THE RANGER 2007

Journal of the Defence Surveyors' Association

Summer 2007

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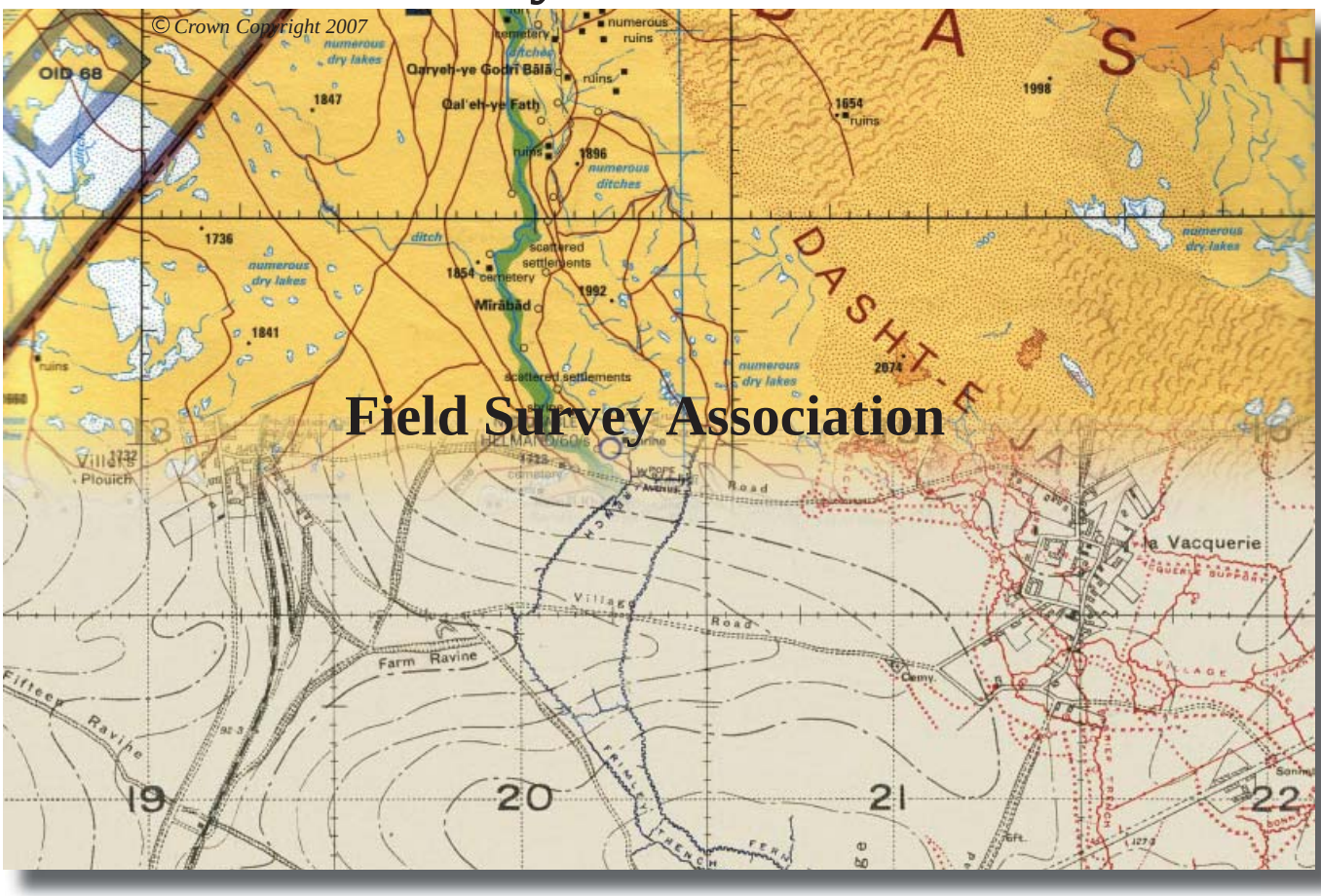

Sound Ranging Association 1927

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Contents - Summer 2007

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In this edition of Ranger…

……we include articles to mark two significant events; the 25th anniversary of the liberation of the Falkland Islands – Operation Corporate - and, more parochially, the 80th anniversary of the founding of the Sound Ranging Association, the forebear of the Defence Surveyors' Association.

Both, in different ways, involved quite stunning triumphs against considerable odds. Operation Corporate was a momentous challenge and a signal success, from the hurried raising and despatch of the Task Force to the other side of the World, the amphibious landing, air/sea battles in the style of the Second World War and the incredible fighting 'yomp' across the island to overwhelming victory.

The other anniversary is based on the development and very successful deployment of, what for the time, was the very much cutting edge of technology – sound ranging. What marks this out as so exceptional is that the entire development, manufacture, testing and implementation was carried out in the front line on the Western Front by the users themselves and despite a distinct lack of support from the Royal Artillery senior staff. It is worthy of note that when the system was subsequently commercially produced, it had been 'improved' by those back in England and then failed to work properly until modified by the users in the trenches!

Whilst details of Operation Corporate will be familiar to most readers, and indeed the anniversary has been the subject of considerable media cover, the story of the development of sound ranging will not be as well known. It is such an outstanding success story, and has such significance to our Association, that the Editor makes no excuse for a degree of repetition in the articles on the subject in this issue. Included in this issue are pieces telling the story of sound ranging in the Great War, another detailing Sir Lawrence Bragg's pivotal role in the project and also a first rate personal account by a Flash Spotter – the closely allied method of detecting enemy batteries – of his time at the Front. In the winter issue we will continue the story of sound ranging up to its use on operations today.

The issue, as ever, also includes a variety of articles looking at defence geospatial matters of today ranging from 14 Squadron's deployment to Afghanistan in the footsteps of Captain Pemberton Leach VC RE to the story of the commissioning of HMS Enterprise. So yet again our usual eclectic mix of articles with something hopefully to suit everyone. Finally, my thanks to Mike Nolan for all his assistance with the sound ranging material.

Alan Gordon

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Opinions expressed in Ranger do not necessarily reflect those of the DSA or the editor.

DEFENCE SURVEYORS' ASSOCIATION

Formerly the Field Survey Association

DSA is a registered charity which maintains liaison between officers, warrant officers and senior non-commissioned officers, both serving and retired, and civilians who are working or who have worked in the Defence domain where the focus is environmental information, hydrographic, oceanographic and geographic surveys, locating and target acquisition, navigation, and geospatial intelligence.

The Association provides a variety of services to its members which include:

- A copy of each edition of Ranger magazine, published two times a year.
- Visits to a wide range of technical, military and historical sites, often not available to the general public.
- Opportunities to attend technical and historical seminars.
- Opportunities to attend events organised by other professional organisations working in related fields.
- Opportunities to network with senior personnel in the Defence environmental and geospatial sector.

Visits organised in recent years include:

Portsmouth Dockyard and HMS Drake at Plymouth
United Kingdom Hydrographic Office at Taunton
Headquarters Royal Artillery at Larkhill
The Joint Aeronautical and Geospatial Organisation at Hermitage
No 1 Air Information Documents Unit RAF at Northolt
The BAE Systems Battlespace Management Evaluation Capability at Farnborough
The Royal Engineers Mess and Museum at Chatham
Greenwich Royal Observatory
The Queen's Cartographic Collection at Windsor

If you would like to join the Association please complete the application form at the back of this edition or visit the Association's website (www.defencesurveyors.org.uk) where you can complete an application on line.

The DSA's Events Secretary, David Wallis, laying a wreath at the Menin Gate on behalf of the Association.

ANNUAL GENERAL MEETING 2007

This year's Annual General Meeting will be held at

The Museum of Army Flying

at the Army Air Corps Centre, Middle Wallop

on

Saturday 28th of July

Details will be announced shortly but book the date now for a pleasant lunch and a convivial afternoon.

Middle Wallop is situated 5 miles from Andover on the Salisbury road.

Bereavements

It is with regret that the Association announces the death of Stan Tress, a former Sound Ranger whose wartime experiences were published in Ranger in the two 2003 issues.

SRA through FSA to DSA
80 Years of Defence Surveying

By Alan Gordon

At the outbreak of war in August 1914 two officers, two clerks and a Printing Company comprised the total Military Survey resources deployed to France to meet the needs of the British Expeditionary Force. However, by the time of the Armistice in November 1918 there were almost 6,000 men serving in the Survey Battalions in France responsible for providing not only survey and mapping support but also the new techniques of flash spotting and sound ranging that had been developed to locate enemy batteries. The majority of these military surveyors were not regulars and so they returned to their civilian careers as soon as possible after the end of the war. This was particularly so in the case of those officers who had been instrumental in taking a scientific concept; that of being able to locate an enemy gun by fixing the source of its sound when fired, and developing it at the Front into a very successful working system known as sound ranging.

By 1927, these former officers, including Sir Lawrence Bragg who had been the driving force behind the development of sound ranging, had become concerned that under the stringent peacetime conditions then prevailing, the expertise gained so dearly during the war would soon be lost. Their answer was to form the Sound Ranging Association to provide a pool of such expertise to be made available to the army should the need ever arise again. The following year the Association broadened its remit to include all those who had served as officers in Field Survey units during the war and consequently changed its name to the Field Survey Association to better reflect its membership.

The Association was officially recognised by the Admiralty, the War Office, the Air Ministry, the Colonial Office and the Ministry of Agriculture, Fisheries and Food, all of which appointed representatives to the Council of the Association.

At this time, and for many years to come, the surveying, cartographic and map production technology employed by civilian companies was broadly similar to that which would be used by the military in the event of war hence, the idea of a pool of qualified civilians providing immediate reinforcement to the army was considered perfectly viable, and was proved to be so in 1939 when members were quickly taken into either military service or relevant ministries.

The Association continued to flourish after the Second World War with the membership criteria broadening over the ensuing years to include Royal Navy officers from the Hydrographic Branch, civil servants employed by appropriate departments, suitably qualified warrant officers and, in 2006, Senior NCOs.

In 1997 the Association changed its title to the Defence Surveyors' Association in recognition of the wider applications of geospatial science in the defence arena and revised its aims accordingly.

80 years on and close links with serving units are still maintained, representatives of the Royal Navy HM Branch, the Royal Artillery and Royal Engineers (Geographic) sit on the Council as did their forebears and the Association looks in good stead to reach its centenary in 2027.

The Worshipful Company of Scientific Instrument Makers Annual Award Dinner

By Tony Keeley

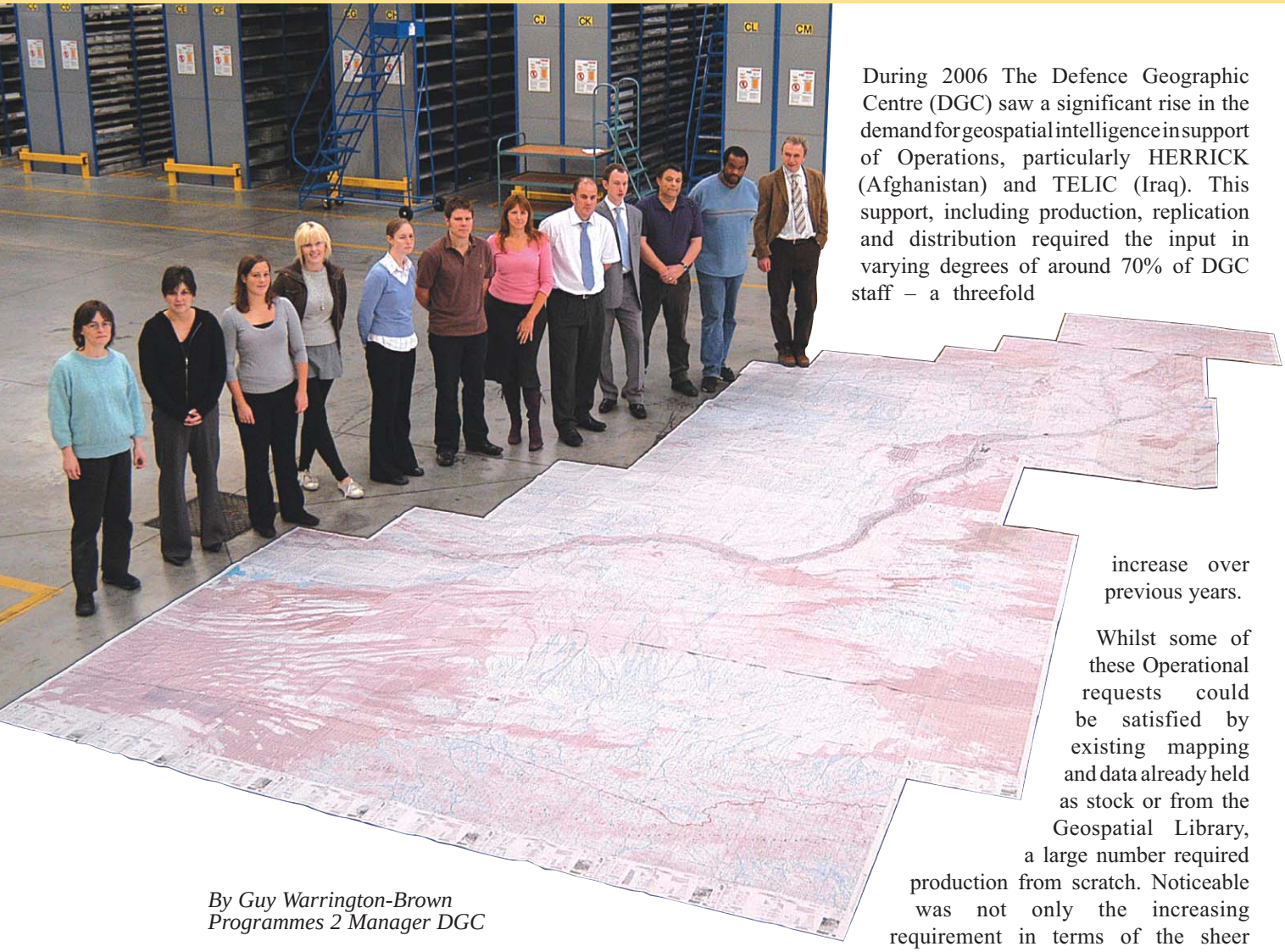
The Company present two prizes annually for students from the Royal School of Military Survey. The prizes are for the top Royal Engineer Officer on the Army Survey Course and the top student on the RE (Geo) Class 1 Technician course. The prizes for 2006 were presented at the Annual Award Dinner held in the Scientific Instrument Makers' Hall by the Master, Captain GP Brocklebank RN, on 1 February 2007. Captain Jo Hardwick RE was awarded the ASC prize after completing her MSc but was unable to attend as she had been posted to the Mapping and Charting Establishment in Canada on completion of the course in October 2006. The Principal of the Royal School of Military Survey, Mr John Knight, accepted the prize from the Master on Jo's behalf. Lance Corporal Oliver Teasdale, achieving his Foundation Degree, was awarded the prize for the best student on his Class 1 Technician Course. His posting to 14 Geographic Squadron RE was delayed to enable him to receive his prize at the dinner. As always the hospitality shown by the Company was outstanding.

John Knight, Principal of the Royal School of Military Survey, accepting the Army Survey Course award on behalf of winner Captain Jo Hardwick RE.

Lance Corporal Oliver Teasdale receiving his prize as best student on the Class 1 Geographic Technician Course from Captain GP Brocklebank RN, Master of the Scientific Instrument Makers.

They want WHAT! by WHEN!

Defence Geographic Centre (DGC) Support to Operations in 2006



By Guy Warrington-Brown
Programmes 2 Manager DGC

During 2006 The Defence Geographic Centre (DGC) saw a significant rise in the demand for geospatial intelligence in support of Operations, particularly HERRICK (Afghanistan) and TELIC (Iraq). This support, including production, replication and distribution required the input in varying degrees of around 70% of DGC staff – a threefold increase over previous years.

Whilst some of these Operational requests could be satisfied by existing mapping and data already held as stock or from the Geospatial Library, a large number required production from scratch. Noticeable was not only the increasing requirement in terms of the sheer number of products requested but also the range of bespoke products required to satisfy specific customer needs, ranging from image maps, road atlases and 3D visualisations through to route graphics, vector datasets and town plans. The demand was so great that priorities were changing at times on a daily basis and consequently it was crucial that there was constant consultation with PJHQ through the DGC Ops Room.

The subsequent need to increase throughput and to develop unique geospatial data or mapping, presented a number of challenges that prompted some innovative thinking in terms of developing the production flowlines. Bulk processing of data reduced timelines. One example of this involved the packaging up of large areas of elevation data (Shuttle Radar Topographic Mission (SRTM)) over Helmand Province when generating contours, spot heights and layer tints. Certain procedures within the mapping processes were identified as specialisms which were allocated to individual staff that had the responsibility of creating that particular component for every sheet in a series for example. This included geodetics, marginalia detail, boundary information and land surface components. Concessions were also made in terms of data attribution, in that attribution was minimised solely to serve the map publishing software rather than for database population.

The statistics for Operation HERRICK demonstrate the diversity of the product range our customers required. November 2006 saw the completion of one hundred and four 1:50,000 map sheets over the Helmand Province, each taking an average of 150 hours to compile. These sheets have formed the basis for tactical level planning. With a surface area of 23,000 sq miles, this is the equivalent of producing new mapping over an area a third of the size of the United Kingdom in just over a year! A wide variety of other products have also been produced ranging from those at the strategic level such as Afghanistan Pilotage Charts, Briefing Maps and Joint Operations Graphics to very detailed Town and Camp Plans to support tactical operations in Built Up Areas.

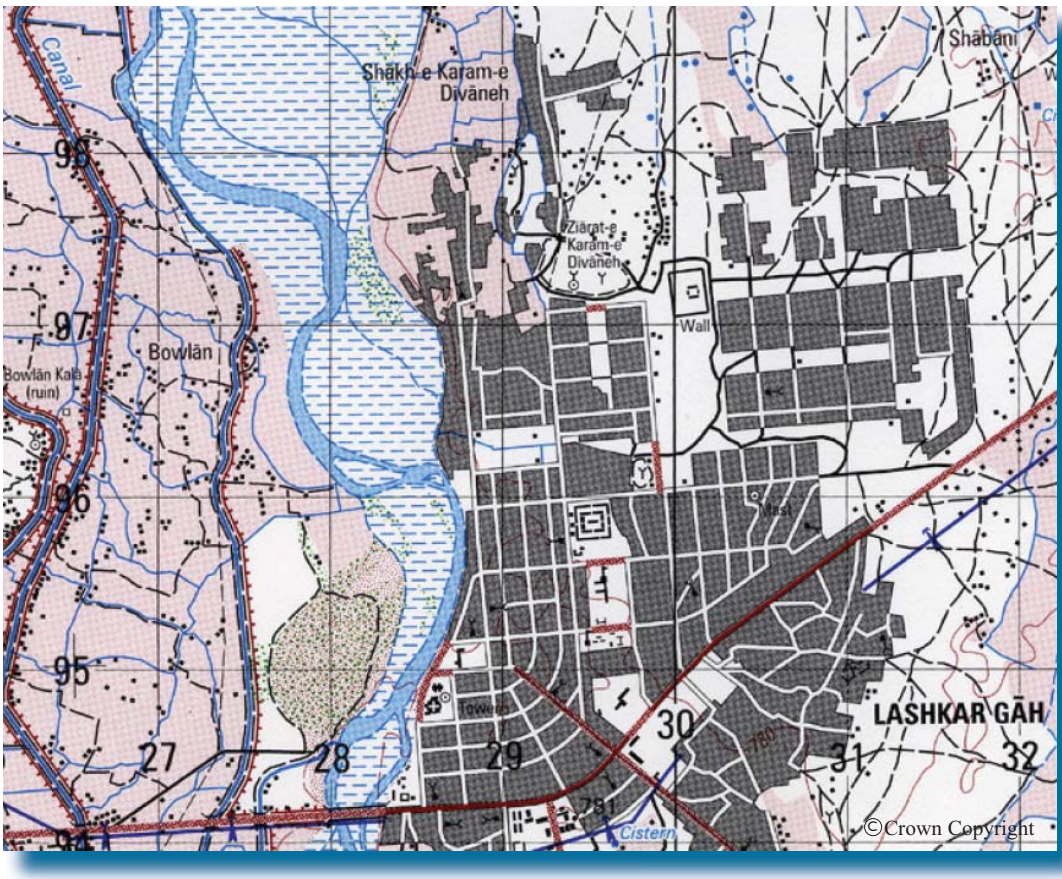
DGC analysed the main routes throughout Helmand Province to identify vulnerable points resulting in detailed route maps. A range of imagery sources was also processed to create a current image layer for key areas. Products have been generated in both paper and digital formats with the raw data passed to the GEOINT teams out in theatre.

Operation TELIC also required a similar range of products including Town Plans, Image Maps and Gazetteers as well as 3D, line-of-sight and fly-through data. As with HERRICK, some of the production statistics are incredible. The Town Plan of Al Basrah, which equates to Liverpool in terms of physical size, was produced at a scale of 1:5,000. It comprised 9 individual sheets which, when joined together, form a map the size of which is the equivalent to the floor area of an average room. It was produced by 18 staff in the two Rapid Response Sections supplemented by an additional 15 personnel with the relevant experience from other parts of the organisation. The team worked a total of 4,500 man hours (3.5 man years) over a seven-week period which ensured its timely completion and dispatch to theatre. The final product contained 17,000 building polygons alone. The town plan has been used as the basis for a street atlas that was supplemented by corresponding Commercial Satellite Imagery (CSI) on each facing page.

DGC will use the experience gained to review and validate emerging requirements which include demands for large scale high resolution datasets, attributed vector data, interactive products and the faster dissemination. There has also been a trend for reach back to DGC – i.e. for the printing and finishing of tasks incorporating data acquired in theatre.

It should be remembered that all of these tasks were competing against other Operational support including Op HIGHBROW (Lebanon) and Op CEREBRAL (Democratic Republic of Congo) as well as standing contingency and homeland security requirements together with a programmed and resourced FY06/07 Production Programme containing some 2,000 individual geospatial products worldwide.

The flexibility, imagination and sheer hard work of the staff involved in this work enabled DGC to meet some very tight deadlines and create new and innovative production flowlines and products. Dare I say however, that many might empathise with the quotation by author Doug Larson *"Accomplishing the impossible means only that the boss will add it to your regular activities!"*



25th Anniversary: Operation Corporate
The Military Survey Involvement

The following article was first published in the RE Journal in December 1982 and gives an 'immediately after the event' summary of the part Military Survey played in the liberation of The Falkland Islands.

OPERATION CORPORATE – THE MILITARY SURVEY INVOLVEMENT

Lieutenant Colonel JS Himbury RE, BSc

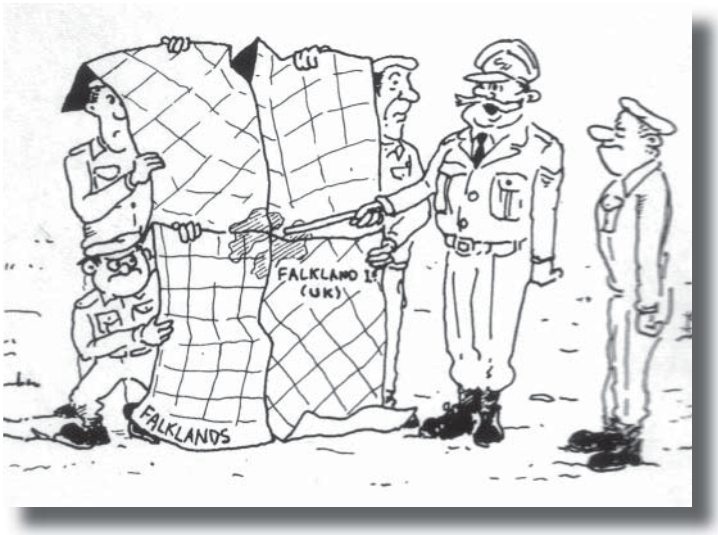
During Op Corporate the Author was serving as SO1 Svy 2 in the Directorate of Military Survey with responsibility for land maps and air chart production and distribution.

Previous to assuming this appointment in December 1980 he had served for 2½ years as Geographic Officer in AFNORTH after attending the NATO Defence College, Rome.

The Background

Op Corporate, the code name for the UK response to the Argentine invasion of the Falkland Islands. The Falkland Islands? Where are they? How Far? – look it up on the map – what Map? Such must have been the questions asked in MOD UKLF and CINCFLEET during the night of 31 March/1 April until impending confusion was replaced by rational thought. Early on 1 April Military Survey was alerted to start what turned out to be a challenging and immensely stimulating operation involving all elements of the Survey Service. Mindful of the date the Directorate Duty Officer was at first a little cautious but map requests for outlandish places are not uncommon, moreover the Falkland Islands had been in the news and he knew how to respond. What he did not at first expect was the speed with which both and quantity and area coverage required would increase, but by then further staff and units had been alerted.

Military Survey works to priorities given by its operational taskmasters, the three Vice Chiefs of Staff and their subordinate operational staffs, tempered by input from CINCFLEET, UKLF and Strike Command. The Falkland Islands and its Dependencies were in the lowest priority area, consequently Military Survey had done little work in the area and no stocks were held in the War Reserve Depot. Fortunately, some twenty years ago the Directorate of Overseas Surveys (DOS), as part of their responsibility to the Ministry of Overseas Development, had produced a 1:50,000 map series covering the Falkland Islands in 29 sheets, together with a two-sheet 1:2,500 series covering Port Stanley. Military Survey, as a routine activity, had taken small stocks of these series. When these became depleted over the years it was their routine re-printing in October 1981 by 42 Survey Engineer Regiment that led to a press report in the Times Diary of 15 April 1982 that *"not everybody was unprepared for the present crisis"!*



"Next time we have a crisis let's make sure it lands in the middle of one damn map and grid zone!"

The Operation starts

Thus when the crisis broke on 1 April, and immediate map requests came flooding in, Military Survey was able to respond with limited quantities of the somewhat outdated DOS map from the shelves at 8 Map and Air Chart Depot. It was fortunate that the rate of change in the Falkland Islands is rather slower than in Western Europe or a twenty-year-old map would certainly have been of little value.

Faced with demands for large quantities for the first elements of the Task Force, a Directorate Operations Room was established on full twenty-four hours manning and immediate reprinting of the existing products at both 42 Svy Engr Regt, Barton Stacey, and the Mapping and Charting Establishment (MCE RE), Feltham, was started. By 2 and 3 April units were able to collect their

initial requirements in full from 8 Map and Air Chart Depot at Guildford and the War Reserve Map Store at 42 Svy Engr Regt.

It is well known that any battle always occurs on the junction of four map sheets. What is not so well known is that it also occurs across a grid zone junction. The Falkland Islands is no exception, and worse, DOS had drawn their civilian product to show by margin ticks only the eastern grid Zone 21 extended westward, thus avoiding the inconvenience of the junction. Military Survey in 1967, as part of a joint production programme with the United States Defence Mapping Agency, had correctly shown both zones of their 1:250,000 Joint Operations Graphic (JOG) but had not the resources to convert the DOS 1:50,000 mapping to the full Military Grid. Thus the classic operational nightmare had occurred of two maps series of the same area with conflicting grid zones. After urgent consultations with HQ Commando Forces at Plymouth on 5 April the solution adopted was to show both grids in the western grid zone (Zone 20) area with prominent warning notes describing the purpose of each: eg one for use with the JOG and one identical to the initial map issues. This solution gave compatibility between DOS sheets already in use by the first elements of the task force as well as the earlier resident Royal Marine Detachment, part of which was still avoiding capture on the Falkland Islands, and to new products now being issued to the main Task Force and Air Forces who would use the 1:250,000 JOG in lieu of the preferred 1:500,000 air charts cover which had not been produced.

Not only standard maps and charts were required. In the first few days copies of many items such as large scale plans of Stanley Airfield and its buildings were obtained from numerous contacts and printed to supplement the meagre information available to the intelligence and operational branches.

DOS air photography was made available to the Joint Air Reconnaissance Intelligence Centre (JARIC) who in turn supplied copies to a variety of military users. Meanwhile as well as reprinting the 1:50,000 map to include the full grid, both 42 Svy Engr Regt and MCE RE had been extracting all additional information they could from the original DOS air photography was well as the more recent helicopter photography obtained from HMS Endurance via the Hydrographic Department. This data was subsequently used to make new editions in the form of Topographic Information Overprints (TIOs). Military Survey Procurement Officers throughout the world were also searching out new material and throughout Op Corporate new information was frequently incorporated into still further new editions.

Although operations were focused on the Falkland Islands, maps and air charts were also supplied for other areas of interest ranging from South Georgia to the British Antarctic Territories, as well as for contingency plans elsewhere. Unlike the main Task Force these contingency plans did not require such large map stocks but they called for a large amount of work in colour copying original maps obtained by Military Survey Procurement Officers from a wide number of sources, the preparation of TIOs and the printing of limited quantities. Other activity was the supply of sets of coloured slides and photographs obtained from commercial firms, Falkland Islanders in the UK, repatriated personnel and so on.

The Requirements increase

Being used to the restraints of NATO Standardization Agreements the influence of Op Corporate was in many ways refreshing.

Having produced the standard series of map cover Military Survey were soon presented with additional requirements and for a change were able to say "Yes"! Examples of these requirements are:

1:25,000 Scale

The first requirements for cover at this scale came from MOD on 22 April for DIS use in assessing the Argentine deployment around Port Stanley. A new survey was impossible and the solution of enlarging the 1:50,000 series to new sheet lines over the required area with the incorporation of a TIO update was adopted. The first product *"Port Stanley and Environs"* was issued on 24 April and led to further requirements from CINCFLEET for similar products over Fox Bay, Port Howard, Port San Carlos and Darwin Settlement. This was followed by a very urgent request for cover of Pebble Island. This was issued to CINCFLEET on 3 May. The success of the subsequent raid perhaps

owes something to the first call on an open line alerting Military Survey to the requirement. By the conclusion of Op Corporate this series had been extended to cover most of NE Falkland Islands between Port San Carlos, Darwin Settlement and Port Stanley.

1:100,000 Scale

The Staff Officer who requests a map of the right size to fit his wall is well known in Military Survey. Perhaps it is not a fair comparison but in Op Corporate complaints were received from the Planning Staffs that the 29 sheets at 1:50,000 scale were proving difficult to handle in Operations Rooms and the 1:250,000 scale did not give enough space to plot detailed positions. The answer was to produce a new planning map with the same grid density as the 1:50,000 series by enlarging the 1:250,000 Joint Operation Graphics covering the Falkland Islands into a 5 sheet series at 1:100,000 scale. This series incorporated a TIO as well as the more detailed grid and proved a most successful map. The task was initiated on 29 April and completed as a joint effort by 42 Svy Engr Regt and MCE RE on 3 May.

1:12,500 Scale

Having produced at 1:25,000 series and filled in the gap between 1:250,000 and 1:50,000 how about the gap between the DOS 1:2,500 and the new 1:25,000 scales? What better than a new 1:12,500 series.

Perhaps this was gilding the lily but the DOS 1:2,500 did not cover much area and lacked contours. There was a need for a new map to cover detail of the final assault, which really came much quicker than many expected, as well as a large scale town plan for the future redevelopment of Port Stanley and its airport. To provide this a new survey at 1:12,500 scale was undertaken as a contract task by DOS and the Hydrographic Department. This made full use of the original DOS air photography as well as the more recent Hydrographic Department *HMS Endurance* helicopter photography and their latest large-scale harbour plots. Work started on 21 April and the first two sheets covering Stanley and airport area westwards towards Two Sisters were issued on 1 May. By the end of Op Corporate the series had been extended westwards to Mount Kent and northwards to Berkeley Sound. The extensive resurvey work was completed by Air Surveyors from 42 Svy Engr Regt being attached to DOS working shift about with their civilian counterparts. The importance of this series in the development of the Falkland Islands later resulted in further extensions as a preliminary to development plans for a new airfield, roads and harbour installations.

Going maps

Information on the topography of the Falkland Islands was scarce and, in MOD, HQ E-in-C (A) Engr 1 had taken the initiative in collecting soil and "going" information from a variety of sources, including the debriefing of Falkland Islanders and RM personnel returned from the Falkland Islands via Argentina. Three NCOs from 42 Svy Engr Regt had been attached to Engr 1 to help in the presentation of data and on 13 April 42 Svy Engr Regt was alerted to complete production of the collated data on a 1:250,000 scale composite based on the inevitable four standard sheets of the Joint Operations Graphic cover of the Islands. The first edition was issued on 16 April and a 2nd Edition incorporating yet more information was published on 26 April. Both editions suffered from difficulty in reading the overprint information under poor lighting conditions and to improve this aspect a 3rd Edition of the immensely popular "RE Briefing Map" was issued on 4 May. The demand was such that a later re-print was required. Some demands received were for the "re-briefing" map which caused some confusion in 8 Map and Air Chart Depot!

Large scale site plans

The ability of Military Survey Air Surveyors to take accurate measurements from air photographs was not overlooked and the Air Surveyors at 42 Engr Regt were tasked with providing large scale profile plots extending the Port Stanley airfield runway alignment. Also, on 10 June, a large-scale plot of the summit of Mount Kent was produced to facilitate planning the installation of radar equipment.

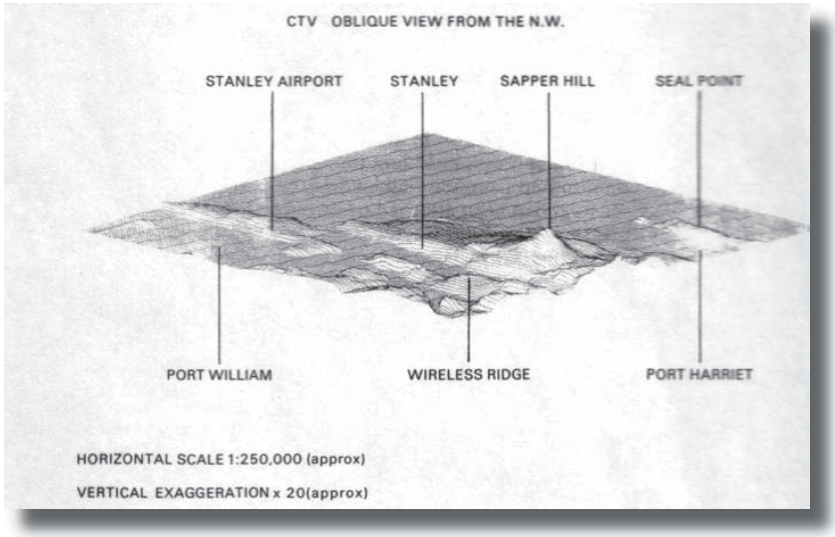
Gazetteers

With the Argentines calling the Falkland Islands the Malvinas and the area of interest extending from the Antarctic to South America the location of names soon presented problems. To help

overcome this difficulty two gazetteers were produced. The first covering the Falkland Islands and Dependencies, which was produced by MCE RE on 11 April literally overnight, involved collecting and sorting approx 1,500 names. A second edition was printed on 27 April using the resources of the School of Military Survey as at that time other unit presses were heavily committed on other work. The second gazetteer was copied from an existing US publication covering Argentina and was printed at MCE RE on 17 April.

Digital terrain model

Military Survey had been extensively engaged in Digital Terrain Model (DTM) production in Europe, and inevitably on 23 April a request for a digital terrain model of the Falkland Islands for use in support of radar location and radio wave propagation studies was received. The answer that none had been produced would not do, so work was immediately started, based on the 1:250,000 scale map contours. Data for the NE Falklands was provided on 30 April with the remainder a week later. The terrain model around Port Stanley was later refined using the new contours from the 1:12,500 mapping.



Computer Terrain View (CTV)

Although full visual simulation is a thing of the future one important by-product from the Falkland Islands DTM were Computer Terrain Views (CTV) showing the ground shape as seen from any selected view point. The technique was developed within a few days and several requests from CINCFLEET for CTVs looking towards Port Stanley from various vantage points were met.

Air charts

The role played by Air Forces in Op Corporate was vital both operationally and in maintaining a constant flow of supplies. To back this up Military Survey was called upon to provide en route and navigation charts to and in the South Atlantic as well as the larger scale air charts required for operations over the Falkland Islands and other contingency plans. This was a major commitment which has continued, although to a lesser extent, well after Op Corporate ended. In addition to these requirements the RAF called for the rapid production of a Moving Map Display filmstrip for RAF Harriers as well as a series of Maritime Patrol Air Charts covering the South Atlantic for use by RAF Nimrod aircraft operating ASW patrols.

The map supply problem

There are many adaptions of the old adage about an Army marching on its stomach, but certainly without a map it marches nowhere and a major concern throughout Op Corporate was to ensure that forces deployed were aware of the new products and that these were quickly supplied.

During the early stages of the operation a WO1 was deployed to Ascension Island to ensure the safe delivery of later editions being produced in the UK for issue to the Task Force as they passed the island. He was also able to rescue from oblivion and forward to the RAF stocks of the US produced 1:1M air charts covering the Falkland Islands and Argentina which under US/UK joint production arrangements had been flown to Ascension Island by the US on 8 April in response to an urgent request. The US speed in delivering stocks to Ascension Island and the UK, together with reproduction material enabling Military Survey to print further stocks, was most heartening.

The expert presence of the Survey WO proved invaluable in the initially difficult period, but as the system of notifying commands and units of new products by a Map Availability Signal supplemented by the Publication of a map catalogue was established, he was returned to the UK and

delivery via the conventional WANTA-MAP Signal and movement by the Standard Priority System (JSP 336) became fully effective.

Statistics are notoriously unreliable but some indication of the size of the task faced by Military survey in meeting the geographic requirements of an Amphibious Task Force operating in a remote area for which no up-to-date contingency plans existed is not amiss. By the conclusion of Op Corporate some 410 different products had been made available, some ¾ million maps had been printed and over 300,000 copies issued. Contrary to initial belief the commitment did not reduce after the departure of the Task Force but increased as new users were identified, new material became available and new editions were produced covering increasingly wide areas of operational interest. Throughout Op Corporate operational branches were seldom able to state specific requirement dates. Copies were invariably required "NOW" for planning, even if the bulk stocks for units would not be required until a few days later. As a result the majority of products were given very short production times with a degree of compromise between time and content; again almost invariably all were followed up by later editions.

The future

The end of hostilities has not seen the end of Military Survey commitments. New work in support of contingency plans has continued as well as extension of the 1:12,500 series as part of the development plans for the new airfield, roads and port installations on the Falkland Islands. One Officer and four Surveyors, complete with a TACIPRINT equipment, have been deployed as part of the Falkland Island Garrison to undertake field survey revision tasks and to provide facilities for the rapid overprint of information such as minefield clearance for distribution to both the military and civilian populations on the islands. It is anticipated that as well as completing revision on the basic map cover there will also be a requirement for training area maps for the future permanent garrison.

The lessons to be learned

Everyone is anxious to take advantage of the lessons learned in Op Corporate. Detailed reports are still being analyzed and it will take some time for these to be implemented. But the main conclusions now being reached are that the range of scales and products required is greater than previously considered and that, once again, to start collecting data when it is needed is too late, it must be actively collected in peace even for the most unlikely areas and even then, without an efficient control organization and flexibility in the employment of production resources, the speed of response will be a limiting factor. In supporting Op Corporate both major Military Survey production units were fully committed and on occasions recourse, although limited, had to be made to the School of Military Survey and Ordnance Survey printing capacity. It now appears a reasonable assumption that in spite of the lack of preparation the geographic support provided in Op Corporate was successful; but NATO and the Rest of the World is a far bigger area to cover and such operations could not be supported without sustained preparatory work in peace.

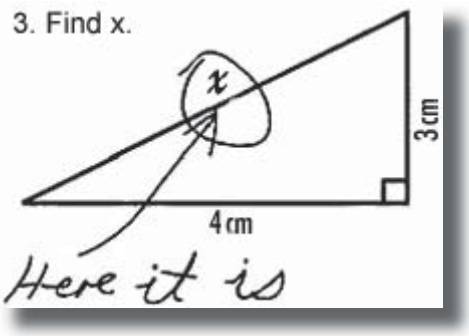
The enemy

Newspaper reports stated that the Argentine forces had spent £2,000 on purchasing DOS maps of the Falkland Islands from a London dealer early in 1982 to support their operations. When captured General Menendez had in his possession a DOS 1:50,000 map, still ungridded; and other captured Argentine mapping compared most unfavourably with our own. Perhaps Military Survey did contribute significantly to our victory in the South Atlantic!

What would Pythagoras think?

After careful consideration, the Department of Education accepted the student's examination answer in this instance but has instructed examiners to be more explicit in setting questions in the future.

First published in Soundings.



25th Anniversary: Operation Corporate
The Hydrographic Surveying Squadron Involvement

The following are extracts from the *'Report of the Hydrographer of the Navy 1982'* which give an overview of the part played by ships of the Hydrographic Surveying Squadron in the liberation of The Falkland Islands.

Introduction

Operations in the South Atlantic have had a considerable effect on all aspects of the Hydrographic Service in 1982. As a result of the steady progress made by the small teams detached to the Falkland Islands each year since the early 1950s – originally from British Antarctic Survey vessels and subsequently from the Ice Patrol Ships *HMS Protector* and *Endurance* – the kelp-free areas in the approaches to many of the main settlements had been surveyed, at least by echo sounder.

But, as in many other parts of the world, large areas remained either completely unsurveyed or covered only by reconnaissances by very early explorers. These early visitors to the islands had included Captain Robert Fitzroy who, accompanied by Charles Darwin, left Plymouth at the end of 1831 on the famous voyage of *HMS Beagle*. To quote Dawson's 'Memoirs of Hydrography'.

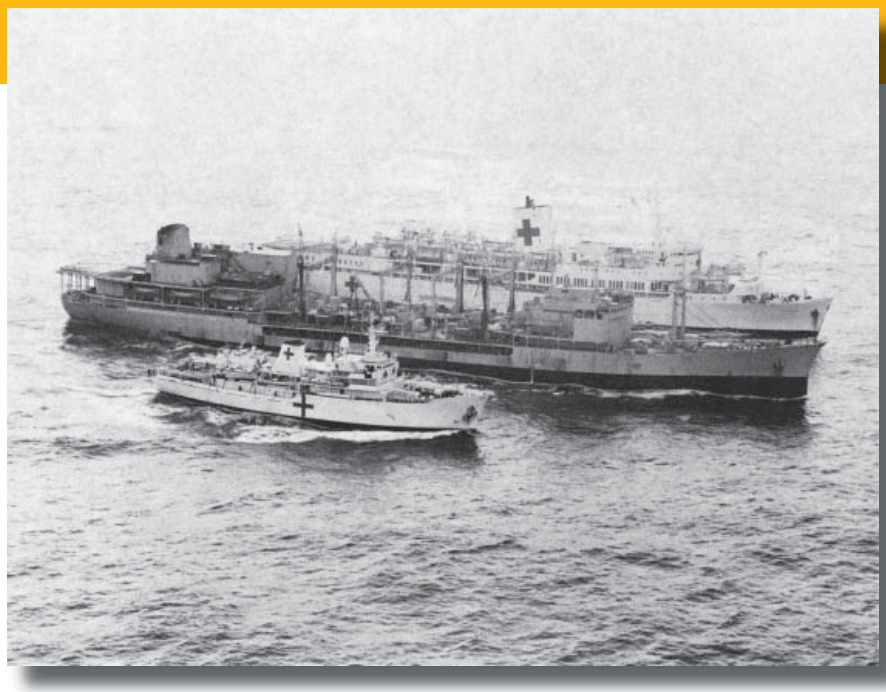
"When on the South American Station, unwilling to quit his post without rendering his services in every sense complete, Captain Fitzroy had hired two additional vessels to finish off the examination of the coast of the Falkland Island and subsequently purchased a third, beside fitting out the Beagle to a great extent at his own expense. But as these gratuitous and noble efforts – which cost him several thousand pounds – had not been sanctioned by the Admiralty, he was never re-imbursed".

Despite this remarkable zeal, however, neither Fitzroy nor any of his successors had ever envisaged the use to which their results would have been put in 1982. The teams led by Lieutenant Commanders David Penfold and Frank Hunt in the early 1950s for example had surveyed San Carlos Water and its approaches with a view to its use by small inter-island launches taking sheep to the refrigeration plant in Ajax Bay; in the event, only one shipment was ever made since there were then no farmers willing to sell sheep as mutton, no boats available and insufficient water for larger ships to load from the factory.

By a remarkable coincidence, a routine New Edition of Admiralty Chart 2558 – Falkland Sound, Northern Part – had been prepared for issue on 2 April 1982 to include work done by *HMS Endurance's* detached team in the southern summer of 1980/81. This was one of the eight modernised charts of the Falklands to have been issued recently out of a planned total of fifteen; five more were at such an advanced stage of compilation that they were able to be provided, as Provisional Charts, by airmail to the Task Force.

Preparing for a heaving line transfer between HMS Herald and HMS Hydra.

Although none of the surveying Flotilla was included in a surveying role in the Task Force which was so efficiently assembled and despatched south, three ocean survey ships – *Hecla*, *Herald* and *Hydra* - were quickly converted to unexpected roles as ambulance ships to assist in the evacuation of casualties, from either side, from the war zone to a neutral port. Whilst on their slow passage south, the crews of all three ships improvised arrangements to accommodate the wounded and practised their reception and handling on board; from their assigned Red Cross Box – well clear of the most



SS Uganda and HMS Herald being replenished at sea from RFA Olmeda.

dangerous areas – each ship closed the principal hospital ship SS Uganda, to embark as many of the injured as they could carry. During the five day passage to Montevideo, the three crews were able to attend to the health and well-being of the 592 injured – both Argentine and British – after their ordeals.

Throughout the campaign, Naval Meteorological and Oceanographic (METOC) officers found themselves practising their art under difficult and challenging conditions. The importance of measuring and forecasting the whole ocean environment in such remote operational conditions was emphasised and many valuable lessons learned.

Even after the end of hostilities, there were still real dangers of serious injuries to personnel ashore as a result of landmines and other operational hazards and *HMS Hydra* remained until Stanley airport could be repaired and extended in order to provide an alternative emergency medical evacuation facility. When *Hydra* returned to Portsmouth on 24 September – the last of the original Task Force to return – she was given the same tumultuous reception as all other ships, after 153 days almost continuously underway without shore leave.

Since all three ships had been declared, under the Geneva Convention, as hospital ships, none had been able to do any surveying of any kind. However, our Task Force had reported many uncharted dangers and urgent requirements for modern surveys, more adequate for the maintenance of the larger garrison to be stationed in the south Atlantic. Accordingly, *HMS Hecate* had her routine refit speeded up to allow her to sail, some six weeks ahead of schedule, as a temporary relief for *Endurance*; during her six month deployment, Hecate has completed many operational surveys and found – amongst many other new dangers – an uncharted islet.

Activities of HM Surveying Flotilla

HMS Hecla

On 14 April, orders were received to curtail the Assisted Maintenance Period (AMP) and prepare to join the Falkland Islands Task Force as an ambulance ship, cleared under the Geneva Convention to act in a casualty evacuation role. The ship was quickly stored, fuelled and watered to capacity and other stores not required were landed, so as to permit spaces – such as the bulk survey store – to be used as temporary accommodation for the ship's company – who gave up their own messdecks for use as wards for the casualties. Red Crosses were painted on the sides, funnel and some horizontal surfaces, which were also painted white, as were the mast and funnel. A Satellite communications system, MARISAT, was installed and set to work in 36 hours, since ambulance ships are forbidden to carry 'secret codes' and all signal traffic to and from Hecla was to be unclassified. The ship's medical staff was increased by one Surgeon Lieutenant and three medical ratings and finally, shortly before sailing, a hastily assembled ship's flight and Wasp helicopter were embarked. Hecla sailed on 20 April for the South Atlantic, under the unfamiliar colours of the Union Flag – a further requirement of the Geneva Convention.

Passage was made via Freetown to embark fuel and water and Ascension Island where a number of urgently needed stores were collected. During the lengthy passage, there was much concentration on bringing the ship to a high state of readiness in flying operations and damage control and also in training about 70 of the ship's company in first aid and basic nursing care so that they could assist the small medical staff in looking after casualties.

Junior rates dining hall, HMS Herald, converted to bunk space for patients being evacuated from the Falkland Islands.

Hecla reached the Total Exclusion Zone (TEZ) around the Falkland Islands on 14 May to rendezvous with the main hospital ship *SS Uganda* who had been converted from an educational cruise liner in 48 hours by Gibraltar Dockyard. The hospital ships remained in clearly defined small areas known as Red Cross Boxes (RCB) diverting as ordered. A short period of relative inactivity followed, during which *Hecla* and *Uganda* carried out mutual flying exercises to test each other's arrangements for casualty reception. On 16 May, Hecla became the first ocean survey ship (OSS) to refuel at sea from a tanker, using a ship-designed rig, which, though untested and unorthodox, proved effective. On 18 May, *Hecla* was ordered to proceed at full speed to a rendezvous with the Task Group about 100 miles NE of the Falklands. Here 24 Argentine prisoners, 11 of them wounded, who comprised the crew of the *Narwal* which had been sunk a few days previously, were embarked for transfer to *Uganda*. Returning to the RCB on 20 May, Hecla and Uganda were joined by *HMS Hydra* and then, on 26 May, by *HMS Herald*.

On 28 May, *Hecla* embarked the first of the casualties considered fit enough to be moved to Montevideo to be repatriated to UK by RAF VC10s equipped as Air Ambulances. Having landed the casualties and embarked about seven tons of medical stores for *Uganda*, 13 medical staff, including three Naval Nurses, also for *Uganda* and six members of the International Committee of the Red Cross (ICRC), Hecla made a fast return passage to the RCB.

Thus started the pattern of the three ambulance ships in turn carrying wounded servicemen between *Uganda* and *Montevideo*. *Hecla* made two further trips to Montevideo, carrying a total of 178 casualties, including – in the second group – 40 Welsh Guardsmen who had suffered severe burn injuries during the attack on *RFA Sir Galahad*. On each visit to Montevideo, several more tons of medical stores urgently required by *Uganda* and the field hospital ashore were embarked. During one of the transfers in Grantham Sound, *Hecla* also landed two portable generators, normally used in Hi-Fix camps, to improve the lighting in the field hospital at Ajax Bay.

Hecla finally left the Falkland Islands on 29 June, after first embarking 33 medical personnel, who were to take passage to Ascension Island before being flown home from there. Ascension was reached on 11 July and Gibraltar on 22 July, where all the stores, and survey data and records, landed for safe-keeping in April, were recovered. The final leg of the long passage home was made in perfect weather and the ship entered Devonport on 29 July to a most moving and unforgettable welcome from a large crowd lining the Hoe and manning the ships passed during the passage up the Hamoaze.

HMS Hydra

In April, *Hydra* was ordered to join the Falklands Task Force as an ambulance ship. Before she could sail on 24 April, in company with *HMS Herald*, a Replenishment at Sea position had to be fitted, the ship painted white with red crosses and the starboard engine replaced.

After the passage to the South Atlantic, *Hydra* joined *HMS Hecla* and *SS Uganda* in the Red Cross Box about 45 miles north of Falkland Sound on 19 May. During the conflict, *Hydra* made four trips to Montevideo with a total of 251 casualties for repatriation.

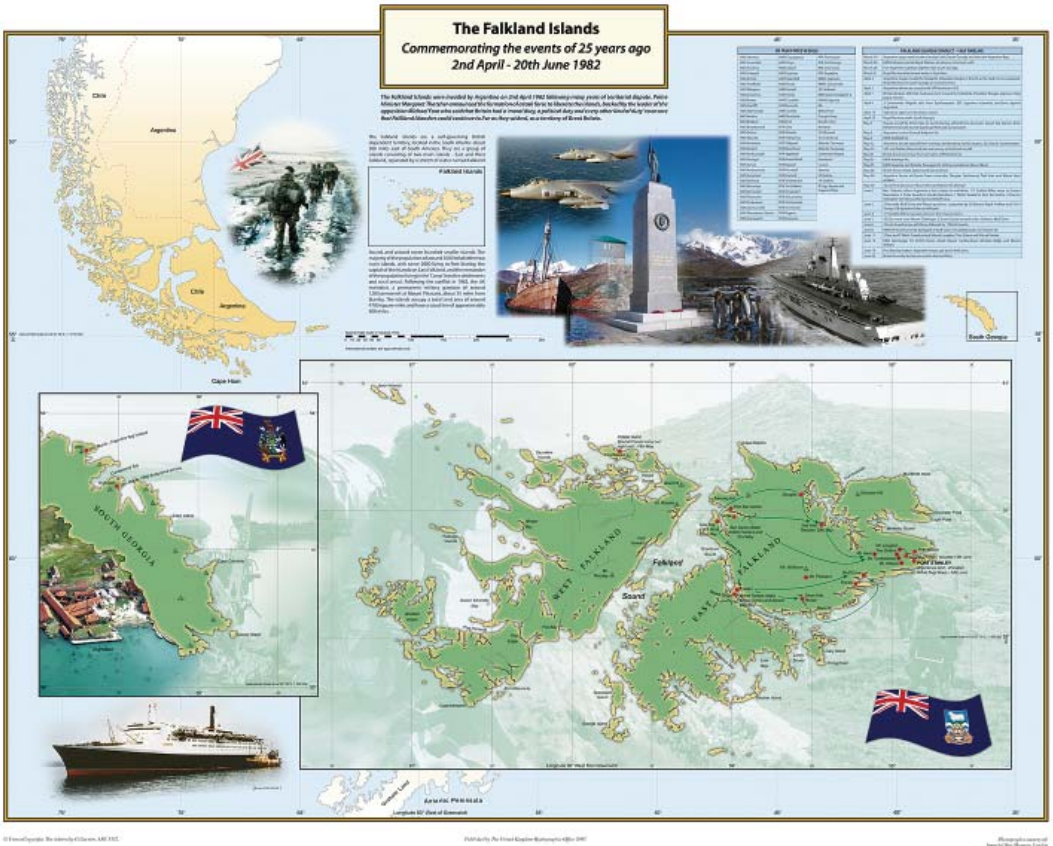
HMS Herald

The majority of the ship's company was recalled from leave when the decision was made to sail the ship to the Falklands. After conversion to an ambulance ship, *Herald* sailed on 24 April in company with *HMS Hydra* after only 17 days alongside. The next four weeks were spent on passage, with the briefest of calls at Freetown for fuel, Ascension Island for mail and stores, and Rio de Janeiro to land a seriously injured rating. During the passage, the ship's company were given intensive training in first aid, the dining hall was converted to a hospital ward, and the wardroom cleared for use as a casualty reception area.

Herald arrived off the Falklands on 26 May, joining *SS Uganda* and HM Ships *Hecla* and *Hydra*. 60 casualties were embarked on 8 June and transported to Montevideo. After landing casualties and embarking food and mail, *Herald* returned again to the Falklands, taking on a further 100 casualties from *Uganda* on 19 June. After an overnight stay in Montevideo to land the wounded, a number of whom were stretcher cases, passage was made back to the UK, calling at Ascension Island en route. The Hydrographer of the Navy, Rear-Admiral DW Haslam CB OBE visited the ship arriving at Portsmouth on the following day to a moving and unforgettable welcome.

The Falkland Islands
Commemorating the events of 25 years ago

The United Kingdom Hydrographic office has produced a poster to mark the 25th Anniversary of the Falklands conflict. The poster shows the geography of the events 25 years ago in 1982 when these British islands were invaded by Argentina. The major events of the conflict are shown in a timeline and the ships of the task force are also listed. The photographs included in the poster are courtesy of the Imperial War Museum (London), The Falklands Islands Tourist Board, *HMS Endurance* and Lt Cdr Forester-Bennett RN. The poster is available direct from the UKHO webshop - www.admiraltyshop.co.uk. The price is £9.95 plus postage.



The Admiralty Collection ®

Sound Ranging in the Great War - A Study in Innovation on the Battlefield

By Stephen Young, SELEX Sensors and Airborne Systems Ltd

None of the work that follows is my own. It is merely a compilation of the excellent work of the authors acknowledged at the end. By bringing together extracts from their collected studies, I have tried to present a story of how sound ranging developed in the British Army between1915 to1918, and to emphasise the tremendous innovation and lateral thinking that prevailed at the time. The facts contrast somewhat with the contemporary view of the British Army of the era.

The British Artillery in 1914

Although Field Artillery Training 1914 stated that *"Indirect laying is the normal method employed in the field"*, the British had been slow to learn from the experiences of the Russo-Japanese war of 1903-5 where such methods had been used widely. In particular, there were no gridded maps available in the first months of the war and methods for ensuring guns fired parallel were largely undeveloped in the Army.

Survey was largely unknown in the artillery and viewed with suspicion by most. Methods had been developed for firing indirect but the idea that guns should fire parallel and "to the map" was unknown.

Targets that could not be seen were pointed out by aircraft, either rarely equipped with radio or, by dropping smoke over the target which could then be observed and fixed by resection, or by dropping notes onto the firing battery position. Since the early maps were inaccurate, the positions indicated were often of little value in themselves but allowed fire to be corrected onto the target by the air observer. The process of resection onto smoke dropped from aircraft and the advances made by naval and coastal artillery in range finding and prediction, led to the formation of Flash Spotting sections which were reasonably effective in good visibility and especially at night.

Developments Abroad

In October 1913, Captain Lowenstein, who may have been Austrian but was serving in the German Army, had taken out a patent to cover the location of sound sources using comparisons of the time of the event from at least three different locations. The German army used this concept in late 1914 and succeeded in locating an allied gun south of the La Bassée canal, but they were hampered by being slow to develop the means of automatically recording the events for analysis.

The French were working on the problem and Professor Esclangon wrote to the Minister of War on the subject but received no response. Professor Nordmann, on the other hand, spoke to his CO, one Lt Col Robert Nivelle, on the subject and was sent to Paris to brief General Painlevé and gain support for experimentation. Nordmann impressed the committees in Paris and was allowed to conduct live experiments. Within four days he had succeeded in accurately locating guns firing blanks and was sent back to the front to continue his experiments.

At the same time, he was put into contact with Lucien Bull, the Irish sub director of the Institut Marey, who had been using an invention called the string galvanometer in electro cardiographic research. The galvanometer had been invented in 1902 by a Dutchman called Einthoven. Bull improved the design, at first by incorporating three strings into the system and later six. Working for Bull was a man called Bocquet who was experimenting with recording electrical signals on a smoked cylinder. His system was eventually taken into service in the French Army and Bocquet seems to have joined the British Army at some stage and served with the Royal Artillery.

Also about the same time, a Captain Rougier was experimenting with a system using observers with stop watches recording the sounds of guns firing and sending a signal using a clicker to record the time of the event. This system was seen and dismissed by the British because human reaction times are not quick enough to capture the exact times necessary to make sound ranging effective

The British View

Eventually the British woke up to what was going on, mainly due to the insistence of a Colonel Hedley who, having visited Paris, went to GHQ and gave a verbal briefing to senior Generals there. They authorised the setting up of a Committee of three officers, Major Winterbotham RE, Captain Lefroy RE, and Major Dreyer RA and sent them in May 1915 to Paris to investigate. Major Dreyer

Figure 1: The Flash Spotters and Sound Rangers Conference Bapaume summer 1917.
Back Row L to R: Capt RW James, ?, ? Holland,? ,? Lynch(Canada), Halford, Howard, Edwards(Australia), RC Peach (Salmon gives one name too few).
Front Row: Capt WR Darwin, Hunt, Newbold, Winterbotham, Russell, Anderson, Marsden, Michaelis, Copeland.

quickly returned to GHQ, saying that artillery had nothing to gain from such tomfoolery but the RE officers stayed on and published a report which opined that there might be something in sound ranging and that the Bull system was the best. They were sent to see a French system at Vosges and their second report confirmed the first.

The Experiments Committee held things up saying *"the method had not yet reached a sufficiently practical stage"*, rather a strange assertion for an experiments committee. After considerable protest at this, they agreed to fund the purchase of one system which was ordered in June for delivery in October 1915. Authority to form an experimental sound ranging section was not received until 12 September, although Lieutenant Willie Bragg, who was to lead it, had arrived in France on 31 August 1915. Willie Bragg was an interesting character. He actually won the Nobel prize for physics in 1916 for his work with his father in X ray crystalography and he was to be one of the key sound rangers of his time and was ultimately responsible for putting together the British Sound Ranging system.

At that time, the British military attitude to science and technology in war was ambivalent. The military thought that the scientists were far too visionary and gadgety to be of any help in the field. The scientists could not understand why their brainwaves and ideas, which seemed to them such war winners, had no appeal to the military mind. The effect of this upon technically qualified soldiers can be seen from what happened when seeking recruits for sound ranging; Bragg only had to ask for a parade at the depot and say *"Bachelors of Science one step forward"* to get a generous response of eager aspirants to some job at which their knowledge could be used.

The effect of concentrating such excellent scientific talent was to produce a brand new revolutionary working system by practical experiment in the chaotic and adverse conditions of the Western Front battlefield. The picture at Figure 1 highlights some of the brains involved. In the centre is Winterbotham, never a sound ranger but sharp enough to see the potential in the fledgling science that the French were using and very heavily involved in Flash Spotting. On the left we have Captain WR Darwin; next to Winterbotham, Russell; and one right of him Ernest Marsden. They were all key scientists who had been working with Rutherford before they joined up.

Sound ranging conferences were held monthly from the beginning of 1917 and they were very important affairs not only because they were a chance for the officers to get together socially but

also because experimentation was taken very seriously. The nature of the men working in sound ranging at the time made them all researchers and they were all involved in experiments of one sort or another to try to improve the function of the equipment or the tools available for processing results.

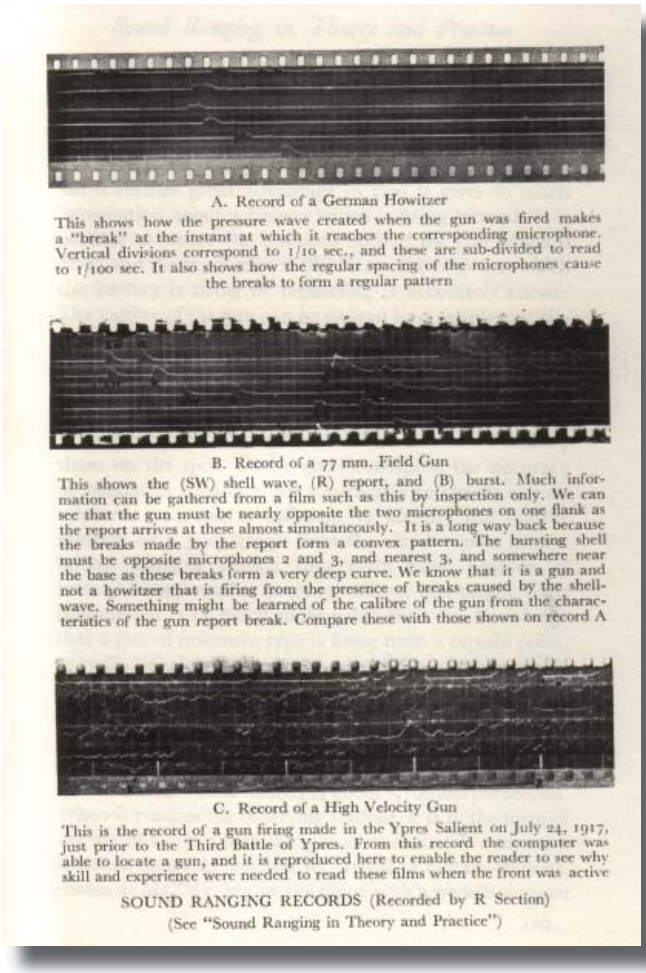
At the conference on 17 January 1918, for example, matters discussed included Lieutenant Gibson's machine for amplifying corrections, Captain Bocquet's device for photographing time on films (he was the Frenchman mentioned earlier working in the Institut Marey at the beginning of the war), Lieutenant Green's machine for representing the position of characteristic breaks on film and Major Bragg's mechanical plotter for converting sound ranging results into target grid corrections for British Gunners.

Sound Ranging Equipment in the Great War

The Einthoven galvanometer was being used by Lucien Bull at the Institut Marey for recording heartbeats. It weighed 150 lbs and had one string. When approached by Professor Nordmann in October 1914, Bull and his mechanic, one G Kelsen, managed to lodge in the narrow magnetic field of his huge instrument three strings instead of one. After the successful experiments Nordmann carried out in Paris using this equipment, Bull constructed a small galvanometer which incorporated five and later six strings.

Bragg first saw the device when he visited Vosges where a Bull section was installed in a ski lodge under a Captain Schultz who was to instruct in the running of the apparatus. It was so quiet a sector, however, that not one enemy gun fired during the two week training. A French battery nearby used to spread their washing on the gun emplacements, removing it quickly if there was a rumour of an enemy plane!

Outside the sound ranging field, Bull's galvanometer was also successfully used to calibrate guns by attaching the system to two wire screens and measuring the time of passage of shot through each down to 1/25,000th of a second.



A. Record of a German Howitzer

This shows how the pressure wave created when the gun was fired makes a "break" at the instant at which it reaches the corresponding microphone. Vertical divisions correspond to 1/10 sec., and these are sub-divided to read to 1/100 sec. It also shows how the regular spacing of the microphones cause the breaks to form a regular pattern

B. Record of a 77 mm. Field Gun

This shows the (SW) shell wave, (R) report, and (B) burst. Much information can be gathered from a film such as this by inspection only. We can see that the gun must be nearly opposite the two microphones on one flank as the report arrives at these almost simultaneously. It is a long way back because the breaks made by the report form a convex pattern. The bursting shell must be opposite microphones 2 and 3, and nearest 3, and somewhere near the base as these breaks form a very deep curve. We know that it is a gun and not a howitzer that is firing from the presence of breaks caused by the shell-wave. Something might be learned of the calibre of the gun from the characteristics of the gun report break. Compare these with those shown on record A

C. Record of a High Velocity Gun

This is the record of a gun firing made in the Ypres Salient on July 24, 1917, just prior to the Third Battle of Ypres. From this record the computer was able to locate a gun, and it is reproduced here to enable the reader to see why skill and experience were needed to read these films when the front was active

SOUND RANGING RECORDS (Recorded by R Section)

(See "Sound Ranging in Theory and Practice")

Figure 2: Sound Ranging record

Despite having excellent recording equipment in the Bull galvanometer, not everything was working so well. The original microphones were useless for locating guns although, under ideal conditions, they could locate howitzers. The Paris Rome microphones were excellent at recording traffic noises, rifle fire, people talking near them, dogs barking and everything except for the low muffled boom of a gun firing! They were very sensitive to shell wave, the sound of the shell in mid trajectory moving faster than the speed of sound but that is not what needs to be recorded to locate the gun which fired it. The microphones were so sensitive to this, however, that it blotted out the sound of the gun firing, so no location could be made.

The French tried to get over this by constructing forms assumed by the shell wave for each type of gun but this did not really work. Not only did every gun type require a different set of curves but they differed according to range and direction of fire. It was all too complicated. What was needed was a microphone that could selectively respond to the right kind of noise.

The solution came in stages. First it became clear that while the gun report was relatively quiet to the ear, it was associated with large pressure changes. It rattled windows.

The British experimental sound ranging section was billeted in a farmhouse in La Clytte near Ypres. It was a usual Belgian farmhouse with a privy in an annexe

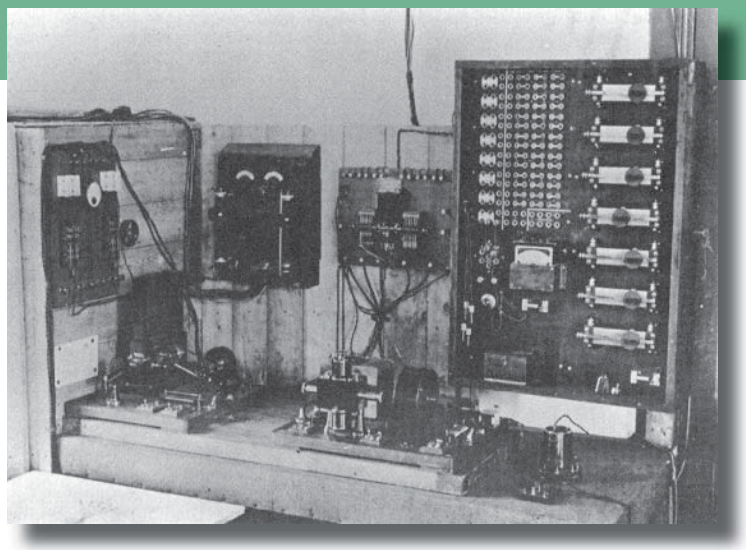


Figure 3: Einthoven Galvanometer: an example is held by the Science Museum at Wroughton.

opening out from the kitchen with no external doors or windows. As all the other windows in the farmhouse were hermetically sealed, the only aperture open to the outside world was the toilet. When sitting on it, the deafening shell wave of a 6-inch gun firing overhead would leave the sitter undisturbed but the faint gun report that followed had a lifting effect on the posterior. The rest of the solution was found later on when the section moved to Kemmel Hill. Here they were joined by a Corporal Tucker who had just left a post in the Physics department of Imperial College London. In the wall just beside his camp bed were 2 small holes, probably made by mice, and he noticed that the gun pressure wave caused a freezing jet of air to play on his face every time the pressure wave arrived. He had been making experiments on the cooling of a hot thin wire by an air jet and he had the inspiration to make a microphone embodying this principle. A thin wire was stretched over a small hole in a container, empty rum jars were very convenient and easily obtainable, and heated electrically. The gun wave cooled it and lessened the electrical resistance and the galvanometer recorded the effect.

However, there was a difficulty with protecting the microphones from the fluctuations in pressure due to wind turbulence. Solid windshields made matters worse because they increased the turbulence. A solution was found by using multiple sheets of camouflage netting. The gusty wind was turned into a smooth flow, rather like holding a piece of gauze under a tap. The information provided on the films shown in Figure 3 also enabled sound rangers to classify the type of weapon that fired the round. This could be done because both the gun firing and the target it was firing at could be located and known and the time of flight calculated. Finally, they could visit the area of impact after the event and dig out the fuse!

One of the most ingenious devices that was of critical importance was the use of a regular microphone base. This meant that microphones were placed at absolutely equal distances on the arc of a great circle facing the enemy line. The advantage of this was that the breaks on the cine film are recorded in a regular pattern making it possible to work even when a lot of guns were firing. This phenomenon was the result of work done by the Australian sound ranger Lieutenant Joseph Alexander Gray, an associate professor of physics at Montreal University, in association with Lieutenant Lloyd-Owen. Lloyd-Owen was the first to use straight lines at Armentieres but later the regular arc became standard.

The microphone positions were fixed by surveyors correct to one metre, and it was this and the laying of line from microphones to the HQ galvanometer that were the most time consuming elements of bringing a sound ranging apparatus into action. Mobile operations were a feature from early 1918 and these were achieved by training one officer in each section in survey techniques. The problem was now communication rather than survey and this was not to be solved until after WW2 and the introduction of radio instead of line.

Another experimental technique that was successful and resulted in increased accuracy of sound ranging was the wind section. Once again, J A Gray made a main contribution. Wind and temperature corrections were always troublesome if they were deduced from meteorological data because both varied so much with height and local contours. Upper winds and temperatures were much the same across the whole front. A wind section was a sound ranging section deployed behind the lines which recorded reports from a known position. A pound of explosive was set off every few hours and the sound recorded by microphones in a circle at about the same range as the enemy guns. Since the position of the explosion was known, one could measure the extent to which the wind and temperature had affected the readings and so circulate to the sound ranging sections in the line the required corrections. Targets more than 12,000 yards away could not be accurately located by a single sound ranging apparatus. However, it could give a bearing to the sound source and when a number of bearings from sound ranging sections were plotted; ranges out to 20,000 yards could be achieved.

Conclusion

The effectiveness of the sound ranging experiment in the two years of "in service in action" experimentation can be seen from the points below:

- 4th August 1914 - No Sound Ranging in service
- 7th June 1917 - The Battle of Messines Ridge

"We were preparing some time for that battle and one of the most important things we had to do was locate every German gun … There were hundreds of German guns in front of us and … we got onto the German guns and knocked them about so badly they gave us very little trouble indeed during the battle.

After the battle … we went over all those German battery positions and compared them with the records which we had worked out and mapped … and we found on comparing results with what we could see on the ground that we had got over 90% of the German guns absolutely correctly located. And … where there was a doubt about the position of a battery, ***in every case the sound rangers were right ..****"*

Major General Franks, Divisional Commander at the Battle of Messines Ridge.

Acknowledgements:

Artillery Survey in the First World War published by the Field Survey Association.

Flash Spotters and Sound Rangers - How they lived, worked, and fought in the Great War by John R Innes (see advertisement in this issue)

Artillery's Astrologers - A History of British Survey and Mapping on the Western Front 1914 – 1918 by Peter Chasseaud.

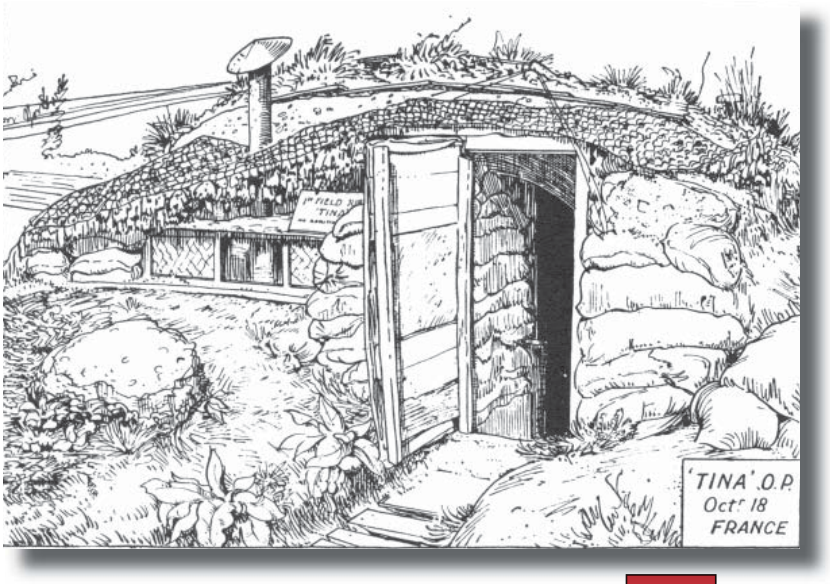
Flash Spotters and Sound Rangers

How they lived, worked and fought in the Great War

By John R Innes

This book is an absolute must for every Sapper and Gunner Surveyor for it tells, in 'first hand' words, the story of our predecessors who served in the mud and terror of the Western Front.

The book is in two parts, the first recounts the development of survey support for the artillery from the small handful of Sapper surveyors in 1914 to the over 6,000 serving by the time of the Armistice in 1918. In easy to read language, the book explains the first uses of scientific methods to locate the position of enemy guns and the growing complexity of the systems until sound ranging reached the point where it could differentiate between the various types of gun used to bombard the trenches.



However, it is the second part that makes the most gripping reading as this is a collection of descriptions, written only a few years after the event, by Flash Spotters and Sound Rangers of all ranks telling the story of their everyday life in the trenches.

The book was reprinted in 1997 by Mike Nolan. Copies can be ordered from Mike on 01635 253 167 or maptnolan@googlemail.com.

Lawrence Bragg's Role in the Development of Sound-Ranging in World War I

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William Lawrence Bragg (later FRS) enlisted in a Territorial Force formation, King Edward's Horse in 1909, shortly after he came up to Trinity College Cambridge to read mathematics. They were mounted infantry, which had been found useful during the Boer War, so they learned musketry and horses. The Horse had been established specifically for training men from the Colonies. Bragg thought that it would be an agreeable way to become acquainted with men like himself: strangers slightly out of place in the ancient university – it was a long way from Adelaide, Australia, where he had grown up. Within weeks he had many friends in the University and felt quite at home; still he found the Horse sufficiently agreeable to recommend it to his younger brother Robert Charles – Bob – who came up in 1912. Bob also enlisted. Every year during the long vacation they went off for manoeuvres. Bragg completed his service in the Horse and was discharged in November 1913.

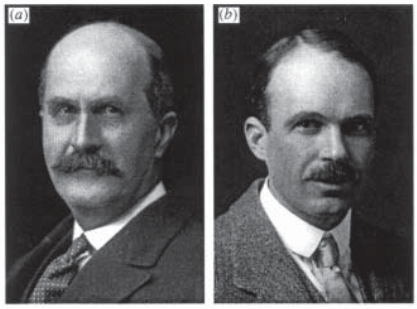
Bragg had taken a First in Part II Physics in 1911. He then started at the Cavendish Laboratory, measuring the velocity of ions in various gases. Despite its renown the facilities were scant, and because of its renown it was jammed with students. It was hard to get things done. Each student had to fabricate needed apparatus. Often glass had to be blown. There was a single foot pump for 40 students, so I was difficult to get to use it. Bragg recalled, 'I was able to sneak it once from the room of a young lady researcher when she was temporarily absent, and passing her room somewhat later I saw her bowed over a desk in floods of tears. I did not give the foot pump back.'

When war broke out in August 1914 Bragg was grateful for his military training. While his friends were frantically trying to join up, Bragg was commissioned as a Second Lieutenant in the Leicestershire Royal Horse Artillery on 26 August. In the French field artillery there was a tradition of serious interest in guns, but in the British and German services the focus was a hauling them into action at a gallop, and then firing over open sights. Tables of logarithms were seldom consulted. It was not Bragg's element. '…my knowledge of horses was not at all extensive and my fellow officers and men were Leicestershire hunting enthusiasts'. The training was monotonous and repetitive, and so was the officer's mess, with seemingly endless discussions of stifles; the months dragged by while they languished far from the front.

Escaping from horses

Out of the blue in July 1915 Bragg was ordered to report to Colonel Coote Hedley, a Royal Engineer (RE) and head of the Geographical Section of the General Staff in London. Hedley told him that on a visit to France he had learned that the French were working on a method to pinpoint the position of German artillery pieces by the sound they produced. Distrusting memoranda, Hedley went directly to General Headquarters (GHQ) in Flanders to buttonhole those in charge about the possibilities. There was 'much apathy and some opposition', but he won. GHQ set up a committee of three, experts on artillery, electricity and topography, to evaluate what the French were doing. The French were exploring three methods: first, having observers at widely spaced points, to measure the interval between a gun flash and hearing the sound with a stop watch; second, to place microphones along the front and record their output on moving smoked paper; and third, to record the output from the array of microphones with a string galvanometer, which the French called the 'Bull-Weiss system'. The committee thought the Bull-Weiss method the most promising. GHQ was not convinced. The committee was sent back to see the methods in action. Again they recommended the Bull-Weiss method. Their recommendation was forwarded to the Experiments Committee at GHQ, who rejected it because it had not been shown to work. The head of the topographical sub-section at GHQ, Lieutenant Colonel Ewan Maclean Jack RE, would not let the matter rest. 'After some discussion' the committee's report was rescinded and a string galvanometer was ordered from Bull. It would be delivered in October 1915.

Now they needed an officer who knew something about sound and electricity to put the method into operation. Would Bragg be interested? Indeed he was. Bragg left the interview overjoyed with his liberation; it made him 'walk on air'. He was seconded for special duty on 19 July, to the topographic sub-section – which was known even on official documents as 'Maps GHQ'.



The Nobel laureates in Physics 1915. William Henry Bragg (left). William Lawrence Bragg (right)

I do not know how Bragg was chosen for the job, though there is no doubt about his credentials and they could not have found a better man. That year he and his father, William Henry Bragg, who was then Professor of Physics at Leeds, had published their book *X-rays and crystal structure*. In May 1915 father and son were jointly awarded the Barnard Medal of Columbia University, given at five-year intervals, which was reported prominently in *The Times* as an 'American Medal for British savants.'

He went over to Paris for a briefing by the French on what they were doing. A leading spirit was Charles Nordmann, a Professor of Astronomy from Paris, who had the idea while serving at the front in 1914 and had obtained permission to give it a try. He teamed up with Lucien Bull, an Irishman at the Institute Marey, who had been making 'string' galvanometers to record the electrocardiograph. The string in the galvanometer was a fine wire that ran through the gap in a powerful magnet. When an electrical current flowed through the wire it moved in the magnetic field. The wire's shadow was recorded on a moving strip of photographic film. For the sound-ranging enterprise Bull increased the number of strings; now they were inserting six. From Paris, Bragg travelled up to GHQ to report to Colonel Jack.

In the first months of the war Maps GHQ was a tiny operation. The army expected a short war; they had excellent Belgian maps on hand. They had only two surveyors with theodolites to take bearings on smoke bombs that British aircraft would drop over German batteries. When the Army settled into trench warfare, Maps GHQ expanded to provide the detailed maps that were needed for France. Since then they had started to use flash-spotting to pinpoint German guns. Now they would add sound-ranging. Jack authorized Bragg to go to England to sign on another officer to help out. Bragg decided on a newly commissioned Second Lieutenant: Harold Roger Robinson (later FRS), of the Royal Garrison Artillery. He had been working at Manchester University on β-rays emitted from metals struck by X-rays.

Early in September they travelled together to the front in the Vosges Mountains, where the French were working with their apparatus. It was a peculiar introduction to battle. During their first two weeks not a single gun on either side was fired. Things were so quiet that the French used their gun emplacements to lay out their washing. Finally German guns fired. The sound-ranging sometimes gave a position for the gun, but usually they did not have any other evidence that it was where deduced. In October Bragg and Robinson picked up the heavy galvanometer in Paris and hauled it by lorry up to the Fifth Army area in Flanders, where they were to start operations. Carbon-graphite microphones and wire came from Britain. The unit had been expanded by the addition of a lorry with driver and mate to carry the massive galvanometer, one lineman and one NCO, and two drivers of Singer cars for the use of the two officers. Bragg had escaped from the horses.

News from home

Then Bragg had bitter news. His brother Bob died of wounds on 2 September at Suvla Bay on Gallipoli, serving as a Second Lieutenant in the Royal Artillery in the 11th Division. Their sister, Gwendolen, eight years old at the time, described how the news reached her at the family home near Leeds: 'But one morning as I was standing by the shallow stone sink in the kitchen, looking out into the garden, my father unexpectedly passed the window, came in, said to me quickly in a low voice "Bob's gone" and then went upstairs to my mother. I heard her cry out.' Soon thereafter Bragg heard that his closest friend from Trinity College had been severely wounded; he died two years later.

Better news came in a later letter from father. On 12 November 1915 they had been jointly awarded the Nobel Prize in physics. Bragg was the youngest laureate ever and they were the only father/son team ever to share a prize. When he received this news he was billeted in the home of a Curé, who proffered a bottle of *Lachryma Christi* in celebration.

The basis for the award was the 'reflection' idea that had come to Bragg one day in 1912 when he was walking the backs along the river Cam. His insight led to the Bragg equation, the elucidation of the nature of X-rays, and the use of X-rays in determining chemical structures. Bragg and his father remembered it as '…a glorious time when we worked far into every night with new worlds

unfolding before us in the silent laboratory'. In his Nobel lecture, which he finally delivered in 1922, Bragg suggested, 'there seems to be hardly any type of matter in the condition of a true solid which we cannot attempt to analyse by means of x-rays'.

The prize also helped to ease Bragg's feeling towards his father, which had been shaken during their collaboration, as we know from his own testimony in later life. Father had reported some of their joint work in two letters to *Nature* that gave credit to 'my son' for the equation but did not even give his name. In 1913 father had been invited to the Second Solvay Conference, along with Einstein, Laue, Rutherford and other luminaries of international physics. In his presentation father described his son's results, giving him the credit. Einstein and other distinguished attendees sent Lawrence a postcard of congratulation. Lawrence felt that his father had been unjust in not permitting him to describe his idea first. Father had acted unthinkingly, not maliciously, and subsequently went out of his way to make amends. Still the incident was '… remembered 60 years later with pain'. Surely this contributed to Bragg's lifelong vigilance to see that credit was always given where due – a key element in his successes as a scientific administrator.

A usable Microphone

Sound-ranging was not working well. They located their first enemy in gun in November 1915, but successes were rare. The firing of a cannon produces very-low-frequency sound waves: a field gun booms at 25 Hz, and larger artillery pieces produce sound at 10 Hz. The diaphragms on their microphones scarcely moved in response to such low tones, and hence the signal recorded by the string galvanometer was almost undetectable on the photographic film. It was especially frustrating because there was abundant energy in the sound waves from the guns. In Bragg's billet in Flanders the latrine was in a small window-less chamber off the kitchen; when the door was closed the only opening to the outside was beneath the seat. Every time that a British 6-inch gun fired from its emplacement about a quarter of a mile away, Bragg's bottom was elevated perceptibly off the seat, even though often he heard nothing at all. They needed a detection system sensitive to low frequencies. Another problem was that high-velocity guns made two sounds, a loud 'shell-crack' generated when the projectile breaks the sound barrier – loud, but useless for accurate gun location – followed by the dull, barely audible boom, the 'gun-wave'. The microphone diaphragm was still vibrating in response to the crack when the boom came, so the boom could not be distinguished on the film. They called this 'washout'. In contrast, the microphones were all too sensitive to rifle shots, buzzing insects, nearby bad language and the like. They did not solve this problem for months.

Nonetheless, Colonel Jack, with his 'unfailing kindness and gaiety', thought the results 'just satisfied requirements', so he started up additional sections. Bragg was authorized to attend unit parades, where he would order: 'all Bachelors of Science step forward'. He would pick the most likely, who usually were willing to volunteer and more than satisfied after they joined up. Like any research group, Bragg's outfit had periodic meetings to thrash out successes, failures, bits of gossip, and so on, followed by what Bragg described as a 'binge of heroic magnitude'.

Each sound-ranging section had 3 officers and 18 others: 1 Sergeant, 1 instrument repairer, 1 photographer, 3 linemen, 2 telephonists, 3 forward observers, 3 batmen and 4 motor transport drivers. The first was designated 'W' – presumably for 'Willy', as Bragg was generally known in the Army as he had been in the family. Bragg was promoted to Lieutenant, 'to remain seconded', on 20 June 1916, and appointed 'Acting Captain whilst holding a special appointment' on 3 September 1916. At first the new men were trained by Bragg at his section. As the expansion continued he set up a school at Merlimont-Plage, 25 miles south of Boulogne. The sound-ranging sections were incorporated into Field Survey Companies, which also included flash-spotters and topographers. Each Army had a Field Survey Company, but remarkably they were all commanded by Maps GHQ. By the end of the war the Field Survey Battalions had 5000 men. There were Companies in France, Italy, Salonica and Palestine.

The sound-rangers worked closely with flash-spotters, who used a flash board devised by Lieutenant Henry Harold Hemming. It eliminated observer suggestibility. When they started to locate a gun each post heard a buzzer when the lead observer had seen a flash. If they had also seen a flash they buzzed also. When all posts were buzzing together, the buzzers to the posts were cut off. If the controller still received simultaneous signals from all observers he knew that they were on the same target. Bragg helped with the electrical implementation of the flash board and he and Hemming – a

Canadian – became friends and collaborators, which was especially useful when the Germans took to setting off false flashes that made no sound.

The microphone problem was solved by Corporal WS Tucker, who had studied physics at Imperial College, London. During the winter he slept in a tar-paper shack. There was a hole near where his head lay on his pillow. Now and again he was annoyed by a chill puff of air against his cheek – a pressure wave from a cannon. It reminded Tucker of an apparatus used to measure wind velocity. He passed the idea on to Bragg, who always gave Tucker full credit. Air currents were measured by taking advantage of the fact that cooling a wire raises its electrical resistance. To measure wind velocity a length of wire was heated by running an electrical current through it. The wire was one limb of a Wheatstone bridge. The voltage drop through the wire was balanced by adjusting a variable resistor in the opposite arm of the bridge so that no current flows through the galvanometer. If airflow cools the wire, the bridge is unbalanced and current flows through the galvanometer.

They tried it with a thin strand of wire stretched over the opening of an empty rum jar. It worked nicely when blown on. To do it properly they needed thin platinum wire. When proper wire came from England they picked up an empty wooden ammunition box, which were lying about everywhere. They ran the platinum wire the length of the box and drilled a hole in the cover for the pressure waves to enter. 'I will never forget the thrill of seeing the first record, in which the shell-wave hardly made the galvanometer string quiver, while the gun-wave gave an enormous kick'. Most other battlefield noises had no effect because they were higher frequency.

Still there were problems. Gusts of wind cooled the wire and distorted the recordings. They tried covering the hole in the box with wrappings. Most either blocked the air movement or did not stop the wind. Persisting, they found that wrapping the box in several layers of standard issue camouflage netting did the trick. Later in the war the Germans experimented with a similar detection system but they never solved the wind problem. Then there was an unexpected but more readily soluble problem. Small insects liked the warmth, but when they settled on the thin wire it would break. The answer was to put copper screening over the aperture to the box. To their amusement the screens officially became 'protector, Earwig, Mark I' on the army stores list.

Sound-Ranging in practice

They remained at the mercy of nature; no sound-ranging system would work well when the wind was blowing toward the German lines. As Bragg wrote, 'due to the "principle of maximum cussedness" the wind in Flanders and Artois was usually westerly'. Sound is thrown upward by a head wind, so it passes above the microphones. When the wind blows toward the observer, sound is deflected downwards and arrives with a 'sharp crest'. Misty weather was ideal: little wind and uniform temperature. Sound curves over hills and buildings, so they do not interfere.

They shifted the making of Tucker microphones to England. The manufacturers did a professional job, stringing the wires through neat metal boxes. The elegant apparatus worked poorly. Just as the performance of a high-fidelity speaker depends on its enclosure, by chance the ammunition box had just the characteristics needed. So there were no more metal containers. The first 20 string galvanometers were from Bull; after that they were made by the Cambridge Instrument Company.

The typical setup for a sound-ranging unit was to have six microphone stations and two observation posts in front of them. The observers would push a key when they saw a gun flash or heard a boom; their signal would turn on the film transport in the galvanometer. Each setup required about 40 miles of low resistance, well-insulated wire – of higher quality then telephone wire. The wires were run on stakes above ground, so they were exposed to destruction by enemy fire and to pilfering – Australians were considered a special menace.

The microphones were usually about 4000 yards behind the front line, along a 'base' of about 9000 yards. Eventually the microphones were spaced 'at absolutely equal intervals on the arc of a great circle facing the enemy line'. At first Bragg rejected this 'fussy and artificial ideal', which was a challenge to the surveyors, proposed by Lloyd-Owen and Gray. However, the advantage is that with this configuration the pattern on the film from the firing of a gun has a regularity that is readily recognized, so that a trained interpreter could pick out the deflections from a single gun when several were firing.

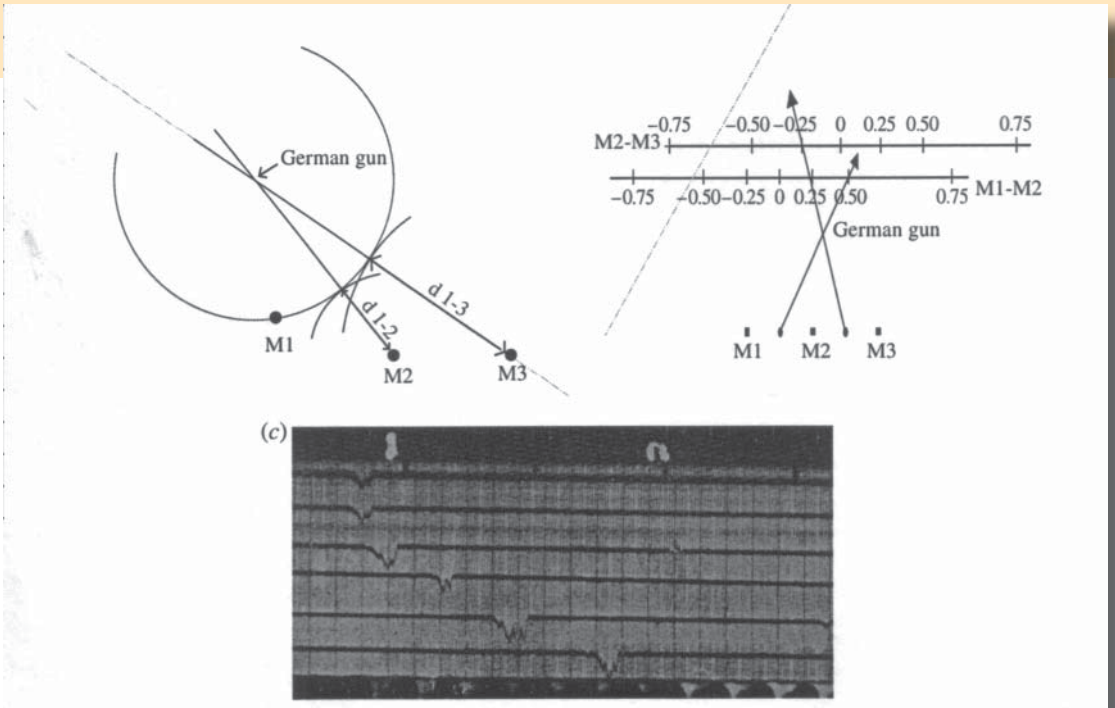


Figure 2. Sound-ranging. (*a*) The basis of the method. The sound first reaches microphone 1 (M1). From the difference in time required for the sound to reach M2 and M3 the distances are calculated that the wave travelled during these intervals. Arcs with these distances as the radii are drawn on the map. The position of the gun is calculated by determining the centre of the circle that runs through M1 and touches the arcs drawn from M2 and M3. (*b*) A simplified view of Bragg's method for ready computation of the gun's position. The arrows represent strings that the operator positions on the scales at the top according the time differences between the arrivals of the sound at each pair of microphones. The gun is where the strings cross. (*c*) A section of a string galvanometer recording of the signals from six Tucker microphones when a German gun fired. Time differences as short as 5 ms were determined from the records.[24]

Figure 2b illustrates how the position of a gun could be determined. The method is cumbersome, so in practice the method shown in figure 2c was used. It merely required the interpreter to position cat-gut strings fixed on a local map at the midpoints between the microphones onto a scale on the upper part of the map. The gun is where the strings cross. The accuracy was usually with 100 yards. Then the camouflaged gun position often could be pinpointed from aerial photographs. With time the analysis became more sophisticated. The records also showed the shell-crack from a high-velocity gun and there the shell exploded. From this information the calibre of the gun could be estimated. This could be verified by sending someone out to the shell hole to pick up the fuse from the exploded shell. Bragg pointed out that 'for determining the calibre of a fun "local information on this point is also useful, if one remembers to divide by two the estimate of the calibre formed by those on the spot from the explosion'.

Sound was also used for ranging the British counter-battery fire. According to Jack, 'An ingenious mechanical plotter was devised by Bragg whereby the necessary corrections could be supplied to our gunners in a very short time, in terms of yards short or over, minutes right or left.'

Their calculations required a value for the velocity of sound, which varies with air temperature and wind direction. At first they used tables to correct for atmospheric conditions. Later they fired charges at a position behind the British lines that was surrounded by a ring of microphones. From these measurements they could calculate the sound velocity at the time and also corrections for prevailing winds.

They knew that they were succeeding when a German order was captured: 'In consequence of the excellent sound-ranging of the English, I forbid any battery to fire when the whole sector is quiet, especially in east wind. Should there be occasion to fire, the adjoining battery must always be called on, either directly or through the Group, to fire a few rounds'. The joke was that the British knew that firing the additional guns would not bother their recordings in the slightest. When they captured German positions they found that they had failed to find less than 5% of the battery positions.

The Germans also worked with sound-ranging, but the best apparatus they developed relied on skilled listeners, who would try to get the bearings by auditory location from amplified signals. They could locate howitzers, but not high-velocity guns. They captured some of the British apparatus in an attack on 30 November 1917, but as mentioned above there were still problems they

could not solve. One of the physicists working on the German side was Max Born (later FRS), who was awarded a Nobel Prize in 1954. He wrote little about sound-ranging and seems to have given as much time as he could collaborating with colleagues in his unit on calculations of the internal energy of ionic crystals.

On one of his home leaves Bragg found that his father was working on underwater microphones to listen for submarines. Bragg pointed out that they might also be used for locating underwater explosions; the sound waves travelled much further under water. His idea was taken up and used in the seas around naval bases. Father's major contribution to the war effort was initiating an echo system for locating submarines (ASDIC).

For accurate firing, guns must be calibrated: the muzzle velocity must be known. Some of this was done at the front. Bragg measured muzzle velocity at a test firing range near the channel, where a test shot could be fired off to sea. The shell ripped through two webs of wire a known distance apart, generating an electrical signal that would be recorded on the galvanometer film, from which the velocity could be measured. Often the muzzle velocity was then painted on the gun barrel.

Sound-Ranging in British attacks

At Passchendaele in 1917, the artillery commanders overseeing the offensive insisted on pushing the flash observation posts up close to the line. Hence it was impossible for them to keep their phone lines working through the heavy German fire, and they were almost useless. The sound-rangers did much better. They located 190 enemy guns in the first 20 days of the British offensive. The British artillery fire smashed and cratered the Flemish countryside into a morass in which men drowned on their way up to face the German machine guns in their concrete pillboxes.

The achievements of field survey and the maturing of the British Army were brilliantly displayed on 20 November 1917 along the Hindenburg line west of the German-occupied city of Cambrai. The operation was proposed by the tank commanders Fuller and Elles as a raid. Surprise was crucial, there would be no advanced gun registration and no preliminary bombardment; the tanks would crush the German barbed wire. Then GHQ transmuted the raid into a breakthrough. At dawn the British guns unleashed an intense bombardment, with a majority of the shells falling on the German gun line. The German guns had been accurately pinpointed by the flash-spotters and sound-rangers. The British fire was effective because they could accurately set calibrated guns from map coordinates alone, because they had precise surveys of the positions of their guns and one or more precisely surveyed stakes or 'bearing pickets' in front of each battery, from which they set the angle on which to lay the gun. Each battery had an 'artillery board', a map with a string coming from the position of the gun. When the string was extended to the target the angle between the bearing picket and the target could be read from a scale. The German artillery was suppressed.

Then a barrage crept across no-mans-land; it consisted of one-third high explosive, one-third shrapnel and one-third smoke. The noise, the smoke and the heavy morning mist concealed the 381 tanks treading across no-mans-land toward the defenders. The Germans counted on their trenches to stop any tanks; they were 12 feed wide, which a tank could not span, but the British bridged them with bundles of brushwood. Most of the German infantry did not wait to confront the attackers; they hurried back to the second and third trench lines. The major problems that the attackers faced were a few anti-tank guns and their intrepid crews, dug in near the German front, which did not ordinarily fire and consequently were not on the British artillery maps. On the first day the British advanced two to four miles, sustaining about 4000 casualties. They took as many prisoners. The church bells rang in London.

The breakthrough was to be exploited by five cavalry divisions that Field Marshal Haig had allocated for that purpose. They failed in part because, as the British Official History, quoting an American, put it: 'You can't make a cavalry charge until you have captured the enemy's last machine gun'. The British artillery had to be moved forwards, and once there they were less effective because the new positions were not yet surveyed. The advance stalled. On 30 November the Germans launched a hurricane bombardment of the British positions, with many gas shells. Then came the counterattack, with storm troops in the van. They slipped through the weak points in the British line and fanned out into their rear. The Germans recovered most of what they had lost and even took part of the old British line.

The most spectacular demonstration of the capability of sound-ranging was locating a giant German gun firing at the Canadian troops on Vimy Ridge from the shelter of a woods 11 miles behind the lines. This was more than twice the distance that a section could detect. Therefore they used three sound-ranging sections, and by coordinating their records they managed to pinpoint the target.

Bragg and Hemming were transferred to GHQ in April 1918 to coordinate the work of all of sound-ranging and flash-spotting units. Bragg was 'appointed Temporary Major whilst specially employed' on 14 June 1918. One of their first improvements came when they learned that German fliers observing the fall of shot would issue the order to fire by wireless. When this order was received at the sound station the film transport was immediately turned on. The short length of exposed film was developed within 15 seconds and they could locate the gun.

The British attack on 8 August at Amiens came after a week of fog and mist that grounded air reconnaissance. The Germans spent the week shifting their artillery to new positions. The sound-rangers had followed their movements, so when the attack began it was Cambrai all over again, the German artillery was swamped by counter-battery fire, unable to stop the tanks that rolled forwards to tear through their wire. As Ludendorff said, it 'was the black day of the German Army'. But after the first surge forwards, the British did not repeat post mistakes. The infantry stopped at set lines, defended themselves against counterattacks, making only small, spoiling attacks, while the artillery moved up, was surveyed into their new positions and issued new maps. Then they were ready for the next surge forwards.

Conclusion

When the war ended, Bragg was a Major with the OBE and the MC; he had been mentioned in dispatches three times. Hemming was also mentioned in dispatches three times, had the MC and was also a Major, as was Tucker. Hemming's additional reward was £100 from the Board of Inventions and Research for his flash-spotting board. He found it a godsend for starting back in civilian life. Bragg had a complimentary review from the Board but no money.

Hemming became a successful banker. Jack retired as a Brigadier General and then for 10 years directed the Ordnance Survey. Histories of the Great War often mention outstanding German Staff Officers. On the British side, Jack deserves more attention. As he wrote, 'I think we are justified in questioning whether there is any branch of the Army which in proportion to the numbers engaged had a greater effect on operations'. Bragg continued his outstanding scientific work and also was an extraordinarily successful developer of scientific programs, using the administrative skills he had honed in the Army. In 1962 four Nobel laureates were named for work performed at the Medical Research Council Unit in the Cavendish Laboratory, which Bragg had formed, obtained funds for, advised, and cheered on. This was a conclusive demonstration of how correct Bragg had been with his idea that X-rays could be used to determine the structure of complicated molecules such as haemoglobin, myoglobin and DNA.

When the war broke out in 1939 Bragg was aghast to see the useless frills that had been added to the sound-ranging equipment, and set some backs up with his outspoken criticisms. Then he watched contentedly as they were discarded one by one.

Acknowledgements

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The Great War Memoirs of a Flash Spotter

By Bernard William Whayman

After the Con.*(sic)* Camp Training, I was sent home on leave, following which I rejoined the 3rd Battn. Northamptons at Fort Darland, Chatham for training of all kinds. I was one of a few men sent to the Brigade Signalling School at Belvedere Camp at Strood, across the Medway, and after several weeks I obtained a Certificate of Proficiency in this subject.

I left Fort Darland at 9.30 pm on 5 11 1917 in a draft of 150, and landed at Calais where we did 4 days of Gas drill, and were under canvas. We were apparently destined for the Cambrai front.

On November 11th the draft was paraded and I was fortunate enough to be one of five selected by a Staff Major of Royal Engineers (Field Survey Coys.) from Hqrs at Montreuil for training as a specialist in the section connected with Gunnery and Observation. The next day the 5 of us proceeded to Etaples for 1 night, and then on to G.H.Q. at Montreuil. We were instructed to march across country about 14 kilos and report at the "School of Observation" Merlimont Plage. After billeting in an empty chateau, we attended the "school" for lectures, and practical instruction for several weeks. At the end of the course I passed an exam and duly had my number, rank and cap badge changed on transfer to F.S.C. Royal Engineers.

I was then posted to the 1st Army front as a qualified Survey Post Observer. With 2 others, I was taken by lorry to Etaples and thence by train to Lillers for 1 night and thence to Army H.Q. at Ranchicourt. The 3 of us were sent to No. 8 Observation Group H.Q. at Vielle Chapelle, from there I was taken by "Maltese" Cart carrying stores etc., to the Observation Post billet, at Laventie in the "Bois Grenier" sector, and 6 miles S.W. of Armentieres (10 12 1917). This front, unlike the Somme was stationary since our earlier attacks at Neuve Chapelle, Aubers, and Loos had failed, and was held by 2 divisions of Portuguese troops with their own light field guns, the heavy guns being British R.G.A.

At this time the front was consequently "quiet", certainly after the Somme. Our post here "A" was near the top of the broken tower of the church and was manned by two of us by day and night. We billeted in an empty cottage minus some of its roof, and we comprised 1 Sgt, 1 Cpl and 6 Sappers, one acting as cook. Our post equipment was 1 Director of Fire instrument, with 3 eyepieces of different magnification, 1 binoculars, 1 chronometer, 1 field telephone and buzzer and 1 magnetic compass. We were connected by field phone with posts "B" at La Couture, "C" at Beuvry and "D" at Annequin, also with Group H.Q. at Vielle Chapelle.

Our first duty was the immediate location of active hostile Enemy Batteries by taking Grid bearings on the flashes or smoke puffs, which were phoned through to the Group H.Q. The N.C.O. operator there informed the other 3 posts and by a system of synchronization between posts, the plotting of the hostile battery position on the military map board by intersecting or trisecting grid bearings was established. All information about enemy activity, Working Parties M.G. and T.M.B. emplacements etc., had to be reported. Also we assisted our R.G.A. in the calibration of their guns, and co-operated with their counter battery office in aim correction on specific targets being shelled.

Our post being self contained regarding rations etc., we fared better than the P.B.I *(poor bloody infantry)*. and managed a fair Xmas dinner in the billet. At this time enemy shelling was spasmodic, but as the clock struck 12 on New Years Eve the enemy fires several thousand rounds including "mustard"-gas into Laventie and surroundings, and the Portuguese had casualties, but we were unhurt. The following night a retaliatory bombardment by our artillery took place. The Aubers Ridge in front of Lille was opposite both our "A" & "B" posts, and as we had height and a powerful instrument; we were able to locate and "fix" his guns, even though he constantly moved and camouflaged them.

On January 18th I was told to report at Group H.Q. at Vielle Chapelle, from where I was instructed to join "B" post at Lacouture; 1 mile towards the front. The O.P. here was in charge of a Corporal with 1 L/Cpl and 6 Sprs., and was situated inside the top of the spire of the church which remained almost intact, though the body and roof were damaged. Visibility inside the German lines was good here, and the villages of Fromelles, Aubers and Illies about 7 miles distant on top of Aubers Ridge especially so.

The spasmodic shelling of the trenches and back areas, also trench mortaring of the Portuguese who held the line here from Fleurbaix to Festubert suddenly increased in March, and we located a big increase in enemy guns opposite, and an enemy attack was anticipated, and any remaining civilians in the area were cleared out. We received orders in case of attack from our Hqrs Officer In Charge. Most of our heavy guns had been diverted to the German attack on the Somme on 21st March, and this front was almost denuded of artillery, except Portuguese field guns. Lacouture continued to be shelled and our post had near misses, 3 Observation Balloons were shot down behind us on March 13th, and bridges behind us were constant targets.

The attack against us opened on April 9th (Battle of Lys). We were lying in our blankets in our billet, when, at 4 am the enemy bombardment opened with terrific shelling with all calibres of projectiles on the village and beyond. The morning was warm with very dense fog, with little visibility, and in the early stages the Cpl. ordered us to burn all maps and intelligence reports and destroy some instruments. By 8 am several shells had smashed up the billet as we took cover in a "splinter-proof" of sandbags we had erected against the gable end. During this barrage we were cut off from retreating to comply with orders to make for Hinges, and as we had 2 men still in the church we waited for the barrage to lift when the German infantry arrived. This was not until 2 pm, and as enemy troops entered the graveyard, our 2 comrades bolted out of the back door, and as we were ready they joined us and we filed out of the ruins where machine gun fire was already operating.

Out in the road a Portuguese Officer speaking English with his men lined up minus equipment, said "Fall in for surrender you English" but our Cpl. replied with some choice English he may not have understood! We were armed with loaded rifles, so with the dense fog and smoke and bullets flying we cut across country to get over the "Lawas canal" to the left of Ville Chappell, where we knew an Army bridge had been recently erected. We were then pleased to see in the foggy distance some "khaki" clad troops moving up in extended order and firing as they came. On crossing the bridge we were stopped by a Major & Officers of 51st Highland Division Infantry, who after identifying us (we had destroyed our specialist badges), and enquiring about the geography of the area said to our surprise, "Get back to your own Officer, and help these 2 men to a dressing station on your way". We gladly complied, and had several "close shaves" with heavy shells, but eventually crossed the La Basse Canal at Hinges and found our Officers and H.Q. at Gonnehem – They said they "had not expected to see us again". We had tramped about 16 kilos and were glad to sleep in a barn.

On April 13th we were ordered to occupy "C" post at Beuvry as the men had been gassed and taken to hospital. As we passed through Bethune it was being heavily shelled and fires were raging. Beuvry had been bombarded with "Mustard Gas" shells. (They contained Dichlorethylsulphide) and the place reeked of it, with many dead horses and mules lying around. We found the continual shelling here made observation from the Church very difficult and after a week were ordered to abandon Beuvry post and go into the more prominent square-towered top of Bethune Church which edifice dominated this area.

We decided to live in the vaults under the church, and during lulls in the shelling we managed to scrounge some eatables and a few bottles of wine. We made many locations of enemy guns, works, dumps and road traffic from the top and directed gunfire on specific targets, apart from calibrations of new guns arriving behind us. About this time our Cpl. i/c advised me to go to a dressing Stn at Annezin (suburb) as my left side was badly burnt and blistered from the Beuvry mustard gas, and get it dressed. It was a young American Doctor, the first "Yank" I had seen, and he said "I guess its self-inflicted, you have been blistering yourself with creosote." I was both astounded and angry, and after a few pointed remarks, I demanded the opinion of a British M/O, whereupon the RAMC orderly winked at me and brought in a be-medalled Capt. RAMC who "tut-tutted" and told him what it was and what to put on it. The Yank then apologised and said "I guess I have made a mistake". Apparently he was attached to RAMC and new to the war. I returned to duty and after one or two hazardous visits to the M/O it healed up.

The Portuguese Army had been withdrawn from this front, and Bethune with the important coal mining area around, was, at this time, defended by the 55th West Lancs Division and the 1st Infantry Division – my old "mob".

On April 29 the Germans had evidently decided to demolish our OP as 2 high velocity guns were firing from different directions, every ½ minute depositing heavy shells dead on the church tower. The 4 of us on top (double post) came down to the bottom of the stone staircase with our instruments and were joined by the 4 from the vaults, as their entrance was being blocked by falling debris. We waited during 8 direct hits on the church tower, the concussion being severe, when the Cpl i/c offered us the option of staying put, but advised that we ran for it and risked being caught in the open by the next shells. After the next burst we ran for it and dived down a cellar about 200 yds away, and eventually another farther away still. We reported to Group HQ at Foqueril with our gear, and returned the next day and fixed up another OP in Bethune Hospice spire, in front of the ruined church.

At 4 am on May 1 a violent gas bombardment drenched the front and rear areas and lasted 8 hours, thousands of "mustard" gas shells were fired. We all donned our respirators and several shells dropped just outside and one in the building and the place reeked of it, and in spite of our masks some of it got through. Some of the men were vomiting and by 4 pm most of us were going blind. The Cpl phoned our HQ requesting permission to evacuate the post, but we were ordered to stay put. Later, as everybody had gone blind he asked for help and an ambulance got through, and we were taken to Cloques CCS, though I had no idea at the time. There we were stripped naked, and contaminated clothing removed, put under warm water sprays, some drops were put in our eyes which were then bandaged, and we were given pyjamas.

A horse-drawn ambulance took us (and others) to the rear during most of the night and we landed in the 1st Canadian Hospital (huts) Etaples. After a week or so, with the aid of inhalers and eye drops began to see again, though my bronchia and breathing were bad. A few days later I (and others) were loaded into an ambulance train where we remained for 27 hours until we got to Trouville-sue-mer. Ambulances then took us to No.74 Army Gen Hospital situated on the hills overlooking Honfleur and the Seine. I was kept here 5 weeks and then transferred to No. 13 Convalescent Depot in Trouville, where we were allowed the freedom of the beach and town in the afternoons. On July 7 I had a medical exam, after which I told the M/O that I wished to return to my original Unit, and the next day I entered a train and a carriage containing 2 Australian Sgt/Majors with whom I shared some rations until we arrived at Rouen. I spent the 9th walking around Rouen, and in the evening I joined the usual cattle trucks train where I spent all night, the next day and that night to get to Etaples, and thence to GHQ at Montreuil. I was told to collect some kit and some pay at Compeignelles-le-grande so I walked 6 kilos and slept the night. Next morning I got a train from Montreuil as far as Houdain and walked to Ranchicourt (Army HQ) where I reported to FSC Office and slept the night.

Drawn by P. S. Willats, 1918 - Flash spotter on duty in the post

I was instructed to join No. 8 Observation Group at Hesdigneul so I walked as far as Labussiere and got a lift to group HQ and was detailed for "A" post. Here, the next day, I found some of the old crowd who were using a disused brewery chimney about 100 ft high on the Choques-Hinges road as an OP, and were billeted in an empty ruined cottage adjacent. At the end of July we kept the billet, but moved to a higher colliery chimney at Vendin-les-Bethune some distance forward. This OP was surrounded by many of our gun positions and was an obvious target and we had some narrow escapes from heavy shelling while locating enemy guns.

On August 9 we observed fires burning inside enemy lines at La Gorgue, Estaires and Lestrem and many villages at night, and it became obvious he was abandoning them. On August 12 we moved forward and as no high buildings anywhere, we erected an "Inglis Observation Tower" behind a few tall trees at La Fosse, covering the top with camouflage. We made a "billet" by scrounging some "elephant" corrugated hutting, plus an old hut left by Fritz. Apart from much shelling we had a deluge of rain and were flooded and muddied. We tried to find a billet in Lestrem, which they had smashed up on leaving, but were shelled and flooded out so we returned to Bivvys plus hut. This OP was working satisfactorily and we directed fire on to much enemy movement on roads during his retreat.

On Sept 25 we moved to La Tourelle and the main Lille-La Bassee road. On Oct 4 we moved on top of the Aubers Ridge to Fromelles seeing plenty of booby traps and mines left by Fritz, and thence to Beauchamp where I spent the night in the top of a tree near a concrete gun site recently abandoned. On Oct 8 I was transferred to "C" Post and found them in Illies church, with a post 5 kilos ahead at Saingin-en-Weppes, in the attic of an empty house, very close to the Germans. The front was now fluid and uncertain, and I found it weird watching them as I was alone all day, my mate had been called back. I had seen none of our infantry and I knew we were in front of our field guns, and a few shells were dropping in Sainghin. I got a message over the phone to "reel in line and get back before dark". My mate came back and we complied with our gear. We then erected our "Inglis Observation Tower" on the main Lille-La Basse road at point T16 in front of Herlies.

On Oct 16 we were informed that the enemy had gone right back everywhere. On Oct 18 our Group was amalgamated, and we marched through Haubordin to Lille, from where we were diverted to Wattignies. Great scenes in all these places after 4 years of enemy occupation. On Oct 24, having been a year in France, 2nd visit, I was sent on leave to England from Wattignies. I walked and lorry-jumped my way the 30 kilos through the devastated area via La Bassee and Bethune to Choques and just caught the train for Calais-Dover and home for 14 days.

On November 8 I left Victoria station for Folkestone and Boulogne, spent 1 night at "rest" camp, next morning got a train as far as St. Pol where I met 2 pals also from leave. Great excitement prevailed everywhere over the impending Armistice and troops were lying about everywhere wondering where to find their regiments which had moved on. We left St. Pol at noon on the 10th and the railway having been restored during our absence, crossed the old trenches near Givenchy brick stacks and La Bassee ruins. The train ran into a siding halt at St. Andre Lille. Most of the leave troops marched off to a rest camp, but 4 of us decided to "dodge the column" and stayed put to sleep in the train. We had been informed the train was to move at 6 am, so we were up at 5-30 am and had a wash and shave in a horse-trough nearby and set off again. Nov 11 1918.

We were walking through one of the main streets of Lille during the morning when a group of French citizens started throwing their hats in the air and shouting “La Guerre est fini” etc. The streets were soon crowded with citizens, French, Belgian and British troops – great excitement prevailed, with “beaucoup celebrations” in liquid form, drink. Later that day we found our HQ in the suburb of St. Maurice, slept the night and a Group car took us over the frontier into Tournai where we stayed 3 weeks.

The remainder of my service abroad was spent in Lille (3 months) Ecault near Boulogne (5 weeks) and Wahn over the Rhine (7 months) and Wirtzfeld-Eupen-Malmedy (1 month). On October 19 we embarked on the Rhine for Rotterdam and crossed to England by Hook of Holland-Harwich, and thence to Larkhill Camp, Salisbury Plain to hand over and instruct officers and NCOs of the Royal Artillery in our particular branch of Gunnery, which had been born and perfected during the war by Officers of the Royal Engineers who kept it for duration only. I was demobilized from Larkhill on Feb 1 1920 and proceeded home.

B.W. Whayman
(Bernard William Whayman)

Late/

2313 L/C 2/6th (Cyclist) Battn. Norfolk Regt.	1 year
43479 Sig 1st Northamptons Infantry, 1st Div	1 ¼ years
527964 Spr. F.S. Coy Royal Engineers	2 ¼ years

(A full description of this unit and its formation and work will be found in the publication “Flash Spotters & Sound Rangers” by John R. Innes, first published in 1935 by George Allen & Union Ltd., Museum St., London – see advertisement in this issue).

GEOINT or Just Back To Basics?

By Lieutenant Colonel Rupert Dash, CO 42 Engineer Regiment (Geo)

Introduction

Within the last two years 42 Engineer Regiment (Geographic) will have deployed the vast majority of its personnel to either Iraq, Afghanistan or both. The Regiment is maintaining a level of commitment that places it on a permanent operational footing. Sustaining a cycle of deployment, reconstitution and regeneration leaves little room for manoeuvre. Against such a backdrop the Regiment is perhaps enjoying one of its finest hours. Liberated by operational necessity and embracing Geospatial Intelligence (GEOINT), the demand for our capability and outputs has reached new heights.

Operational Success

The Royal Engineers deployable geographic support footprint, made up of organic HQ staffs and Regimental augmentees, is providing direct and intimate support to all those involved in the prosecution of combat operations, from the Commanding General down to the frontline soldiers and airmen. The main break through has been the acceptance of geographic support at Battlegroup level. However, the complexity and dynamic nature of combat operations in Afghanistan and Iraq cannot be underestimated and as a result the consumer base for our tactical support products stretches far beyond the Battlegroup boundary. The support is primarily focused on battle space management for the planning and command and control of tactical operations. Traditional value added map production and terrain visualisation have been transformed with high quality imagery (stereo and mono) and ground truth information collected from ground patrols. The two-man team supporting the Bastion Battlegroup in Helmand Province have been producing up to 900 products of varying types in support of each deliberate operation, all this over an above the provision of standard series mapping.

The success of support at Battlegroup level has identified the need for robust teams with a wide range of skills and experience. Imagery as a source is increasing in importance. The deployment of imagery analysts brings valuable new skills, understanding and access to new sources. Their deployment alongside geographic technicians within an operational user community and faced with operational necessity, is one of the best collaborative environments for GEOINT to develop.

Afghanistan is a good example of comprehensive deployed geographic support. The Regiment continues to ensure that the operational theatre has a consistent geographic picture through control and management of the Theatre Map Depot in Kabul, currently manned with personnel from 135 Independent Geographic Squadron RE(V). 135 are also providing maintenance support to the Afghan Country Stability Picture (ACSP) within HQ ISAF. This provides the Force-level view of all regeneration activities, and informs national governments and aid agencies as well as the ISAF HQ. The Regiment also has a presence in the Counter IED cell at Kabul, Regional Command South in Kandahar and the UK Task Force HQ in Lashkagar. The Special Forces component and the Operational Intelligence Support Groups (OISG) are all supported with GEOINT teams (geographic technicians and imagery analysts).

GEOINT: Western Desert 1942

Missing Skills Sets

Without doubt the deployable geographic community is providing highly valued and widely recognised support. Yet this success has highlighted a need for certain skill sets that have, for very logical reasons, been eroded. The output of the deployed team is predominantly a bespoke or value-added product, either paper or digital. The effectiveness of this output relies on sound knowledge of cartography and imagery exploitation, skills that up until the mid 1990s were taken for granted. It is a difficult challenge to apply cartographic principles such as those associated with symbology, generalisation and visual hierarchy when your production experience, system application or underlying data does not support it. However, without an appreciation of these principles we will also lose contact with the essence or psychology of cartography, the concept that recognises and supports human cognitive processes. The obvious

example is the acceptance and continued use, in the absence of alternatives, of the JOG Air for land based activities; a situation further complicated when used with additional overlay information and made worse when displayed as a raster product.

Imagery permeates almost everything we do operationally and is certainly evident in the majority of our operational outputs. What is clear is that there is a wealth of imagery available, mono and stereo, classified and unclassified. However, accessing and exploiting it requires both knowledge and experience. High fidelity mono and stereo exploitation at the tactical level is an achievable reality now and it is rapidly becoming a necessity for geographic technicians to understand the fundamentals of photogrammetry.

The Cold War Contingency Planning Malaise

It is ironic that the core skills we now see ourselves needing again are those we associate with traditional map production. The rigorous and institutionalised Cold War production role certainly delivered people who understood the principles of cartography and photogrammetry but, it also delivered decades of isolation from the operational community. With a lack of operational necessity, the geographic technicians had little or no interaction and identification with the end user. We were fortunate that the mammoth collaborative production effort of NATO nations delivered excellent topographic mapping over NATO's area of interest. Bosnia, Iraq and Kosovo, together with Microsoft, ESRI and Intergraph soon adjusted that picture, replacing it with an every growing need for deployable production and exploitation. Since Bosnia the community of Geo assets external to the Regiment has grown significantly to the point where most of the senior level technicians are embedded within operational formations. Whilst there is still a clear and essential need for the service that the Regiment provides to the Front Line Commands, the need for embedded 'intimate' support continues to grow.

GEOINT: Afghanistan 2007

Back to Basics

In 1997 Military Survey celebrated its 250th anniversary. The historic display for this landmark occasion illustrated the extensive support Military Survey has provided Defence. Covering a period that saw the birth, expansion and decline of the British Empire and two World Wars, and led by notable figures such a Lord Kitchener, it was almost exclusively expeditionary in intent. The common theme was the provision of information to allow commanders at all levels to plan a campaign, visualise the battlefield and prosecute operations. In the 18th Century it would have included field sketches (a field survey panorama) of the battlefield to aid planning, in the 19th Century it would have included the addition of hill shading to base mapping to provide terrain orientation. In the 20th Century it certainly included the exploitation of imagery and imagery analysis to provide photomaps that identified German trenches and gun positions prior to major operations such as Operation Veritable (the Rhine crossing). Whilst techniques and methods continually evolved, the principles and understanding of the military intent was always well understood.

The reality is that throughout our history, with the exception of the Cold War years, the Royal Engineers have provided intimate geographic support to an operational user community. We have adapted and used whatever information we can access to provide the best and most appropriate support. If we need to call what we should be doing now GEOINT, in order to finally shake off the Cold War Contingency Planning hangover and to orientate a new generation of technicians, analysts, planners and commanders then it is surely a worthy cause. In the broadest historic context, and as represented by the comprehensive and continually evolving operational support provided today, we are just getting back to basics, reconnecting with the operational end user and putting his needs before all others. Now as ever before, the work of the Sapper is never done, and we rely on him to pre-empt and deliver change before it is highlighted as a problem.

Greyfriars Bobby

By P O'Brien, President, Edinburgh Branch, Royal Engineers Association

In 1839 Donald McNab Scott joined the Corps of Royal Sappers and Miners in Perth as a Sapper in the 14th (Survey) Company, one of the four surveying companies. In 1858 C/Sgt Scott, by now posted to Edinburgh Castle, was living in lodgings overlooking Greyfriars Kirk cemetery. One day he spotted a small shaggy dog wandering among the tombstones and he coaxed him into the house for a meal. The small dog, known as Bobby, then returned to lie on his master's grave and did this every day until his own death.

The dog kept in contact with Scott although he would not stay with him. Every payday Scott would buy him a meal out of his wages – it is believed he trained the dog to go to a local restaurant every time the one o'clock gun fired to be given a meal. Bobby got so used to doing this that the story spread around the people of Edinburgh and when the gun fired a crowd would gather daily outside the church to see the dog trot out through the main gate. The Inverness Advertiser featured this story in 1864, and several other newspapers picked it up and the Legend of Greyfriars Bobby began. The story has also been turned into a novel and two Hollywood films.

Colour Sergeant Scott however, the forgotten man in the remarkable tale, died in 1893 and was buried in an unmarked grave in Piershill cemetery. Earlier this year local historians located his grave and the One O'clock Gun Association decided to honour his contribution by having a headstone dedicated to his memory. The service was held on the 10th of August 2006 in Piershill cemetery and the Edinburgh Branch of the REA was invited to attend. A colour party made up of Branch Standards from the REA, Royal Navy, Royal Marines, Royal Artillery, Scots Guards, the RMP and Parachute Regiment was on parade. Tam McArthur carried the REA Branch Standard and George McIlwraith of the Glasgow Branch acted as the Queens Colour. The Reverend Neil Gardner, Chaplain to Edinburgh Castle conducted the service of dedication and the headstone detachment formed by WO1 (RSM) A Bone RE and WO2 P Dixon RE from 72 Engr Regt (Volunteers) unveiled the headstone.

First published in Sapper magazine

Review of the Royal Engineers (Geographic) Specialisation

By Peter Walker

Background

In October 2005 a Review of the RE(Geo) Specialisation was initiated, its aim being to provide an analysis of current RE(Geo) capabilities, focused on the requirement to ensure that RE(Geo) officers and soldiers have the right training to meet current and future customer needs. Training Branch, HQ Joint Aeronautical & Geospatial Organisation (JAGO), conducted this Review. Inputs were sought from a wide range of customers across the chain of command in all three Services and from RE(Geo) personnel through the completion of questionnaires, as well as conducting a series of unit and headquarters visits, along with discussion groups to provide additional information.

Results of the Review

The following key recommendations have now been endorsed:

- Retention of the Army Survey Course for RE(Geo) career officers as a 14 month residential course, with accreditation by Cranfield University being maintained as a Master of Science Degree in Defence Geographic Information.
- Merger of the three existing Military Engineer Geographic Technician trades (ME Geo Data Tech, ME Geo Terrain Analysis Tech and ME Geo Production Tech) into a single trade with a common syllabus, with accreditation by Sheffield Hallam University being maintained as a Foundation Science Degree (FDSc) in Applied Computing.
- Opportunities to be developed to allow all ME Geo Techs to achieve a Bachelors Honours Degree in Applied Computing through Sheffield Hallam University by the time of reaching Warrant rank, with a norm of 50% of this requirement being achieved through personal development.
- Development of an RE(Geo) Skills Framework which will define the competences required by RE(Geo) personnel in five categories: Career RE(Geo) officers, junior RE officers posted to RE(Geo) units for one tour, RE(Geo) WOs and SNCOs, Class 1 ME Geo Techs, and Class 2 ME Geo Techs.

Training Development Cycle for RE(Geo) Personnel

Soldiers seeking a career in the Specialisation now follow a training development model as set out below.

Training Development Cycle for Military Engineer Geographic Technicians

Activity	Duration	Remarks
Aptitude Course	1 week	At Royal School of Military Survey, Hermitage
Basic Army Training	12 weeks	At Army Training Regiments (16 year old recruits go to the Army Foundation College, Harrogate, for one year)
Combat Engineer Training	9 weeks	At Royal School of Military Engineering, Minley
Driver Training	13 weeks	At Defence School of Transport, Leconfield
ME Geo Tech Class 2 course (FDSc NQF Level 4)	11 months	At Royal School of Military Survey, Hermitage
Tour with operational unit	24-30 months	Includes completion of Experiential Modules for both FDSc National Qualification Framework (NQF) Level 4 & Level 5. Also normal to complete a Junior NCO leadership cadre (4 weeks) during this tour.

Activity	Duration	Remarks
ME Geo Tech Class 1 course (FDSc NQF Level 5)	10 months	At Royal School of Military Survey, Hermitage(extended by up to three months for courses in 2007, 2008 and 2009 to cover bridging modules to ensure soldiers who were trained in the old trades qualify in the new single trade)
Further tours with operational units		
RE Command, Leadership and Management Course for Senior NCOs	3 weeks	Timing of this training will depend on career progression, but normally start 7-8 years after the soldier has joined the Army (ie 1-2 years after completion of the Class 1 course) and continues until the soldier either retires from the Army (22 year point) or achieves a commission. Soldiers have opportunities to gain further academic accreditation potentially leading to award of an Honours Degree in Applied Computing. Some soldiers may also achieve Honours or Masters Degrees in a variety of geospatial subjects where specific military appointments require this level of expertise.
ME Geo Tech Sergeants' Course	3 weeks	
Further tours with operational units		
RE Command, Leadership and Management Course for Warrant Officers	1 week	
ME Geo Tech Warrant Officers' Course	1 week	

Army Survey Course

RSMS is adjusting the content of the Army Survey Course to reflect the changes recommended in the Review, including development of a stronger focus on Defence geospatial requirements. The modules covered on the course are listed below.

Module Number	Module
1	Analytical Techniques
2	Reference Systems
3	Information Systems
4	Positioning
5	Image Processing
6	Spatial Analysis
6.1	Introduction to Spatial Analysis
6.2	Point, Area and Overlay Analysis
6.3	Spatial Interpolation and Surface Modelling
6.4	Error Management
6.5	The Future of spatial analysis
7	Imagery Exploitation
8	Spatial Data Presentation
9	Spatial Software and Systems
9.1	Systems Analysis
9.2	Benchmarking
9.3	GIS Standards
9.4	GIS Software
10	Defence Geographic Requirements
11	Group Project

Military Engineer Geographic Technician Courses

RSMS has now revised the structure of the Class 2 and Class 1 ME Geo Tech courses. The common ME Geo Tech Class 2 course has been introduced from February 2007, and a pilot common ME Geo Class 1 course in March 2007. The pilot Class 1 course includes bridging modules to enable soldiers trained at Class 2 in the old three trade structure to qualify in the new single trade at Class 1. Outlines of the new courses are given in Tables 3 and 4.

Table 3 - ME Geo Tech Class 2 Course

Module	Training Weeks
Geographic Information Dissemination	3
Map Science	7
Spatial Data	3
Fundamental of Geospatial Imagery	4
Personal Effectiveness and the Professional Working Environment	3
Application of Information Systems	5
Terrain Information Exploitation	5
Geographic Support to the Planning Process	4
Spatial Analysis	3
Work in Operational Environment (Experiential)	0
Ex In the Dark	1
Container Training	1
Total Course Length (Training Weeks)	**39**

Table 4 - ME Geo Tech Class 1 Course

Module	Training Weeks
Advanced Professional Working Environment and Future Developments	1
Systems Management	2
Task Planning and Technical Management	3
Data Base Design and Implementation	3
Imagery Exploitation	2
Network Analysis	3
Surface Analysis	3
Advanced Terrain Factors	3
Advanced Spatial Analysis	3
Cartography and Geographic Information Dissemination	4
Ex In the Dark	1
Maths	1
Exams	2
Analysing the Working Environment (Experiential)	2
Total Course Length (Training Weeks)	**31**

Whilst merger of the three trades has been a somewhat emotive process, feedback from many soldiers during the Review identified a strong requirement for ME Geo Techs, even at quite junior levels, to have a comprehensive awareness of the Joint Service and all-Arms environments and a

good understanding of intelligence processes. The new common syllabi adopted on the Class 2 and Class 1 ME Geo Tech courses have been designed to achieve this. However, in addition to these fundamental requirements, some ME Geo Techs are likely to need further training in more precisely defined technical areas, either to enhance what they have already been taught on the ME Geo Tech courses or to help them to develop additional specialist skills. Consequently, a variety of Specialist Qualification (SQ) courses will be introduced to ensure appropriate development of soldiers when they are posted into specific appointments where a higher level of knowledge and skill is necessary to meet operational needs. SQs may include requirements such as advanced geospatial database management, advanced exploitation techniques, geodetic survey skills and printing. However, there is still work to be done to scope SQ requirements, size the training throughput, and design the necessary courses.

Conclusion

A detailed review of the training development requirements for the RE(Geo) Specialisation had not been conducted for over 10 years. Whilst continuous interaction with Defence customers had ensured that courses at RSMS had evolved to reflect changes in operational needs, a comprehensive examination was needed to ensure that geospatial requirements in a digital battlespace environment will be properly covered during training in the future. The main recommendation for change emerging from the Review has been the merger of the three ME Geo Tech trades into one. This change reflects the need for RE(Geo) personnel, even at a junior level, to have a comprehensive understanding of all aspects of the Specialisation. There is a risk that RE(Geo) soldiers will not maintain a sufficiently high level of expertise in very tightly defined aspects of the business if their training is covering a broader spectrum of knowledge and skills. However, this risk had to be balanced against the need for so many personnel to be able to operate effectively within the all-Arms environment, working also in Joint Service and international headquarters. Where high levels of technical expertise are required to meet the tightly defined criteria set out in particular job specifications, this will be achieved by giving appropriate and timely training to much smaller number of soldiers through SQ courses.

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Defence Geographic Centre Open Day

The Intelligence Collection Group (ICG) was formed on 1 June 2006 with the remit to deliver intelligence, information, services and force elements to Defence and to support the achievement of Defence objectives. The ICG is part of Defence Intelligence and the HQ, currently based in Feltham, commands four units - Defence Geographic Centre (DGC), the Joint Aeronautical and Geospatial Organisation (JAGO), the Joint Air Reconnaissance Intelligence Centre (JARIC) and the Joint Services Signals Organisation (JSSO). In order to allow our key stakeholders to gain a better understanding of the role of ICG and its GEOINT capabilities, Brigadier David Potts MBE, Commander ICG, directed that each unit shall hold an Open Day.

The DGC held its Open Day on 7 February 2007 at Feltham. The event was aimed at key appointments, or their representatives within DGC's user community together with their respective geospatial leads.

77 guests began a full morning session with a series of briefings. The opening address by Commander ICG was followed by Lt. Col. Ross Thurlow, SO1 Ops HQ ICG and Director DGC, Mr. Stuart Haynes, who briefed our guests on the roles and responsibilities of ICG and in particular, on the developing capabilities and ability of DGC to deliver GEOINT, geospatial information, services and liaison to Defence. A short refreshment break was followed by presentations from Lt. Col. Nick Sutherland, COS DGC, and Mr. Peter Jones MBE, AD Capability Development, who continued the main communication theme for the day - demonstrating the value and development of GEOINT and geography as a key enabler in underpinning operations and the capability and capacity of DGC to adapt to satisfy evolving operational requirements.

Presentations focussed on raising awareness of the specific DGC GEOINT contribution to current high priority Defence operational commitments. Additionally, to advise on the range, volume and potential utility of DGC GEOINT outputs and services such that operational users, commanders and planners exploit them to the best possible effect, and that they in turn contribute to the definition of requirements to inform further capability developments.

The high operational tempo in recent years has placed a huge demand on the requirement for timely and relevant geospatial information supported by a wide range of GEOINT products. This is as true for ongoing operations in Afghanistan and Iraq (Op HERRICK and Op TELIC) as it has been for short notice operations such as the Non-combatant Evacuation Operation from Beirut (Op HIGHBROW).

The Defence Geographic Centre is a key enabler in this process, responsible for the production and/or acquisition of geospatial information and, as required, its subsequent analysis and dissemination to Defence and International partners. In the last 18 months DGC has been focussed on a major production programme to map Helmand Province in Afghanistan, providing paper and digital map products from 1:500,000 up to 1:2,000 scales supported by a variety of GEOINT and interactive products, for customers ranging from the strategic planners to the war fighter. At the same time DGC has supported ongoing operations in Iraq and met numerous short notice commitments as well as a wide range of other enduring tasks. Key to the recent success has been the flexibility and responsiveness required to support and produce existing products whilst at the same time developing and implementing innovative solutions to meet new and emerging requirements.

The Open Day also gave an opportunity to provide a more rounded picture of DGC's capability and to mitigate the risk that a strong emphasis on support to active operations could detract from the importance of DGC's strategic and long term collection and production programmes.

The guests had an opportunity to view products at first hand in a series of round robin briefs in the afternoon as they toured MacLeod and Hotine buildings for displays on 'Production of Geospatial Information', 'Modelling and 3-D Visualisation', 'Collection and Research' and 'Replication and Dissemination'.

DGC received an overwhelming response to the initial invitation letter, so much so that an additional Open Day took place on the 5th February. This in turn was attended by 85 guests. Hosting such events requires meticulous preparation and a great deal of organisation to ensure the day runs smoothly. Thanks go to all involved – to the presenters, escorts and timekeepers, the caterers, the MGS and Security Branch, Services Branch, Communications and Information Systems Branch and

Lieutenant Colonel Nick Sutherland briefing delegates on GII.

the multitude of staff across DGC who prepared briefing materials, collated portfolios, assisted with administration or washed teacups. The day couldn't have happened without them.

Feedback from those who attended either day has been entirely positive.

To summarise, the key messages emanating from a very successful day are:

1. GEOINT and geography are critical to the successful planning and execution of operations. DGC must be engaged as early as possible to determine requirements and to ensure customer expectations are met.

2. DGC is the principal MOD capability for the collection, production and provision of GEOINT and related services, above the high water mark.

3. DGC has made an unprecedented contribution to recent and current operations, in the form of more, higher quality GEOINT, faster than ever before. This has been achieved through the flexibility, dedication and innovation of a large proportion of DGC's workforce, making the best use of information and technology.

Laser-Scan Becomes 1Spatial

Laser-Scan have announced that they have renamed the company as 1Spatial to reflect its ongoing evolution in the spatial data marketplace. Laser-Scan has been in existence since 1969. Originally building laser plotters, the company moved on to the scanning of paper maps to create digital databases. The company has transformed over time, and is now the world leader in spatial database management with a specific focus on spatial data quality control. Laser scanning has also evolved into something quite different as well. The name change to 1Spatial reflects these fundamental changes.

In the footsteps of Captain Pemberton Leach VC RE

By Major Hamish McCarthy
Officer Commanding 14 Geographic Squadron RE

Captain Edward Pemberton Leach VC RE, a military surveyor, was awarded the Victoria Cross for actions against the Shinwarris near Maidanak, Afghanistan, on 17 March 1879, when covering the retirement of the Survey Escort who were carrying Lieutenant Barclay, 45th Sikhs, mortally wounded. His citation reads further 'he behaved with utmost gallantry in charging, with some men of the 45th Sikhs, a very much larger number of the enemy. In this encounter Captain Leach killed two or three of the enemy himself, and he received a severe wound from an Afghan knife in the left arm. Captain Leach's determination and gallantry in this affair, in attacking and driving back the enemy from the last position, saved the whole party from annihilation' (London Gazette: 6 December 1879). One hundred and twenty one years and twenty four days later an advance party of 14 Geographic Squadron RE would deploy to Camp Souter, Kabul, and be accommodated in barrack blocks named after this gallant latter day Geographic Officer whose actions have been immortalised in a recent painting by Peter Archer displayed in their Regimental mess.

The Hermitage Officers' Mess painting of surveyor Captain Edward Pemberton Leach winning the VC.

The Squadron had been tasked with providing Geographic support to Headquarters Allied Rapid Reaction Corps (HQ ARRC) in their command of International Security Assistance Force IX (ISAF) for Afghanistan. This was an enduring UN mandated organisation under the command of NATO and operating since 2002 with the mandate expanded from the environs surrounding Kabul to supporting the Afghan government's efforts to extend its authority beyond Kabul, making the

14 Geographic Squadron in Afghanistan

country more peaceful and more stable. In this mission they were joined by a section from their sister Squadron, 13 Geographic Squadron RE, who were given geographic support to the UK's Helmand Task Force fighting in the south of the country, and who in time, they would support and re-enforce.

The established strength of the ISAF Geographic Support Group (GSG) was 2 officers and 27 men. The deployment was a 'one-off' nine-month commitment for 14 Geo Sqn from 10 Apr 06 to 1 Feb 07, linked to UK leadership of ISAF and HQ ARRC providing the framework for HQ ISAF IX. Their mission, as endorsed by HQ ISAF Chief Geographic Officer, was

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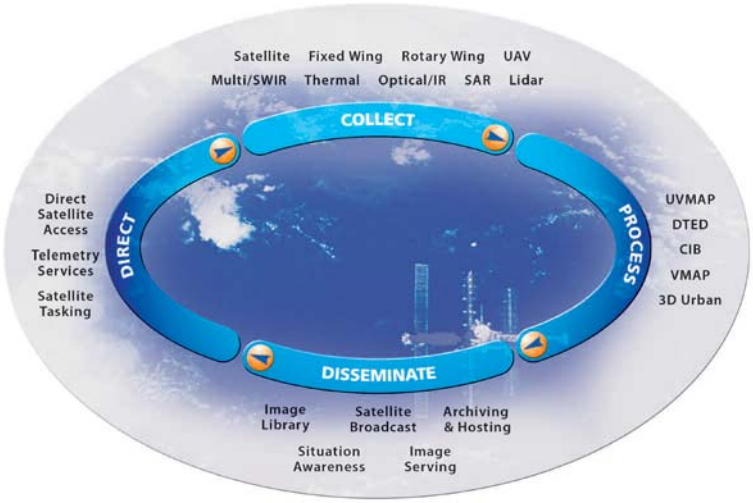

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"to support the expanding [ISAF] mission, leaving a legacy of geographic information to be exploited by follow on forces and Afghan agencies including Afghan National Army, Afghan National Police and AGCHO (Afghan Geodetic & Cartographic Head Office)"

The GSG was equipped and organised to provide the full range of field deployable geo capabilities including bulk reproduction and field data collection as well as TERA, data management, and imagery exploitation. It also re-located, and managed on a day-to-day basis, the ISAF Theatre Map Depot (TMD). The GSG was based at Camp Souter, collocated with HQ BRITFOR, the UK Kabul Patrols Company (KPC) and, when in theatre the Tactical Imagery Wing, (TIW) a RAF/RE Geo photo reconnaissance team.

The Squadron deployed in two phases; an advance party of 10 under the command of Captain Easingwood arrived in Kabul on 10th April 2006 with the mission to set up the GSG and meet the initial operating capability requirements of the ISAF IX HQ as it took over from the incumbent HQ. The main body joined them on 10 June 2006 in order to meet the full operating capability of ISAF and their take over of authority for stage 3 on 31st July 2006.

The Squadron was located at Camp Souter, named after Captain Souter VC of the 44th Regiment, one of two men (the other died) who, during the Retreat from Kabul, wrapped the colours round their bodies thus saving them and being immortalised in a picture by WB Wollen, RA. The camp itself is situated on the outskirts of Kabul along Route Violet (aka Violent), the route that leads through the Khoord Kabul pass where the nightmare of retreat for the Army of Afghanistan began in 1842 to Jallalabad where, for Dr Brydon one of the few European survivors, it ended and into Peshawar via the Khyber Pass, a significant Main Supply Route (MSR). The sighting of the Squadron some 5 miles away from the HQ in Kabul was unfortunate and in time would hinder the support the squadron was able to lend. Crucially it meant that the movement of Geo soldiers, products, liaison with customers and command and control was at the mercy of force protection measures and threat alerts as it was then in 1842.

Geographic support began in earnest with the arrival of the main body but had to co-exist with mandatory force protection duties, training and regular alerts. The squadron had deployed with 75% of its technical capability but only 35% of its manpower, so technical work was often halted as technicians provided security details and basic life support functions that normally the Squadron's constituent Support Troop (remaining in Germany) would carry out. All of the soldiers were multi-tasked to make up for the manpower shortfall, the Squadron Officer Commanding and Squadron Sergeant Major providing the core of all vehicle escort duties.

LCpl Gardener datalogging during a patrol with the Royal Marines

The ISAF GSG proved that the squadron remains pre-eminent in its expeditionary capability and that its soldiers continue the tradition of working in environmentally extreme and dangerous conditions. The GSG contributed to the ISAF mission in five main successful areas.

The re-location and significant expansion of the Theatre Mapping Depot from a map store based out of the French/German led Kabul Multi National Brigade (KMNB) location catering to units in the capital into a hub capable of GID/map supply to the whole theatre working out of Kabul International Airport.

Spr Thompson and Cpl Tully in Tacisys

The Squadron undertook substantial lithographic work focussing on the creation and bulk production of ISAF MISC series mapping, including airfield image maps, town and city image maps and the first country-wide mines map series. This included products specifically designed to be releasable to Afghan National Security Forces (ANSF) and other host nation agencies.

The Squadron found that deploying a digital pre-press and medium format press gave ISAF Chief Geographic Officer, Lt Col Pat Fryer, ownership of a flexible and high capacity production capability. It was used consistently throughout the deployment and was probably the ISAF GSG's most significant contribution to the mission. Intra and inter-theatre airlift was stretched throughout the deployment, making Reachback for bulk production an unreliable option. This applied equally to Reachback from UK TF in Helmand to the ISAF GSG in Kabul as it did from UK TF or HQ ISAF in theatre to the Defence Geographic Centre in UK, which again hindered the amount of effective support that the ISAF GSG could provide to support UK forces in Helmand.

The Squadron lent expertise and assistance to the Canadian-led Op RAMPANT LION imagery collection project, both in ortho-rectifying the stereo imagery and the follow-on task of mosaicing and tiling it into exploitable regional datasets, and by surveying Ground Control Points to enable an independent check of the positional accuracy of the processed imagery. This was a US/Canada and Afghan led project which would provide up-to-date ISAF/ANSF releasable imagery.

The Squadron was frequently called on to reinforce embedded geo staffs at HQ ISAF, Regional Command (RC) West, RC South and UK Task Force in Helmand to cover gaps, provide surge capacity or to assist in the development of procedures for effective GID/map supply. This at times was frustrating for the squadron hierarchy as it infringed on their normal works, but greatly contributed to the overall ISAF mission, whilst providing education to its technicians and a great fillip to the drudgery of camp routine.

Considerable low level geo support was also provided to the UK Kabul Patrols Company directly who were co-located with the GSG on Camp Souter, a company of Royal Marines followed by a company from 5 Scots. Squadron personnel deployed with these troops in data collection roles to further populate and densify the local area database and took post in the sangars weekly so that they could enjoy a rest day.

It was not all work however, normal fitness and a regular sports routine was encouraged, coupled with some excellent welfare donations from the Royal British Legion and Royal Engineers Association, the Squadron enjoyed considerable sporting success and social events, certainly better than the England's performance in the World Cup.

During the mission the Squadron's personnel rotated through as postings moved many on. The last elements of 14 Squadron returned to Ayrshire Barracks Mönchengladbach on 1st Feb 2007 under command of their new Officer Commanding Major Roly Cockwell RE, who joined them from HQ ISAF. After a period of leave the Squadron will embark on a programme of military and technical exercises to focus on new skills and lessons learnt from their recent deployment. The busy cycle of continuing operational commitments, technical and military training continues as the Squadron prepares for their next mission.

Lieutenant Colonel R G Dash RE

Commanding Officer 42 Engineer Regiment (Geographic)

Lieutenant Colonel Rupert Dash enlisted in to the British Army in 1984. On completion of the Commissioning Course at the Royal Military Academy Sandhurst, he was commissioned into the Corps of Royal Engineers in 1985. His subaltern appointments were as Troop Commanders with 62 (Independent) Cyprus Support Squadron and 32 Armoured Engineer Regiment. A year was spent as Officer Commanding No 3 Doppler Section, 512 Specialist Team Royal Engineers, working on the Special Mission Tracking Program for the United States Defence Mapping Agency. Subsequently he was Squadron Second-in-Command within 28 Amphibious Engineer Regiment, a Battle Captain in Headquarters Northern Ireland and a Staff Officer Grade 3 within Headquarters RE 1st (United Kingdom) Armoured Division.

On promotion to Major in 1994, he attended the Army Survey Course at the Royal School of Military Survey, which was followed by a staff appointment in the Intelligence Division of Headquarters LANDCENT. Whilst in this appointment he deployed with the Headquarters to Sarajevo on its first rotation. On his return he commanded 14 Independent Topographic Squadron RE where he enjoyed success with the Squadron on various fronts; highlights being the deployment of the Squadron in support of the Allied Rapid Reaction Corps' mission to Kosovo and winning the Army Minor Units' Football Cup. Following his command tour, he was posted as Chief of Staff of the United Kingdom Liaison Office in the United States National Imagery and Mapping Agency (NIMA).

Lieutenant Colonel Dash was promoted in 2002 and took up a Staff Officer Grade 1 position within the Intelligence Division of the Supreme Headquarters Allied Powers Europe (SHAPE). In 2003, he returned to the UK as Deputy to the Director of the Defence Geographic Centre – his first UK based tour! Lieutenant Colonel Dash assumed command of 42 Engineer Regiment (Geographic) in April 2006.

Rear Admiral Ian Moncrieff BA

The UK National Hydrographer

The UK Hydrographic Office is delighted to announce the appointment of Rear Admiral Ian Moncrieff BA as the UK National Hydrographer, Deputy Chief Executive (Hydrography), based in Taunton, Somerset.

Rear Admiral Ian Moncrieff BA has joined as UK National Hydrographer and comes to the UKHO with a long and distinguished Naval and Joint Operations background spanning 30 years of which 20 have been seagoing. He was previously a Joint Operational Commander as Commander British Forces South Atlantic based in the Falkland Islands for the past 18 months. He is looking forward to making a significant contribution for the UKHO in the important area of its International Relations and in the future development of the organisation.

Ian is excited about becoming a member of the UKHO team and this challenge that will allow him to bring his background and experience to bear in an area that has great resonance for him as a mariner – safe navigation at sea. He says that "The UKHO rightly has an enviable worldwide reputation and I join it at an important time in its development as we seek to deliver more digital products to the maritime community in the clear, cost-effective and easy to use format that the user needs and deserves".

He has been the Executive Officer of an aircraft carrier and commanded the destroyer HMS Nottingham and Antarctic patrol ship HMS Endurance. His active service includes OPERATION SHARP GUARD (Former Republic of Yugoslavia) and OPERATION BOLTON (Iraq).

Ashore, his staff experience includes a strong pedigree of senior appointments in Policy, Plans and Programmes in MOD Centre, as well as Fleet and Royal Marines HQs.

Ian was Director Communications and Information Systems (Navy) and Assistant Chief of Staff (CIS) to CINCFLEET before graduating from the Higher Command and Staff Course and the Defence Strategic Leadership Course in 2005. He is a member of the Honourable Company of Master Mariners and the Institute of Directors.

Mike Robinson, Chief Executive of the UKHO welcomes this appointment, saying: "This is an excellent appointment which will be of considerable benefit to the UKHO, our international hydrographic relations and to our defence customer. Ian brings with him considerable expertise and experience. He will play an important role in the future development of our organisation."

Captain Ian Turner, Captain HM and Hydrographer of the Navy, also welcomed the appointment saying: "I will be working closely with the new National Hydrographer to support of the UKHO's vision to be the world leader in the supply of hydrographic information and services. The fact an Admiral has been appointed in this new role indicates the value placed on the Royal Navy's engagement in the future business of the UKHO. Meanwhile my role will remain located in Devonport with responsibility for operating the Royal Navy's surveying ships within the Fleet Command and I shall continue to provide specialist hydrographic advice to the UKHO as a non-executive director on the UKHO Board."

Ian and his wife Marion have moved to the Taunton area. They have two teenage sons, Andrew who is studying Politics at Liverpool University on an Army bursary and James who has just entered his GCSE year. Interests and pastimes include sailing, golf and tennis and he has had work published as an amateur wildlife photographer.

Dr. Andy Wells
Sales Director - Infoterra Ltd

To me geography has always been a passion. From my initial exposure to the delights of polder field patterns in Holland to the excitement of digging holes in the side of Scottish hills looking at soil structure, there has always been something about the interaction of humans with the landscape that has brought both interest and enjoyment. After O and A levels in the subject including the creation of Central Business District mapping in Halifax, I chose to continue my studies at Aberystwyth University. My father (a mechanical engineer), who did not believe geography to be a true science, persuaded me to take a joint honours degree with Physics and Electronics. Whilst attempting to manage three parts of a degree was challenging there was no doubt that this did direct me to specialise in the satellite technology and remote sensing in the final year. At this point, with no clear idea of what career to take, the offer of university funding to undertake a PhD (combined with the thought of three more years of mid-Wales rugby) was tempting. The technology of the time was limiting (using the DIAD system with a whole 512k of memory – i.e. about 1 image if you were lucky) but the outcome successful.

In 1994 I became a visiting research fellow at the University of Greenwich (newly formed from Thames Polytechnic) with the sole remit of undertaking research which would improve the department's research rating. Forays into bracken, childhood accident mapping, soil science and land use further strengthened my wish to find a career in geospatial technology (the posh term for geography). Academia was not for me, however, and after a chance meeting with John Allan two year's later (the then head of ERDAS), I spent the next four years extolling the virtues of ERDAS Imagine (software for image processing) to anybody who would listen to me. This was an exciting period for commercial technology in the geospatial market with the likes of ESRI, Mapinfo etc. leading the way as more and more organisations began to understand the fundamental benefit of geography for their requirements. This period also saw my first participation in the defence sector with involvement in AIDU, DGIA's Tacisys programme and an explosion of interest in 3D Visualisation following the launch of Silicon Graphics desktop series.

By 2001, another chance discussion (as you can see my career was well organised and planned), I joined the then National Remote Sensing Centre as head of sales for their Systems and Software team. Involvement with the European Space Agency and specialist sensor technology kept me busy for the first year until Infoterra was formed under the direction of EADS Astrium. In the next four years, three posts within the business, two house moves, two children and involvement in almost all aspects of the Infoterra company including aerial imagery, laser altimetry, land management, census mapping in Africa and, of course, defence applications around the world kept me very very busy.

As Sales Director for Infoterra, I feel in something of a privileged position. I am one of those lucky people who is paid (not enough if my boss is reading this) to work in an environment that is challenging, of real interest, provides a wealth of value to all who use it and is applicable to everybody. To me, geography remains at the very heart of what defines us as individuals and what we spend our time doing both at work and at home. In my leisure time- har har, I clean up after my children, ferry them to Rainbows (mini-Brownies) and sleep when possible. Other interests when allowed include DIY, beer, films and trying not to put on weight.

An Unusual Enterprise

By Captain Vaughan Nail RN

To offer an insight into the relatively rare event of introducing a new survey vessel into service, this article describes the early life of *HMS Enterprise* from build to the achievement of full operational capability. To see this period in context, it is perhaps worth looking at the origins of the project, which sought to provide a replacement capability for the ageing *Hecla* Class vessels by the year 2000.

A Staff Requirement for three vessels (two small hydrographic survey vessels and one larger oceanographic vessel) was eventually approved in 1997; but what could have been a relatively straightforward process towards design and build was diverted into the closest possible examination of a potential Private Finance Initiative (PFI) solution. An extreme version of this could have seen the Royal Navy capability reduced to the partial manning of several commercially-owned vessels. As this process wore on without satisfactory resolution, a capability gap developed as the older vessels were withdrawn without replacement. Towards the end of 1999 a more conventional solution was decided upon, although by this time the procurement budget did not allow for a three ship outcome. The newly formed Integrated Project Team was designated as the naval pilot project for "Smart Procurement", which ensured the robust support of capability managers in the MoD as the project was reshaped and pushed towards "Main Gate". In order to provide some sort of offset for the capability shortcoming implied by having only two ships, it was determined that they should combine the hydrographic and oceanographic roles and be manned to 150% (three watches) to allow for greater availability. The preceding PFI negotiations were not completely without merit as many of the design features and logistic support mechanisms were brought forward into the new project. The eventual Prime Contractor for the build, Vosper Thornycroft Ltd, became the design and support providers for the service life of the vessels; a contract that could potentially extend for 25 years.

This background is important, because it set the scene for the challenges faced by the new Ship's Companies as they joined their units in build in Appledore, Devon. The eventual design, at 3,500 tonnes, 90 metres overall, with a 16 metre beam, was quite large and accommodated a comprehensive range of scientific and surveying instrumentation, almost all completely new to service. The step change in hydrographic capability was matched by the superb oceanographic suite; both being integrated in a complex data network. Amongst other novel features, the ship also incorporated a modern electric power generation and distribution system, in which demands for propulsive power were automatically managed alongside other ship services. The complement perhaps represented an extreme version of "lean manning", with less than 50 officers and ratings, including a significant number of less experienced personnel, running the ship at sea. It was therefore crucial that the level of automation and system reliability compensated for this reduction. As the whole capability

August 2001 - HMS Enterprise fitting out at Appledore Shipbuilders in Devon.

Spring 2005 – HMS Enterprise sails from Soudha Bay, Crete after a fuelling stop during oceanographic survey operations in the Eastern Mediterranean Basin.

developed, it was hoped to deliver 330 days availability for operations each year, with maintenance and support being provided anywhere in the world.

The overriding challenge was to build operational capability for deployed naval operations as soon as possible. Capability was built around the well understood pillars of manpower, equipment, training and sustainability. Success is reliant on understanding the relationship between these very different facets, recognising that incremental development in one pillar must be matched with appropriate development in the other three. The initial focus must be on building whole ship knowledge to enable the safe operation of the ship and her systems, firstly in harbour and then at sea. Individual performance grows into team performance and eventually whole ship performance, but the beginnings are necessarily modest. From the command perspective, one becomes very aware of what is within one's own powers to deliver and what reliance must be placed on external support, particularly for logistics. Again, the emphasis must be placed on growing self reliance, while making secure those rear links and enablers which will sustain the ship through life.

The story of *HMS Enterprise's* acceptance into service was not an entirely happy one to begin with, since the delivery end of the ship's novel propulsion system, the two azimuthing podded drives, was transferred to her sister ship after a salt water contamination in *Echo*. In October 2003, she was therefore perhaps the first Royal Navy ship to be commissioned without any means of propulsion. This short-term setback was turned to advantage by the implementation of a comprehensive training programme and the completion of some harbour surveys of Dartmouth using the new and highly capable survey motor boat. These early surveys highlighted synchronisation problems in the multibeam sonar system, which affected positional accuracy in post-processing. Concerns were also raised in relation to the limited processing power of the computers designated for post processing of the very dense datasets. Although small isolated datasets could be processed quickly, only when larger datasets were brought together could the statistical analysis of the sonar record be properly achieved; this proved almost impossible until both software and hardware were upgraded in the following weeks. Working in the River Dart also highlighted the importance of maintaining tight control on environmental factors, in particular sound velocity. This had always been a factor in depth measurement, although not generally a substantial error source. With multibeam sonars, accurate knowledge of sound velocity is crucial to beam forming and increasingly impacts on the accurate measurements of both depth and position as distance from the nadir beam (i.e. directly underfoot) increases.

Acceptance trials started in earnest in the late spring of 2004 and thanks to the important pioneering work by the Echo team, many of the technical teething problems had already been addressed. An intensive sea safety training package was followed by a comprehensive trials and system calibration programme, conducted in the Western Approaches to the English Channel in unusually favourable weather conditions. By the end of May 2004, the manpower, training and equipment pillars had reached appropriate levels of development and the ship was ready for Operational Sea Training. The training syllabus, conducted initially as a single ship and then as part of a small naval task force, proved challenging but manageable. The demands of this period allowed the Ship's Company to grow in confidence as individuals and as a team. Importantly, they came to understand the capabilities and limitations of the "ship", in the whole sense of this word which combines the effect of man and machine.

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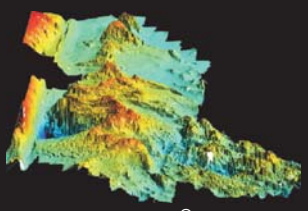
The instruments interface directly to the ship's data network and are prepared for synchronised operation to eliminate interference problems. Data Management and Data Processing solutions are available.



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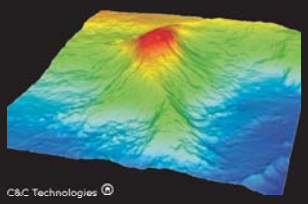
EM 120 is the leading multibeam echo sounder system for full ocean depth surveying and mapping. It offers stabilisation of acoustic beams for both yaw, pitch and roll, and produces clean, high precision bathymetry as well as acoustic seabed imagery/sidescan. Due to high power transmission of acoustic pulses and low noise receivers, the maximum swath coverage can be up to 25km. EM 120 can be integrated with a higher frequency system to an optimal seabed mapping system for all water depths. It is prepared for integration with SBP 120 sub bottom profiler, and interfaces directly to on-board data networks.



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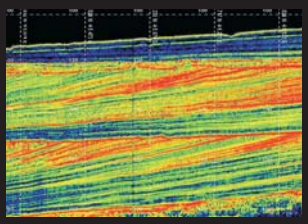
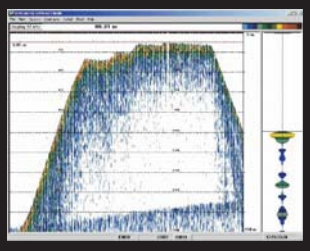
EM 300
EM 300 multibeam echo sounder is designed to do mapping from 10m depth to beyond the continental rises, including the shallower ocean basins. It operates down to approximately 5000m depth with swath widths up to about 5000m. Small transducers and compact electronics make the installation easy, and the system accuracy is generally well within the IHO standards.



SBP 120
SBP 120 is a sub bottom profiler for hull mounting, for operation in all water depths. It is a narrow beam profiler, beamswidths can be 3, 6, or 12 degrees. The system produces pitch/roll stabilised beams over a 30 degree swath and the system operation is optimised by integration with a multibeam echo sounder.



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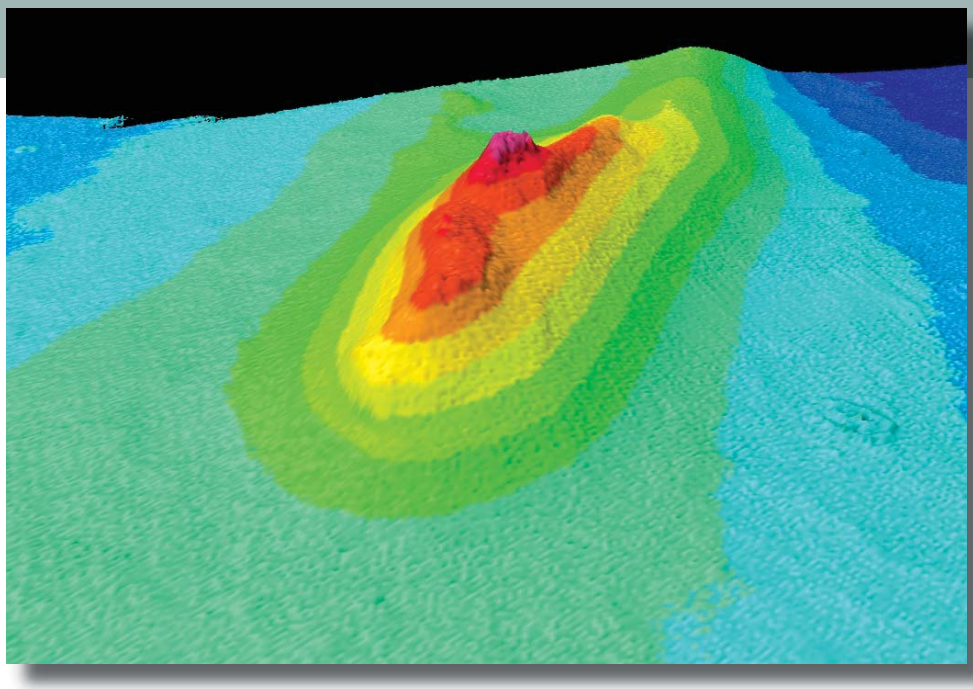

Elevation model of seabed on the approaches to Al Jubayl, Saudi Arabia.

Full operational capability could only be proven by a sustained period of operations, exposing the ship to a wide range of tasks. After deploying in early August, *Enterprise* paid her first foreign port call in Nice, before participation in the French Naval Review off Toulon. Within a few days, she was in the old Roman port city of Brindisi for the first of many crew rotations and then, after a short passage across the Adriatic, to take in hand a hydrographic survey of the northernmost part of the Albanian coastline. By this time, although the ship's routines were running smoothly and equipment had been proven, the capability to acquire, process and compile a complex hydrographic survey remained largely untested. Therefore, this first survey was suitably challenging, with plenty of shoal water to keep the survey launch busy and the ship's bridge teams on their mettle. The raw bathymetric data proved to be of a good quality, providing further evidence of the quality of the sonar installation and confirming the findings of the earlier trials programme. Post-processing nevertheless posed a considerable challenge, particularly when merging sounding data from ship and boat. With both *Echo* and *Enterprise* engaged in complex shallow water surveys, shortcomings in the ability of the data processing systems to handle the gigabytes of bathymetric data being acquired daily had provided the impetus for a further upgrade for both hardware and software, including new data visualisation tools. Perhaps unsurprisingly, pre-release laboratory system testing by the various contractors did not stand the test of continuous operations and the difficulties of mid-survey configuration control changes became, at times, almost unmanageable. In the background, constant liaison was taking place with the support authorities and UK Hydrographic Office in order to resolve the outstanding difficulties.

In order to take military capability to the next level, participation in a more complex joint exercise was required. The ship joined the major NATO Reaction Force exercise off the southern coast of Sardinia in mid October, in support of the then NATO MCM Force South. The direct tasking was relatively simple, but the communications requirements of such a complex exercise made huge demands on a relatively small specialist staff. Nevertheless, the transits to and from the exercise provided a welcome break from survey activities off Albania and an opportunity to catch up with the compilation of the survey records.

The Undulating Oceanographic Recorder is deployed from the A frame.

With the major elements of the hydrographic survey complete, the emphasis shifted towards a lengthy oceanographic data gathering operation in the eastern Mediterranean basin. The data volumes associated with oceanographic tasks are somewhat less demanding, but problems of a different nature may be experienced by exposing scientific instrumentation to the extremes of sea and weather, which is a necessary part of the operation, particularly in the Mediterranean Winter conditions. Instead of the oceanographic station (i.e. data point) sampling methods used by previous ocean survey vessels, often at intervals of many tens of miles, the new capability conferred the considerable advantage of continuous sampling of the top 500 metres of the water column by undulating profiler. This data was supported by a continuously operating hull-mounted Doppler current profiler, which separated ocean current and tidal stream movement from the ship's own velocity, with sampling down to a depth of several hundred metres. If this real-time data was correlated with the latest sea surface satellite imagery, then it was possible to extrapolate ocean conditions over a wide area, while looking at local conditions in detail. Much work remains to understand how this potential could be exploited for operational purposes. For now, oceanographic databases will be populated with high quality information, at a much accelerated rate of collection.

After a final visit to Monaco, the ship returned to Devonport from her first nine-month deployment at the end of May 2005. Further task force level training in Exercise *Neptune Warrior* and the Trafalgar 200 Fleet Review were to follow, but by September *Enterprise* was again transiting the Straits of Gibraltar, en route to the Northern Arabian Sea.

So what may be gleaned from this experience? A ship is a complex "system of systems" which provides a capability only when matched with well-trained and motivated personnel, supported by a robust logistic tail. From the CO's perspective one is uniquely positioned to witness and leverage the efforts required from one's own resources and those of the broad supporting cast. Despite the early procurement setbacks, which had a serious impact on the Service's hydrographic output at the beginning of the decade, the end result more than met expectations in terms of capability. Indeed, improvements in armament, the periodic embarkation of Royal Marine detachments and other incremental additions have broadened the scope of employment during unsurpassed periods of availability.

Anniversary Dinner
60 years of the Army Survey Course
21 January 2008 – The RAG

A dinner will take place at the Army & Navy Club (The Rag) on 21 January 2008 to celebrate 60 years of the Army Survey Course. It is proposed to attempt to contact as many past students as possible, both British & Overseas. The venue is such that it is provisionally intended to be able to accommodate 120 diners which will include a number of VIPs. The event will coincide with DGI 2008 which will encourage overseas attendance. A proposed format is a champagne reception at 1830hrs followed by a 3-course dinner with wine and port followed by a cash bar. Provisional costing at this stage is unlikely to exceed £20 per head because of the generosity of a major sponsor, ESRI. The initial issue is to find contact addresses for past students. The DSA, RE Institution and REA are good sources but the difficulty will be overseas contact though the DGC will help. At this stage please note the date in your diaries and if you have contacts from your particular courses these would be most welcome. Queries/Information should be addressed to the organiser, Tony Keeley Hon Sec DSA, at keeley.tony@rsms.ac.uk telephone 01635 204244 or The Royal School of Military Survey, Denison Barracks, Hermitage, Thatcham, Berkshire, RG18 9TP.

DEFENCE SURVEYORS' ASSOCIATION
(formerly the Field Survey Association)

MEMBERSHIP APPLICATION FORM

To: Honorary Membership Secretary
103 Hawthorn Grove, Combe Down
BATH, BA2 5QQ

E-mail: membership@defencesurveyors.org.uk

Personal Details:

Family Name		**First Name**	
Title/Rank		**Decorations and Qualifications**	
Date of Birth		**Service and Rank (if applicable)**	
Postal Address for Communication			
Home Telephone Number		**Work Telephone Number**	
Home E-mail		**Work E-mail**	
Summary of relevant experience and courses with dates and/or details of professional, commercial or academic background in the Defence Surveying business[1]			
Name and Contact details of Sponsor[2]			

Sponsors do not need to sign the form as the Honorary Membership Secretary will confirm that sponsors are content to support the application.

Submission of Applications. Applications may be submitted either by e-mail or post using the addresses given above. When accepted for membership, applicants will be informed by the Chairman and receive an introductory pack from the Honorary Membership Secretary.

Membership Fees. Do not send any money with this form. New members are required to pay an annual membership fee of £15 starting from the 2nd January after they join. You will be sent a standing order form in due course which you will be asked to complete and return to the Honorary Treasurer covering the fee for the next calendar year. Any member who wishes to do so may alternatively pay the annual subscription of £15 by cheque, Any such cheques should be made out to the 'The Defence Surveyors' Association', and reach the Honorary Treasurer by 2nd January each year (Roy Wood, DSA Hon Secretary, 9 The Chase, Donnington, Newbury, RG14 3AQ).

Data Protection Act. In accordance with the Data Protection Act, the above information will only be held for administrative purposes by the DSA.

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[1] This information will form the basis of short biography for inclusion in Ranger Magazine (6 lines maximum). Please append additional information if there is insufficient space on the form.

[2] Any applicant who does not have a sponsor but believes that he/she meets the criteria for membership of the Association should contact the Honorary Membership Secretary who will provide advice on possible sponsors using his knowledge of the membership list to assist the applicant in finding a suitable sponsor.

This form can be downloaded from the DSA website at www.defencesurveyors.org.uk. If you would prefer to reply in hard copy but do not wish to remove this page from the magazine please photocopy this application form. Replies in either hard or soft copy are welcomed by the Membership Secretary at the addresses given above.

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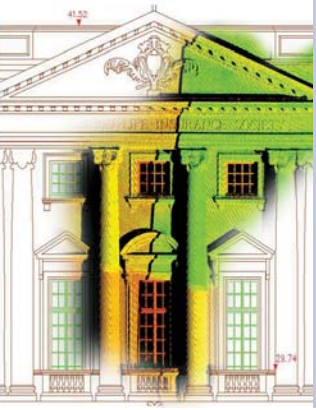

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