A Collaboration of Multidisciplinary Scientific Research and British Military Training in Sabah

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The author attended the University of Southampton between 1990 and 1996 and gained two degrees before being commissioned into the Corps in December 1997. After attending RE Troop Commanders' Course 120, he was posted to 25 Engineer Regiment as a troop commander, and from February to March 2000 led Exercise Pelopor Finn which is described in the following article.

Earlier this year, in May, he was posted to 69 Gurkha Field Squadron as operations officer, and is due to undertake a six-month tour of the Falklands.

Introduction

In December 1999 over £150,000-worth of materials, rations and scientific equipment were shipped from the UK, America and Australia to the Far East. In January 2000, 34 people came together from all over the UK to undertake two weeks' training in skills ranging from jungle survival to single rope climbing technique, and satellite communications to heli-extraction drills, and to form a team which then flew 8000 miles (with another £275,000-worth of equipment) to Kota Kinabalu (Sabah, Eastern Malaysia) to join 28 people from Australia and Malaysia for Exercise *Pelopor Finn*.

The team carried out environmental infrastructure improvements and conducted scientific research within the tropical rainforest during a five-week period, undertaking a multiplicity of projects. Members travelled over 15,000km by road and dirt track; consumed over 1250 ration packs and 12,000 litres of self-purified water; man-packed over 4 tonnes of stores and materials into the heart of the rainforest; collected over 138 flora samples and made over 5000 physiological and psychological tests. Members cumulatively ascended over 7000m using single rope technique; collected survey data for over 30 features of global scientific importance and conducted 49 hours of continuous global positioned satellite (GPS) surveying; ascended the highest peak in South East Asia, Mount Kinabalu (4101m); and white-water rafted down 9km of the Padas Gorge.

The aim of the exercise was to assess the ability of a military expedition to collaborate with civilian scientists in order to undertake multidisciplinary scientific research and British military training in an extreme environment.

The objectives were:

- to cut a 12km ecological trail in order to allow access for scientists to study the unique tropical flora and fauna within previously isolated regions of the rainforest. Concurrent to this the collecting of flora samples and the testing of the new British Army boot would be undertaken;
- to undertake a physiological and psychological-based (P&P) research programme. This would involve a number of research organizations such as the Defence Evaluation Research Agency (DERA (UK)), the Defence Nutrition Research Centre (DNRC (Australia)), the Defence Science and Technology Centre (DSTC (Malaysia)) and a number of universities, both British and Malaysian;
- to undertake a GPS-based survey programme in order to set up a system of ground control at the Danum Valley Field Centre (DVFC);
- to undertake a construction programme which involved the manufacture of a number of tree-top canopy sampling towers and a weir at the DVFC;
- to undertake a venture package consisting of climbing Mount Kinabalu, white-water rafting and snorkelling.

With the progressive closure of British overseas bases, the ability to carry out imaginative, challenging and worthwhile adventure training\expeditions to extreme environments has become increasingly difficult. The demise of the Cold War has also had a marked effect by substantially reducing defence spending in the West, including Britain, and reducing defence research spending which is likely to lead to reduced effectiveness when our fighting forces are asked to undertake operations that require rapid adaptation. Poor field testing is likely to lead to mis-evaluation of defence products and procedures.

However, to overcome these difficulties a mutually beneficial relationship could be formed by British military training in extreme

environments being used as a vehicle to conduct defence-based research field trails. There are a number of possible benefits to be gained from this partnership. For example, substantial cost reductions due to rationalization of travel and logistics, and for defence research establishments the added advantage that the testing population is likely to be representative of the end user.

Exercise *Pelopor Finn* was proposed to develop, apply and assess a number of scientific research and military training collaborations in the extreme environment of the tropical rainforest with a view to establishing procedures and protocols for more such work in the future. With this in mind the progressively integrated scientific and military relationships outlined below were established:

- The execution of engineering tasks for scientific ends. This was facilitated by the trail, tower and survey projects. The scientists stating their requirement based on their needs and experience, the military executing the projects using their expertise.
- The complete independence of military and scientific objectives, the latter using the former' expertise and logistics chain for their own means. This was realized by the recruiting of a botanist from the Royal Botanical Gardens, Edinburgh. The botanist collected specimens along the trail cut by the army but effectively operated independently of them to fulfil her objectives.
- The need for co-operation between scientific and military expertise to achieve a single objective. On the expedition this was realized by the survey team that comprised two members from 42 Survey Group and two academics from the University of Southampton. The team was to introduce a system of ground control at the DVFC as well as survey in sample plots which required the identification of flora; the military were to provide the GPS equipment and survey knowledge, the academics the knowledge of flora.
- The complete integration of scientific and military personnel. The DERA, DNRC and DSTC physiological and psychological study used the military as a test population and required continuous interfacing and feedback between the two parties throughout the expedition whilst the men undertook their expedition objectives. The testing of the new British Army warm weather boot also loosely falls into this category.

Assessment of the ability of these relationships to function effectively formed the basis upon which this exercise was set up. The ability to

Physical training. Trail and survey teams undertake a stretcher and log race whilst single rope technique is practised by the tower team.

execute the objectives, though crucial, was seen as a vehicle to test the collaboration between civilian and defence research scientists and the military.

Planning and Execution

Planning for the exercise began in November 1998. A proposal was put to 25 Engineer Regiment and the Corps of Royal Engineers to secure formal backing and a working budget. Eminent patrons (General Sir John Stibbon KCB OBE and Professor Sir Ghillean Prance MA DPhil FRS FLS), were recruited, a number of recces conducted, a website set-up and a planning team assembled by September 1999. The expedition concept and objectives were mapped

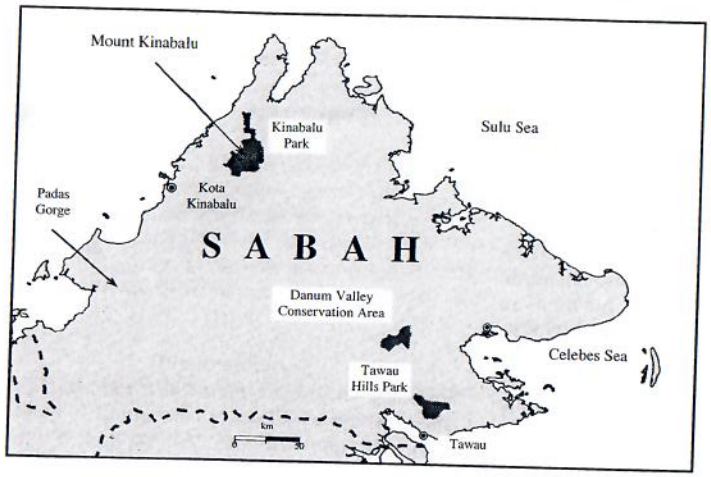


Figure 1. Map of Sabah showing expedition and adventure sites.

out and from these the roles of the management team were devised, planning targets set and the planning procedure commenced.

Recruitment for the expedition started (to fill the trail, tower construction and survey teams) and training was set up. The training programme reflected the mixed skill levels and experience of expedition members, the hostile nature of the tropical environment (seldom less than 27°C, 80 to 95 per cent humidity and over 2m of annual rainfall) and the need to integrate civilians into a military-run expedition environment. Training consisted of the following:

- Treatment of casualties.
- Jungle helicopter casualty evacuation procedures.
- Communications training.
- Living and operating in the jungle.
- Use of basic engineer equipment.
- Information recording, including diary writing, photography and video footage collection.
- Single rope technique (SRT) for tower team only.
- Survey training for survey team only.
- Photography.
- Adventure training qualifications.
- Two to four hours daily arduous physical training.

In addition to the all this, two fund raising activities were undertaken. A 4100m endurance SRT climb at the Europa Hotel, Belfast, which enabled the tower team to get some extra training at heights of over 120m. The second, an endurance dive in Lough Neagh (County Antrim), involved three members of the trail team undertaking an underwater swim with a cumulative distance of 27.6km. Funds were raised for the expedition and for a local charity.

Expedition Deployment

The expedition was based at two locations: the Tawau Hills Park (THP) and the Danum Valley Field Centre for a period of three weeks (22 Feb to 15 Mar 00), see Figure 1.

The Tawau Hills Park Site

At the park the following projects were undertaken: trail cutting, flora sampling, P&P testing, and the testing of the new British Army warm weather boot.

At any one time 36 expedition personnel were located at the site, including the HQ element, and it was from here that the expedition was co-ordinated and commanded through the HF net at the Ranger's Station *(see Figure 2)*. Also located at the Ranger's Station was the expedition supplies, science laboratory, botanists' store, medical centre and equipment storeroom. Scientists prepared their equipment at the Station and walked into (or stayed in) the jungle to join the trail cutting team to carry out observations at one of the five camps along the trail route.

Trail Cutting. This project was lead by Sgt Franklin and his command team of Cpl Thorne, Cpl Johnson, LCpl Milligan and LCpl Vasey. The team cut a two to three-metre wide trail into the heart of the rainforest along a steep ridgeline involving an accumulative ascent of over 792m, clearing on route thick vegetation, deadfall and traversing washed out shallow ravines. In addition they had to construct engineer targets such as steps (over 400), three bridges, walkways and a helicopter landing site.

The men lived in one of five camps along the route. Each man belonged to one of four, four-man patrol teams (each with a specialist role – signaller, medic, chainsaw operator and team commander) which were co-ordinated by Sgt Franklin. A survivability team ensured that there was sufficient purified water.

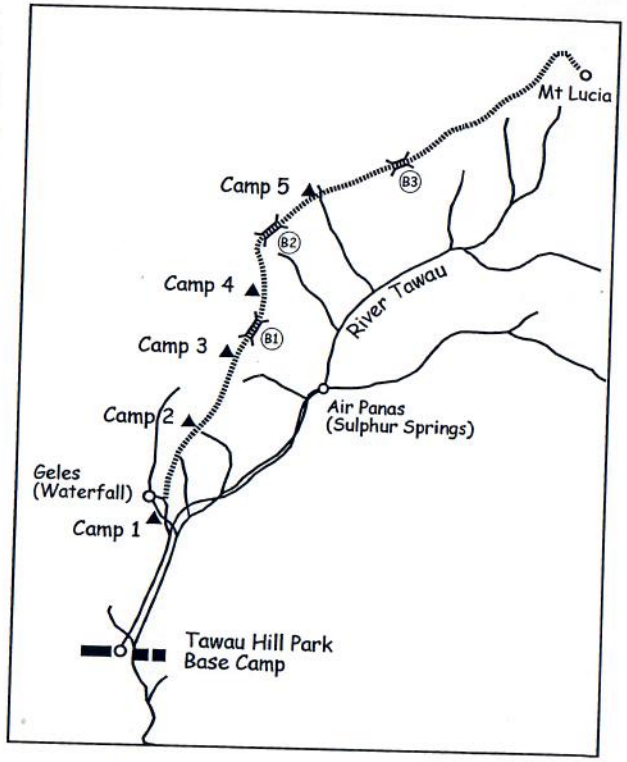


Figure 2. Schematic of the trail site showing the Ranger's Station (Base Camp) five trail camp sites, engineer targets (B1 to B3 – the HLS was at B2) and significant features.

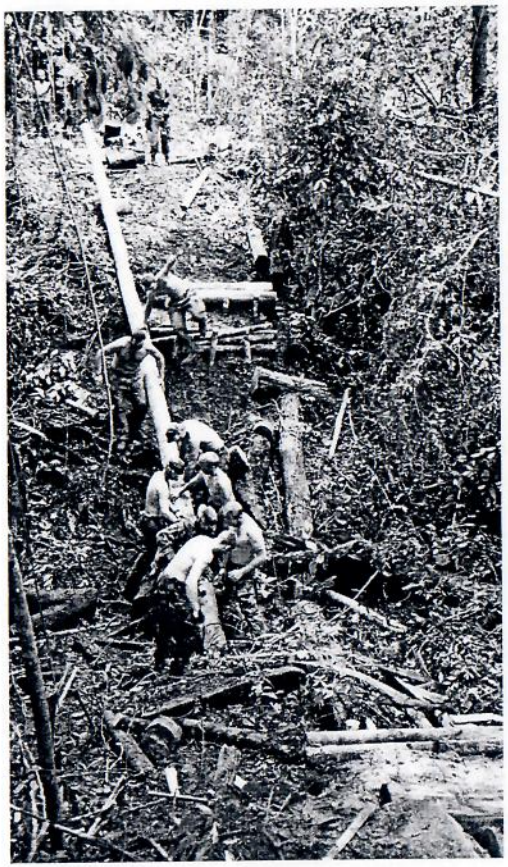
Flora Sampling. This aspect of the expedition required the recruiting of a civilian expedition member, Vlasta Jamnicky, from the Royal Botanic Garden Edinburgh (RBGE). This botanist provided an excellent opportunity for field-work. Using the logistical support of the military ensured that botanical research could be carried out under the best possible conditions and it is felt that the military and scientific aspects integrated well. Given the RBGE's limited research funds this particular field trip would not have been possible without the military's support and co-operation.

The botanical work was undertaken with collaboration of Malaysian botanists from Kinabalu Parks and the Danum Valley Field Centre. The work consisted of collecting plant material of special research interest at the RBGE on and around the trail cut by the Army. Herbarium material was collected in addition to silica gel dried leaf material for DNA analysis. These collections contributed directly to several key research projects currently in progress at the RBGE. The material also made a general contribution to southeast Asian botanical studies, a subject of intense study for over 30 years at RBGE. The Malaysian State Herbarium Sandakan at the Forest Research Centre in Sepilok, and the herbarium of Sabah Parks (all in Sabah, Eastern Malaysia) received duplicates of all collected specimens for their own collections.

Physiological and Psychological Research. This required the recruiting of MOD research civilians. The exercise provided the defence science community with an opportunity to study human performance in an extreme environment. The outcome was international collaboration between The Technical Co-operation Program (TTCP) countries, Britain, USA and Australia, and collaboration between Australia and Malaysia. The scientific team was drawn from the DERA (UK) and DNRC (Australia). DSTC (Malaysia) provided scientific observers and limited logistic scientific support. By providing food, this scientific collaboration was a major financial contributor to the expedition.

The aim of their research was to document the effects of arduous exercise in an extreme environment on physical and mental health and to evaluate combat rations and a new carbohydrate supplement as suitable nutrition for such conditions.

DNRC contributed three scientists and up to £80,000 towards the scientific programme. DERA UK provided two team members and up to £14,000 of financial support which came in



Zulu bridge, a 10m long non equipment bridge, is being constructed together with steps.

the form of fresh rations, equipment and consumables. The programme attracted logistic support from the US Army Systems, Natick USA (carbohydrate supplements, HooAh® and Ergo®, value £8000), Australian Army Support Command (combat rations, value £9600) and RAAF air freight. Many leading scientists provided academic direction for the programme.

The programme was the most detailed evaluation of combat rations to be conducted in a tropical environment. Scientific testing for each of the 35 participants (including those at the DVFC) included a minimum of 170 tests, including urine, saliva, skin and blood tests as well as physical (fitness, body composition) and psychology testing. A smaller number of participants were fitted with heart-rate monitors and radio pills for measurement of energy expenditure and body temperature. Fluid balance was measured by recording water consumption and urine volumes. In all, over 5000 individual tests were conducted. And, to add to this workload, the dietary intake of all subjects was recorded. Team members were actively involved in the analysis of data over the following six months and the first draft findings should be available by the end of this year.

Equipment Trials. Like the P&P research, the exercise provided another defence organization, the Defence Clothing and Textile Agency (DCTA), with an opportunity for a user development trial. During the expedition, £3000-worth of boots were issued to personnel with the aim of assessing the boot's performance under tropical conditions and producing a recommendation for introduction into service. Each trialist was requested to wear one of the four boot types and while doing so to maintain a weekly diary stating the amount of time that the boot was worn, his/her opinion of the boot, and the state of user's foot during use.

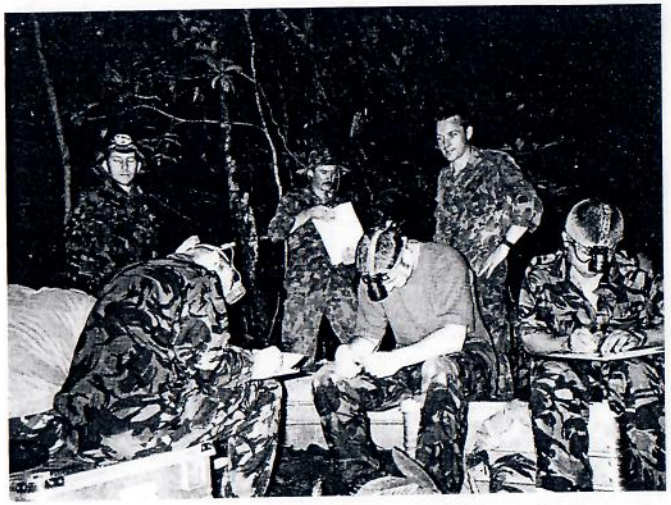
The Danum Valley Field Centre

At the DVFC the following projects were undertaken concurrent with work at the THP: Construction, a GPS survey programme and P&P testing. At any one time there were 19 expedition members at the site. There were also lab facilities, medical and equipment stores, a survey office and transport and guides provided by the Royal Society.

Construction of Sampling Towers and Bridging. The DVFC had a single, 40m-high, vertical sampling tower from which tropical rainforest canopy processes and phenomenon could be observed and recorded. The Royal Society had stated that a number of other such towers would be of great benefit to add appreciation of spatial variation in canopy processes. Designs were drawn, individuals trained in SRT and a rehearsal build was undertaken in the UK, before a decision was taken to construct two towers. All materials except the bolts were to be provided by the Royal Society and the Royal Engineers would provide the expertise, bolts and enabling equipment.

Due to heavy rainfall water levels in the River Segama rose by 5m and a number of bridges were washed away. The weir project was therefore abandoned in order to construct a major bridge for vehicular access for the team and other researchers to a substantial portion of the conservation area that had been cut off.

Surveying. As apart of the global carbon survey called Indforsus, at the DVFC a number of 30 by 30m plots were sampled from which data on the species content, biomass and canopy damage were recorded. It was intended that these plots would then be used to calibrate satellite imagery of the area to extrapolate country-wide carbon budgets. This has, however, not been possible as all the plot locations recorded at the centre have been made using arbitrary bench marks bearing little relationship to international positioning systems\protocol. Therefore, there was a need for a better system of ground control in order to improve the quality of all survey data at the centre.



Members of the trail team undertaking psychological tests under the supervision of the research scientists from DERA and DSTO.

The survey team proposed to provide a survey of ground control by using state of the art GPS equipment. They covered a 15 by 15 km area from which a map and database could be created with a drag and drop facility to detail all the control points and important features/facilities in the DVFC area.

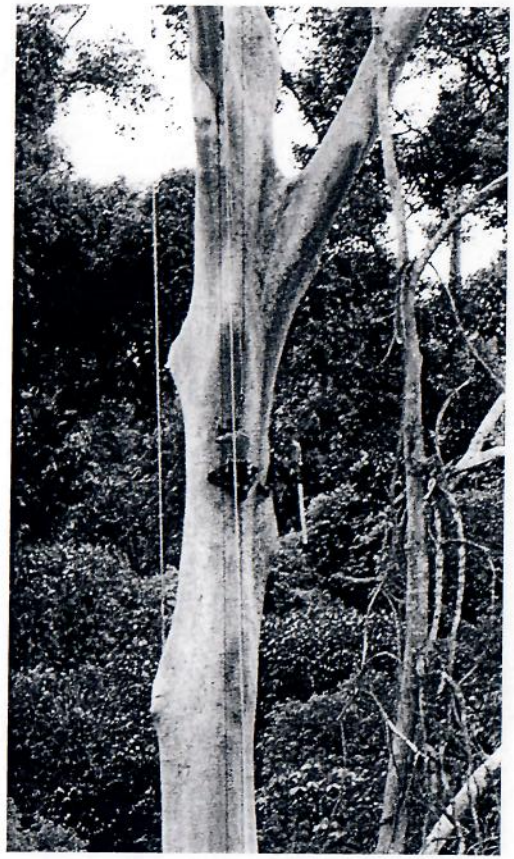
Once expedition activities were completed the expedition undertook a number of venture activities. Conducted over five days, these included the climbing of Mount Kinabalu, white-water rafting down the Padas Gorge and snorkelling at Mamutik Island.

Discussion and Conclusions

This exercise was without a doubt an extremely ambitious undertaking – planned in a short period of time, it involved a large number of agencies, both civilian and military, from four different nations and a logistic undertaking that involved sending over £425,000-worth of equipment half way around the world. Using British military training requirements and assessment of the fulfilment of the scientific objectives as criteria of the expedition's success the following may be concluded:

- Though the benefit to the military of the training conducted is difficult to quantify, due to the non-tangible nature of such objectives, it is without doubt that the expedition created the "sort of challenging situations, stresses and dangers inherent in military operations"[1]. The remote dispositions of the project teams, limited resources available and nature of the tropical environment more than fulfilled these requirements. Individuals had to develop mental robustness through humour, initiative, physical and psychological endurance; self reliance, and trust in the team and the leader – not once did expeditions members as a whole express the possibility of failure despite some extreme conditions and situations.
- With respect to the expedition's objectives, all were completed successfully: the trail was cut complete with engineering works; the survey work will introduce ground control at the DVFC; all three construction

[1] Extracts from "British Military Adventure Training Doctrine" in "Army Training and Recruiting Agency News" December 1997.



Setting up towers requires two members of the trail team to mark out at height. The men often had to work at heights of 40 to 70m in the tropical canopy for six to eight hours at a time.

tasks at the DVFC were completed; the physiological and psychological testing resulted in 5000 unique measurements; the botanist fulfilled all sampling requirements; the DCTA boot study was completed and venture activities were carried out without incident.

- With respect to the assessment of the expedition aim – preliminary findings indicate that civilian, MOD scientists and military personnel from a number of research agencies/projects can collaborate on a multidisciplinary research project, and produce worthwhile data/research. That this is a mutually beneficial relationship resulting in substantial cost reduction, the transfer of knowledge and representative, constructive feedback from service personnel.
- Finally, military expeditions are able to attract substantial participation from the scientific community. For example, it is estimated that if the turnover of all agencies is considered Exercise *Pelopor Finn* has resulted in the generation of over £250,000 of expenditure as a direct result of expedition activities. This not only goes someway to substantiating the hypothesis but also, most encouragingly, suggests that there is a **need** from the research establishment to undertake such similar work in the future.

Greater detail and in-depth analysis of the procedures and protocols that enabled the expedition to be successful are analysed in the *Post Expedition Report* produced for the Royal Geographic Society.

Follow The Sapper

LIEUTENANT COLONEL M C McCABE BSc(ENG)

LIEUTENANT Colonel Mike McCabe was raised in South Africa and England. At regimental duty he has served in Germany, Northern Ireland, the United Kingdom, Cyprus, and the Gulf. Various staff appointments have taken him to the Ministry of Defence (three times, once as a pleasure), Headquarters 2 Armoured Division, Bosnia, the Netherlands, and Italy. On Operation Granby *he served as second in command of 21 Engineer Regiment, then based in Nienburg. He was also "the First of the Few" to command 77 Engineer Regiment (Volunteers).*

LIFE is full of surprises; at least mine is. When I went to Nienburg as second in command of 21 Engineer Regiment in 1990, the Berlin Wall was still firmly in place and anyone predicting that the regiment would deploy to Kuwait via Saudi Arabia and Iraq would have been gently helped into a waiting ambulance. We now look back across ten busy years to that extraordinary war, which effectively ended for us with the cease-fire of 28 February 1991. It was a clear victory, and the end of a six-month period of considerable endeavour and impressive achievement for the whole regiment, and particularly for its field squadrons. The privilege of telling the regiment's story quite properly rests with our commanding officer and his squadron commanders, and their (now not so) young troop and section commanders, who so ably led the way. I will just touch on a little known "domestic" detail which reinforces, to me anyhow, the usefulness of knowing a bit of Corps history. As always, reduced explanation leads to sweeping generalizations.

The regiment was originally intended to provide support to a reinforced 7 Armoured Brigade, rather than to the division which followed. At first it was a "rate-capped" grouping of: our own RHQ, most of 1 and 4 Field Squadrons, and 45 Field Sp Squadron. To this was added two thirds of 26 Armoured Engineer Squadron, but disappointingly not its OC or squadron HQ who we knew well, and various very valuable individual reinforcements. 49 Field Squadron (EOD) temporarily joined us in theatre. After elementary beginnings we soon benefited from increasingly valuable brigade work-up training which progressively emphasized vigorous fire and manoeuvre in a bold attacking spirit. By the time that 1 (UK) Armoured Division had arrived, with its hybrid divisional engineer structure, some asset-stripping became inevitable and the regiment regrouped itself accordingly, doing whatever it could to make the best of things.

More live fire and manoeuvre and obstacle breaching exercises demonstrated that the dust, smoke and gunfire from our own and enemy actions would generate considerable obscuration on and near objectives, and in the run-up to them. After one completely dark night, with no ambient light, and we also had to work out better methods of improving coordination without breaking our very effective light discipline. We simply had to be able to find our own regimental vehicles very quickly in all circumstances. Most of everything that made us Sappers was on them. This was no easy matter in the mixed and widely dispersed blocks of vehicles that made up a battle group or echelon halted on the line of march, or when standing by as an attack went in.

Our two field squadrons also had to support three "battle groups" (ageing terminology even then), based on two Challenger regiments and one Warrior battalion. The squadrons themselves had to be as strong and flexible as possible but capable of regrouping quickly as the CO or OC judged necessary, including to support the third battle group or to reinforce or relieve each other as required, or potentially even the other brigade. However, regrouping in close contact was generally undesirable and whatever could be held forward in the field squadrons by way of task vehicles or mines and explosives needed to be with them from the outset. If they suffered casualties, mechanical or otherwise, then we had to be able to extract them or aid them, or replace them from a mobile regimental reserve held as far forward as possible while accepting, but limiting, the tactical and technical risks of doing so.

Challenger and Warrior could manoeuvre like fast frigates at sea on the hard desert of Iraq and