

14 THE OFFSHORE YEARS

Prelude

I like to think my offshore interests lasted most of my life, but it is true to say that owing to force of circumstances my really active activities in marine matters peaked in the two decades spanning the late 1960's to early 1980's.

I grew up, however, in the firm knowledge that my mother's family had close connections with the sea, and in particular with sea-going from Southampton. Her father, JF Clark, was secretary of Southampton Docks, and her mother, Cecelia Harvey, the daughter of the Captain Harvey who in 1870 became a hero by 'voluntarily' going down with his ship, the steam ferry 'Normandy'. I have written of this elsewhere. Of the two sons of Captain Harvey one died in another shipwreck (the 'ss Mauritius') and one abroad, in Cape Town. My Harvey root was definitely deeply immersed in the sea.

One of my mother's brothers, Cyril, became a senior engineer at Southampton Docks, and thanks to this circumstance we were able during our twice yearly Southampton visits to tour the docks in a tug, sometimes going aboard the great ocean liners of which many were based there in the years between the wars. I see them lined up bow to stern, some with one funnel, others with up to four, alongside the long wharf of the New Docks. One vivid memory is of the land reclamation taking place between this new wharf and the original coastline - a mixture of water and silt spouted in mini-fountains into what was then a watery waste-land. The explanation provided was that the land was being built up by pumping a slurry of dredged silt and water from farther offshore.

In the 1930's my parents took to having three weeks of family camping by the sea in south Cornwall during the summer holidays, usually at Pendower Beach. These were the years of my growing interest in matters biological, and at low tide I spent many hours on the wave cut platform west of the beach. My early biological interests did not, however, prevent me from becoming a predator on the prawns then to be found lurking below the bladder wrack in the many rock pools. I was a conscience-motivated vegetarian in those days, but since I cooked the prawns by dumping them in boiling water my concern for animal rights appears not to have extend too far beyond the class mammalia. I was proud, though, of the agility which I developed in leaping from rock to rock during these activities, and which later proved to be a useful accomplishment in my geological career.

It was in Cornwall when I was about 16 that I decided I was going to build a boat. I got as far as designing it, and when we arrived back home I started by fabricating its keel – an original and probably highly impractical one. At the point when my mother saw the alarming spectacle of the boat actually materializing in front of her eyes, she put her foot down very firmly indeed. I did not always automatically withdraw when my mother became positive, but in this case I decided it would be politic so to do, and wait until later.

In the disruption of the war years Southampton and Cornwall faded into the past. With goodwill but somewhat minimal help from the struggling university staff I

acquired my degree in geology at University College, London, which was evacuated to Aberystwyth from autumn 1939 for the duration. I did, though, have one valuable first year in London prior to the start of war, when I became motivated to study geology by the inspirational lectures of Professor WBR King. By and large, geology in those days stopped at the coast, although this was of course well recognized to be a changing feature. It seemed odd that steep slopes surrounded the main continental land masses, and the gap between the mountains of Scotland and Norway was to me inexplicable. All this, though seemed to be accepted as part of the unavoidable facts of life, rather on a par with the equally inexplicable fact of anything existing at all. Somehow the compressive stresses which had resulted in rock deformation had managed to be communicated at depth from continent to continent.

The only available explanation was provided by a hypothesis so far out of touch with the reality of daily life that it was not thought suitable for serious consideration, although it was in accord with many of the known facts. This was the Wegener Hypothesis, which drew attention to the apparent fit of some of the continental masses, together with their parallel geology and faunas. The hypothesis proposed that an original super continent had split and the fragments drifted to their present position, but it failed to provide a convincing mechanism for such an intrinsically unlikely happening. I do not recollect meeting anybody who took the implications of the Wegener Hypothesis seriously until Drummond Matthews, working from Cambridge University, discovered the ocean floor magnetic stripping which laid the foundations for the Theory of Plate Tectonics in the 1960's.

Long before this I twice narrowly missed chances to be in on the ground floor of the new study area of offshore geology. By the time I graduated in 1941 Professor King, with whom I claim the status of having been a favourite student, had become Major King, Chief Geologist in the Royal Engineers. For my unavoidable military service I would have liked to have joined him, but his group was minuscule. The best he could offer me in the first place was a lead into the RE Survey Branch, which I would have taken up had I not at that point been offered a direct commission into army radar work. The principal wartime task of Major King later turned out to be a study of the geology of the English Channel and the French beaches, in preparation for the invasion of Europe and in particular the laying of the 'Pluto' oil pipeline. I like to think he might have called on me to take a part in this study had I been accessible to him when it started.

At the end of the war I was abroad and Major King had again become Professor King, but now at Cambridge University. As I awaited demobilization in East Africa I explored two possible routes into a geological career. The first, my preference, was to join the Geological Survey, the second was to study for a further degree under Professor King at Cambridge. Thanks to his influence I was formally accepted for the second possibility whilst still overseas, but I finally turned the chance down when on return to the UK in 1946 I was offered my coveted post in the Geological Survey. Professor King had been proposing that I should undertake postgraduate studies in palaeontology, but it would have been surprising indeed if, once at Cambridge, I had not become involved in the pioneering offshore work for which the university was to become distinguished.

So. In autumn 1946 I found myself a coalfield geologist working in the English Midlands, as far from the sea as it is possible to get in the British Isles.

The Scuba Period

In late 1959 I was promoted to the post of District Geologist of the South Lowland Unit of the Geological Survey, based in Edinburgh. With our entire family Lucette and I migrated northwards in a reserved first class carriage - great event! Within a few years two circumstances combined to push me towards a renewal of contact with matters offshore.

The first was that with offspring production behind us we started taking Mediterranean camping holidays. The first of these was actually in 1958, when we went to the Collioure/Banuls area, then again in 1961 - a long trug from Edinburgh. By 1963 we had moved even farther south to the Costa Brava, where we found a good camp site close to a pleasant but at that time unspoiled rocky beach. One does not spend long hot hours on a decent Mediterranean beach without soon investing in mask and snorkel, and at that point it becomes apparent that the undersea terrain not only visibly exists, but comprises an accessible, very different, and entirely fascinating world.

Meanwhile, back in Scotland, the South Lowland Unit was in 1963 engaged amongst other activities in revising the geology of an area which included the Berwickshire coast. The geologist in the field was Terry Smith, and when I made my regular liaison visit to the area we discussed a circumstance on the coast near Burnmouth. Lower Carboniferous strata were there steeply dipping and well exposed in the cliffs and the wave-cut platform, but on account of a fault several hundreds of feet of the succession were cut out of the visible exposure, and their nature was therefore completely unknown. It was, however, apparent that these rocks were likely to be exposed in the sea bed below low water mark. We realized that if it were possible to somehow access this submerged section it would make a useful contribution to knowledge of the strata in the area.

We decided it would be impractical to expect non-geologist divers to undertake the detailed examination likely to be necessary, and the only way was for ourselves to become divers. The Assistant Director Scotland at the time was Dr Mitchell, who was an inovatively minded person, but learning to dive was distinctly not a legitimate part of Geological Survey work at the time, even in my own view, so it had of necessity to be a private activity.

In early 1964 we joined the Edinburgh branch of the British Sub-Aqua Club, did our indoor training in Portobello Pool during the winter, and started open water diving in the spring of 1964. For my first open water dive Jack Gillespie, a sort of 'amateur-professional' diver, held me by the hand and took me straight down a mud slope to 60ft. Not the recommended procedure, but less hazardous than what I believe to have been my second dive, which was led by Stuart Termier, a fanatical diver who was a medical doctor and Chairman of the Edinburgh BSAC at the time. We boldly went off a rocky coast into a pretty rough sea with near zero visibility. No holding of hands this time, just a struggle against the breakers, and it was not long before I ended up thankfully straddled on top of a rock feeling as weak as a kitten. I later discovered

that I, together with most of the party, had contracted hypothermia, brought on by strenuous activity in cold water. The water was not deep, but this was one of my few narrow shaves whilst diving – it was my first practical lesson that in this activity it is as well to proceed with circumspection.

In 1964 we had another family holiday at the same camp site on the Costa Brava, but this time I used my newly acquired logbook proving my status as BSAC Class 3 diver to obtain entry to a series of boat dives run by an operator in nearby San Feliu de Guixols. Conditions were idyllic. The sun was always shining, the sea calm and warm (down to the thermocline), visibility well over a hundred feet. We dived some distance offshore, and the procedure was for about twenty of us to follow the dive leader, who periodically stopped to count that all were still present. On two occasions when a diver was missing, though, there was nothing he could do about it except hope for the best; fortunately on both occasions his hope was realized.

By far the most memorable of these dives was on 8th August 1964 through a series of cathedral-like interconnecting caves below a limestone islet in the Islas Midas. As we emerged from the darkness back into sunlit water on the far side, the whole world appeared to be of a most marvellous cobalt blue colour, set off by the streams of silver bubbles rising from our aqualungs. I was later to see a similar effect from a submersible returning from the darkness of deep water on the continental slope off western Scotland. The purity of the translucent blue illuminating the whole world in these circumstances is one of the marvels of the offshore.

Back in Scotland I was becoming fairly thoroughly integrated into BSAC, diving at least once and often several times a week, either on formal club outings or with informal groups, usually at the weekend but sometimes in the evenings. Although I made such geological and geomorphological notes as I could, these were initially for the most part not scientific dives; they were apt to be aimed at wrecks, lobster and clam fishing, or just looking around in new areas. Sometimes we dived from the coast, sometimes from fishing boats - we had fisherman contacts particularly in Dunbar, North Berwick and Port Seaton. There was normally no charge for taking us out in the boats, but we were expected in return to occasionally free fishermen's nets which had become snagged on the sea bed. Dunbar and North Berwick were standard venues for coastal dives, but we dived at most accessible places between the Forth Rail Bridge and St Abbs Head. Over the years there were club outings farther afield - many to the Oban area, but also to Skye and Mull.

A favourite dive became the wreck of the ss Breda of Amsterdam, lying in about 100ft of water in Ardmucknish Bay close to Oban. This was a relatively largish vessel of around 4000 tons, sunk during a wartime air raid and its superstructure later depth charged by the Navy to remove a hazard to navigation. Its general location was known, but it was John Butler, one of my principal diving buddies, who in summer 1966 found its precise position after two weeks of intensive searching. The wreck had been previously unvisited by scuba divers and was in a 'pristine' condition, with numerous attractive objects to be picked up - loose portholes, navigation lights, bits of aeroplanes and trucks. There were also piles of army sandals, gas masks and brass locks complete with keys spilling out of the wreckage and onto the mud of the sea floor. The ship, still upright, had been carrying a mixed wartime cargo bound for somewhere in the tropics. On its deck was a mini environment of coarse pale brown

sand with numerous flapping scallops, quite different from the dark mud of the sea bed some 40ft below.

After a while I acquired a small Avon inflatable, capable at a pinch of taking half a dozen divers, together with a Seagull outboard and a trailer to transport the inflatable plus our diving gear. This greatly improved my offshore mobility, and there was never any problem in recruiting volunteers to accompany me wherever I wished to go. We visited and dived in many places, including around every islet and rock in the Firth of Forth

In around 1966 Stuart Termier retired as chairman of the Edinburgh BSAC, and in fact died not long afterwards. He had known he had a weak heart, but had a devil-may-care attitude which drove him to indulge his passion for diving regardless. I became chairman in his place.

Club activities involved a lot of training, both during Wednesday sessions in Portobello Pool and weekend sea dives. I also not infrequently swam at lunchtime in the Commonwealth Pool or other of the indoor pools with which Edinburgh is well endowed. On account of these activities I was often able to boast of being in the water as many as five times in the course of a week. The club had a compressor room at Port Seaton, but for its headquarters it acquired the rental of an old house near Portobello Pool, also a small but adequate club room near the harbour at Dunbar.

I twice witnessed a dichotomy in the club, when groups of more experienced divers broke away from the training routine to undertake work which could not be accommodated with the presence of trainees. Training demands a lot of organization, and experienced divers are apt to resent having to spend the bulk of their precious underwater time on this one basic activity. What to do with his/her skills once acquired, though, is one of the problems facing amateur divers. After absorbing the fascination of the marine environment, most wish to spend their time undertaking some rewarding or meaningful activity – hence a willingness to volunteer for such jobs as underwater archaeological projects.

The first dichotomy happened at the end of my initial year with the club, when a group which included Jack Gillespie proposed to engage in quasi-professional paid salvage and similar work, which the rules did not permit under club auspices. They wanted to bend the rules, and there was a row at the AGM, at the end of which a group resigned from the club to go it alone. It seemed like a disastrous weakening of the club at the time, but was soon mended - there were always plenty of keen new people following up behind.

The second dichotomy was when I myself gradually became more concerned with geological diving, operating from my inflatable with a small group of the more informed divers. This did not necessitate leaving the club, but it did mean that I progressively withdrew from involvement in sea training and into my own small group. I tried hard to set up a meaningful ‘scientific’ group to embrace as many members as possible. We did in fact carry out a fair number of ‘scientific’ dives but with most of the divers it was hard going. They were willing enough to take part, but soon found their support role not too rewarding. They became exceedingly easily distracted by any passing lobster, and in the evenings by any local pub. Nevertheless

in the early days we kept a scientific dive logbook, which I later appropriated and still have. Underwater geology and biology are generally activities which require professional geologists and biologists, there being little place for the area searches and bulk materials handling which amateurs can usefully undertake in studies of marine archaeology.

The very first of these 'scientific' dives was at Burnmouth, in pursuit of the initial objective for which Terry Smith and I had taken up diving, although I have to say that a desire to get my head under the water whatever had by now become an equally important part in my motivation.

All divers become fascinated by the undersea, where they find they have the ability to operate in an environment so very different to that of their everyday lives. Below its often grey and forbidding interface with the atmosphere, divers have privileged entry to a world more strange than the surface of the moon, with waving jungles of kelp, encrusted walls of sea anemones and dead man's fingers, sand dunes and mud flats inhabited by scores of unfamiliar creatures. It is essentially a hostile world, but they discover they have the technology not only to master it but to move around in three dimensions like a bird. This is heady stuff, and the fascination never wholly wears off, although unless there is some special objective it is, over the years, apt to slowly diminish to a point where the organization and time-spend for brief repeat visits come to seem scarcely worth the not inconsiderable effort.

For me, Burnmouth was one of the special objectives, and I lost count of how many times I dived there – it must have been getting on for forty times between late 1964 and 1969. As a means of doing geology I fear it cannot be said to have been a cost-effective operation.

On 5th December 1964, then, a group of eight BSAC divers set out from Burnmouth in a small fishing boat to investigate the submarine Carboniferous section. Terry Smith and I had previously walked out across the wave-cut platform at low tide to set a marker buoy at its seaward edge. The first job of the divers, or rather the boat, was to lay a 1000ft traverse line seaward from this buoy, with a second buoy at the far end.

The depths turned out to be not more than 100ft even at high tide, and the samples were mostly sandstone, collected from the tops of numerous steeply dipping sandstone layers separated by gullies normally floored with modern sand. The exercise proved there was a worth-while section to be examined, but since the key positions needed to be hunted for in the gullies, which were located over fossil bearing mudstones, thin coals etc, it was clearly only professional geologists who could usefully undertake the bulk of the detailed examination needed.

Another legacy of this first dive was that a particular prominent sandstone ridge, almost breaking surface at low water, became named 'Wee Maggie Ridge' after the young lady diver in whose search sector it lay - she in fact discovered it. This was a key ridge, easily recognized near the middle of the section. The name stuck and years later found its way into geological literature. Many of the sandstone ridges and other rock layers were in fact lithologically distinctive, and after a few dives it proved normally to be possible to quickly locate oneself in the section.

Other 'scientific' dives included an unsuccessful attempt to check if clams oriented themselves towards the current (under the aegis of Barry Heptonstall of Edinburgh University - a non-diver), and about half a dozen dives to check on the occurrence of diatomite in lakes in the Southern Uplands. Substantial deposits were present in all of them. Recording of signs of former low sea levels was an ongoing study at most dive locations.

Start of offshore survey

In 1966, driven by Prime Minister Wilson's 'white heat of technology' philosophy, the formal attitude of government to geological survey offshore began to undergo a major change. The Institute of Geological Sciences (as BGS was then called, having previously been GSGB) was provided with substantial new funds to produce a detailed geological map of the UK continental shelf. This meant developing new instrumentation, techniques and work practices - and recruiting new personnel for the task. As the only senior staff member of IGS who had ever got his feet wet I found myself in an enviable position, effectively with money and facilities flooding in to fund my hobby, which very soon ceased to be solely a weekend and evening pursuit - although until early 1969 (when I resigned my chairmanship of the Edinburgh BSAC) it remained that as well.

We had been pottering close inshore. Now we were required to go well offshore, to map areas in which few geologists had any real experience, although there were small groups at IOS (Institute of Oceanographic Sciences) and at some universities. In IGS the offshore unit heads became William Bullerwell (the IGS geophysicist), John Wright (a Highland geologist), and myself (basically a coalfield geologist). Any existing IGS land staff who wished to transfer to the new field were readily accommodated, but after brief trials not many did so wish. Terry Smith resigned from the Survey to take up an academic job and was essentially replaced by Anne Small (née Carter) of the South Lowlands Unit, who learnt to Scuba dive, examined most of the early offshore material and brought the Burnmouth project to publication. Martin McKeown, a diver in the London Office, worked with me on some scuba activities. Glyn Rhys in the Leeds office allowed himself to be transferred. In the end Bullerwell, Wright and I had essentially to build up new units mostly of young inexperienced staff recruited direct from university. One exception was Denis Ardu, who joined in early 1969 with some experience of offshore diamond mining in southern Africa. He immediately became the No 2 of CSU2 and eventually took over from me in 1975 when I became Assistant Director Scotland.

In 1967 there was, however, something of a hiatus. Money and equipment was beginning to become available to IGS, but there was a shortage of personnel. The first IGS offshore survey was contract sparker traversing in the Moray Firth out of Lossiemouth in 1966, organised by Bullerwell. A few days were set aside for sea bed sampling using a light weight gravity corer and a Shipek grab, imported commercially from the US. I spent a few days aboard the survey vessel, mv Rosherville, which was a sort of large launch, but the sampling exercise was of value mainly in showing me some of the problems to be faced - notably the gravity corer needed to be very much heavier than the one supplied, more flexible and under better control to stop it swinging around dangerously.

As the senior of the three offshore unit heads, and located in the head office in London, Bullerwell was in a formative position concerning the application of IGS offshore funding as it became available. He was a world class geophysicist, but very much a Londoner. He always wore a suit, including on the rare occasions when I saw him at sea. The influence of Bullerwell resulted in the Marine Geophysics Unit, under his wing in London, being established as a separate entity to the two offshore geological units (CSU1 for England based in Leeds, and CSU2 for Scotland based in Edinburgh). This was a major tactical error, akin to dividing field mapping between two geologists, of whom one was expected to wield the hammer whilst the other made the map - geophysical techniques proved to be the principal data-gathering methods available to the offshore geological surveyor. MGU eventually moved to Edinburgh, and the relationships between the units were cooperative, but also apt to be strained. This set-up was an error which became entrenched, however, and IGS marine staff had to live with it. It was not adequately corrected until the re-organisation attendant on funding problems after 1980.

In late November 1967 I formally became 'District Geologist South Lowlands and Continental Shelf Unit 2', combining two very different areas of activity whilst awaiting authorization of two separate DG posts, which did not come until October 1969, when Innes Lumsden took charge of the (somewhat neglected!) South Lowlands part of my brief. One inexpensive way in which IGS could be seen to be making an early geological start was to adopt the Burnmouth scuba work as an official project; another was to look at the largish collection of offshore samples amassed over the years by the Royal Navy and held at the British Museum (Natural History). The samples turned out to be of limited value although Anne Small examined them comprehensively. I was also enabled to visit the Isle of May aboard the Northern Lighthouses vessel mv Hesperus (very luxurious!), and the island of Inchkeith (still littered with the ghostly wrecks of wartime housing). In addition I was charged with conducting a weekly scuba training session for NERC staff at Drumseuch private swimming baths, which were hired for the purpose.

These were all peripheral activities, but in mid 1967 we began to become involved with the contractors George Wimpey, who had an offshore branch operating marine sampling and shallow drilling vessels. They had developed a pneumatic vibrocorer able to take core samples of unconsolidated sediments in up to around 200 ft of water, and also had an over-the-side diamond drilling capability. My first serious offshore activity was aboard a Wimpey ship - the mv Olna Firth - in the Irish Sea, jointly with Glyn Rhys and John Hull of CSU1. We carried out sediment sampling on a grid pattern and drew lines separating the different sediment types, thus creating the first IGS offshore geological map. Meantime MGU was surveying in the same area with the MV Murray Firth, a sister ship of the Olna Firth.

In December 1967 CSU2 had a week-long loan of a substantial fisheries research vessel, the mv Clupea, operated by the Scottish Office from Aberdeen. It was decided to use the time for sea bed sampling in the Firth of Forth and its approaches out as far as the Wee Bankie, working as long a day as feasible. None of the promised new personnel had yet materialised, so part of the geological staffing had to be drawn from the Edinburgh based land units. With an element of persuasion two rather dubious volunteers were enlisted to join myself and a geophysicist from MGU. Another potential volunteer who shall be nameless - and who managed to get away - stated that 'if my ancestors came out of the

sea onto dry land, that was the best thing they ever did'. However, he admitted to me much later that this view had been a major career error, which he regretted.

At the time of the Clupea cruise the days were short, so we were often working in the dark, the wind was strong and cold, and a lot of water was sloshing around the decks. Let us admit that one needed to be keen to enjoy the physical situation. One of the volunteers was David Greig, later to put his experiences into verse:

***From scenes like these auld Scotia's grandeur springs.
I left my heart (or some part of me) on the Wee Bankie.***

*Bottom-sampling can be fun
Beneath the Riviera sun,
Or if you are a hearty fellow
Along the front at Portobello.
A sport for many a rotten swine
In the crowded Piccadilly Line.
My pleasure then was scarce concealed
When told that I had been detailed
For work which would be done afloat
Upon a bottom-sampling boat
During a German Ocean cruise.
Visions I had of birds and booze,
Of sun-deck pranks and dry martinis
And buxom blondes in small bikinis.*

*And then I heard that there I'd meet
One Shipek Grab, some Slav petite,
A warm Atlantic maid
Who'd brighten every escapade
With which we'd while away the time.
Such were my foolish dreams sublime.*

*Departure day dawned bright and calm
Three days of this would be a balm,
Knit up the ravelled sleeve of care;
And all of you were paying my fare.
And so we came in AI order
Down to Leith docks, and went aboard her.
She wasn't quite what I'd expected
Not that I'd say she looked neglected
But somehow she looked faur too wee,
And wee in dock means weer at sea.
The swimming pool must be 'tween decks
And not a sight of the other sex.
I searched in vain for any bars
But, what a lot of sweetie jars!
An odd cruise this, but early days
To damn the venture with faint praise.
Let us be brave, upright and gallant,*

At least until we see the talent.

*At noon we sailed, 'neath the smiling sun,
But into the berth next but one,
And there the afternoon we lay
Sucking in oil the livelong day.
As we lay the sun was shrouded
The sky became all overclouded,
And from the east the wind's song swells
And I finger my comforting box of Kwells.
Nor yet a damsel, meek or frisky,
Nor yet a smell of rum or whisky
To brighten up the prospect grey.
Then 'twas too late, we'd sailed away.
Too late to rectify my folly
Too late to envy Scott and Wally
Free from the trials of a sailor's life,
Safely at home with weans and wife.*

*The awful truth you'll have jaloused
That DCG had been confused;
His one-track mind had let him slip
Into the crew of this slave ship.*

*To stop a long tale getting longer
Suffice to say the wind got stronger,
Three days force 8 from east or north
As Scotia swanned about the Forth.
Fidra, the Bass, and back to Largo,
Loth to give up our corporeal cargo;
The Lamb, St Abbs, and then Kirkcaldy,
Cold and wet and bruised of body.
To Aberdeen on a southerly win'
A rail strike away from kith and kin.*

*The company contained no madam,
Just Eden, Tully, and McAdam.
And Shipek Gab's a brazen chick
Who'll chop your hand if you're not quick,
And surely make you rue the day
You ever let it go astray.
She on the bottom of the ocean
Scrabbled about with fond devotion
From dawn of day to past eight bells,
And brought up mud, and sand, and shells,
Mussels and wilks and fish like stars;
All to fill the sweetie jars.*

*Bottom-sampling might be fun
Beneath the Riviera sun,*

*But there's no scope for hankie-pankie
Among the waters of Wee Bankie.*

DCG 30/1/68

As facilities became available, it seemed initially best - since CSU2 could not normally carry out geophysical traversing - to concentrate on 'visual' methods, that is to say physical examination of the sea bed, notably in order to pinpoint and sample the rather infrequent exposures of bedrock. My scuba diving experiences were the mainspring of this decision, and scuba methods did have some relevance in shallower water. However, we early borrowed a sea bed camera from the NERC Research Vessels Unit for use in the first place at Burnmouth, and also Harry Robertson, our photographer/technician, developed a camera attachment to a Shipek grab. With this we were able to take automatic photographs at the same time as samples. We teamed up with Liverpool University to put a remote television on a small sea bed drill, the Harrison Drill, which they were trying to develop.

We soon got round to using side scan sonar and a pinger on geological ships. These were geophysical instruments but easy to operate, and unlike most were flexible enough to be readily deployed between sampling stations. Moreover they were vital to location of underwater bedrock exposures where these occurred. With the same objective in view we undertook three cruises with the submersible Pisces, obtaining numerous bedrock and sediment samples, photographs and video records, and with the British Aircraft Corporation we developed our own unmanned submersible (Consub) carrying TV, still cameras, and a sampling drill.

Not all these early experimental initiatives were successful. The small drills were inadequately robust, and the submersibles, although they produced impressive results, were not normally cost effective as geological tools; also their standard manipulators were developed to a point where these proved to be more useful than the rock drills we mounted on them. The initiatives, however, set CSU2 firmly on the track of marine equipment innovation.

Gravity corers for rock and sediment sampling (and means of handling them in severe conditions) were soon developed, together with more robust electric drills of several types. In later years, under the guidance of Denis Ardu, CSU2 sea bed drills and vibrocorers took the lead in their field and have had widespread application in the commercial sector. Dennis Ardu became for a period the Chairman of the Society for Underwater Technology.

Offshore geological survey can most easily take the form of geophysical traversing, followed by interpretation of results, followed by drilling - from a platform or drill ship - to various depths to check on the interpretation and obtain engineering data for proposed structures. This is the routine commercial procedure and the only feasible course (except for mapping of superficial sediments) in many areas, such as the central North Sea. However, in hard rock areas, eg around Scotland, good quality geological investigation using a CSU2 'visual' approach is possible without the expense of heavy-weight drilling. A 'visual' approach does, however, necessitate a well motivated team oriented in that direction, and at its core needs to be a group of geologists who are familiar with the actual appearance of the sea bed - this effectively means an efficient scuba group.

As work moved farther offshore the CSU2 scuba project at Burnmouth was concluded with some photographic and geophysical (side-scan sonar) work followed by the publication of several professional papers which showed useful results and claimed the project as demonstrating a new working technique. Thereafter the scuba team was slowly built up to about six active members as staff and equipment became available, permitting the group to become wholly independent of BSAC assistance. This was facilitated by the fact that new entrants to CSU2 were young and marine oriented.

After the early years scuba ceased to be more than a subsidiary activity, although a number of projects continued to be run and the team also proved to have a useful facility for equipment recovery and removing cables from the propellers of survey vessels. A valuable, but less tangible, benefit was the atmosphere of personal enthusiasm engendered by the existence of the scuba team – rather analogous to the hoped-for effects of sending company executives on contrived adventure training courses. Long-term, however, where the work is not an essential activity the continued existence of such a team leans heavily on personal predilections at all levels.

Scuba projects were mounted in the Oban area (to obtain dateable material from offshore muds), in the Moray Firth (to examine sea bed exposures) and off the Outer Hebrides (to seek the country rock below Tertiary igneous bodies). There were a couple of scuba dives from survey vessels, on the Blackstones Bank (when I was accompanied by John Butler) and on a glaciated pavement off Mull, when I was with Garry Gauss). The Blackstones Bank dive was video taped from the submersible Pisces, as it was an adjunct to the 1971 series of dives with this vehicle. The depth was about 130ft, which is near the comfortable limit of working on air, and whilst the dive was going on I had the distinct impression of being light headed – not a disagreeable feeling in itself, but not one to be encouraged. The Mull dive was on a huge undulating plain of basalt covered by tightly encrusting marine life and a scatter of boulders.

Pisces

In 1969 Vickers Oceanics commissioned the newly acquired Canadian manned submersible Pisces II in western Scotland, and its first commercial contract was in the Clyde Estuary with NERC to evaluate its potential for scientific work. I took part in this evaluation and in further cruises with Pisces II and III during the years 1970, 1971 and 1973. A total of 51 geological dives were made in the course of these four cruises, lasting up to 4 hours or so each and normally carried out at the rate of two per day. The mother ship in 1969-71 was the Vickers Venturer, and in 1973 the larger Vickers Voyager. We summarized our evaluation in a paper published in 1977. Briefly - submersibles had good geological capability but were a distinct luxury in terms of large scale geological survey.

The 1971 work was in fact not requested by CSU2, but commissioned because Vickers was short of commercial contracts at the time and NERC was persuaded that a job had to be found for the submersible in order to maintain the capacity in the UK. Needless to say I jumped at the opportunity of another Pisces contract when it was offered. The 1973 cruise to Rockall Bank was similarly wished on us, in this case because it was desired that the UK consolidate its claim to the area (in the face of Irish

claims) by demonstrating active research in this part of its territorial waters. A similar activity at around the same time was the placing of a (completely useless because of its low power) navigation light plus a plaque on the top of Rockall Island. In addition a number of other research cruises - geophysical and biological - were undertaken with the same motivation by British universities and the IOS.

How many times did I myself go down in the submersibles? I do not know, but probably over 20, mostly off western Scotland but half a dozen on Rockall Bank. Some of the dives I count as being amongst the highlights of my career, partly because I felt privileged to visit such inaccessible places, and partly because some of these were so beautiful. Beautiful, and strange too, although strange in a way with which I was to a degree familiar from my scuba activities. The geomorphology was fascinating, ranging from overhanging cliffs in the side of a 600ft deep ice-gouged underwater canyon in the Clyde Estuary to monotonous plains of gravel at the top of the continental slope west of the Outer Hebrides, and mud filled hollows with sea pens and scampering Nephrops (scampi) going about their business. The groves of cold water corals at 600ft on Rockall Bank had never before been seen by anyone, although broken specimens had been dredged.

Pisces was designed to operate at depths of up to 3000ft. We never exceeded 1400ft in the course of our geological work, although one planned dive would have been to 2000ft on the Anton Dohrn Seamount had it not been aborted at the last minute on account of deteriorating weather conditions.

There were plenty of solid rocks to be sampled, partly because many of the dives were aimed at doing just that in a much more controlled way than was possible with equipment dangling over the side of a ship. I have to say, though, that the hard rock geology did not look all that special, largely because every rock face was heavily encrusted with life-forms, of which the most spectacular were the layers of brittle stars living one on top of another on the Blackstones Bank. No wonder they were all so skinny! Glowing encrustations of dead man's fingers and sea anemones were features familiar from scuba work.

It all sounds like good fun, and it was, but it was hard work too. We evolved a working technique which involved a pre-dive site survey (to choose the best location) with pinger, echo sounder and sideways sonar, preferably in the form of three parallel traverses across the likely area. Since the submersible was usually required to scuttle on the sea floor in darkness illuminated only by its headlights, there was position fixing to be attended to. It was important that every expensive minute on the sea floor be well spent. With this in view we made extensive use of video and audio recording, photography, and the available sampling methods, which included a manipulator plus basket, canvas buckets and various rock drills. Methods and equipment evolved from dive to dive, but from the start I tried to keep an audio recorder continually open for a stream of comments about whatever was observable. My rule was that silences were wasted time.

The submersible's crew was contained in a main sphere 2m in diameter with three forward portholes, one of which was used by the Vickers pilot, and the others by the geologist or geologists. There was also a smaller separate instrument sphere. This was not a job for anyone with claustrophobia. On early dives, in addition to the pilot

we carried two geologists, partly for familiarisation purposes, but latterly for comfort reduced this to one, freeing the other to provide surface support via sonar telephone from the mother ship (concerning position, direction to take to reach the target etc).

Two months after our Rockall Bank dives the same Pisces III submersible sank in 1600ft of water off Ireland due to accidental flooding of its instrument sphere. On that occasion there were only two Vickers pilots aboard and they had to survive for three days on available oxygen supplies before they could be rescued. This they managed to do, but only just. This near disaster, which had world wide lead-news coverage whilst a massive rescue effort was being mounted, made it rather clear that, apart from being uncomfortable, a crew of anything more than two was distinctly inadvisable.

A key element in the successful operation of a Pisces submersible was the technique which Vickers evolved for launching even in the quite heavy seas with which it was often necessary to contend. The method improved over the years, but by 1973 had developed into the following.

Launching was done over the stern from a swinging A-frame whilst the mother ship was under way, running before the sea to reduce motion caused by the swell. Using the main hoisting cable slung from the A-frame, the vehicle was lifted from the deck and lowered into the sea with its narrower stern in front, the stern being held steady by a second, towing, cable. Once in the sea the hoisting cable drum was declutched and the vehicle took on the motion of the sea, held only by the towing cable. A scuba diver who had been standing alongside the conning tower during the launch then detached the hoisting cable, the towing cable was paid out to place a safe distance between the vehicle and the mother ship, which then slowed to permit the diver to detach this second cable. The diver was then taken off onto an inflatable and the submersible was instructed to vent its buoyancy tanks and commence its dive.

Recovery was the reverse of launch. A diver was placed aboard the vehicle and an inflatable assisted in handing him the towing cable from the mother ship, which he attached to the stern. When settled into a steady towing mode, the towing cable was winched in until the main hoisting cable could be lowered down, declutched, for the diver to attach it to the lifting point of the submersible. At a suitable moment the diver clamped the base of the swinging A-frame to the lifting point and the A-frame was raised, keeping the towing cable taut to minimise sideways swing.

The 1973 near disaster came about during the recovery phase, when the towing cable was being manoeuvred for attachment to the submersible. The cable became snagged round the external latch securing the hatch of the instrument sphere. Since the submersible had been operating under considerable pressure at depth, the hatch was pressed well home into its seating, and the latch, a turn-device normally quite difficult to move, was therefore relatively loose - loose enough to be moved by the snagging cable. The result was that the hatch opened and water first gently lapped in, then flooded in as the submersible slowly settled. Two justifiably very alarmed pilots found themselves returning at undue speed to the sea bed which they had left not long before. Fortunately the incident did not disable their sonar telephone, so they remained in contact with the mother ship.

The problem now became getting a very long recovery cable attached to the vehicle on the sea bed. The tidal pull on the length of cable required was such that it proved too unwieldy to latch it to the small hole provided at the normal lifting point. Eventually an unmanned submersible operated in conjunction with a cable ship managed to insert a specially made umbrella shaped prong into the open instrument sphere, and the submersible was hauled unceremoniously to the surface dangling below the bow of the cable ship.

In 1976 I was invited to Vancouver as the joint guest of the University of British Columbia and the offshore branch of the Canadian Geological Survey. Apart from talking about marine geology I was required to discuss the method for launch and recovery of their Pisces submersible, since on the Canadian west coast they had not progressed beyond having the mother ship heave to and simply lift the vehicle over the side - a restricting if not dangerous procedure. Odd, too, since Pisces was of Canadian manufacture. I had a day at sea on this exercise, but the Canadians simply did not have the set-up to operate a Vickers type launch.

Shipborn survey

Routine survey of the type needed to permit the preparation of a comprehensive series of geological maps covering the UK continental shelf depended on the availability of ships with the capacity to operate the necessary instrumentation efficiently for most of the year, without too many hold-ups on account of the weather. Several types of survey were involved.

Routine geophysical traversing included gravity, magnetic, shallow seismic and sideways sonar recording, mostly from over-the-side towfish, and once these were deployed the ship had simply to keep going on straight traverse lines on a 24 hour basis. Deeper penetration seismic surveys were sub-contracted to specialist oilfield operators, but BGS commissioned these only in special areas, because of their expense and since it already had access on behalf of government to a huge number of commercial deep seismic records.

BGS geological sampling followed after interpretation of the shallow seismic survey, which was done either back in the office or often carried out by a CSU geologist working aboard an MGU ship. Standard sampling was on a grid basis, with deviations based on the geophysical interpretation. Early efforts such as those from mv Roscherville in 1946 and mv Clupea in 1967 primarily comprised collection of sea bed sediments by use of Shipek grabs, but by 1967 we were developing our own heavy gravity corers for deeper penetration, with separate barrels for rock and sediment sampling, and we tried these out from a fishing boat at Burnmouth, doing little good to its winch in the process.

In mid 1967 was the Irish Sea contract with George Wimpey aboard the mv Olna Firth, using their pneumatic vibrocorer, and this was the first phase of a lengthy collaboration with this firm. Even earlier, in the spring of 1967, I went with Leeds and London colleagues plus Wimpey Marine staff to Newcastle to inspect a ship called the mv Relco. On the basis of a 5-year contract with BGS, Wimpey purchased this vessel and converted it into a geological sampling ship, which they renamed mv Whitethorn. It was subsequently fitted with a multi-point anchoring system, over-the-

side drilling capability and large skip hoists for deployment of two vibrocorers, plus a control system for our heavy gravity corers.

The gravity corers and their control systems were my personal contribution, but later development of increasingly sophisticated electrical vibrocorers and sea bed rock drills of various calibres was largely due to Denis Arduis, who joined CSU2 in early 1969. Nigel Fannin also joined later in 1969 and was ultimately responsible for considerable improvements to core recovery achievable with the over-the-side drilling capability.

We enlisted the help of local manufacturers in developing this suite of instrumentation, but also went out of our way to build up our own maintenance workshop facility in Edinburgh. By late 1968/early 1969 CSU2 and its space requirements were both growing rapidly, and even though we had an out of town store it became imperative to move out of the existing BGS office at 19 Grange Terrace. As a stop gap, in late 1968 I had to locate four CSU2 staff into my own room and shift myself to the basement.

After looking at various properties, we eventually found a set of prefabricated offices being vacated by the electronics firm Ferranti at Granton. Ferranti had a laser mounted in what was to become our sedimentology laboratory, and during our inspection demonstrated to us the splitting of a brick with a laser beam.

At Granton the unit strength built up to about 15 or so, and for a number of reasons it was just as well that at this phase we were separated by several miles from the offices of the land survey. The Assistant Director Scotland was now Jim Robbie, whose sympathies were with the land survey units, very keen to build up their own strengths and not too pleased to see all available new resources being directed to CSU2. The heads of the three offshore units were effectively working directly to the Director of BGS, Kingsley Dunham, through an offshore committee based in London and chaired by himself. Since Kingsley Dunham knew little of the operational technicalities, and Jim Robbie knew nothing at all of them, we were essentially left to get on with it on our own. A very satisfactory state of affairs as far as I was concerned.

Mv Whitethorn was chartered by BGS for 10 months each year, sharing its time between the two continental shelf units, mine in Edinburgh and that of John Wright in Leeds. We therefore had time to employ other ships on an ad hoc basis.

In 1969 we chartered the mv Strathclyde, belonging to Strathclyde University, for a survey of the Clyde Estuary, using Shipek grab, gravity corer and dredge. This was at a time when one of the sights of the Clyde was the liner QE 2, in an advanced stage of construction in a waterside shipyard, surrounded by a maze of scaffolding.

Off the Kintyre coast the skipper had the misfortune to reverse the Strathclyde over our dredge, wrapping its wire round his screw and severely damaging the drive shaft, also loosing the dredge for us. Poor man. He wore a nautical uniform with peaked cap and gold braid, and was justly proud of the shining brass of his vessel, but that was the end of the cruise. I rather suspect it may have been the end of the Strathclyde as well, since it was an oldish ship and expensive to run.

We took careful note of where the incident occurred, so that John Butler and I were later able to return there with an inflatable and diving gear, and recover the dredge. It was quite a triumph to dive down through clear green water and at once see the dredge lying there almost immediately below its calculated position.

Amongst the vehicles which we used were the NERC vessel John Murray, a relatively small custom built research ship, primarily designed for university oceanographic research. Somebody once said that the John Murray was the only ship he knew which was able to roll in a flat calm. Our first cruise was off western Scotland, when the hydraulic system of the A-frame broke down, so we were unable to use it for sea bed sampling. After trying to work with the ship's winches, we ended by having to content ourselves with running sparker traverses, which I was very willing to do, although unfortunately the results were of dubious quality due to the absence of anyone aboard who really knew how to tune the equipment. However, the data gathered was good enough to form the basis of a PhD for Paul Binns, since when his career has blossomed in seismic record interpretation.

We also used a larger Dutch vessel called the Maria W. This seemed to be very long and very grey. Its distinguishing feature, however, was its slowness, and as our work proceeded it became slower and slower. The skipper felt this was due to marine growth on the hull, and he offered to put the ship on a nice sandy beach somewhere at high tide, so that when the tide went out all the members of the ship's company could apply themselves to scraping its bottom. In due course this was done, and the ship sat like a very large stranded whale on a sandy beach somewhere off western Scotland.

Scraping the ship's bottom was a messy but enjoyably energetic business, but misfortunes occurred when the time came to get the ship off the beach at the next high tide. The skipper placed the engines in reverse at high revolutions, causing the screws to dig a large hole in the seabed and deposit the debris as a bar beneath the middle of the ship, which remained stuck. The harder he revved the engines the larger grew the bar, causing him to desist and reconsider. The matter then became critical, as it turned out that the next high tide was the peak of the tidal cycle. This time it was resolved not to compound the problem by using the engines. Instead the ship's anchors were taken out by the ship's boat and the anchor winches were used to inch the vessel backwards at the critical moment. It was the same procedure as followed by Captain Cook to get the Endeavour off Endeavour Reef in the Great Barrier Reef. In both cases the procedure worked. When the Maria W had been removed it became apparent that a significant proportion of the debris it had excavated was not sand but semi-consolidated dark grey mud crowded with *Turritella* shells, the beach sand being a veneer.

Probably the most colourful of the ships we used for geological sampling, if that is the right adjective, was a Breton oil-rig support vessel called Steelfish. The colourfulness related to the crew and their diet, which was centred round a stainless steel tank of wine. The ship was not large, but had a relatively big open rear deck with an A frame at the stern, ideal for accommodating one of our electric vibrocorders. By the time we used this ship, which was in about 1974, we had got round to mounting pingers on our vibrocorders so they could be located if accidentally dropped. In the event Steelfish dropped two, and at £3,000 each it seemed worth making an effort at retrieval. We

were in the central North Sea, and it so happened that Vickers Voyager with Pisces aboard was in the area on pipeline work, but available to be chartered for one day.

The co-operation of Vickers Voyager and Steelfish proved to be awkward, partly because the English spoken by the skipper of the latter was distinctly limited. When Pisces had located and buoyed one of the vibrocorers, we found Steelfish, wishing to recover the vibrocorer, and Voyager, wishing to recover Pisces, manoeuvring in close proximity. Steelfish was instructed to stand off, but the skipper eyed the buoy and announced with gleaming eyes 'Je vais le prendre'. The skipper of Voyager was equally determined and Voyager was by far the larger - he advanced steadily on Steelfish, towering over her, and an interesting situation would have developed had the latter not backed off at the last minute.

We only located and retrieved one of the vibrocorers - the other went to join the accumulation of human debris spattered for a while on the sea bed.

Our ability to carry out innovative developments in this new offshore field depended partly on Wilson's 'white heat of science' approach, with the availability of funding to go with it, and partly on the willingness of the Director, King Dunham, to give their head to the people on the ground. He also actively encouraged learning from others, and for this reason I was able to undertake a four week tour of US and Canadian marine geological and hydrocarbon establishments in 1974. I got to the Canadian east coast, Quebec, Calgary, Vancouver, San Francisco, San Diego, Houston and the Gulf coast. It was worth seeing some of the core stores, but I felt we had nothing much to learn concerning marine operations.

I also got to Holland, Denmark and Norway. The director of the Norwegian Survey had some very nice blue petunias growing in his office, and it was from him I learnt to undertake similar horticultural activities later, in my office at Murchison House. In Denmark I had one of my three lifetime experiences of being surrounded by a throng of apparently admiring acolytes hanging on my every word (concerning base maps for offshore survey), a little like, it almost seemed, Jesus Christ. The other two similar occasions were in explaining the working of radar sets to wartime artillery officers and in telling the folks in Dover about life 50 years earlier on the wartime South Foreland.

When we started our offshore survey in earnest we had deliberately concentrated on the west coast, the reasoning being that we could enter new areas there and pick up later on the considerable commercial work being carried out in the North Sea. This policy meant we were apt to be much in demand to give lectures largely attended by staff of oil companies looking ahead to the time when they would wish to move west. As state employees we were not payable, but I got presented with a dozen bottles of whisky in respect of a conference organised by the Financial Times. This was the occasion when after I had considered the possibility of petroleum provinces on and around the Hatton-Rockall plateau, a gentleman in the audience got up and commented that he had heard also that the moons of Saturn were made of petroleum.

When I left CSU II to become Assistant Director Scotland in 1975 I handed my marine responsibilities to Dennis Arduis at about the time when a much larger Wimpy drilling vessel than Whitethorn was being commissioned, largely for contract work on behalf of BGS. Wimpy Sealab had a helicopter deck, a central well for drilling and

lowering sampling equipment, and dynamic positioning so that it could dispense with the six massive anchors which Whitethorn had to deploy to keep on station. Sampling equipment was also getting larger and more reliable; both the vibrocorers and seabed rock drills grew impressively in size during the next few years under the direction of Dennis, together with the related BGS Edinburgh workshop facilities.

The result of all this activity was that by the early 1990's BGS had published an enormous collection of offshore geological maps and memoirs covering the shallow and deep geology and geophysics of the whole of the UK continental shelf. It has been an impressive achievement, and I suspect that BGS is a world leader in the field.

My departure from CSU II by no means marked the end of my offshore activities. I continued to work with the BGS diving group, joining them in expeditions on the rather debatable grounds that I was the Safety Officer of Merchison House and needed to be au fait with what the group was doing. The last of these expeditions was to the Outer Hebrides, when I fear we slightly stretched a point by allowing families of the divers to accompany us. And very enjoyable it was.

One of my first actions on retiring was to acquire Lucette K, an Anderson 22 (sailboat) kit, complete with echo sounder, and in 1981 I started applying myself to the construction of this boat. The primary objective I had in view was to cross the Channel and sail in the French canals, but I also had a hankering to get back to the beautiful sheltered waters of the Scottish west coast.

The offer of a two-year job in Fiji totally disrupted these plans, but in Fiji, where my post was distinguished by the name Principal Geologist Offshore and Seismology, I had my own little research vessel, HMFS (Her Majesties Fijian Ship) Latui, which gave ample scope for getting around the islands, mostly running sparker surveys. I often found myself the only Caucasian on board, with a crew of half a dozen or so Melanesian sailors showing signs of being not all that long out of the bush. Lucette and I also purchased a 16ft sailboat, the Red Baron, from a departing ex-patriot, and in this comfortable little boat we spent many hours sailing in the lagoons around Suva, usually accompanied by Ian and June Everingham. Thanks to a hefty handicap we won a number of racing trophies. Ian was the Senior Seismologist in my group and whilst not as crude as Australians are able to come, he was distinctly inclined in that direction. June was a poppet, and very artistic.

I suppose the principal output of my stay in Fiji was a colourful booklet I wrote entitled 'Fiji as a Petroleum Prospect'. I very much doubt if Fiji is a petroleum prospect, but in the interests of my hosts I did my best to make it one, and the booklet was at least a first shot at a resumé of the geology of the islands, which had previously not existed.

In late 1983 Lucette and I joined Don and Caroline Tiffin plus two of their daughters, Canadians whom I had first met in Vancouver in 1974, in sailing their boat, the Girl Anne, from Auckland to Tonga. I have written of this elsewhere. It was a memorable trip, and landing on one of the uninhabited Kermadec Islands was top equal of my offshore experiences; top equal, that is, with diving in Pisces on Rockall Bank. Living in southern England one has the impression of a crowded world, but this is far from one's feelings in the open ocean of the SW Pacific, or scrabbling on the ocean floor in the blue/green waters around Rockall Bank.