore into stone, on the sides of the fortified towers facing the channel. The French concluded that there is additional support for the suggestion of a change of level of 3.70-3.80 m (12 ft 1 in – 12 ft 6 in) since the beginning of the Christian era. If the relative sea level has risen that much, it must be pointed out that the western inner harbour would have had a very small radius indeed, with a depth of less than 1 m (3 ft), while the slipways and Nine Quays would have been 1 m (3 ft) above sea level 2000 years ago. Nevertheless, the suggestion that the most recent relative sea level rise is on the order of 3.0 m (10 ft) or more, is consistent with my previous observations concerning the tectonics.

The CUUEG discovery of the 4th-7th century glass ingot in the western inner harbour suggests that ships were still using it as late as that. There is literary evidence that the harbour was active in the Byzantine period, and Apollonia was the capital of the Pentapolis, showing that it was not in a state of terminal decline.

A comprehensive and insightful publication in 2010 by Sintes proposes four phases in the evolution of the city plan and function, based on his analysis of changes in the architecture of buildings and structures of the sea defences. These successive plans are based on the excavation at the Block Forts and estimates of the depth of each channel and structure at each date (though, as far as I can see, they have not included the possibility of two phases of earth movements). Sintes notes that, during his work at Apollonia, a thick layer of sand covered the lower half of all ten slipways, concealing the observations that we made in 1958-59. It was impossible for him even to consider excavating through hundreds of tons of sand. This accumulation may be at least partly the result of waves washing over the West Island since the rock wall collapsed.

According to Sintes' model, in the first phase of the port's development, the West Island was connected to the mainland by a natural isthmus that separated what we now regard as the east and west harbour basins, while the entrance to the west harbour was over the ridge to the west of the West Island (see Fig. 1.7). The slipways were built on the West Island during this stage, but, since the basin was exposed to the worst northwest storms, the citizens eventually decided to fill in the gap between the island and the Grotto Reef with a rubble mole, and cut a channel through the isthmus by the Block Forts to create a port with two basins.

My rough calculations show that construction of the slipways by cutting away the overburden of rock, the creation of the wave-trap, the hollowing out of the West Island with the open work area and hollowed caves, plus the deep quarrying on the eastern side of the island, removed in the order of 100,000 m^3 (3.5 million cu ft) of rock. This could have been used to build rubble breakwaters and to provide squared ashlar blocks for buildings in the city itself. The sculpting of the East Island additionally produced about half as much re-usable stone as the West Island.

During the second phase, the Hellenistic period, the citizens built massive defensive walls with towers to protect the whole city, both on the seaward defences and inland, around to the theatre, and out along the eastern rubble breakwater. Sintes judges the inner western basin to be 4 m (13 ft) deep at that time, while boats or galleys not stationed on the slipways could be pulled up on the sandy beach on the southern side of the basin. This is the area where there are the parallel buildings that we proposed in 1958-59 as quays, which would have served the same purpose.

The third phase in Sintes' synthesis is the Roman epoch, which shows the reduced perimeter of the harbour clearly for the first time. There is no suggestion that this was caused by uplift, but the ten slipways are now covered over and defined as an area of dry land. The Nine Quays appear on the map for the first time, and are defined, tactfully, as warehouses, with a question mark. The channel between the West and East Islands is shown as filled in, as if there was only one island during all phases, which is curious, since the channel is now 7 m (23 ft) deep, and would have been open at all times in the past, unless blocked deliberately with rubble.

In the fourth phase, described simply as "late", the channel between the basins has been filled in, and the gap between the islands has been partly filled with rubble.

My primary reaction to Sintes' proposals is one of a total welcome for seizing the big ideas and the big questions about Apollonia. My own suggestion is that the channel between the ports probably existed as a natural connection quite early on, and that the blocking of the gap to the west of the West Island had to be early, because without it the

basin was exposed to almost constant northwest winds and would have been useless. There are plenty of rubble breakwaters in ancient Greek ports from this date. The waste rock from excavating around the islands provided the material early on. When the tectonic uplift occurred at the time of the late Republic or Early Empire, the channel between the basins became impassable, and had to be deepened. This would explain the down-cutting that the French reported.

Apollonia continued to thrive in one way or another until the 7th century AD, and it is probable that at some stage an attempt was made to block the channel between the forts to protect against pirate attacks or Arab raids.

Finally, perhaps as late as 700 AD, the harbour sank by more than 3 m (10 ft).

Many of the details of these models, which I have described as plausible, including mine, still need checking more carefully. We need definitive confirmation, not plausible proposals. But the delightful consequence of the synthesis by Sintes is that dozens of factors can now be seen to be important in context, bringing the key issues sharply into focus. By further precise work, we can arrive at a complete description of what happened to Apollonia, how it grew, and how it died.

Sintes says that Apollonia is one of the most important ancient coastal cities in the Mediterranean, and he adds that neglect and relative lack of study of the city is scandalous, especially since the ruins are eroding so rapidly. He quotes the work of myself and the Cambridge group, crediting us with the first complete survey on which subsequent serious research should be based. He is generous with his comments on what I always presented as a non-archaeologist's common-sense attempt. Experts had to follow to do the real archaeology.

Incidentally, there are many dubious copies of the original Apollonia map published by rather careless scholars who, for reasons that I do not understand, have altered and simplified the plans of the city and individual buildings that were plotted so carefully by Nick Wood. The distorted and oversimplified maps conceal from modern scholars the true extent of our knowledge of this unique early Greek harbour. The best source for information is the map and plans in this book, my own publications on Apollonia, and detailed plans by Sintes.

* * *

The efforts that I have made over 60 years to map, excavate, protect, and understand Apollonia in all its glory have, in the end, produced useful but modest results. The sense of futility in attempting to combat and defeat the forces of the waves that I experienced on my first day there in 1958 has returned. The evocative Grotto Reef passageway has collapsed; storms destroyed the wall on the West Island in the early 1960s; the plans to map and excavate the city to modern standards and details were overtaken by the Libyan civil war; the Dutch proposal for a protecting breakwater was a non-starter in the political chaos. The building of a multi-storey hotel in Marsa Susa, almost within the area of ruins, has damaged the appearance of the ancient city and ruined its appeal to tourists. There are constant rumours that the tiny fishing harbour will, one day, be developed as a major port, though why anyone would think that such a shallow bit of the coast was suitable for large modern ships is inexplicable. The work under water by Sintes has been excellent, but serves rather to emphasize how much still needs to

be done. I thoroughly approve of his speculative reconstructions of the sequence of inundation and adaptation of the city to changes of sea level but, in effect, this work produces a set of hypotheses that need proving or checking by many weeks of diving on the site. We need to understand the original function of many unusual structures. That work will, on the present evidence, not be attempted in the near future.

Cyrenaica, the eastern part of Libya, has for several years been within the area dominated by the secessionist army that is not recognized by the government in Tripoli, nor by the United Nations. A state of lawlessness exists there. Paul Bennett has reported that, on his visit to Cyrene and Apollonia in 2020, he saw the ancient ruins being flattened for modern buildings, and open ground with buried ruins being ploughed for farming. Dense groups of houses have been built at Apollonia with untreated sewage discharged over the ruins. The water is cloudy with algae and filthy with pollution.

Like Jean-Pierre Misson, I find that I have come to adopt Apollonia as a friend of the family. I feel personally about its fate. I know that I am watching its death, with the loss of the detailed and unique information that I had hoped to decipher and preserve in 1958. The sea is claiming everything: bit by bit, blocks are corroding, stones being shifted in storms, roofs collapsing, ceramics being removed by swimmers as souvenirs. Apollonia, I tried to save you. You have been neglected, ignored, bombed, smashed by waves, traduced, misinterpreted, distorted, covered in sand, polluted, exploited, and abandoned.

And yet …

What can be salvaged from this tragic mess? Is Apollonia itself really so important as an ancient port? Are there others where we could study and preserve the same features? Sintes considers Apollonia to be exceptionally important, and as I have personally visited hundreds of other ancient ports (Chapter 6), I can confirm that there is no other early Greek port preserved to anything approaching its completeness. The great harbours, such as Leptis Magna near Tripoli, or Caesarea in Israel, are Late Roman constructions, built with all the resources available through the wealth and infrastructure of the Empire and the extensive use of hydraulic concrete. Apollonia displays intact the Greek or Phoenician construction techniques and the spatial plan from 600 years earlier.

Arising from a strange sequence of visits by interested parties from several countries, starting with Captain Beechey in 1822, we have gradually built a broadly reliable plan of the submerged city, certain buildings and features have been studied in detail (the Block Forts, the harbour entrance channel, the apsidal building, the fish-tank), and a small number of items have been raised and preserved in museums. That constitutes a fair academic outcome from a difficult geographical, environmental, and political situation. But the city itself is now in a very unfortunate state, and further work, either to study and understand it, or to preserve it, is scarcely possible for decades to come.

What will happen to the ruins in those years?

Let us first consider the worst case. If building and development at Marsa Susa continue unchecked and with no respect at all for the ancient city on land, it is just conceivable that the Byzantine basilicas could be bulldozed flat and built over. If that happened, the continuing erosion of the low cliff would be a threat to the new houses, and people would be tempted to reinforce the beach and the cliff to repel the waves. The obvious source of stone to do this would be the ruins just nearby in shallow water. If the stone blocks were dragged onto the beach, the last vestiges of the underwater city would

be minimal indeed, and future study almost pointless. This scenario is very unlikely, so let us look at more optimistic possibilities.

On a scale of decades, it is possible that the modern buildings will be fitted with proper drainage and sewage treatment. If that were to happen, the seabed ruins as they are now would be more or less accessible, and only partly damaged – similar to the condition of some of the Roman buildings in the sea close to Naples. The attachments of algae to the stones will do some damage, but not much. Those areas that have collapsed, such as the Grotto Reef and the broken wall on the West Island, could be studied by divers, the fragments measured, and the original features graphically reconstructed. The very bottom layer of foundations, where cut blocks are in contact with bedrock, is unlikely to be disturbed. Thus, a survey by an acoustic or optically sensing 3D integrating robotic autonomous underwater vehicle (AUV) might still detect many accurately positioned remains. Cuttings in bedrock, such as slots for dowels of lead and iron, or sockets for wooden beams, will not be destroyed. Technology developed in the next decades may revolutionize the accuracy of underwater surveys, with Artificial Intelligence to create reconstructions.

Taking this long view, the situation is not so depressing. On a scale of 2600 years, another decade or so is not long to wait, even if some of the detailed trimmings and finer structures of the city are destroyed. The deep-seated foundations will remain for our descendants to visit. They will have the maps, photographs, and many publications to guide them.

On this more cheerful note, I am happy to hand over responsibility for understanding and nurturing Apollonia to a much younger generation.

APOLLONIA ON MY MIND

The ocean conceals secrets, ancient, modern, and future. Nic Flemming's memoir recounts the life of a pioneer in ocean science. Each chapter describes a thread that structured his work: underwater cities, submerged Ice Age caverns dripping with stalactites, the limits to ocean exploitation, ocean climate change, prehistoric settlements on the continental shelf, ocean law, and safe scientific diving. Flemming is paralysed from the chest down and has used a wheelchair for the past 52 years; one chapter assesses how he has continued to work in rough conditions and at sea, visiting 60 countries since his accident.

Flemming's early experience with the Royal Marines Special Boat Service provided the foundation for a scientific research career under water. Intrigued by a report of a sunken city seen from a helicopter, he set out to map the submerged Greek city at Apollonia, near Benghazi, in 1958-59, as a Cambridge undergraduate. Doctoral research on the cause of submergence and uplift of hundreds of coastal Mediterranean ruins was followed by adventures in now-submerged caves from the Ice Ages when the sea level was lower.

In 1965, as industry awakened to the potential of seabed exploitation, Flemming journeyed around the world to assess marine technology and forecast future developments for UK industries. This led to participation in the UN Committee on the Law of the Sea and in the design of a Global Ocean Observing System.

Flemming later turned to academic research around submerged stratified prehistoric settlements. Advances in seabed mapping now enable marine archaeologists to study and plot numerous sites in the context of the Ice Age terrestrial landscape.

This is a multi-disciplinary adventure story that argues that different skills and fields can interact creatively with surprising results. It will be enjoyed by all those interested in the development of underwater archaeology, climate science, and ocean exploration.

HONOR FROST FOUNDATION
GENERAL PUBLICATION 2

sidestonepress
ISBN: 978-94-6426-032-8