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GALILEO – The European Global Navigation Satellite System.

Images courtesy ESA

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

DEFENCE SURVEYORS' ASSOCIATION

In 1927, a group of officers who had contributed to the great success of the Artillery in 1917-1918 by the provision of counter-bombardment data from Sound Ranging & Flash Spotting and led by the Nobel Prize-winners Sir Lawrence Bragg and Harold Hemming formed the Field Survey Association as an old comrades association and a known pool of expertise if called upon for another war. The association was in abeyance during the Second World War but many members again saw active service. The Association resumed activities in 1945 and, in 1997, was renamed the Defence Surveyors' Association more properly to reflect the multi-disciplined changing nature of Geographic Intelligence support to the three Services

The aim of the DSA is to promote an understanding and appreciation of defence surveying, mapping, and charting and geospatial intelligence in historical, current and future contexts and to keep past and current members of that community in touch with one another. Members are from defence, industry, academe and private sectors.

Chairman's Remarks

Welcome to the 2017 Winter edition of the Ranger. In this edition the Defence Surveyors' Association brings together an interesting collection of historical papers as well as topical subjects concerning technology, applications and operational capability. Brig Ben Kite, in his paper on the National Centre for Geospatial Intelligence, also recognises the importance of the rich and varied heritage of our discipline. As we approach the centenary of the end of World War I there are lessons to be learnt from the experiences of those involved. In her article on Mapping WWI for the Army Battlefield Guides, Barbara Taylor reminds us of the importance today's military commanders place on military history through battlefield tours. In this edition of the Ranger there are excellent articles that inform us of historical developments and operations in both WWI and WWII, as well as the more recent past in Alan Gordon's article on 42 Survey Engineer Regiment in the 1970s.

As SSgt Havenhand observes in his paper the Geospatial world continues to change at a rapid pace. This places an enormous challenge on those serving today. However, the adaptability and commitment of defence personnel remains outstanding. It is therefore appropriate that we learn about the RE Geo Science Foundation Degree graduation ceremony at RAF Wyton where Defence and Sheffield Hallam University celebrated the commitment and achievements of our young specialist technicians.

Today the DSA strives to engage with the wider Defence community, not least by engaging with WBR and the DGI Conference in London each January. The field of GEOINT extends beyond the serving community into other government Departments, academia, industry and NGOs. In many cases these various segments work closely to bring together specialist skills and capabilities. It is evident from Brig Kite's paper that collaboration is key to the successful exploitation of GEOINT; not only collaboration across UK Defence but also with our allies and commercial and academic partners.

It is important that the DSA continues to raise awareness of historical achievements across Defence surveying, mapping and charting whilst playing a key role in influencing those involved in future capability, be that in industry, academia or government. Through our annual Seminar, the AGM and Dinner, and this publication, the flagship activities of the DSA, we meet the needs of our diverse membership. However, for the DSA to remain relevant and indeed flourish, it is essential that we engage with those active in the community. To this end the DSA welcomes new members from those currently serving as well as other sectors.

This year's Seminar was held for the first time at the Arlington Arts Centre, just outside Newbury. Through Mike Nolan's enthusiasm and drive this event continues to attract a good audience and his plans for next year's seminar are well under way with an excellent panel of speakers. The Seminar will take place on Friday 8th June 2018, again at the Arlington Arts Centre.

Finally, I would like to thank Chris Nash for his tireless efforts and excellent guidance of the Association over the past three years as Chairman.

John Knight - *Chairman*

Prize Awards for 2016/2017

The following prizes were awarded and presented by the President of the DSA, Major General Roy Wood:

Royal Navy

Lieutenant Ed Raymont Royal Navy

Through his outstanding work during Exercise Unmanned Warrior 16, Lieutenant Ed Raymont is nominated for the award of the Defence Surveyors' Prize having made a significant contribution to the advancement of the technology associated with the acquisition and management of geospatial data in the Defence geospatial arena.

Exercise Unmanned Warrior 16 (UW16) was the largest UK deployment of oceanographic gliders and the multi-national, collaborative autonomous tasking of sub-surface unmanned vehicles. Lieutenant Raymont played a pivotal role in the exercise, leading the Mobile Survey Team and working closely with a wide range of system providers from defence, industry and academia in a determined bid to achieve the GeoInt objectives, maximising the capability of UUVs (Slocum gliders, Seagliders and REMUS 100/600).

A skilled practitioner, Lieutenant Raymont's impressive system knowledge combined with his drive and determination to demonstrate the force multiplying capability of these systems resulted in the provision of high quality geospatial intelligence. In support of Mine Counter Measures objectives in particular, he provided specialist hydrographic expertise to optimise geospatial data collection, processing and analysis. His impressive understanding of Maritime Autonomous Systems (MAS), acute awareness of user needs and adept data manipulation allowed effective demonstration of the tactical employment of these systems to mature credible capability choices.

His involvement was also critical in the oceanographic theme of the exercise. With the aim of maximising accurate geospatial data collection, he remotely planned and executed the launch and recovery of oceanographic gliders, coordinating with military and civilian organisations to carry out the largest scale glider launch of its kind. This was all completed in a relatively tight time window due to poor weather and significant water space management challenges.

Lieutenant Raymont excelled throughout UW16, and through his dedication and professionalism he has undoubtedly enabled significant progress in the assessment of the capabilities of emerging autonomous and remote controlled technologies and their part in future military operations. He has maximised the learning opportunities for naval scientists and engineers in geospatial intelligence and also played a significant part towards enabling operational forces to develop concepts of operations for the employment of unmanned systems in real-world naval scenarios.

Royal School of Military Survey, Royal Engineers

WO2 (QMSI) Jason Harrop MSc RE

WO2 (QMSI) Harrop has been the QMSI Geodesy and Navigation at RSMS, his main responsibilities include providing governance and teaching to the Military Engineer Geographic Technician programmes and the All Arms Defence courses. With his Masters level qualification he has also been an important component of the GEOINT MSc course programme in terms of teaching delivery and as a respected Research Project Supervisor, leveraging his expertise within the field of Geodesy and Geospatial Reference Systems, and his comprehensive understanding of the wider GEOINT support requirements.

Technically impressive, he has sought opportunities to build the Geodetic Positioning capability throughout the ME Geo specialisation, taking on the responsibility of planning and delivering a pilot

Positioning Task Manager's course with great success, testament to his ability to pinpoint areas where tangible improvements can be realised and act accordingly

During a period without a Department Head due to retirement, he has absorbed the additional responsibilities ensuring that his team have maintained a high level of capability whilst he independently provides a consultative facility to the wider Defence audience. This is evidenced by his involvement with the Royal Military Academy Sandhurst in developing and delivering a bespoke Desert Navigation package to the teaching staff.

An innovative thinker, with a comprehensive understanding of how GEOINT support can be delivered, his consultation during the Advanced Warfighter Experiment (AWE) conducted on Salisbury Plain which aimed to de-risk equipment and inform future concepts, requirements definition and Equipment Programmes to meet identified capability gaps. The Command and Battlespace Management function invited five Companies offering a Dismounted Situational Awareness solution to attend, each solution, although similar, was very different in what was offered, this was particularly evident in the standard of Mapping presented and Navigation functionality embedded into the Battlespace Management Applications. An extract below articulates WO2 Harrop's impact during the experiment:

> *"We were delighted to have WO2 Harrop on board because he provided AWE with an assurance and confidence mechanism that enabled thorough experimentation to take place. His experience and knowledge also offered additional areas to consider as part of the Plan of Test to further explore what the capabilities were able to achieve beyond that submitted in their White Paper submissions. This allowed boundaries to be tested with very interesting results, results that provided invaluable data to the Companies as they would never usually be exposed to such expertise.*
>
> *Having the expertise of WO2 Harrop to hand was invaluable. He may say that we never really used him to the full but his input was of substantial benefit to the experiment".*
>
> *Maj W J Duggan IG, SO2 Command & Battlespace Management*

The above extract reinforces WO2 Harrop's unassuming yet significant impact and influence on the opportunities he is involved with.

More recently WO2 Harrop embarked in working with the British Cartographic Society (BCS) delivering their Restless Earth project to secondary schools across the UK, this project aims to introduce students to map reading and cartographic design skills using real world scenarios. This year BCS have introduced a new scenario for Restless Earth, known as "Project Harrop", based on the 2009 floods in Cumbria. The comments below from Alice Gadney highlight the impact his involvement had:

> *"WO2 Harrop was instrumental in guiding me and putting together the scenario – the new scenario is titled "Project Harrop" reflecting his direct impact on the workshop development. Feedback from delivery of Harrop's scenario at Kirkbie Kendal school on 28 Feb 17 was exemplar with highly praiseworthy comments on WO2 Harrop's presentation and his ability to enthuse students regarding cartography and the importance of geospatial support to the emergency services and local government".*
>
> *Mrs Alice Gadney, Restless Earth Coordinator, British Cartographic Society*

WO2 Harrop took the Restless Earth Project from an overly complex series of daunting tasks utilising Japanese script mapping, to a relevant and highly interesting scenario based on an historical flooding event in Cumbria. Development of this project was solely down to his imagination and educational vision and was completed outside of his busy work schedule. The scenario encourages the students to appreciate the applicability of geospatial support and how it can be used to aid decision making.

It is for his considerable commitment to RSMS, Geodetic Positioning capability and the wider GEOINT support that WO2 Harrop is nominated for the Defence Surveyors' Association prize.

Royal Engineers (Geographic)

Lieutenant Colonel Alex Harris Royal Engineers

Lt Col Alex Harris has been proactive in delivering substantially beyond the remit of his specialist role (managing topographic foundation requirements pan Frontline Commands) during his two year tenure in JGI. In so doing he has routinely engaged with stakeholders from a wide range of organisations, ranks, interests and nations and has justifiably attracted widespread verbal acknowledgement of his individual contributions. This citation is forwarded for the DSA Council's consideration for formal recognition of Harris' output that has advanced many areas of Defence Geospatial interests.

During a turbulent period of recurring gaps in the SO1 and B1 status of JGI staff he has been instrumental in the development of Geospatial Standards both nationally and internationally. He has fulfilled leadership roles in both the multinational Defence Geospatial Information Working Group (DGIWG) and, exceptionally, the Five Eyes Allied System for GEOINT Standard Forum (ASF). In both groups he has deployed a blend of informed specialist understanding and military judgement to achieve consensus on the prioritisation of collaborative effort in areas of technical complexity. This is all the more impressive given he was single handed in organising a combined DGIWG/ASF conference for two weeks in May this year. Entailing significant administrative effort, and liaison with numerous stakeholders from the facilities team at Cambridge University (at both Jesus and Queens Colleges), to MOD finance and the 120+ delegates from 50+ nations, he has burnished the British national reputation. As an indication of the effort required an allied nation allocated circa 250K dollars to arrange hosting the equivalent event in 2018; Harris achieved this within his personal capacity, while simultaneously sustaining the impetus of the technical collaboration.

Similarly in the NATO Geo community he has routinely and effectively engaged up to the one star level, elegantly promoting national and allied interests. Among a cohort of experienced OF4/5s and civilian geo specialists he has been instrumental in streamlining policy and interoperability arrangements to enable effective response to the increased operational demand. Examples of his particular contribution include refining the release arrangements for nationally owned Geospatial Information and coordinating Geo classification practice with alliance security policy. Furthermore the recent NATO Geospatial Board approval of the pilot study into Human Geography (HG), was shaped substantially by his national and multinational collaboration in related working groups. This has set the conditions for coherent geospatial representation of the distribution and analysis of ethnic, religious and linguistic properties and increased the future informed understanding available to shape Key Leadership Engagement.

Consistently demonstrating impressive capacity to apply himself widely, effectively, intelligently and imaginatively he has achieved substantial progress across manifold specialist fronts, specifically in the foundation geospatial services, standards, international collaboration and HG areas. He rightly attracts my strongest recommendation for consideration for award of a DSA prize in formal recognition for his specialist contribution while in post at JGI from Aug 15-Aug 17.

Royal Engineers (Geographic)

WO2 Damon Mitchell

Within the Royal Engineers (Geographic) community, SSgt Mitchell is widely considered to be the foremost expert in advanced imagery exploitation. Assignments within 42 Engineer Regiment and to Geographic Support Groups supporting specialist Defence capabilities have enabled him to build a deep understanding of imagery exploitation techniques and applications. His posting to the Royal School of Military Survey (RSMS) as a Phase 2 training instructor ensured that his extensive knowledge was imparted to a generation of geographic technicians, the impact of which will benefit Defence for years to come. Recently assigned to the Reconnaissance, Intelligence and Geographic Centre in Northern Ireland (RIGC(NI)), he has implemented profound changes to working practices and output.

On his arrival at RSMS in summer 2013, SSgt Mitchell continually placed considerable effort into developing an Advanced Imagery Exploitation module, ensuring that it included an awareness of Imagery Intelligence (IMINT). His attendance on a Full Motion Video course demonstrated his professional diligence by examining the potential for all sources of imagery to be exploited

geospatially. Throughout his time at RSMS he showed enormous initiative, increasing his professional effectiveness, whilst also developing the synergy between the Imagery and Geospatial Intelligence (GEOINT) disciplines. His voluntary promotion and instruction of imagery exploitation techniques benefitted the RIGC(NI), the Tactical Imagery-Intelligence Wing and IMINT Wing. His visits to IMINT Wing, to identify and then suggest ways to improve the interaction between geospatial and imagery analysts, were met very favourably.

Through his efforts, IMINT Wing now fully understands the capability of advanced imagery exploitation and the vital importance of analysing imagery within a geospatial framework. As a consequence of SSgt Mitchell's collaboration, IMINT Wing is reviewing the UK Imagery Analysis Course (UKIAC) to include innovative imagery analysis techniques and photogrammetric procedures to exploit all imagery sources. Additionally, through SSgt Mitchell's engagement, the Wing now recognise the absolute importance of working within a geospatial framework and the UKIAC will now include a five-day module where the students will be introduced to the fundamentals of geospatial exploitation (cartography, geodesy, spatial data collection from imagery and basic spatial analysis techniques) to enable IMINT to be spatially analysed. The Senior Instructor of Geospatial Exploitation Wing, RSMS, had the following comment on his impact:

> *"SSgt Mitchell is a deep SME in the field of imagery exploitation and has excellent knowledge of the subject and associated specialist imagery software. This combined with his intellect, communication skills and operational experience has been a catalyst for enhanced Geospatial and Imagery Intelligence interaction within the Joint Intelligence Training Group. This is the real measure of him; an advocate of imagery exploitation, he sees the bigger picture and has the energy and determination to maximise opportunities and add operational value".*

His posting to the RIGC(NI) provided the ideal environment for him to reinvigorate imagery exploitation processes and generate innovative GEOINT products. Within a short period, he not only delivered in both areas, but also left a lasting legacy thanks to his implementation of comprehensive training and support plans. Highly adept in realising the potential of imagery manipulation software, SSgt Mitchell facilitated the generation of three-dimensional models from high-resolution digital surfaces using wet film imagery. The Commanding Officer of 5 Regiment Army Air Corps had the following to say:

> *"Drive, determination and considerable technical ability are required to make profound changes to established processes and output. Possessing all these traits, and an infectious enthusiasm for his trade, Staff Sergeant Mitchell has ensured that the systems and personnel of the RIGC(NI) are pushing the limits of wet film imagery exploitation".*

It has taken considerable knowledge, skill and patience to develop and implement procedures for the digitisation of wet film frames and their subsequent manipulation by specialist software. Orientation parameters critical to the complex calculations that allow images to be rectified were absent from the data reported by the camera. Using a variety of software tools, he was able to formulate their values enabling image rectification and the application of more advanced exploitation techniques. The resulting models have demonstrated their utility in a variety of UK Counter Terrorism tasks delivered to a range of customers. In addition, he has been critical in recognising the need, and establishing the user requirements, for a replacement digital sensor. The Officer Commanding RIGC(NI) stated the following:

> *"SSgt Mitchell possesses enormous passion for his trade. As a result, he has enforced changes in working practices, employing no small amount of tact and diplomacy in the process. This has resulted in a revolution in the quality of geospatial intelligence product leaving the RIGC(NI); we are now able to offer a much higher level of appreciation of the ground and answer very specific RFIs that we were hitherto unable to. Furthermore, he has provided me with invaluable advice that has been instrumental in ascertaining and defining the desired attributes for RIGC(NI)'s future digital sensor requirements".*

These sentiments were echoed by the Geospatial Analysis Troop Commander:

> *"SSgt Mitchell's technical acumen is superb. His successful formulation of unreported orientation parameters have enabled the accurate orthorectification of digitised wet*

film imagery. In addition, he has ensured that, as standard, stereo-pairs of image frames are digitised thus enabling the generation of high resolution digital surface models and point clouds. The resulting 3D models are proving extremely popular with our customers, particularly the 3D intervisibility studies. The training and support he has provided to both RE(Geo) and RAF personnel has also been first class".

Providing a comparative summary of the changes implemented at the RIGC(NI), Commander Royal Engineers (Geographic) stated the following:

"I visited RIGC(NI) two years ago in another role and noted that there were significant problems with the way in which the unit was using scanned digital imagery and little technical knowledge of the underlying issues amongst either the RE or RAF personnel. Returning more recently as CRE Geo I was struck by the obvious step change that had occurred since SSgt Mitchell's arrival. His analysis of the underlying issues, development of rigorous and practical solutions, and patient coaching and mentoring of Geo Tp to understand and apply those solutions has made a profound difference to the standard of intelligence product that RIGC(NI) is able to provide to its operational customers".

SSgt Mitchell's three years in RSMS and 10 months at the RIGC(NI) have significantly enhanced the RE(Geo) and IMINT capability and operational output from these units. Trusted to develop and implement training for our geographic technicians, a proven deliverer of high quality GEOINT in support of operations and the recognised subject matter expert for imagery exploitation within RE(Geo), SSgt Mitchell is fully deserving of a nomination for the Defence Surveyor's Association RE (Geo) prize.

(WO2 Mitchell was not able to attend the Prize-giving because of his posting to the United States).

DSA Award.

Comment by Damon Mitchel.

"Chuffed to bits with my DSA award and prize for doing something I enjoy!!"

Part Four: A Decade of Economic Problems and Industrial Strife

By Alan Gordon

Background to the Seventies

The 1970s were overshadowed by continuous industrial relations strife, political upheavals, a dire national economic situation and the increasingly violent 'troubles' in Northern Ireland that also spilled over onto the mainland and even to British Forces based in Germany where 14 Squadron in Dusseldorf was bombed twice.

The Regiment after the 1972 Reorganisation

The unit created by the 1972 reorganisation was a very different one to its predecessors. 19 Squadron remained much the same in organisation and role but on the 1st of January 1973 its title was changed to 19 Geodetic Squadron in order to better reflect the work it was carrying out. 22 Squadron's capability was truly reflected its new title of 'Map Production' as it now included all the elements necessary to produce *ab initio* mapping from air survey to print finishing. 13, whilst still accommodated separately in B Camp and still with an 'independent' feel about it, mirrored the capabilities of the other two squadrons but on a smaller scale and with all its reproduction equipment housed in the Mobile Train trailers. The squadron was also given responsibility for two new map supply initiatives. Under the direction of the newly created AD Survey UKLF a War Reserve Map Store, later renamed War Reserve Map Depot, was established in the old cookhouse in B Camp and Home Defence Map Stores were set up around the country with 13 Squadron tasked to maintain them.

Regimental Life in the First Half of the Seventies

This period saw the phasing out of the 'A' trades by encouraging tradesmen to take a technician course or by them attending a conversion course at the School so that all military surveyors, other than the storemen, became technicians. The introduction of the 'military salary' in 1970 raised considerably the living standards and expectations of the soldiers. This, together with the fact that the days of postings to former colonies were long over with most military surveyors now only moving between Hermitage and Barton Stacey led to the first intrepid few buying houses in the vicinity of either Newbury or Andover. If a homeowner did get a posting elsewhere in the UK, mainly air surveyors to JARIC or 1 ASLS, then many chose to commute weekly and live in the Mess where they were known as 'bean stealers'! The future seemed to be a rather settled one comprised in the main of moving up and down the A34 - a very different life to that experienced a few years earlier.

Field surveying in exotic locations: setting up the base camp at Mado Gashi during Exercise Fourpence 1974.

Within the Regiment there were two very different lifestyles depending on one's trade. For the field surveyors of 13 and 19 Squadrons it was a continuous series of overseas deployments often to exotic locations and little involvement in the humdrum unit events such as guard duties and parades. For the remainder, other than the air surveyors' annual deployment to Norway and Wednesdays with its military training and sports afternoon, there was little to differentiate their working life from a civilian's with the same trade; they went to work and plotted map detail, fair drew it or printed it and then went home or back to their room.

The midweek military training sessions were generally neither arduous nor taken particularly seriously and fitness was seen to be achieved mainly through sport which left the non-sportsmen not

necessarily very fit. Drill parades were regular features and occasions such as the Queen's Birthday were celebrated in this way often with pupils from the village school invited to watch. On the 30th of November 1974 13 Squadron marked its 150th anniversary with displays and an impressive parade.

Major General B StG Irwin presents a theodolite to commemorate 13 Squadron's 150th anniversary to the OC, Major M StG Irwin, his son.

Another aspect of life at this time was the almost constant stream of official visitors both military and civilian, national and international, including in August 1972 Lord Carrington, the Secretary of State for Defence, all of whom were shown the full gamut of the unit's technical capabilities.

All this was against a background of ever increasing industrial strife led by militant coal miners and a crippling national financial situation. This came to a head at the end of 1973 when the miners went on strike and to reduce electricity consumption and thus conserve coal stocks, the government announced a number of measures including the "Three-Day Work Order", which came into force at midnight on the 31st of December. Consumption of electricity was limited to three consecutive days each week, television finished at 10.30 each night and most pubs were closed. The Regiment had to abide by these rules with the exception of those working in support of operations in Northern Ireland. The '3-day week' continued until the end of March but strenuous financial constraints continued until the end of the decade.

Lord Carrington, the Secretary of State for Defence, was one of many visitors to the Regiment.

The 'Troubles' in Northern Ireland

The IRA terrorism campaign had little direct impact on the Regiment and, despite the 1972 bombing of the Parachute Brigade Headquarters only twenty miles away in Aldershot, Barton Stacey was never fenced in and the guards carried only pick helves – unfenced, with its guardroom in the centre of the camp and located immediately adjacent to fast dual carriageways heading in all four directions the camp would have seemed to be a prime target.

The Regiment received continual technical tasking in support of *Operation Banner* from 1970 onwards starting with the production of town plans which by 1974 were themselves being revised. A range of 1:20,000 map sheets were produced during these early days which would then also enter a revision cycle over the ensuing years. There were few air surveyors or cartographers who at some stage did not work on Northern Ireland mapping. Other than this the unit's involvement in the province itself was generally quite limited.

The only physical counter terrorism measure at Barton Stacey was the fencing in of the guardroom.

Production Work

No sooner had the Regiment reorganised in 1972 than its tradesmen gained national recognition for their skills when 22 Squadron won the prestigious 3M 'Excellence in Lithography Award' for the production of a 1:25,000 sheet of Junk Bay, Hong Kong. Print Troop Commander Captain Gerry Gerhard took the troop to London to be wined and dined at the 3M Awards ceremony in the Dorchester Hotel and on their return the winner's cheque for £200 was promptly deposited in the PRI account.

In addition to the nonstop Northern Ireland work there was always ongoing map production work in air survey and carto troops; production of Norwegian sheets following each Exercise Carto Norge

deployment and revision of mapping of British Honduras, Malta, Anguilla and Hong Kong to name but a few of the tasks and during 1973 and 1974 there was a major effort to produce new maps of the UK Training Areas. The printers were always busy and normally worked a two shift system and by 1974 output was running at some 3.75 million impressions a year from over 350 sheets.

Field Surveys in the Early Seventies

This decade was marked by almost continual overseas surveys many to exotic locations – these were perhaps the 'golden years' of field surveys.

13 Squadron's field surveyors spent six weeks during February and March 1972 detached to the Military Adviser Team Gulf to produce ground control for new mapping and whilst there they had the unpleasant task of recovering the remains of some 130 people from a crashed Scandinavian air liner. The two major exercises that year involved an enlarged troop from 19 Squadron deploying to the east of Lake Rudolf in Kenya on *Exercise Topo Kenya* to establish the control for six new 1:100,000 map sheets by EDM and altimetry. This was to be the first of a long series of annual exercises in Kenya. The other major exercise was *Carto Norge* but now mounted by 22 Squadron with field survey assistance from 19. In April surveyors went to Germany on *Exercise Firefly* to set up special cameras at Hohne as the next phase of the battlefield illumination project previously trialed at Moody Down. UK surveys included work on the Flannan Islands west of the Hebrides and tasking for the Royal Navy and RAF to set up inertial navigation systems.

The following year 19 once again sent a troop to Australia and in May and June virtually the whole squadron moved to North Wales on *Exercise Red Robin* to provide assistance to the Ordnance Survey. 22 Squadron mounted the annual *Carto Norge* and a reconnaissance was carried out in Kenya to prepare for a major exercise in 1974. There were small tasks continually throughout the year with few, if any, field surveyors residing in A Camp for very long.

During 1974 there were three major overseas exercises. From April to June a troop from 19 Squadron were employed in Cyprus on *Exercise Quantum* establishing 49 third order stations in the Troodos area for new 1:50,000 mapping by the Cypriot authorities. From August until November the whole of the squadron, less a small rear party, was deployed to Kenya on *Exercise Fourpence*. The main task was a first order traverse connecting two Doppler stations fixed previously by 512 STRE covering over 500km in the north east of the country. The task required the use of 60 foot high Bilby Towers for nearly half the distance. Despite the difficult terrain and the need to construct the towers the task preceded ahead of schedule and several other small tasks were also completed. Air Survey Troop from 22 Squadron, supported by the Army Air Corps spent two months during the summer in Norway on Exercise *Abanila*. This replaced *Carto Norge* that year and involved field preparation as the first stage in the production of a block of twelve sheets of series M711, the Norwegian national mapping series at 1:50,000.

Apart from these major exercises field survey tasks were carried out across the UK including Northern Ireland and on Malta, the Solomon Islands, Ethiopia and several surveyors were attached to Field Squadrons working in Malawi and the Sudan.

In June 1975 a large detachment from 19 Squadron accompanied by pilots and ground crew from 7 Regiment AAC deployed to Tvildemoen near Voss in Norway on *Exercise Carto Norge 75* to continue the field work for the production of the twelve sheets of M711. The task comprised checking lake levels and bench marks, air photo annotation and finding, pre-marking and flying spotting photography of 61 trig points as well as establishing five new control points on the Hardangerjokulen Glacier. The exercise was a technical success and the detachment returned to Barton Stacey at the end of August. Whilst this was the major field survey task of the year parties were also sent to Cyprus, Sudan and to BAOR.

13 Squadron: Exercises and Displays

From early spring, through summer and into autumn 13 Squadron's Mobile Train could be seen slowly lumbering out of B Camp and onto the new dual carriageways of the A303 heading off to an exercise or to showcase their expertise at a military or civilian display. The squadron deployed tactically to undertake field surveys of the type likely to be required in wartime and carry out map production in the field as well as practising military skills and living in the field. During 1972, for example, the unit set up and operated in Bulford, Weymouth, Hawley and Mereworth Woods in Kent, a location used by the squadron for many years. Most years the unit deployed to BAOR and

Although only ten years old the Mobile Train was already too slow and cumbersome for the more mobile operation of the early Seventies.

it always took part in the biennial NORTHAG Geographic *Exercise Dominate*. All the exercises in the UK were standalone Military Survey events with the only direct support to the field army provided by the Land Rover based Close Support Team that deployed with formation headquarters.

In 1973 the squadron deployed to Germany for a BAOR exercise named *Barletta* where the unit joined with 14 and 135 Squadrons to test a new concept of rapid map revision. However, the exercise also confirmed that the days of the slow and cumbersome 'mobile train' were numbered as it could not satisfy the needs of the faster moving operations that were now the norm.

Each summer 13 Squadron provided the Military Survey element, either the Mobile Train or Close Support Team, for displays such as the Aldershot Army Show, RE Demonstration, RSME Open Day and Ripon Weekend and occasionally at civilian events that were relevant for example, ''Surveying 1972' at Leeds Polytechnic. Manning a display was a popular duty and provided a chance for a few days away from the routine of life in B Camp.

New Equipment

Despite the country's deepening financial woes the Regiment received a trickle of new equipment throughout the decade. Field Survey Troop gained newer model electronic distance measuring equipment but perhaps the major change was the introduction of Hewlett Packard programmable desktop computers and software that replaced innumerable computing forms and mechanical calculating machines such as the Brunsviga, Facet and the small handheld Curta.

Air Survey saw the arrival of a further two Wild B8s one of which was then enhanced with a tri-axis locator and electronic read out, Zeiss DP1 anaglyph plotting machines replaced the aged Multiplex and the pre-war Cambridge stereo comparators were replaced by a Hilger Watts instrument that output the observations directly onto punched tape.

A Wild B8S with tri-axis locator and EK8 which provided a digital read out of co-ordinates thus providing an aerial triangulation capability.

There seems to have been little innovation in either cartographic or photographic equipment during these years but there was total change to the printing inventory. A Directorate 'Printing Machine Review' in February 1975 identified the need to replace all the existing machines and the latter part of 1975 and early 1976 saw the complete replacement of all the presses in 22 and 13 Squadrons and also 135 Squadron TAVR. The three Crabtree Countesses and the Ensign in 22 Squadron were replaced by two Roland R2U IV two-colour colour machines and two Heidelberg SORD Z two colour machines. The Crabtree machines in 13 and 135's mobiles were replaced by Heidelberg SORD single colour presses. The 27 ton weight of the Roland machines required strengthening of the machine room floor but the first SORD Z was installed in early November 1975 and was printing only two weeks later. Installation continued, beset by a few problems, over the New Year and the fourth machine was in operation on the 1st of March and the printers were equipped with modern high speed presses. The faithful Crabtree presses were taken away for scrap in April.

The 1974 Defence Review and its Impact on the Regiment

The country's dire financial situation prompted a Defence Review in 1974 that was driven by the government's urgent need to save money and it achieved this by reducing commitments and, consequently, troop numbers. Its main policy change was to shed virtually all the remaining global responsibilities and concentrate almost solely on supporting NATO with forces in West Germany that were to be reinforced with 'cheaper' UK based troops. A major restructuring of the army was

designed to eliminate a command level – the brigade – by the introduction of the 'Field Force' albeit this was a relatively short lived experiment that was soon reversed. The direct impact on the Regiment was that by 1978 it was to lose 50 posts bringing its establishment down to 308 all ranks and 62 civilians and to reduce to only two squadrons.

1976 and the Final Reorganisation

It was originally proposed that the reduction to only two squadrons should be achieved by disbanding 19 Squadron with one of its field survey troops going to 13 Field Survey Squadron and that 22 Squadron should remain. This proposed organisation was then reviewed to take into account the decision to drop the mobile capability within the Regiment as it was too slow and cumbersome to meet the needs of the times. This effectively removed the need for a field survey squadron and so it was decided to reorganise on a trade basis to improve overall efficiency and production capability with the minimum loss of survey tradesmen but considerable savings in administrative manpower.

Although the function of the map production squadron remained exactly the same it was decided that as 13 was the oldest survey unit the number would be retained at the expense of 22. And so it was that on the 26th of June 1976 the Regiment re-organised into its final structure of 13 Map Production Squadron and 19 Topographic Squadron, which reverted to its original title, with RHQ Troop remaining the same. The occasion was marked by a ceremonial parade that included the disbandment of 22 Squadron and the re-designation of 13 Squadron.

Both Squadrons were restructured on a trade basis with Field Survey, Air Survey and Map Supply in 19 Squadron and Carto, Photo and Print in the Map Production Squadron. The practical implementation of this reorganisation involved all the Regiment's field surveyors being pooled into two large Field Survey Troops within 19 Squadron and all the air surveyors also moving to 19 to form a new and larger Air Survey Troop. At the same time the UKLF War Reserve Depot, responsibility for the UK Regional Map Stores and the Map Supply Points (MapSP) came under command of 19 Squadron to form Map Supply Troop.

All the cartographic and reproduction technicians were organised into three troops in the new 13 Map Production Squadron; Cartographic, Photographic and Print. The mobile train was returned to Ordnance for eventual disposal with the exception of a print semi-trailer that was moved to a hard standing between the photo studios and the squadron headquarters hut. It was painted blue and was primarily used as a Display Team 'prop' that fed pre-printed stock of antique maps and cartoon animals which were given away during events. Whilst not on display duties it was used for production work.

All the single soldiers living in B Camp moved into their new squadron's accommodation in A Camp leaving the Regiment's footprint in B Camp as solely the War Reserve Map Depot and the MT lines that were now occupied by 19 Squadron's vehicles.

RHQ Troop also initially included the Regimental Technical Control Office headed by a Technical Adjutant but the following year technical control was devolved to the Squadron's Technical Control Officers (STCO).

The majority of the fifty posts that were to be lost came from administration personnel and the need for less troop management as there were less troops within the reorganised Regiment. Most of the latter were met through senior ranks not being replaced following retirement but a small number had to be made through redundancies of Senior NCOs in 1978.

A More 'Military' Surveyor

A key proviso of the Defence Review was that everyone in uniform had to have a designated war role that could not be carried out by a civilian. This ruling was implemented through a system called the 'Redistribution of Regulars upon Mobilisation' or REDRUM, a topical acronym as the most famous race horse at that time was the multiple Grand National winner Red Rum. The Regiment was almost totally committed to reinforcing BAOR with 13 Squadron detailed to provide a complete second shift to the Survey Production Centre (BAOR), 19 Squadron's field surveyors earmarked to provide support to the Royal Artillery and Air Survey Troop to help man the combat map supply system in Germany. Map Supply Troop was to support the UK based Field Forces, man the War Reserve Map Depot and UK Map Stores. Additionally, a number of officers and senior ranks were committed to augment Survey staff at various formation headquarters on the continent.

This stress on a war role also led to a more professional approach to the 'military' aspect to the military surveyor's life. Previously the Wednesday morning sessions had paid almost lip service to military training but now new Army Training Directives were introduced covering all aspects of training from shooting and NBC to first aid but especially stipulating specific levels of personal fitness. Tests of this fitness comprised an annual personal fitness assessment (APFA), a twice yearly basic fitness test (BFT) and an annual combat fitness test (CFT) the latter replacing the 'ten mile bash', all overseen by a newly established Army Physical Training Corps SNCO. All the tests were rigorously implemented as a report on the tests results formed part of the Annual Fitness for Role inspection.

Two Very Eventful Years: 1976 and 1977

1976 was a very busy year for 42 Survey Engineer Regiment for in addition to the considerable upheaval caused by the major reorganisation in June there was a continual heavy technical workload all carried on against the background of the hottest, driest weather in living memory.

During May 13 Field Survey Squadron carried out its last deployment to *Exercise Dominate* in Germany before returning to say farewell to both its mobile train and to B Camp and life as a field survey squadron. A troop from 19 Squadron spent most of June on Cyprus on *Exercise Pole Star* and two officers, 35 soldiers and 14 attached Army Air Corps personnel spent July and August in Norway on the final *Exercise Carto Norge* for which the squadron achieved joint runner up in the Engineer-in-Chief's Award for 1976

Corporal Jimmy Hamilton laying a pre-mark during Exercise Carto Norge 76 – the final three Carto Norge exercises would not have been possible without helicopter support.

As well as major deployments there were also a number of small survey tasks including trails of new short range electronic distance measuring devices, conducting an important geodetic survey and fixing 58 positions to very high accuracies to be used for recording aircraft trials at the Royal Aircraft Establishment (RAE) West Freugh in Scotland and a visit to the Quarter Oil Rig in the North Sea to verify a Doppler Fix for an oil company.

Meanwhile map production work centred on the ongoing task to produce the twelve M711 sheets to very exacting national mapping standards for the *Carto Norge* project, training area maps, Northern Ireland town plans, re-print work and the usual run of miscellaneous tasks from a wide variety of 'customers'. The Print Troop operated a permanent two shift system at this time with Photo Troop busy in support and also running the Rapid Print Team which deployed to Germany in October to support CRE 3 Division on *Exercise Don Jon*.

In the middle of the baking hot summer Her Majesty the Queen visited the Royal Engineers at Minley Manor. Detachments from the Regiment included a MapSP, a field survey stand including satellite tracking equipment and a printing section with a semi-trailer containing a Heidelberg SORD printing press.

The year ended with 19 Squadron mounting another major exercise, *Fourpence*, in Kenya from the 13th of December until the end of February, again involving a contingent from the Army Air Corps. The aim of the exercise, centred on Marsabit, was to provide additional heights and plan positions for 1:100,000 mapping and to complete a ring traverse from the 1974 exercise area and, although considerable results were achieved, work was hampered by the lack of air support that was used instead for VIP transportation.

No sooner was 19 Squadron back in the UK than it celebrated its 150th anniversary with a ceremonial parade on the 26th of March 1977 with the salute taken by Major General J Kelsey CBE and watched by over 600 spectators which included many former members of the squadron. Ken Howard, the well-known military artist, was commissioned to commemorate the anniversary with a water colour of a survey party at work on the Ordnance Survey trig pillar near Barton Stacey village.

Four days after the anniversary a detachment left for Belize to carry out field surveys for a 1:25,000 photomap of the New River Lagoon Training Area, gravity survey bases and collect information on obstructions and airfields for Series 1501 (Air).

In August once again a Field Survey Troop with augmentees from other units, some 50 personnel in all, visited Northern Kenya on *Exercise Fourpence*. During this three month detachment the troop managed to complete one main traverse including building towers, carry out gravity observations, station construction and a densification of the control from Isiolo to Marsabit.

An unusual task - observing on the Frigg oil rig in the North Sea.

The Squadron's other Field Survey Troop carried out a number of smaller field survey tasks including a survey on the Frigg oil rig in the North Sea to determine its position in relation to a meridian line between Norway and UK, surveys at Lulworth Ranges, RNAD Coulport, RAE West Freugh and a reconnaissance at Aberporth for a future major survey task.

13 Squadron was very much a 'military map factory' albeit with its production interrupted not only by the usual postings in and out but now also by mandatory twice weekly PT sessions and breaks for adventurous training weeks.

The air survey and cartographic work included revision of the 1:20,000 Northern Ireland mapping and plotting the *Carto Norge* 1:50,000 Norway mapping. Air Survey Troop was also involved in a research and development target locating project called TARLOCS which was the creation of a point positioning database centred on Hildesheim in the 1 (BR) Corps area using a Zeiss Stereocord and Hewlett Packard desktop computer.

Northern Ireland received two deployments this year from the Regiment. Ordnance Survey Northern Ireland was replacing its one inch to the mile mapping with a new 1:50,000 scale series and Military Survey undertook the responsibility to field check the three sheets that fell in the border areas most affected by the 'troubles'. The work was to be carried by the Regiment under *Operation Bureaucrat* with soldiers operating in a covert role. The first sheet was checked between the 10th of June and the 5th of July by a detachment of one officer and five soldiers. The second deployment to the province, but in a very different rol, took place in August when an officer and 26 soldiers were attached to 518 Company RPC to serve for four months as the Magilligan Prison Guard Force.

Photo and Print troops were endlessly busy mainly on reprint work but all planned technical work ceased in early November when the Regiment was put on standby to become – firemen!

Throughout the decade industrial relations especially in the public sector had been deteriorating often with the government compromising at the last minute. However, when the Fire Brigades Union called a national strike the government's response was *Operation Burberry*, the mobilisation of the Armed Forces to man a large fleet of Second World War vintage 'Green Goddess' fire engines. So it was that on the 7th of November the Regiment was put on standby and ordered to provide twenty 6-man crews for firefighting duties in Hampshire and the Isle of Wight together with command and administrative support.

Events moved quickly and 18 Green Goddess fire engines were collected and tested and most soldiers received a four hour concentrated course in firefighting at Portsmouth. A multitude of equipment was also collected from various depots all over Southern England, an operations room was set up and teams formed and put on one hour's notice to move. The deployment order came on Sunday 13th November and by dusk all the crews had reported that they were established in their fire bases at Aldershot, Basingstoke, Winchester, Eastleigh, Southampton, Gosport and Portsmouth.

Within a few weeks the Royal Navy and the Green Jackets took over various towns leaving the Regiment manning only Basingstoke, Eastleigh and Southampton. The manpower released by these changes allowed the formation a 'Mobile Column' of six Green Goddesses with ten crews at fifteen minutes notice to move to anywhere within South East District.

Christmas leave and the various unit parties were cancelled but in early January the unit handed over its remaining responsibilities in Hampshire to the Royal Navy and it then look responsibility for Oxfordshire and Buckinghamshire.

The strike ended on the 17th of January and the withdrawal from fire bases was complete by the 19th. After a week spent on cleaning and returning stores the unit went on a week's leave. During the ten weeks on deployment the unit fire crews attended sixty four incidents, half of which occurred during the week in Oxfordshire and Buckinghamshire.

A 'Sun' page three girl visiting the Mobile Column at Barton Stacey just before Christmas.

One aspect of the unit's involvement in Operation Burberry which was not widely known was the production of United Kingdom town plans by 13 Map Production Squadron for use by the firefighting crews. In all some 120 sheets were produced in quantities ranging from 6 to 200 copies of each, with a final total of 5,500 plans.

An unexpected bonus from the strike was a huge boost in the profits of the unit club – the 'Bumpers Club' – due to the 'captive' audience of the camp-bound Mobile Column. The club had only recently been formed as it was considered that the NAAFI did not provide an acceptable level of service. It was overseen by a warrant officer and manned as a Regimental duty; it was an instant success and continued to thrive throughout the unit's remaining time at Barton Stacey

However, possibly the most significant event of this period was the arrival of TACIPRINT.

Loading a MapSP at the WRMD ready for an exercise.

Close Support: the Map Supply Point and TACIPRINT

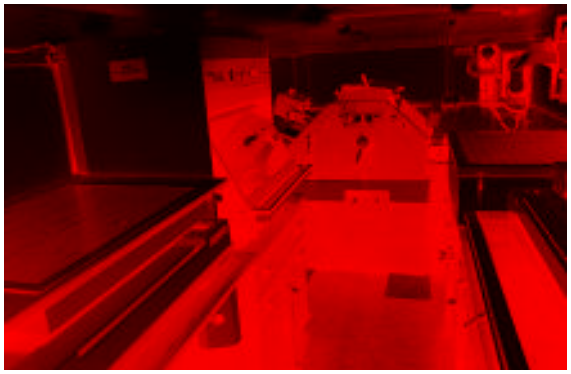
During the Sixties British Forces in Germany adopted a more mobile strategy which in turn gave greater importance to the combat map supply system. As a result Military Survey developed the map truck or Map Supply Point (MapSP), a standard 4-tonne truck racked with dexion shelving to hold map stocks for issue in the field. These vehicles were first taken into service in 1969 and in the early Seventies the Regiment received the vehicle to support the UK based formations.

Whilst the Close Support Team continued, albeit now under the title Rapid Print Team, to provide a level of close support to formations it was of a very limited nature. However, a more versatile solution was under development.

By 1972 the mobile train and its technical equipment was becoming obsolescent and the train was also difficult to conceal, had poor off-road capability and was unsuitable for air transportation and so a replacement was required. As a consequence, the Military Vehicles Experimental Establishment tasked Marshalls of Cambridge to carry out a study into a truck-mounted replacement train to be in service by 1975. However, the project did not proceed due to the financial constraints of the times.

In 1974 the decision was made that the train could no longer deploy tactically with BAOR formations and the need to provide a field deployable reproduction capability able to operate with the mobile formation headquarters became an urgent priority. After much deliberation in BAOR followed by a mock-up and trials the solution was to install a light table, contact exposing frame, plate developing facility, an Océ dyeline machine, a Rotaprint RA2S press and a paper trimmer in a standard box body mounted on the ubiquitous 4-tonne truck which would tow a generator as an independent power source. The vehicle was to be manned by a crew of three, a cartographer, photographer and a printer. The system was called TACIPRINT.

The really ingenious element was the product. Pre-screened segments of standard NATO 1:50,000 mapping were butt joined so that the area of interest was in the centre of this 'tacimap' and an overlay with the tactical information was keyed to it and then it was printed in black. The effect was that the



Inside a TACIPRINT showing the cramped but efficient working space.

base topographical detail appeared grey and the overprint information stood out in solid black. The system was very well received during trials and a contract was let to produce TACIPRINTs for 42 Regiment, 14 and 135 Squadrons.

During the latter part of August the prototype TACIPRINT was received by the Regiment for trials. Captain CR Robbins RE was appointed UK Trials Officer and, with the vehicle and team of three technicians, deployed to Germany and then moved by LSL to Denmark with 6 Field Force on *Exercise Arrow Express* during the period 1st to 30th of September 1977. In mid-November TACIPRINT took part in *Exercise Avon Express*, a large multi-national ACE Mobile Force exercise on Salisbury Plain. In December the trials team took TACIPRINT to Northern Ireland where they demonstrated the system's capability at a number of locations and received favourable reports at each albeit the preferred option in the province was for a ground mounted version. Early in the New Year TACIPRINT was handed over to 14 Topographic Squadron for BAOR trials. The Regiment received its production model TACIPRINT in the summer of 1978 and by the end of that year had deployed on three exercises in support of the UK based Field Forces.

MapSPs and TACIPRINT were the principal means of Military Survey providing close support to the field army for the next quarter of a century deploying to the Falklands, the Balkans, Iraq and Afghanistan as well as innumerable exercises in UK and on the continent.

To the End of the Decade

Early January 1978 brought the news that the Norwegians had rejected the second block of four M 711 sheets produced under the *Carto Norge* project as not meeting their stringent national mapping standards. An immediate inquiry revealed that the flight planning had not taken into account the extreme nature of the terrain and sun angles resulting poor photography which, together with frequent changes in the plotting team, had caused the rejection. The poor photography had earlier been identified and the area had been re-flown in October 1976 and used to produce the final set of four sheets during 1977. All air surveyors were stereo tested to identify the best operators and a more rigorous plotting procedure put into place and, using the new photography, the failed sheets were plotted again during 1978. All the sheets were finally accepted and the last sheet was printed in 1982 bringing an end to fourteen years of Norwegian mapping in the Regiment.

Early in the year the final 'tweek' to the Regiment's organisation occurred when the two field troops were amalgamated into one large troop. The troop's year was dominated by a large task at RAE Aberporth, a detachment to Cyprus for the SBA boundary pillar review and *Exercise Fourpence*. The latter was the fifth exercise to Kenya and this year's was a major deployment involving sixty personnel from the squadron supported by Royal Marines, 135 Squadron and several other units. It lasted from the 9th of August until the 4th of November with base camp at Eliye Springs on the shore of Lake Turkana and involved surveyors working on the islands in the lake. The *Operation Bureaucrat* deployment this year was to the 'bandit country' of South Armagh where the eight man team of field and air surveyors, following a period of intensive infantry training, operated from the company bases of the 1st Battalion Parachute Regiment. The Troop also took part in trials at Barton Stacey to test a variety of towers to replace the Bilby.

Whilst the field surveyors came and went on their travels Air Survey Troop was fully occupied with the Norwegian 1:50,000 mapping, revision of the Northern Ireland 1:20,000 series, plotting large scale plans of several RAF Germany airfields and the production of a series of mosaics of towns in Belize, tasks that would keep them busy until the end of the decade. Carto Troop also worked on these tasks as they left the air survey stage as well as work to keep the presses running. The reproduction technicians were always busy and in 1977 completed 243 different tasks resulting in 636,000 copies involving just fewer than 3 million impressions.

1978 saw the first of a series of annual camps designed to get the entire regiment away from Barton Stacey as an entity and to undertake a programme of events based on 'fitness and fun'. The Regiment moved by special troop train from Andover to Penally in South Wales where inter troop competitions and a long coastal walk were designed to blow away the 'cobwebs', engender camaraderie and increase the general fitness of all. In addition to the annual Regimental camp each troop had to plan and participate in an adventurous training exercise once a year.

The Regiment's military involvement ramped up considerably in 1979 with personnel taking part in fifteen exercises, mainly in BAOR but with TACIPRINT vehicles also deploying to Italy and Denmark. Even the Annual Report on Unit (ARU) inspection took the form of a short notice terrorism based exercise at the disused camp at Longmoor overnight on the 3/4th of November.

The major field survey task at RAE Aberporth finally drew to a close in March 1979. The task had covered the whole of Cardigan Bay, involved 45 people over a year to 'fix' 103 stations, 21 at first order, 31 second order and 51 third order. In addition 78 kilometres of precise and 19 of third order levelling had been carried out.

Levelling through Aberystwyth – not so glamourous as surveying in Kenya but the RAE Aberporth task was an importance major project.

Following intensive training in ambush and patrol techniques and weapon handling the final *Operation Bureaucrat* took place in late spring this time hosted by 43 Commando Royal Marines. As well as a civilianised car, an ubiquitous 'mini', it included a helicopter for inaccessible areas and a cabin cruiser complete with fishing rods on Lough Erne. The soldiers particularly enjoyed the chance to grow their hair long so as to appear 'civilian' whilst deployed and the SSM enjoyed equally telling them to get it cut upon their safe return.

Detachments to Cyprus for *Exercise Pole Star* during May and June and again later in the year for the SBA boundary pillar check, another major deployment to Kenya from 20 Jul to 24 Oct for *Exercise Fourpence* to continue the work carried out during the previous years and two weeks during September in France and on the Channel Islands carrying out a reconnaissance for a geodetic connection to France filled the field surveyors' year.

The Op Bureaucrat '79 team in their 'working dress' and long hair 'disguise'

The 1979 'fitness and fun' camp was spent at Penhale in Cornwall and again was based on strenuous inter-troop competitions, a very long cliff-top walk and an introduction to dingy sailing.

Regimental Life at the End of the Seventies

The nation's dire economic and industrial relations situation continued throughout the decade which ended with moratoriums on expenditure still in place for everyday items such as stationary and vehicle use and the unit's drivers on stand by for a potential petrol tanker drivers' strike. Rampant inflation had wiped out the financial gains of the beginning of the decade with technician soldiers amazed to find that their salary was considerably less than that of the firemen they were replacing because they were on strike for even greater pay.

The serious security situation led to a ban on wearing uniform outside of camp with married personnel arriving for work with civilian coats over their uniforms. Military coaches were painted in various colours to disguise them although they were then the only buses on the road not emblazoned with a company name and occupied solely by young men so they were still fairly obvious.

The shiny green combat suits of the early Sixties had been exchanged for suits made of disruptive pattern material and gaiters and puttees as worn by the soldiers' grandfathers were finally done away with when the 'combat boot high' replaced the DMS ankle boot. Also the days of greatcoats and mackintoshes were long gone with the combat jacket worn in inclement weather. Guard mounting was now in combat kit and the rigorous inspection in Number Two dress dropped with that uniform now worn solely for parades.

Despite these trials unit social life carried on in both messes as it always had and the Bumpers Club continued to thrive. The decade ended as each previous year had with an impressive bonfire night event in Roberts Road organised by 19 Squadron and a children's Christmas party organised by 13 Squadron just before the Regiment went on Christmas block leave.

Extracted from the "Empire Survey Review"

By Colonel M.N. MacLeod

Colonel M.N. MacLeod: Though I am down to talk about the Empire Survey Review, I am proposing to talk about something else first. Some of you are members of a body called The Field Survey Association, and as I may not have an opportunity of talking about it again I want to advertise it a little now.

Some of you may know that when the Great War broke out the survey organization consisted of one Officer with one clerk, at G.H.Q. *(I am not sure that there may not have also been two M.T. drivers)* and a similar "force" on the line of communications; it finished up the war with some 200 Officers and nearly 4,000 other ranks. I doubt if any other branch of the Service expanded more. Our Military Survey organization now, though larger than that of 1914, is the only part of the Army which is on a "long service" basis. That means to say that, whereas the ordinary soldier serves for five or six years and then goes to the Reserve, his place being taken by another man, the survey soldier serves for 21 years, and then goes into the Ordnance Survey as a civilian. Although we have a bigger organization now than we had at the beginning of the War it has no "reservists." With our world-wide commitments, it is most difficult to estimate beforehand what our requirements will be in the matter of supply of survey material to the British Army in future wars. We can put in an estimate which the Treasury may divide by two, or some other figure which they think appropriate.

As we are not prophets, some means of expanding the organization is very desirable. Now surveying in the Army is something like a "key" industry. One might call it "The" key industry and any failure in respect to it would have serious effects.

Not much has been written about survey work in histories of the Great War but this only means that not many people understand it. Those who do will find reasons for thinking that the turning point of the War was the surprise artillery bombardment at the Battle of Cambrai on 20th November, 1917, which was based entirely on the work of the 3rd Field Survey Company. That attack was the first successful attack of the Great War. This type of surprise - artillery bombardment based on maps and surveys – was repeated with similar good results in all the battles of 1918 and had great influence on their results. The Survey work involved was done by Field Survey Battalions, the Officers of which after the war maintained an informal Association for holding an annual dinner, and by that means tried to keep in touch with one another.

A few years ago, largely through the efforts of Brigadier Winterbotham, that informal Association was put on a more formal basis and called the Field Survey Association." Brigadier Winterbotham also secured its recognition by the Army Council. The object of the Association is to "ear-mark" qualified personnel who are interested in survey, who have the necessary scientific knowledge, and who are prepared to offer their services as officers in the event of war. No military obligation is incurred by joining the Association. The only obligation is to pay an annual subscription of 5s. On the other hand, the fact that the Association is recognised by the Army Council would undoubtedly be of assistance to its members in obtaining suitable employment should their services be offered or required in the event of a future war.

That is all I need to say about it here.

Long Range Imaging

By Nikolaos Galiatsatos

Nikolaos Galiatsatos is Burnham Lecturer in the Wing of Geospatial Exploitation, Royal School of Military Survey, UK. His research interests include landscape archaeology, mapping deforestation and forest degradation, water security, and integral geography. He is an expert on Remote Sensing, GIS, and Cartography and he has published extensively on these topics. His most recent publication was the Highlight Article *Mapping from CORONA: Geometric distortion in KH4 images (with I. Scollar and C. Mugnier)* in *Photogrammetric Engineering & Remote Sensing*.

Long-range imaging

Detect, Recognise, Identify; also called DRI (see figure 1). These are terms used daily by analysts, representing an effort to go from rough resolution to fine detail so as to be more confident in their judgement of the situation. Can we read the text on a pound coin from 50m distance? Can we recognise a face at 200m? Can we identify a vehicle at 10+km? Can we do all the above during difficult atmospheric conditions (e.g. rain, haze, heat)? This is where long-range imaging comes in. Generally, the ability to DRI enemy locations, movements, and intentions at long range can give substantial advantage in any conflict.

Figure 1 – Johnson Criteria DRI; an outdated but still universally used standard for rating thermal infrared cameras for surveillance and security.

Since the Cold War years, a large effort was in place to create long range imaging systems that would provide the capability to recognise and potentially identify characters on the ground from a safe distance. Already, during early 1960s, the Gambit (aka KH-7) programme operated a space platform that carried a long range imaging system which reached spatial resolution of 40cm. According to the Johnson Criteria, one potentially could detect that 'there is something there' if there was enough cast shadow on the ground. In 1971, the Advanced Gambit (possibly KH-8) programme could in theory reach spatial resolution of 15cm (NRO, 2011) which would provide the analyst with more confidence on detection and potentially recognition of the character on the ground.

The advent of CCD (Charged Coupled Device) (Boyle & Smith, 1970) and CMOS (Complementary Metal Oxide Semiconductor) sensors brought the digital image with all its advantages (Light, 1996). The main trade-off was the spatial resolution. Only recently digital sensors managed to reach the spatial resolution of the 1960s film photographs (Galiatsatos, 2009).

The sensors alone cannot provide high spatial resolution. For this, there is need for a large optical system, just like with the Gambit satellites. If, for example, a Hubble-like optics system was placed into sun-synchronous orbit for remote sensing purposes, it would be able to provide spatial resolution of 5-10 cm at the expense of swath width. The main limitation for building enormous optics is logistics. Astronomers use probably the largest optics. For example, the European Extremely Large Telescope (planned 2022) is expected to reach at Normal Mode 10m spatial resolution at the surface of the moon. The VLT (Very Large Telescope) combines eight telescopes to reach 20cm spatial resolution at the surface of the moon, but in Interferometric Mode (trade-off when compared to Normal Mode: clarity of image). Another way to improve spatial resolution would be through the use of a large FPA (Focal Plane Array), e.g. Maenner (2012). An example of this approach is the ARGUS system. Generally, the sensors and the optics become larger while the pixels become smaller and numerous (Rogalski, 2012). Still, there are limitations.

Limitations - Atmosphere

One of the main limiting factors is the atmospheric turbulence (e.g. heat) and scattering (e.g. rain). Both of these distort the light, resulting in blurry images that make DRI extremely difficult if not

impossible. Steinvall *et al*. (2013) have shown that the atmospheric turbulence influence decreases the higher the camera system is placed. Simultaneously, the atmospheric scattering increases as the path is larger, but the influence is negligible. The topic of atmospheric turbulence would deserve a paper on its own, as many approaches have been developed to solve the problem. Figure 2 comes from a review paper (Schutte *el al*., 2012) that summarises these approaches.

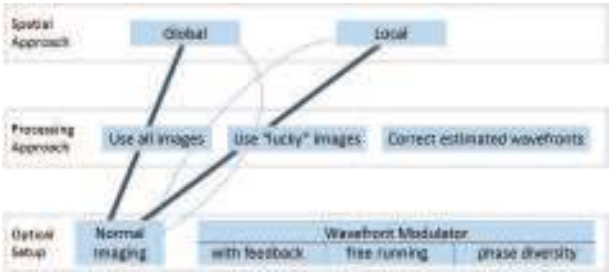


Figure 2 - To give more insight into how turbulence compensation methods interact with the observed imagery, Schutte et al. (2012) ascribed the following properties to turbulence compensation methods: 1) spatial approach (global or local scale), 2) processing approach ('using all images', 'selecting a lucky image', or 'estimating the correct wavefront'), and 3) optical setup ('normal' or 'using a wavefront modulator').

One of the approaches is the *lucky imaging* (aka anisoplanatic imaging), a method initially developed by amateur astronomers. While professional telescopes have laser beams that measure the atmospheric turbulence and thus feed algorithms to compensate for this, the amateur astronomer would get hundreds of images and then search for the *lucky one* with the clearest atmospheric conditions. This method has now improved and while the idea of collecting many images in a fraction of a second remains, the final image is a composition of the sharpest parts of all these images instead of just one lucky image (figure 3; e.g. Jackson *et al*., 2014). Within RSMS (Royal School of Military Survey), one of the students (Marsh, 2016) experimented with rain and lucky imaging open source software with satisfactory results (see figure 4).

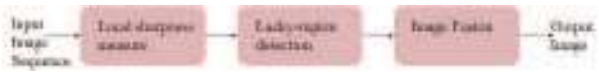


Figure 3 – A sequence of images is inserted in the algorithm which searches for the sharpest parts in each of them. These parts are then fused together to create the output image.

Figure 4 – Image portion under rain conditions (on the left) in direct comparison to after lucky imaging processed image (on the right). Due to camera speed restrictions, only five images were acquired and processed. From: Marsh, 2016.

Limitations – Camera system

No matter the Moore's Law progress towards larger FPAs with smaller detectors, they are expensive and still out-of-reach for most operations. There are however approaches that can be used so as to increase the spatial resolution; the most known one is the *super resolution* approach. The idea is that if many images are acquired from the same spot with subpixel motion, then their fusion can create a higher resolution image (see figure 5). In theory, the spatial resolution can be doubled by using super resolution reconstruction approaches (Lin & Shum, 2004). Apart from the reconstruction-based approaches (Park *et al*., 2003), there also exist the recognition-based approaches, mostly used in forensic face detection, whereby certain pre-configured patterns are identified in the low resolution data.

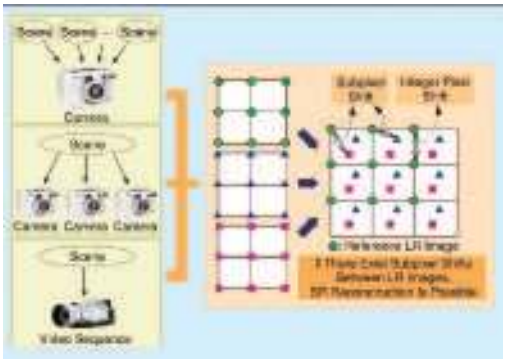


Figure 5 – Basic premise for multiple image reconstruction (Park et al., 2003). The sub-pixel shifts between the scenes are required to reconstruct information and increase spatial resolution of the input.

A simplified version of the super resolution approach is currently operational on SPOT-5; it is called the *super mode*. Two images are captured at 5m spatial resolution and an offset of half a pixel. The images are then interpolated and a new image is created with a spatial resolution of 2.5m. Potentially, a swarm of satellites flying in tandem at close distances and pointing at the same area could provide a higher spatial resolution image than what their own individual cameras can produce.

Within RSMS, one of our students (Braarud, 2015) experimented with super resolution reconstruction algorithms and found that the Almalence algorithm would improve the resolution by roughly 1.6 times (figure 6).

Figure 6 – After the hand-help SLR acquisition of five Low Resolution images (left) from 40m distance, the output (centre) has a resolution similar to roughly 25m distance (compare to the right image) (Braarud, 2015).

Many more methods have been explored about how to increase the spatial resolution by going beyond the camera limits. Luo *et al.* (2015) experimented with multiple phase height and multiple wavelength acquisitions to reconstruct a super resolution image. Birch *et al*. (2015) experimented with the use of a microscopy approach, the structured illumination, to an outdoor environment, with promising results at 920-990nm.

Limitations – Clouds and night

When working with optical systems, the clouds, haze, and even pollution (e.g. smog) create a curtain to the scene that cannot be penetrated. Furthermore, optical systems won't operate well at night. For this, Radar systems are used, as they can 'see' through this curtain. The Spot-light mode SAR (Synthetic Aperture Radar) acquisition can provide the highest spatial resolution (e.g. staring spotlight mode of TerraSAR-X provides 25cm spatial resolution). Still, this is not enough and therefore the SAL (Synthetic Aperture LaDAR) has been researched and developed the last 15 years. While it greatly increases the resolution and can operate during night conditions, it suffers when aerosols or turbulence exist in the atmosphere because it operates at smaller wavelengths.

Most of SAL research is currently classified but a glimpse to it was given to us by Ricklin et al. (2007). The concept is similar to SAR with the difference that in this case a Laser beam is used. This means that it can focus in a small area with very high resolution. It thus provides 3D-like images (figure 7) and because of the wavelength range it operates, it can look into urban canyons without the fear of interference (an area where SAR struggles). SAL also has the potential to see through camouflage as Gschwendtner & Keicher (2000) have demonstrated in their coherent laser experiment.

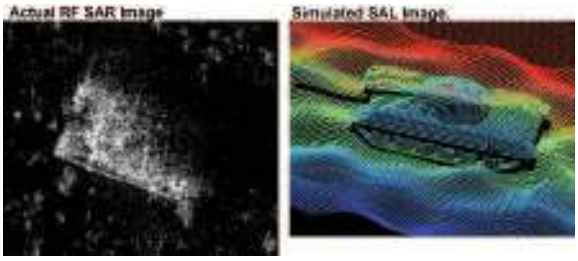


Figure 7 – A comparison between SAR and simulated SAL images showing the potential of SAL for 3D-like imaging that would greatly improve DRI (Ricklin et al., 2007).

Conclusion

Long range imaging is very important in military operations, especially if DRI can be provided at good confidence levels, as it allows more time and confidence for decisions. Atmospheric conditions, limitations of camera systems, and cloud/night conditions are some of the difficulties that operators face. This paper presents a few of the approaches that are used so as to partially overcome the difficulties and produce a more promising DRI image.

This paper does not intend to be exhaustive, as there are so many other technologies and techniques out there that haven't been mentioned; multi-aperture, tomography, and adaptive optics to name a few. Instead, it is just an effort to bring together in a small paper the most common techniques along with an academic touch, while simultaneously showcasing some of the work that the students do at RSMS. Thus, if the reader is interested in learning more, the references can provide a good starting point for the exploration.

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Foundation Degree in Science in Applied Computing

By Mrs Philippa Farnell - Training Coordinator RSMS

Thursday 8 December 2016 marked a notable occasion when thirty one Royal Engineer Geographic Technicians were awarded a Foundation Degree in Science in Applied Computing at a Graduation Ceremony at RAF Wyton in Cambridgeshire, home of 42 Engineer Regiment (Defence Geographic Information).

Colonel Cockwell MBE making his address.

This Foundation Degree programme, accredited by Sheffield Hallam University and run by the Royal School of Military Survey, has been running for many years and is one of very few such programmes in the British Army and most notably the graduation ceremony is the only offsite event sanctioned by the University.

Brigadier Kite OBE, speaking with students.

The ceremony was to mark the culmination of almost five years of hard work and study. To achieve this award, students are required to follow an initial nine-month course, three years' experience in an operational unit and a further nine months' study at the School. The Foundation Degree is designed to integrate academic and work-based learning through collaboration between employers and the training deliverers. It focuses on vocations, skills and knowledge that are relevant to the needs of the employer. All this training is designed to give the Geographic Technicians the vital skills they need when deployed on operations. The key to the success of the programme is the strong partnership between the Royal School of Military Survey and Sheffield Hallam University.

Vice Chancellor Husbands speaking with students.

For the first time in its history, the graduation ceremony was held outside of Hermitage, the home of the Royal School of Military Survey; instead it was hosted at RAF Wyton, the new headquarters of 42 Engineer Regiment (Geographic), in the Skyways Conference Centre. As the majority of students are posted to RAF Wyton on completion of their training, it was deemed most fitting to host the event close to where the Graduands live to promote a good turnout with the opportunity for friends and family to attend.

As the day of the event arrived, and with staff and students suitably gowned, the ceremony commenced. Professor Chris Husbands, Vice Chancellor of Sheffield Hallam University, presided at the ceremony with Brigadier Kite OBE, Commander Joint Forces Intelligence Group, attending as the senior military representative. After the academic procession entered, the Principal of the Royal School of Military Survey, Dr John Knight, welcomed guests, students and family to the ceremony. Professor Husbands delivered his keynote address stressing the value the University placed on the relationship with the School and the important place Foundation Degrees have in the learning process. Mr Chris Symonds, the Public Orator and Head of Training, then called forward the Graduands to be congratulated by the Vice Chancellor before receiving their certificates from the Executive Dean, Professor Mike Bramhall.

Following the award of the Foundation Degrees a number of prizes were then announced:

Each year the Worshipful Company of Scientific Instrument Makers awards the student that has attained the highest overall result in the programme taking into account both the Level 4 and Level 5 scores. The winner is invited to a special dinner at their impressive Hall in Southwark. The prize winner for 2015 was LCpl Antony Claypole from Course 19, and the winner for 2016 was LCpl Jess Thomson from Course 23.

Dr Knight, Professor Husbands, Maj (Retd) Keeley.

The Sheffield Hallam University prize is awarded to the student that has achieved the highest final mark on the Level 5 course that year. 2015's winner was LCpl Antony Claypole and the prize for 2016 was presented to LCpl Liam Bowler from Course 23.

The Royal School of Military Survey are very fortunate to have a supportive network of patrons that are so invested in the future of the trainees that they sponsor prizes for the graduation. These prizes tend to focus, not just on the academic achievements of the students, but also the attitude and the dedication of the soldier. These prize winners are chosen by the Principal in consultation with the Senior Instructors and staff who have taught the students.

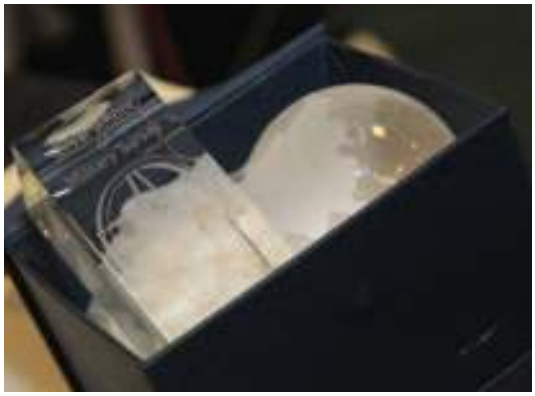
The James Walke prize is awarded to the Level 5 student who has shown the most sustained academic effort for the duration of the course. The 2015 prize was awarded to LCpl James Smith from Course 20, and the 2016 prize was awarded to LCpl Jess Thomson.

Students.

The Terry Straeter prize is given to the Class 1 Technician who has made the most contribution to team spirit and leadership. The award was presented to LCpl Adam Watts from Course 20 for 2015, and LCpl Lomas from Course 22 was presented the award for 2016.

The REA prize is given to the best Class 1 student for each course. The award reflects the technical merit tempered by contribution to the course.

The 2015 winners were: for Course 19, LCpl Hadley Booth-Millard and for Course 20, LCpl Adam Watts.



One of the prizes.

The 2016 winners were: for Course 22, LCpl William Greene and for Course 23, receiving her third award, LCpl Jess Thomson.

LCpl Thomson represented the graduates in expressing their thanks to friends, family and the staff of the Royal School of Military Survey.

Following the formal proceedings the Principal invited the Vice Chancellor to make a presentation to Maj (Retd) Tony Keeley, a long-standing member of staff at the Royal School of Military Survey and original organiser of the graduation. Tony retired in July 2016 having served, first as a Royal Engineer (Geographic) Officer, and more recently as a Civil Servant in the Royal School of Military Survey, so it was a fitting tribute for his dedicated service to the School.

Dr Knight himself was then surprised with an unexpected gift from Sheffield Hallam University to mark the occasion of his retirement in March 2017, and in recognition of his enormous contribution to the collaborative partnership. Two versions of the briefing notes were produced to keep this part of the ceremony hidden from the Principal. Dr Knight was overwhelmed by the gesture and was extremely grateful.

Student with family.

Colonel Cockwell MBE, Commander Royal Engineers (Geographic), addressed the students where he emphasised the importance of the continuing and successful integration of both geographic training and the geographic expertise within the Intelligence community.

The ceremony was drawn to a conclusion with a keynote address from Brigadier Kite OBE.

Graduates and their families then had the opportunity to meet with the academic staff from the University and the military guests over a drink and an impressive buffet laid on by the Skyways team.

The Foundation Degree, as well as being an excellent programme that enhances the delivery of geographic training, has been a very considerable feature in the recruitment of young talent into the specialisation and has proven very popular with the graduates as many go on to register with the University to complete their Level 6 BSc.

Platform Party plus all Graduates.

Prize Winners.

Special thanks are due to a number of individuals-

Professor Mike Bramhall for his significant contribution and support to the Royal School of Military Survey over many years. This was also to be Professor Bramhall's last graduation ceremony before his retirement from Sheffield Hallam University in April 2017.

The University Events Organisers, Patricia Lee and Samantha Jackson, who worked tirelessly, and patiently, with the Training Coordinator to produce a successful event.

Dr Gobe Hobona who attended and represented Envitia, our sponsors for the reception, and to whom we are extremely grateful.

Audrey Mcadam and Dion Peacock from the Skyways Conference Centre team who worked above and beyond expectations to ensure that the graduation ceremony went exactly as planned.

And finally, I would like to offer my congratulations to the graduating party and wish them every success in their future academic studies and military careers.

Flash Spotters & Sound Rangers

How they lived, worked and fought in The Great War

By John R. Innes

"Flash Spotter and Sound Rangers", first published in 1935 by George Allen & Unwin was the only book known to have been published which recorded in some small way the activities of the men of the Field Survey Companies and Field Survey Battalions on the Western Front and elsewhere during the Great War 1914 - 1918.

Little or no space was given to the work of these new units in official histories of the war and the contribution made by the Field Survey Companies and Battalions to the success of counter-bombardment in the artillery battles of 1917- 1918 has been largely overlooked or forgotten.

"Flash Spotters and Sound Rangers" has long been out of print and copies of the original edition, usually priced at more than £60, only rarely appear on the second-hand book market.

A souvenir facsimile limited edition of this book, was privately printed to coincide with the Military Survey Service's Celebration, in 1997, of the 250th Anniversary of the founding of Military Survey.

Copies of the 1997 reprint, priced at £20-00, plus postage and packing in U.K. of

£2-00, can be ordered, or further information obtained, by emailing maptnolan@gmail.com or telephoning Newbury (01635) 253167.

High Wire Act at The DGC

By Mark Dowlow

Current Role: C1 Task Team 7, Defence Geographic Centre. Responsible for 18 Staff split between Geospatial Air Information Team and Raster Production Sections.

Career: Trained as a Cartographic draughtsman and have nearly 40 years' experience, the majority of which has been spent at DGC. In that time he has principally been involved in map production at a range of scales, both by traditional and digital cartographic methods. He initially worked in Air Information collection in the mid to late 1980's and returned to head GAIT, first as C2 in 2008 and latterly as C1 TT7

Home Life: Enjoys watching most sports, especially Motorsport events. Also enjoys gardening and bonsai, sea angling as well as keeping fish, principally Japanese Koi Carp.

Powerlines and overhead cables pose a considerable danger to low flying aircraft, with those involved in Military low flying and helicopter activity for training and search and rescue particularly at risk.

The Defence Geographic Centre1 (DGC) produces mapping and data outputs to facilitate low flying within the UK. Since 2011, following a pro-active capture programme, it has held data on 99.9% of all UK powerlines from the 400 Kilovolt (kV) National Grid down to the 11kV 'domestic' lines within a linear UK powerlines database. UK utility company provision of powerline data to DGC is not mandatory under UK Law, so data capture and maintenance is a mixture of voluntary company provision, in-house research using imagery and on-line sources as well as direct reporting from aircrew. Within the database, lines have traditionally been held in a linear form in three height bands based on voltage with the highest, Height Band 3, for 400kV National Grid and the lowest, Height Band 1 for 11kV 'domestics'. These linear powerlines are depicted on DGC and No.1 AIDU products as well as being ingested into Defence aviation mission planning and in-cockpit systems such as for A400M utilising the latest digital XML Vertical Obstruction Data (XVOD) and Air Information Exchange Model (AIXM) formats.

A400M photo – Defence Image Library Copyright.

[1] The Defence Geographic Centre (DGC) is part of the National Centre for Geospatial Intelligence (NCGI) and falls under Joint Forces Command. DGC's Geospatial Air Information team (GAIT) is responsible for the collection, maintenance and provision of flight safety critical Obstruction and Powerline data to Defence

In 2012, DGC received a request from Chinook Helicopter users to capture our Height Band 3 UK National Grid 400kV network as individual pylon obstructions within DGC's Digital Vertical Obstruction File (DVOF) in addition to the linear format. Point pylon capture within DVOF is standard practice outside of the UK where linear data is largely not held, however in the UK, traditionally only the very highest pylons were held as point features.

Chinook – Defence Image Library Copyright.

Following the request a programme of work began utilising acquired National Grid pylon location data combined with researched pylon heights to identify and capture over 33,000 individual pylon obstructions. These were verified against imagery, and where missing in areas such as Northern Ireland and Northern Scotland, the remaining pylons were manually captured from imagery in order to complete the network. This ensured that powerline chains were visible as lines of points within legacy digital formats that cannot view linear data.

The original Chinook request only stated the requirement to capture the highest Height Band 3 pylons and although DGC felt it was important to capture the Height Band 2 lines in the same way it could not allocate resource to the task without a specific user requirement. However, in mid 2016, Tornado Squadrons requested the capture of metal Height Band 2 powerlines as individual pylons to ensure visibility in their legacy mission planning system.

Height Band 2 132kV pylon – Mark Darlow Copyright.

The challenge for the team was that utility companies do not routinely capture the positions of individual pylons and manually capturing large numbers of pylons from imagery would be extremely time-consuming and resource heavy. The decision was made to utilise the Ordnance Survey's MasterMap product to identify individual pylons, verifying and amending their location against imagery as required. Software routines were devised to transform the Ordnance Survey's four point pylon 'footprint' data to centred points before automatically ingesting them into DGC's master aeronautical obstruction database, DVOF. These routines allowed 80% of the points to be automatically ingested using DGC's bespoke in-house matching tool whilst the remaining 8,000 points were processed manually.

To establish a standard height for UK Height Band 2 Powerline pylons, the team used imagery to assess and measure a range of sample powerlines across the UK. The result was an Above Ground Level (AGL) height of 130ft with a vertical accuracy of ±30 feet. As a result of this work, approximately 43,000 new UK pylons were added to DVOF and published for the air community for AIRAC (Air Information Regulation And Control) 05/17 effective on 27 April 2017. Importantly, this meant that for the first time, air platforms such as Tornado and Typhoon which can only utilise older data formats that don't support the visibility of linear data can now 'see' strings of pylon points in their mission planning and in-cockpit systems.

This initiative fulfils a long time ambition bringing UK data into line with the rest of the world depiction and providing flight safety critical visibility of lines for all older platforms that cannot utilise the modern data formats. This leaves only the minor assessment of wooden Height Band 2 gap-fill pylons which should be finished later this summer.

Tornado.– Defence Image Library Copyright.

The project was a great piece of collaborative work within DGC's Geospatial Air Information Team with invaluable assistance from the DGC's Geospatial Applications Branch support team. The collection and publication of this data is a major step forward for air safety within the UK and provides an improved outcome for the user community in ensuring the visibility of Height Band 2 and 3 powerlines across all Defence air platforms.

Gridded Oblique Photography

''The Merton Method''.

By Mike Nolan

By 1927 The Air Survey Committee had evolved a method for the flying of area survey photography

which involved flying parallel strips of forward-overlapping vertical air photos with lateral overlaps between adjacent strips of photos. Shortly after, it also published Major Hotine's "Arundel Method" of producing 1:25,000 and smaller scales mapping from survey photography flown by the above method.

The Geographical Section, General Staff (GSGS) and the War Office then embarked on a long staff battle with the Air Ministry to try to get the RAF to accept the commitment to fly such area cover in war. Unsurprisingly, the R.A.F. was loth to accept such a commitment over enemy territory but was prepared to undertake such photography in undeveloped overseas areas such as Iraq, Afghanistan, Aden and Somaliland.

Between the two world wars several such aerial surveys were undertaken including also other strategically important areas such as Hong Kong, Johore and Malta. The R.A.F. delegated the role of survey flying to Air Co-operation Command generally accepted as being the least important and provided of its responsibilities. Only when this command had developed into the Tactical Air Force for the invasion of Normandy did it become really effective. In the B.E.F. both the Lysander and the Blenheim had proved very vulnerable to enemy fighters.

The introduction of the high-altitude Spitfire for photographic reconnaissance, primarily for intelligence purposes, is well recorded and needs no repetition. The Spitfire also largely met the requirement for survey photography for the 1:25,000 scale mapping of Normandy for Operation Overlord, though much of this was flown as single strips rather than area survey blocks. Furthermore, the difficulty in obtaining the required overlaps between strips in this single-seat aircraft meant that the two-seater Mosquito with its better visibility was later used for gap-filling.

In the early operational theatres, in Eastern Africa, the Levant and the Western Desert, Survey photography was not easily obtained. In Eastern Africa, 60 Squadron SAAF managed to produce photography suitable for extemporary strip maps along routes but on moving to Egypt their aircraft were unable to operate in forward areas and much of the reconnaissance photography even had to be flown in Hurricanes.

Meanwhile, despite the vulnerability of the Lysander in France in 1940, and despite opposition to the idea by the RAF, the Royal Artillery had been investigating the use of the Auster as an AOP. The Auster, first used in Tunisia was also employed in Italy and N.W. Europe with conspicuous success despite its seeming vulnerability to enemy fighters, a symptom perhaps of increasing allied air superiority.

Concurrently in 1940, Major John Merton R.A., working at the Photographic Section Larkhill, was developing a system for target location using gridded oblique air photos taken by an AOP from which target co-ordinates could be derived. His method was based on the experiences of the early AOPs in the campaign in France and Belgium in 1940 where AOP pilots found targets 6,000 to 7,000 yards distant were difficult to locate on the existing 1:50,000 scale GSGS maps when flying at about 600 feet above ground level. His proposed solution was to use gridded oblique photographs which were believed to be easier to handle and read in the cockpit and which showed every physical detail of the countryside in a panoramic form compared to a generalised and often out-of-date topographic map. The use of Infra-Red film was preferred to panchromatic film to increase the range of visibility and especially in poor weather conditions.

Acquiring this oblique photography was assumed to be simple and rapid under almost any weather condition and safer than obtaining vertical photography by overflying enemy territory and the minimum time from take-off to delivery was believed to be 9 hours for a corps frontage. The method was based on taking a strip of oblique photos, on which the horizon is shown, flown at a low altitude

of about 3,000 feet behind and roughly parallel to forward defence lines using an RAF F24 camera with an 8-inch focal length lens.

In essence, oblique photographs taken safely from behind forward defence lines provided a detailed panoramic picture of the ground showing more detail than on a conventionalised topographic map.

When gridded these photos could be used by an AOP pilot in the air when spotting targets. Targets located by an AOP pilot could be reported to battery positions by means of a grid superimposed upon the pilot's prints. These targets could then be quickly co-ordinated on an artillery board.

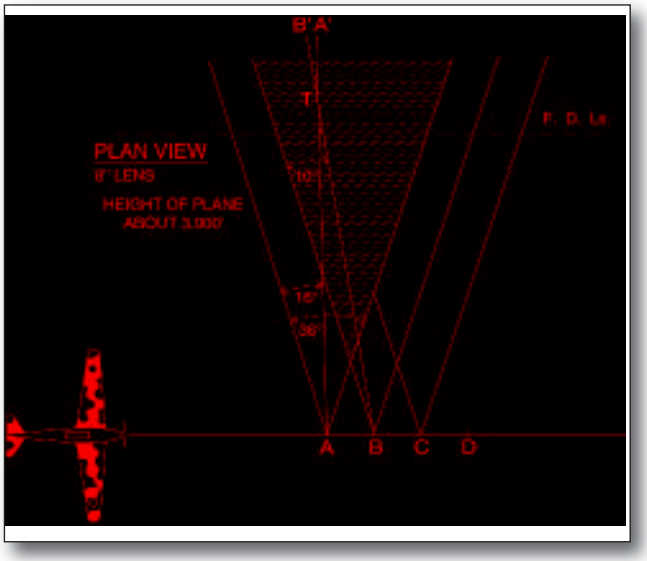


Diagram 1 – Overhead view of flight line and oblique exposures.

As shown on Diagram 1, any two consecutive photos cover a large area of identical ground. By means of resection, the ground plumb points immediately below the aircraft at the time of each exposure could be derived. From the co-ordinates of plumb points the bearing from the plumb point to any target appearing on the photography could be derived and plotted on an artillery board. The intersection of two, or more, such bearings from different photos in the run when plotted on the gridded artillery board would give the target co-ordinates.

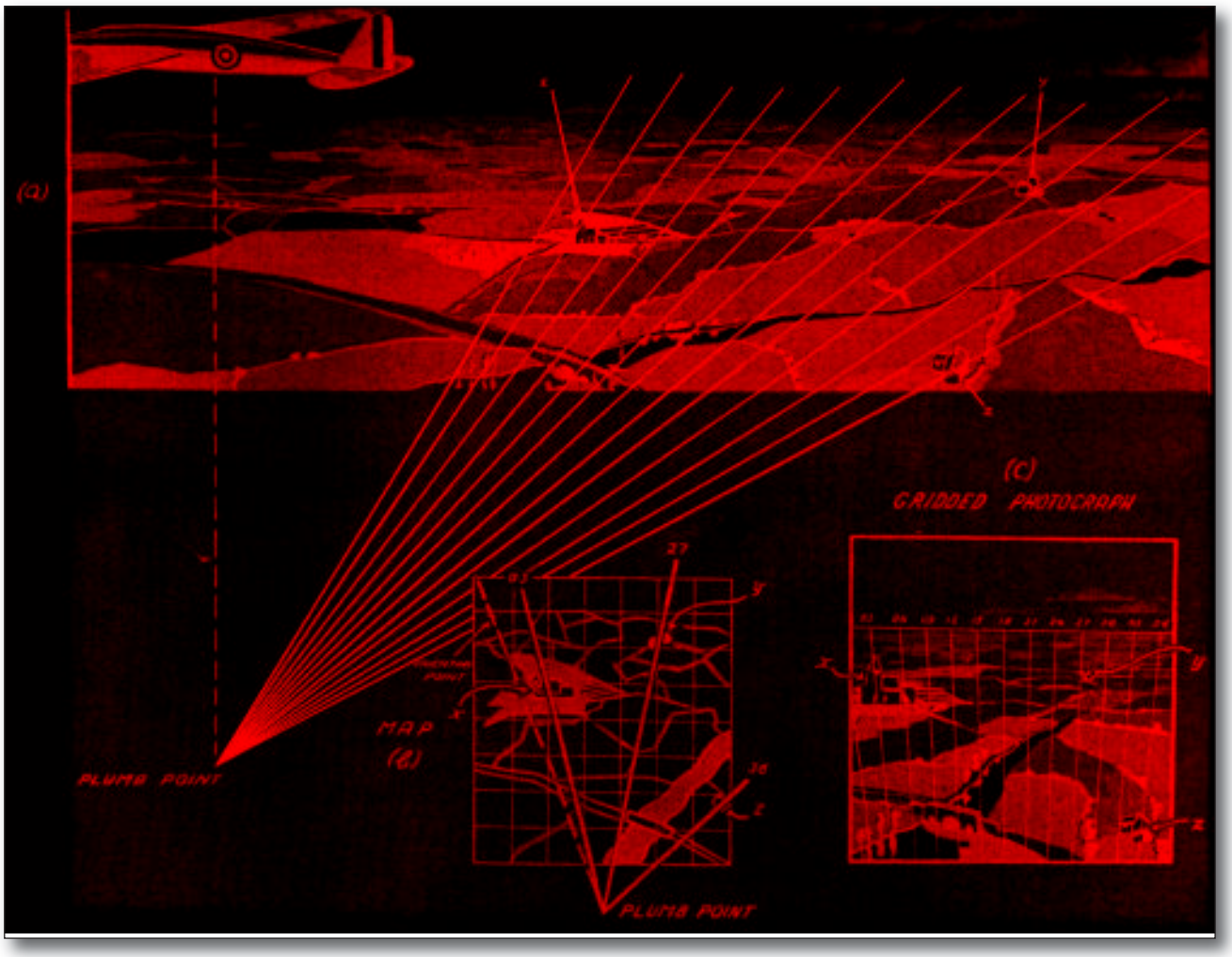


Diagram 2 - The Vertical Grid Lines (a) and on Map (b) and Gridded Photo (c).

The diagram shows the target T at the intersection of a ray 16 degrees from the left edge of Photo A and 10 degrees from the left edge of Photo B. The target could also have been fixed by a ray about 1 degree from the left edge of Photo C.

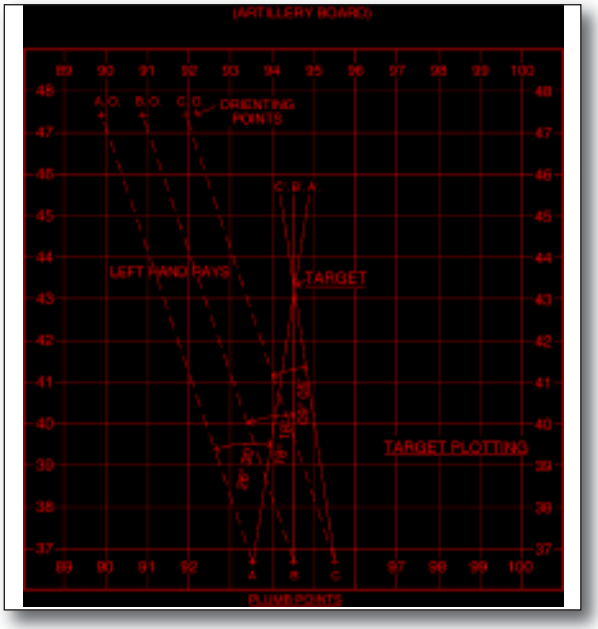


Diagram 3 - Target Plotting on an Artillery Board.

Diagram 2 - shows the imaginary fan of rays from a plumb point at the time of exposure and how they appeared on a map and gridded photo.

Diagram 3 shows an artillery board on which a target at grid 945433 has been co-ordinated by three rays from the plumb points of Photos A, B and C, with rays 26 degrees thirty minutes from the left edge of Photo A, 18 degrees 18 minutes from the left edge of Photo B and 9 degrees 5 minutes from the left edge of Photo C.

The Procedure.

Once the CCRA had specified the part of the Corps front to be covered, the Air Liaison Officer of the Army Co-operation Squadron specified the actual start and end points of the run, the flying height, usually 3,000 feet but anything between 1,000 and 5,000 feet, and the distance between plumb points.

The distance behind the FDL depended upon the types of target to be engaged. The effective depths of photographs for target indication was 10,000 yards from the flight line. Where both allied batteries and targets were to be fixed, the run was usually 3,000 yards behind the allied batteries so that they would be imaged well into the foreground. For more distant, counter-battery, targets a second line of flight nearer the FDL might be necessary.

The Photographic Section loaded the F24 camera with Infra-Red film and set it at 12 degrees depression.

The pilot then had to fly to within 5 degrees of horizontal with the Type 35 camera control unit set to achieve the required ground interval between exposures.

It was planned that the Air Liaison Section would have an NCO and 2 Surveyors RA attached for the purpose of deriving plumb points and directions of photographs working on the first newly processed wet prints while the photographers produced up to 15 copies of each print.

Prints were gridded by fixing one of a set of 20 standard grids, for depression angles of 0 to 19 degrees, under the negative on the contact printer.

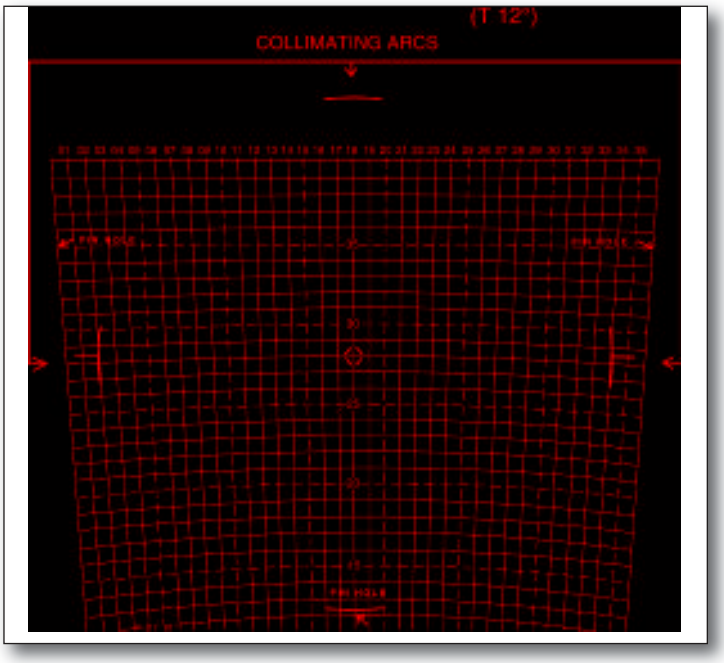


Diagram 4 - Example of a Grid.

Diagram 4 shows a grid for a depression angle of 12 degrees (T 12) with 36 rays at one-degree intervals, numbered from 00 to 36 and these rays on a gridded photo could be used to indicate the direction of a target located along one of them.

With each set of grids was provided a celluloid tilt graticule. This allowed the photographer to find the tilt of the camera from any negative containing a horizon. The Tilt Graticule was laid over the negative with the collimating circle coincident with the four collimating crosses on the negative and the horizontal degree line parallel with the horizon shown on the photograph. To the reading of the horizon on the tilt graticule was added a small correction for the distance

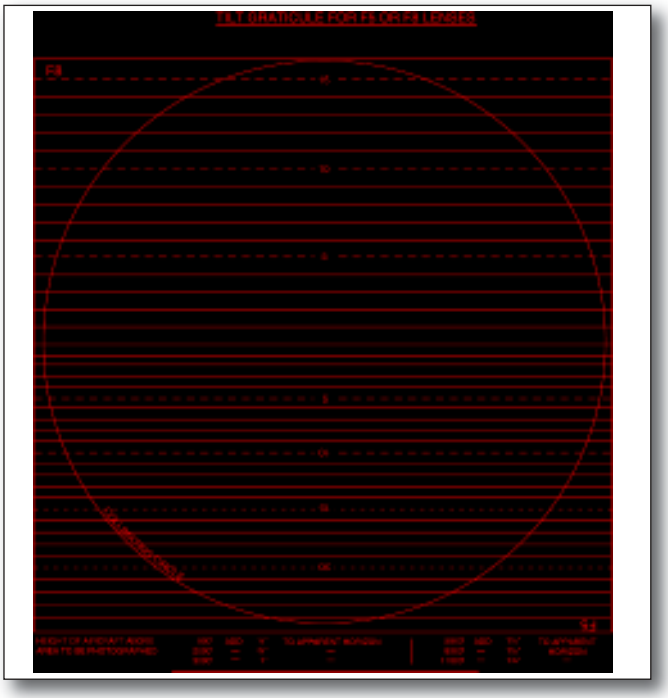


Diagram 5 – A Tilt Graticule.

of the true horizon above the apparent horizon.

Having obtained a corrected reading of the horizon on the tilt graticule, a grid was chosen with the nearest value of T. The selected grid was positioned under the negative on the contact printer so that the collimating arcs on the grid registered under the collimating crosses on the negative, with the horizon line on the grid parallel to the horizon shown on the negative and slightly above it. To enable reprints to be made later, the position of the grid was registered to the negative by making three pinpricks on the negative.

Each photo was lettered A-Z, or A-Z, AA, BB, CC etc., if more than 26 photos in a run, and the height of the aircraft was noted together with the calibrated focal length. On the reverse, or beneath the photo, if it was mounted on card, was shown the co-ordinates of the plumb point

To derive the plumb points and orientation of the photo, four clearly defined "control points" were selected on the photo which could also be identified on the map, two wide apart in the foreground, one further away and one in the distance, important for finding the bearing of the photo.

The rays through these points were then set off on a piece of tracing paper which, when laid over the map with the rays fitted over the control points then the true position of the apex of the rays could be identified; a classic tracing-paper resection. The co-ordinates of the apex point were noted. The co-ordinates of an orienting point about 12,000 yards along the left-hand edge of the photo were also recorded.

The resection was actually performed with 1:25,000 scale celluloid Tetley Fan covering an arc of 80 degrees with range arcs at 500 yard intervals from 1,500 to 18,500 yards ranges. The notch at its apex could be located at a pin positioned through the relevant plumb point.

The co-ordinates of plumb and orienting points were recorded on the back of each print. Additionally, a Trace was recommended to ease the setting up of plotting boards quickly and accurately.

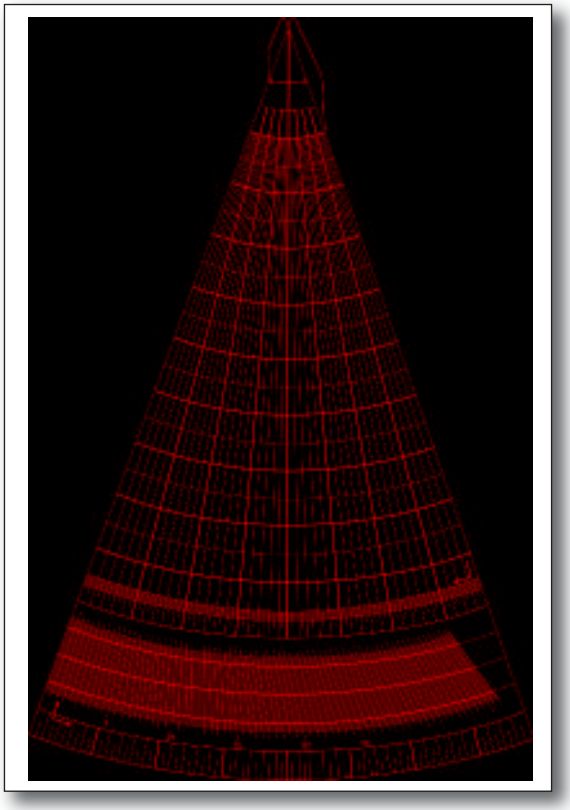


Diagram 6 - The Tetley Fan.

Target Plotting.

For target plotting, at least three plumb points and orienting points were plotted on a No. 3 Artillery Board, labelled with their photograph letters as in the Diagram 3 above.

Target Indication.

When ground personnel or the batteries also held copies of prints of the run, six-figure target references could be given simply in terms of the "grid" shown on a single photo. This system of reporting from one photo was obviously preferred by the pilots

Where ground personnel did not hold copies, the pilot would signal the intersecting bearings in the form A159, B100, A and B being the photos, 10 and 15 being the ray in number of degrees from the left hand edge of the photo and 9 being the estimated tenths of a degree.

Where possible, targets were to be indicated from photos widely separated to give the best intersections, e.g. from photos A and C of a run rather than from photos A and B.

Where ground personnel did not hold copies of photos, target indications such as A265 B183 were plotted on the artillery board by constructing lines at 26 degrees 30 minutes from the line Plumb Point A to Orienting Point A, and 18 degrees 18 minutes from the line Plumb Point B to Orienting Point B, the intersection of these rays being the target position on the grid, as shown on Diagram 3.

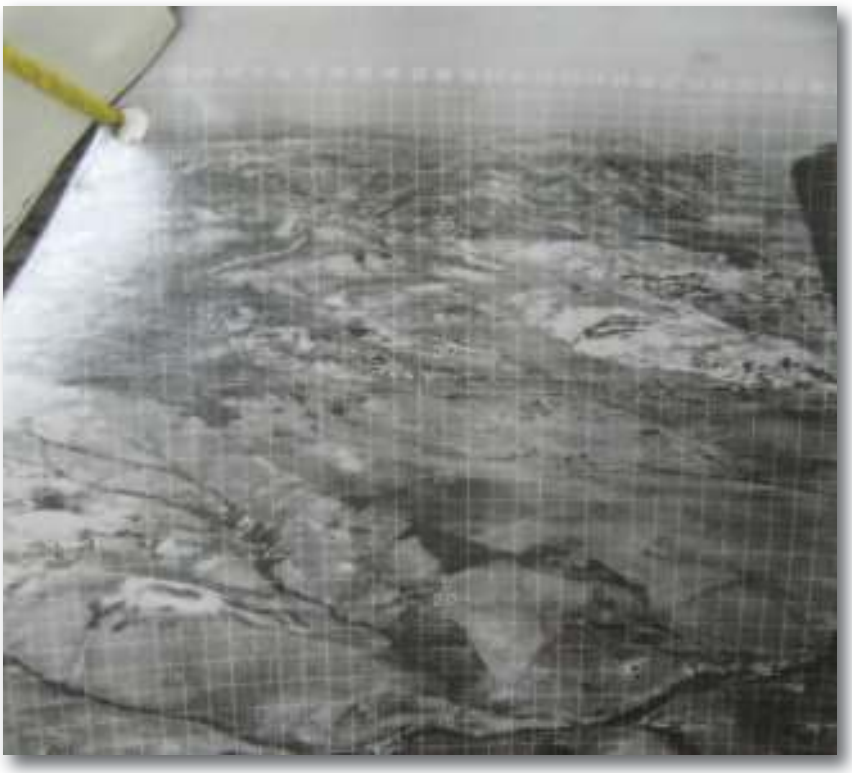
When ground personnel or the batteries held copies of photos, ground positions were received in the form A265259, the target position was then identified in at least two other photos as widely separated as possible to obtain a good intersection and plotted as before.

In both cases the Tetley Fan was used but other expedient graphical methods and aids were also available.

Table of Range & Scale of Oblique Photos.

An aid to appreciation of the range and size of objects on oblique photos a table was provided showing ranges and scales for various distances of horizontal grid line at various heights.

Writing to Major Merton on 23 May 1943, Major R.L. Howell of HQ RA 5 Corps described the first occasion the method had been used operationally in Tunisia, the photos being taken by "Spike" Millington in a Hurribomber of 225 Squadron RAF with twelve Spitfires as escorts. This Hurribomber, the only one fitted for Merton photography, was shot-up on the ground four days later, but by 23 May 1943 six Spitfires were equipped to do Merton photography. The area of the strip was NE of Madjez-El-Bab, the run starting near Heidous and finishing near Sidi Mehene. The photo shows the River Medjerda and the main road running N.E. from Medjez to Tunis. The only maps available were allied reprints of the French 1:200,000 and 1:50,000 series, of doubtful quality, so the resections were done on the Corps grid. *(PRO Air 20/2208)*



Example from Tunisia.

Other references have been seen showing that they were also used extensively during the crossing of the River Rhine in 1945 and that the system was adopted with enthusiasm by the U.S. Army.

The above description is simply a précis of the principal parts of the pamphlet "Gridded Oblique Photography (Merton Method) Provisional October, 1941." It is not known if later editions of this pamphlet were produced or if the method was further developed.

However, the Geographical Section, General Staff was not, initially at least, impressed by the proposal to adopt this method. Having struggled for years to try to persuade the RAF to accept responsibility for the production of survey standard vertical area survey cover in order to be able to produce 1:25,000 scale topographic maps suitable for artillery use, it was dismayed at the apparent diversion of resources on a method which was based on the use of the 1:25,000 scale base map/scale, when the only areas where such a scale was available were Italy and Germany and when the army was then fighting in the Western Desert on questionable mapping.

Due to the lack of suitable "native" mapping at large scales, at the beginning of the war the then head of GSGS, Col Boulnois, had even strongly considered the adoption of the 1:100,000 scale as the standard topographical map scale.

In March, 1942 Col. M.N. McLeod then Director General at the Ordnance Survey wrote to an old acquaintance from Flash-Spotting days in World War One, Lt Col H.H. Hemming at Larkhill seeking a personal opinion on the divergence of view between Merton and the then head of GSGS, Col. M. Hotine,

Hotine's view was simply that if a 1:25,000 scale map was not available the method was impracticable. If a 1:25,000 scale map was available it should be easier and quicker to pinpoint directly from the map. Hotine had even instructed Major Bill Williams, the RE Survey Liaison Officer at Army Co-operation Command Headquarters to evaluate, in the air, in a suitable aircraft, the use of the 1:25,000 scale map for pin-pointing targets but Williams had not been able to persuade the RAF to do this. RAF officers, to whom Williams had spoken, were of the opinion that the 1:25,000 scale map was unnecessary and that pinpointing could be done perfectly well on the 1:63,360 scale map.

McLeod thought that if target location was the primary objective a fast aircraft using a 1:25,000 map vertically over the target should give the more accurate result, but, if observation of fire and ranging were the main considerations then a slower platform working over the battery position might be the better solution. In his view, predicted fire had great tactical advantages over observed fire, though he accepted that the Gunner having to deliver predicted fire at inaccurately located targets with inaccurate data or worn guns might be inclined to regard it as "chancey".

He concluded that while RE Survey was doing its utmost to provide 1:25,000 scale maps (of Normandy, The Benson Project) mainly for the artillery it was of no use if the artillery preferred to use oblique photographs.

What Hemmings' response was is not known.

Later in the war, in early 1945, Merton was involved in trials for determining water depths by means of the use of simultaneous photography with cameras using green and red filters, the Transparency Method. Trials were undertaken in Ceylon and a report was written on 29 Jan 1945 but the war ended before the methods were applied operationally.

Merton was one of the most gifted and prolific artists of the last century, both Her Majesty the Queen and Princess Diana having sat for him. He died in 2012, aged 97. His obituary in the Daily Telegraph may be found on the internet.

Merton's stunning triple-portrait of Princess Diana illustrating this note is reproduced by kind permission of the Cardiff City Hall.

Courtesy of City of Cardiff Council.

Obituary - John Merton

Merton's obituary published in the Daily Telegraph in February 2011 is reproduced by kind permission of the Daily Telegraph

John Merton, who died on February 16 aged 97, was one of the most prolific portrait painters of the last century, and enjoyed a reputation for depicting sitters at their best.

As an exhibitor at the Royal Academy Summer Exhibitions, Merton produced three pictures which were the most talked about of their respective years. The first was his triple portrait of Mrs Daphne Wall (1948). The selection committee disliked it, but the RA's president, Sir Alfred Munnings, threatened publicly to resign if it was not hung, and it was shown on a separate easel. It caused a sensation, and drew enormous crowds.

Ten years later Merton's triple portrait of Jane Dalkeith (now the Dowager Duchess of Buccleuch) had the rare distinction of being awarded an immediate "A" (for Accepted) by the committee. Kenneth Clark called the picture "really rather wonderful", and Cecil Beaton hailed it as "the picture of the century".

The third picture, which attracted widespread interest when it was shown in 1987, was a triple portrait of Diana, Princess of Wales. "She is undoubtedly the most beautiful woman I have ever painted," Merton said. The Princess, wearing a tight-fitting yellow dress, gave the artist five sittings, one at Kensington Palace and four more at his studio near Marlborough in Wiltshire. Merton worked on the picture for around 1,000 hours.

The painting was hung in Cardiff City Hall, and in 2005 was temporarily, and controversially, removed from the wall hours before the Prince of Wales arrived on an official visit with the Duchess of Cornwall.

Among his many other works, Merton made a silverpoint drawing of the Queen (1989), which is now in the Royal Collection, and produced triple portraits of Sir David Piper and the Duke of Grafton for the National Portrait Gallery.

Noted for the meticulousness of his work, Merton's inspiration was the art of the Italian Renaissance. In his early years he used egg tempera; later he developed his own formula using gelatin. Typically, in a short sitting he would make hundreds of slides of his subject with a stereo camera, exploring various combinations of lighting, attitude and expression, and he would then work from these using a binocular viewer.

John Ralph Merton was born on May 7 1913, the eldest of five sons of Sir Thomas Merton, the physicist and Professor of Spectroscopy at Oxford University. John's talent as a draughtsman was evident from boyhood, and when he arrived from Eton at Balliol College, Oxford, he was allowed to study at the Ruskin School of Drawing instead of taking a degree. His father took him on a number of visits to Italy to study Renaissance art — Botticelli was to become a significant influence on his work.

Commissioned into the Royal Artillery in 1940, Merton headed the research unit at the Gunnery School, Larkhill, where he developed a system of photographic reconnaissance known as "the Gridded Oblique", which allowed for more accurate identification of targets. The Americans adopted it and took more than a million gridded obliques before crossing the Rhine. In 1942 Merton was appointed MBE (military) and in 1945 he was awarded the American Legion of Merit.

In 1944 Merton was appointed assistant to Lord Mountbatten's scientific adviser at Kandy, in Ceylon. There he invented a method of measuring from high altitude the gradient and depth of water on beaches, helping to assess their suitability for landings by troops. The plan was to make use of this technique before attacking islands held by the Japanese, but the war ended before it could be put into practice.

Merton published a two-volume selection of his paintings and drawings, A Journey Through an Artist's Life (1994 and 2003). In 2003 he had a retrospective at the Fine Art Society in London.

He enjoyed coming up with quirky inventions for his children at their home in Wiltshire. Among them was a boat constructed from old aircraft fuel tanks, which they could sail on the river Avon; and a paddle wheel in the river which generated a current in the family's swimming pool so that the children could swim "against the tide".

John Merton married, in 1939, Viola Penelope von Bernd, who died in 2009. He is survived by two daughters; another daughter predeceased him.

The Royal Engineers had been there already!

By John D Adshead

I joined the Colonial Survey Service (CSS) in 1953 and after first attending the SMS officers' training course at Newbury found myself in Northern Nigeria, in August 1954, putting into practice what I hoped I had learnt. Although Nigeria had an exemplary pattern, of triangulation chains (which, incidentally, was referred to as such when I was training) it was not complete. This was especially the case in the far north where the ground was too flat for the chains to be extended there without the kind of resources the-Survey Department would have needed and did not posses.

Luckily, Brigadier Hotine, who was then running the CSS, had been sufficiently far-sighted to persuade the RAF to take air photographs of our colonial territories while they still had the necessary resources readily available to do so - and as a consequence a Lancaster with all the necessary back-up had duly photographed the greater part of Nigeria in three enormous radar-controlled spirals of overlapping vertical air photographs.

My job was to identify suitably situated photo-points on the ground which occurred on 3 successive overlapping photographs and then to fix their positions by star observations using the position-line method. These photo-points were to be chosen, with no more than 25 miles between them, to form a network which could then be used as a lattice of control for a slotted template lay down and the subsequent mapping of the ground detail from the photographs.

One of the locations I chose for a photo-point was on the edge of a large village called Damaturu where, as usually happened, the best photo-point was not also a suitable position for an astro-fix. This, consequently, necessitated choosing a separate point for the latter and linking it to the photo-point with a measured line the true bearing of which was obtained by a sun azimuth observation. At Damaturu the ground between these two positions was covered by fairly tall dried grass which had to be cut down to get a clear line of sight - and, by sheer chance, in doing so, a very substantial concrete beacon shaped like a rather fat sugar loaf was revealed. This was painted white and bore the inscription "REW 4 1928". I had no idea what it was but decided it might be of interest so incorporated it into my ground survey.

Although the Nigerian postal service was remarkably efficient given the relatively undeveloped nature of the country, all "bush" surveyors were provided with a messenger whose job was to get completed survey work back to headquarters as soon as possible and to find his way back to his surveyor on his return even though the latter had probably moved on in the meantime. Most of our messengers were veterans of the war in Burma and were extremely reliable and enterprising but I was surprised how soon my own messenger was back with news of REW 4. Headquarters had pulled out all stops and had immediately got onto the CSS in England and they in turn had sourced the Geographical Section of the General Staff (GSGS) - and luckily they knew all about it. Apparently the Royal Engineers had been in Northern Nigeria in 1928 (the year I was born) and, amongst other things, had carried out six astro-fixes strung out right across the north and it was one of these that I had quite fortuitously stumbled across. Unfortunately I no longer have the relevant figures but my astro-fix results were for all practical purposes the same as those of my predecessors which, as a rookie surveyor, delighted me and gave my confidence a nice little boost!

REWs 1 to 3 were to the west of where I was operating and REW 5 was not in a useful position for our then purposes but REW 6 was in an ideal location near the rest house in Maiduguri and I was asked to locate it, tie it to a suitable photo-point and, if there was time, carry out an astro-fix as a check. Maiduguri was the headquarters of Bornu Province and I usually visited the treasury there

once a month to get the pay for my survey gang so this was not a problem; and when I next went to Maiduguri and using the helpful instructions supplied by GSGS I very quickly found REW 6 close to the rest house. Unfortunately, by this time the rainy season was beginning to affect the weather and there was too much cloud cover to enable me to do any astro and I had virtually resigned myself to just doing the photo-pointing work and moving on.

The rest house was close to the European club and during the day I received an invitation to go to a dance at the club that evening - and at this point I think I should mention that my wife had trained as a land surveyor and that not only was she with me when I was in the field but that she was also an enormous help with the work I was doing. The thought of going to a dance in rather more civilized circumstances than we had become accustomed to was extremely enticing and we gleefully dug out our best evening clothes for the occasion.

However, as we set off to the dub that evening, we suddenly realized that the cloud cover had vanished and that the sky was clear and full of stars. Neither of us spoke; we just look at each other then rushed back inside and with the help of our cook got our kit assembled and set to work. REW 6 was very close to the road and our photo-point was close by; and although the road was a dead end and devoid of vehicular traffic, it formed part of one of those endless footpaths which criss-cross Africa and quite a bit of local pedestrian traffic was on it that evening. What the passers-by made of our little cameo by the roadside I cannot imagine: there was I, dressed for the evening, stop-watch in hand, using the theodolite, which looked rather exotic and wonderful in the dark with its own little lighting system, close to where my wife was sitting at a trestle table in the road in her long evening dress busily writing by the light of a pressure lamp while keeping an eye on the chronometer! We were greeted by the passers-by in the usual cheerful and friendly way of the African but I cannot help thinking that they must have been shaking their poor old heads and thinking that our behavior just proved their worst suspicions that all Europeans were mad!

Mind you, when I fixed a photo-point north of Maigatari very close to the border with Niger, I think the opposite was probably true! I had been asked to incorporate into my survey a nearby international boundary marker about 100 yards from my theodolite station which necessitated my gang cutting the usual sight line through the scrub to it. When I glanced up to see that the line was clear, I saw great clouds of dust rising from where I expected to see the marker - and became aware of lots of shouting and loud laughter emanating from the murk. My headman emerged from the dust as I approached and said with a grin "Dey go tief (steal) Frenchie country" and, sure enough, there was my gang on a high, shouting and laughing, and shoveling great piles of dusty sand from Niger into Nigeria. The press was not present so no diplomatic incident followed! My headman, who co-incidentally was from Niger, did however mutter to me that it was a pity that the gang did not work as hard when they were doing their ordinary daily work!

My final contact with the work of the Royal Engineers occurred the following year when I was running a 60 mile control traverse between Bida and Mokwa. This traverse more or less followed the route of the Al which apparently had been built originally in this part of the country by men of the West African Frontier Force. This traverse took me very close to a trig point established by the Engineers and I was asked to tie my traverse to it. The papers for this trig point are worth mentioning. They were exemplary and included water colour panoramic views of the surrounding countryside which as well as being very useful from a practical point of view were clearly painted by someone who was at heart quite an artist. What the papers did not say was that the trig point was guarded by a 20 foot python which I had not noticed and which I nearly trod upon much to the great amusement of my faithful gang.

Happy days

First World War 1914/18
A Middle East Spy Ring

The Arrohnson Saga being the story of "NILI"

By Tobias (Tony) Hitman FRICS

Introduction

This is a little known but well documented story of a Jewish spy ring which during the First World War operated out of Palestine and provided information to the British Army in its campaign against the Turkish and German Armies. Chronologically, the battle at Gallipoli had been lost and in 1916/7 the British were poised to attack Turkey from Egypt via the Sinai Desert with the battle lines drawn up at Gaza.

Background

The records of the spy ring are contained in the home, now a museum, of the Jewish family Aarohnson in Israel...It is situated in a small town north of Tel Aviv and south of Haifa nestling in the hills and overlooking the coastal plain and the Mediterranean Sea.

The Aarohnson family came to Palestine from Romania in 1882. At that time Palestine was a sparsely inhabited province of the Ottoman Empire under Turkish rule and an anti Semitic Governor Djemal Pasha. They and their compatriots with great difficulty but with the financial help of Baron Edmond Rothschild settled in the town which would take the name of Zichron Yaakov.

In addition to Aaron who came with them the Aarohnsons had four more children Sarah, Rivka, Shmuel and Alexandra. Aaron the eldest of the children and the main character in this saga grew up to be a brilliant young man. He studied geology and botany in France and he travelled extensively in Europe. Aaron's discovery of the mother of wheat catapulted him into worldwide fame. The Americans were particularly interested and he visited and collaborated with the United States Department of Agriculture. With financial aid from America, Aaron was able to build an agricultural experimental station on the seashore at Atlit below Zichron Yaakov.

The Beginnings of the Spy Ring

As the war progressed, the Turks moved their army into Palestine to face the British in Egypt. Without consideration for the population, particularly the Jewish communities, they requisitioned most of what was valuable in the way of stores of food and accommodation.

Aaron had been brought up under the anti semitic rule of the Turks and he concluded that if the Allies won the war, they might be more amenable than the Turks to the establishment of a home for the Jewish people in Palestine. Aaron therefore recruited the family members and likeminded friends to join him in providing intelligence to the British. They knew that if they were caught, as spies, they were likely to be tortured and most certainly executed.

It was decided to name their organization "Nili" an acronym for "See! NetzachYisrael LoYeshaker" from the Bible "The eternity of Israel will not lie". The spy ring operated around the Agricultural Research Centre at Atlit where information gleaned by members was transmitted and collated. Aaron, the acknowledged head was assisted by his sister Sarah who ultimately became his deputy, and his brother Alex. Avshalom Feinberg a young friend of Aaron, a distinguished scholar and friend of the family shared the same aspirations and joined the ring.

Communicating with the British

Aaron and his associates had two difficulties. Firstly, Britain and Turkey were at war and it was dangerous to attempt to cross the enemy lines from Palestine to Egypt via the Sinai Desert. Secondly, if they managed to reach British Headquarters in Cairo how they would be able to reassure the British that they were genuine and not Turkish enemy agents.

The route they chose with false passports was via Beirut in American warships which called at Mediterranean ports including Port Said and Alexandria. Reassuring the British of their intentions proved difficult.

Aaron sent his brother Alex and sister Rivka on the first mission. They were not trusted and ordered to leave the country and they left for neutral America. In the absence of any news from his siblings, Aaron decided to make his way to Egypt by the same route. He successfully gained the confidence of the British and they agreed to accept intelligence from him and his associates. The line of communication was by British ships from Port Said anchoring off the coast of Palestine at Atlit.

The Intelligence

The intelligence gathering was achieved by a widely spread network of Jewish associates in both Palestine and Syria. The information included the disposition and movement of Turkish and German troops, their weapons and gun emplacements and their supply routes, all of great use to the British. There is the example of a Jewish doctor responsible for examining Turkish and German troops moving down to the front who was able to report on the names of regiments, numbers of men and their weapons. The information reached Atlit but transmission of the information to the British was erratic depending on the weather and British ships safely anchoring off the coast.

The Outcome

There were three battles at Gaza. The first two under the command of General Murray were frontal attacks on the Turkish lines and were repelled.

Subsequently, in 1917 Commander in Chief Allenby was appointed to lead the offensive and on 1/2 November 1917 the third Battle of Gaza was fought and assisted by the intelligence provided by NILI particularly with regard to the terrain he was able to outflank the Turkish German lines and break through to capture Jerusalem and Syria.

The British recognized the assistance of Aaron and his friends, this was formally acknowledged by British officers and politicians in documents on display in the museum.

Regrettably, towards the end of the war a member of the spy ring was captured by the Turks and under torture he gave the names of his colleagues and they were rounded up. Two, Joseph Lishansky and Naaman Belkind were hanged in Damascus and Sarah, Aarons sister was tortured and subsequently committed suicide in the family house. Another leading member Avshalom Feinberg was killed in Sinai in an abortive attempt to reach Egypt through enemy lines. Aaron, the leader of NILI died in an air accident over the British Channel at the end of the war.

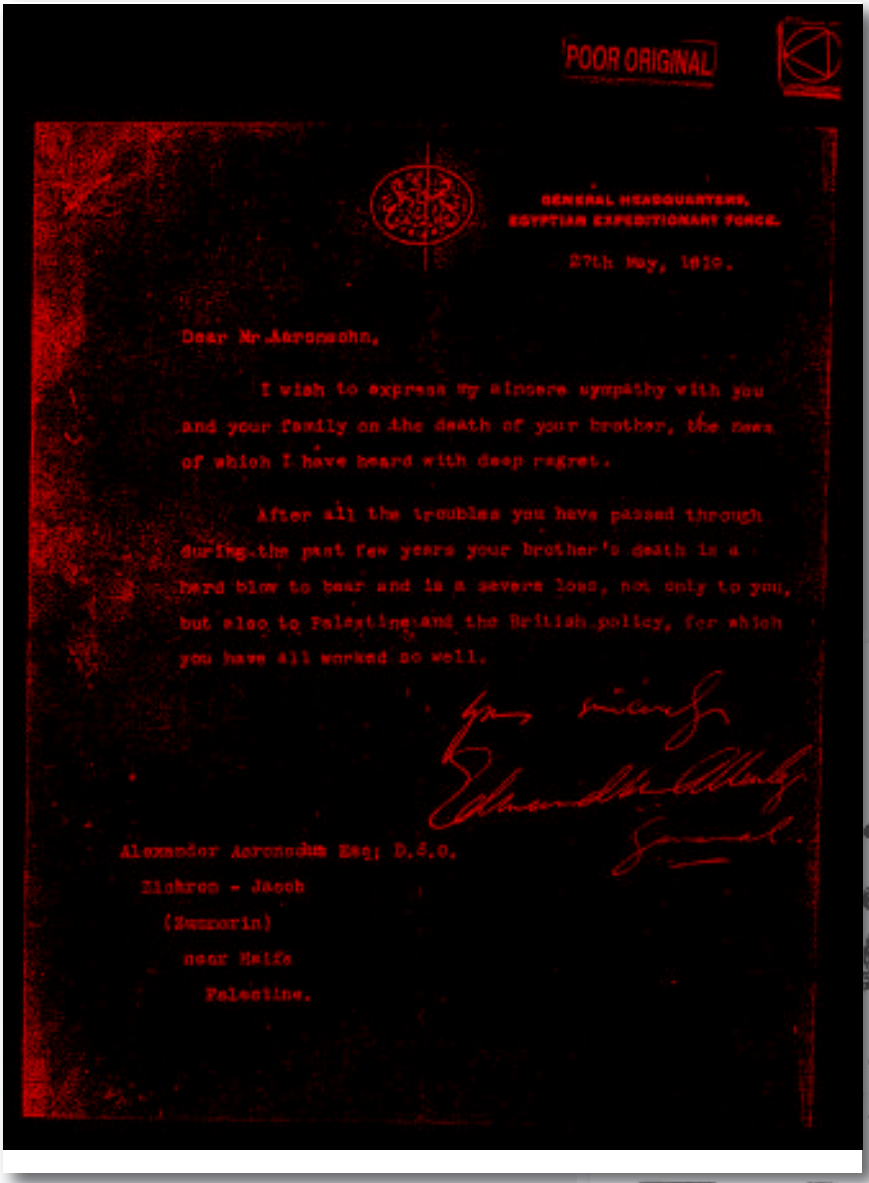
The agricultural Research station was destroyed by the Turks.

Appended to the article was a letter, dated 27th May 1919 signed by General Lord Allenby, of condolence to Alexander Aaronsohn on the death of his brother Aaron.

Alexander himself served as a Lt in the British Army and he was awarded the DSO “For gallant conduct and daring on the 2nd September 1918 penetrating the enemy’s lines and carrying out a reconnaissance which resulted in information which proved invaluable in subsequent operations”.

NB

The author Tobias (Tony) Hitman FRICS was commissioned as a 2Lt in the Royal Engineers on the 29 September 1946 after service in the ranks from 1945. He served in Egypt and Palestine in the late NILI Museum in Israel and the site at Atlit where during the mandate; the British built a camp to house illegal Jewish refugees.



POOR ORIGINAL

GENERAL HEADQUARTERS,
EGYPTIAN EXPEDITIONARY FORCE.

27th May, 1919.

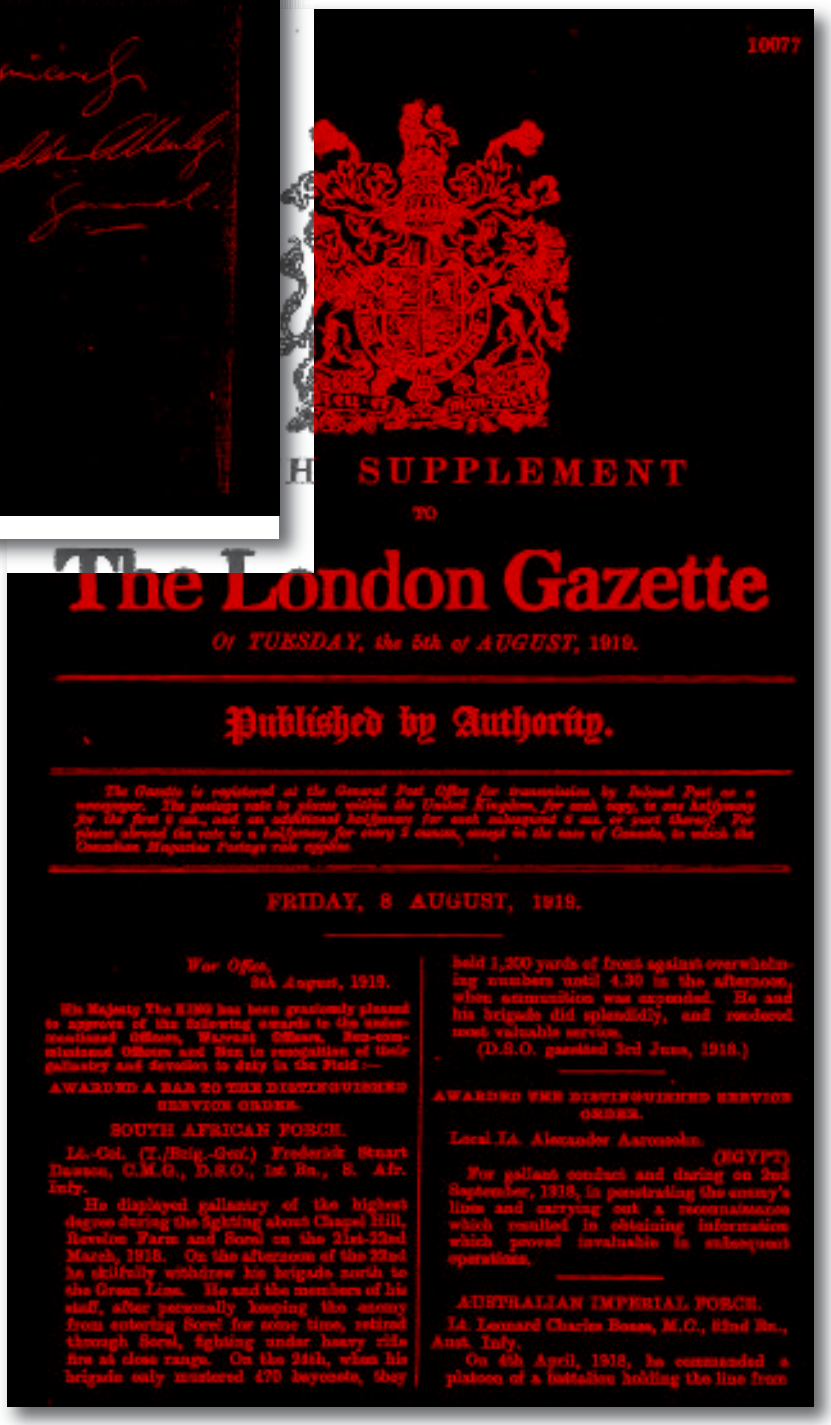
Dear Mr Aaronsohn,

I wish to express my sincere sympathy with you and your family on the death of your brother, the news of which I have heard with deep regret.

After all the troubles you have passed through during the past few years your brother's death is a hard blow to bear and is a severe loss, not only to you, but also to Palestine and the British policy, for which you have all worked so well.

Yours sincerely,
Edmund H. H. Allenby
General.

Alexander Aaronsohn Esq; D.S.O.
Zichron - Jacob
(Samarin)
near Haifa
Palestine.



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SUPPLEMENT
TO
The London Gazette
Of TUESDAY, the 5th of AUGUST, 1919.

Published by Authority.

The Gazette is registered at the General Post Office for transmission by Inland Post as a newspaper. The postage rate to places within the United Kingdom, for each copy, is one halfpenny for the first 8 oz., and an additional halfpenny for each subsequent 4 oz. or part thereof. For places abroad the rate is a halfpenny for every 2 ounces, except in the case of Canada, to which the Canadian Magazine Postage rate applies.

FRIDAY, 8 AUGUST, 1919.

War Office,
8th August, 1919.

His Majesty The KING has been graciously pleased to approve of the following awards to the undermentioned Officers, Warrant Officers, Non-commissioned Officers and Men in recognition of their gallantry and devotion to duty in the Field :—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

SOUTH AFRICAN FORCE.

Lt.-Col. (T./Brig.-Gen.) Frederick Stuart Dawson, C.M.G., D.S.O., 1st Bn., S. Afr. Infy.

He displayed gallantry of the highest degree during the fighting about Chapel Hill, Revelon Farm and Sorel on the 21st-22nd March, 1918. On the afternoon of the 22nd he skilfully withdrew his brigade north to the Green Line. He and the members of his staff, after personally keeping the enemy from entering Sorel for some time, retired through Sorel, fighting under heavy rifle fire at close range. On the 24th, when his brigade only mustered 470 bayonets, they held 1,200 yards of front against overwhelming numbers until 4.30 in the afternoon, when ammunition was expended. He and his brigade did splendidly, and rendered most valuable service.
(D.S.O. gazetted 3rd June, 1918.)

AWARDED THE DISTINGUISHED SERVICE ORDER.

Local Lt. Alexander Aaronsohn.
(EGYPT).

For gallant conduct and daring on 2nd September, 1918, in penetrating the enemy's lines and carrying out a reconnaissance which resulted in obtaining information which proved invaluable in subsequent operations.

AUSTRALIAN IMPERIAL FORCE.

Lt. Leonard Charles Boase, M.C., 52nd Bn., Aust. Infy.

On 4th April, 1918, he commanded a platoon of a battalion holding the line from

Letter, dated 27th May 1919 signed by General Lord Allenby, of condolence to Alexander Aaronsohn on the death of his brother Aaron.

RPAS - Operational Cencept Demonstrator

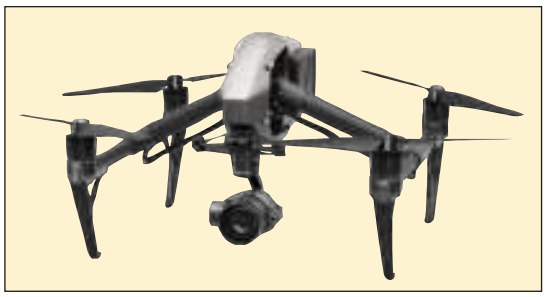
By SSgt Havenhand, SST 2IC

It's safe to say that technical development in the survey industry has neither slowed or showed any indication of slowing in the near future. Equipment manufacturers are constantly developing superior instruments and software, often marrying different capabilities into all-in-one solutions. The industry has also taken to the skies and for some time now, even the hobbyist with little survey or GIS background is able to perform data capture and exploitation at minimal cost. Remotely Piloted Aircraft Systems (RPAS), more commonly referred to as UAVs, are not new but the cost, availability and the functionality has taken a massive leap forward in the last few years. Another jump ahead is the understanding of what these devices, coupled with the right software, can deliver across different industries. Agriculture, Journalism, Law enforcement and Border Patrols to name but a few are all embracing the capabilities that RPASs can provide; even Amazon want to use them to deliver customer packages. Clearly, the military have also been exploiting the uses for aerial platforms for some time, from the largest such as Reaper and Whatchkeeper providing support to ground troops with long range capability, down to the bat-sized Black Hornet with the ability to capture video and stills within a 300m range.

The range of RPAS currently in service, the Reaper and the Black Hornet nano RPAS.

The Special Support Team (SST), 42 Engr Regt (Geo) are now also looking at exploiting aerial platforms to support the likes of the Technical Response Force (TRF), Defence Nuclear Emergency Organisation (DNEO) and UK Resilience as well as a wide spectrum of ad-hoc taskings often encountered in by team. Therefore, SST conducted some low level investigations with trial licences of photogrammetric software and still images captured from a privately owned RPAS. The investigations concluded that with little more than some cheap capture equipment and some commercially available programs, there are potentially endless uses that RE Geo could exploit when using RPAS to provide Geo support to wider defence. As a consequence of this investigation 42 Engr Regt (Geo) had a business case approved which has initiated an Operational Concept Demonstrator (OCD), to fully investigate the use of such equipment within SST and across RE Geo.

DJI Phantom 4 Pro and DJI Inspire 2.



The OCD is to procure 2 x Commercially available Off The Shelf (COTS) RPAS; in this case the DJI Phantom 4 Pro and the DJI Inspire 2. Alongside the capture platforms SST are also going to trial a number of photogrammetry packages running on a high-spec laptops which can deal with the system requirements of such memory-thirsty programs.

At present there are a number of actions happening in the preparation for the equipment arriving. Firstly, SST submitted a categorisation application and waits on a response from the Military Aviation Authority (MAA). This will hopefully give the team the necessary authority to use the identified platforms for the range of tasking/testing SST wishes to carry out over the next year. Running parallel to the categorisation, SST is filtering its soldiers through the defence delivered RPAS pilot course at RNAS Culdrose. The course provides training equivalent to the Civilian Aviation Authority (CAA) approved National Qualified Entity (NQE) and also provides knowledge of policy and skills needed to operate within the Defence Air Environment. Once categorisation and training is complete, the equipment will be purchased and the trial can begin.

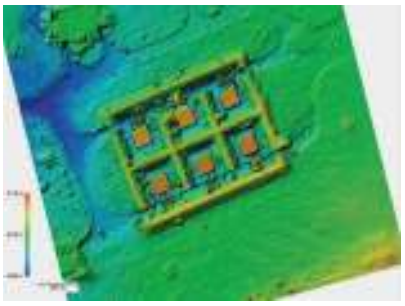
Stills from RPAS which can be used to give rapid situational awareness prior to processing in photogrammetry software.

A plan for the trail has been put together which will test the soldiers' ability to not only operate and test the equipment's limitations, but also investigate the type of products it is possible to generate using the photogrammetry software and ArcGIS following the export/import of the self-generated data. With the current generation of high resolution ortho-rectified imagery, DSMs and 3D point cloud/fully rendered models, it is anticipated that these products would provide exceptional, rapid situational awareness products to the command nodes that SST typically support. These would be self-generated but without the need to deploy the likes of photography equipment and 3D LiDAR scanners which can be timely and manpower intensive. Additionally, with the ability of live Full Motion Video streaming the team can feed video to commanders and various agency representatives to allow them to see and explore the full extent of an area of interest and follow operator progress during a task.

Comparison of NP Imagery and Imagery generated by photogrammetry software using still images captured during an RPAS flight.

There is also a plan to look at conducting comparisons to data collected using conventional survey techniques and LiDAR scanning methods. Although we are not looking to gain the precision and accuracy associated with conventional methods, the team want to investigate how the equipment being investigated can be used alongside in-service survey equipment to conduct tasks such as large scale surveys.

The OCD is currently scheduled to run until Aug/Sept 18 when a report will detail findings and give appropriate recommendations to the future use of this type of equipment; potentially laying the stepping stones needed for the SST to jump aboard a technology which is already taking off. This OCD has the potential to open up an exceptional capability that could enable the wider RE Geo community to self-generate quality, timely data in order to provide a better service to commanders and decision makers across Defence.



Example of a shaded DSMs created using AGISOFT Photoscan.

Measurable 3D model created from still images from COTS RPAS.

Map of the issue - The South Downs Map

In about 1979 the Directorate of Military Survey accepted the responsibility for Map Reading training in the army. As a first step it took on the responsibility for a new course at the School of Military Survey to train unit map reading instructors of all arms how to instruct the Common Military Syllabus (Recruits) in the subject of map reading. The first two-week course was run in mid-1980 at about the same time as the formal opening of the recently rebuilt barracks by H.M. Queen Elizabeth II and the course, aptly named Map Reading Instructors' Course or MAPRIC, quickly became accepted by the army as a most useful course. With modifications, and doubtless improvements, it has continued to the present day.

As with map reading over the years, recruits were taught on the military version of the 1:50,000 scale map of Great Britain but shortly after the MAPRIC got under way, it was suggested that a filmstrip of conventional signs and marginalia appearing on Series M745, the 1:50,000 scale series of Germany should be produced and that a training area map of Salisbury Plain should be produced to the specification of Series M745 but the idea never came to fruition.

However, as is often the case, this proposal is now revealed to be a case of "reinventing the wheel".

Recently found in the Defence Geographic Centre Map Library is a map of the South Downs conforming to the specification of Series GSGS 4250, the 1:50,000 scale map of France which was to be the operational tactical scale map used on D-Day and subsequent operations on the continent.

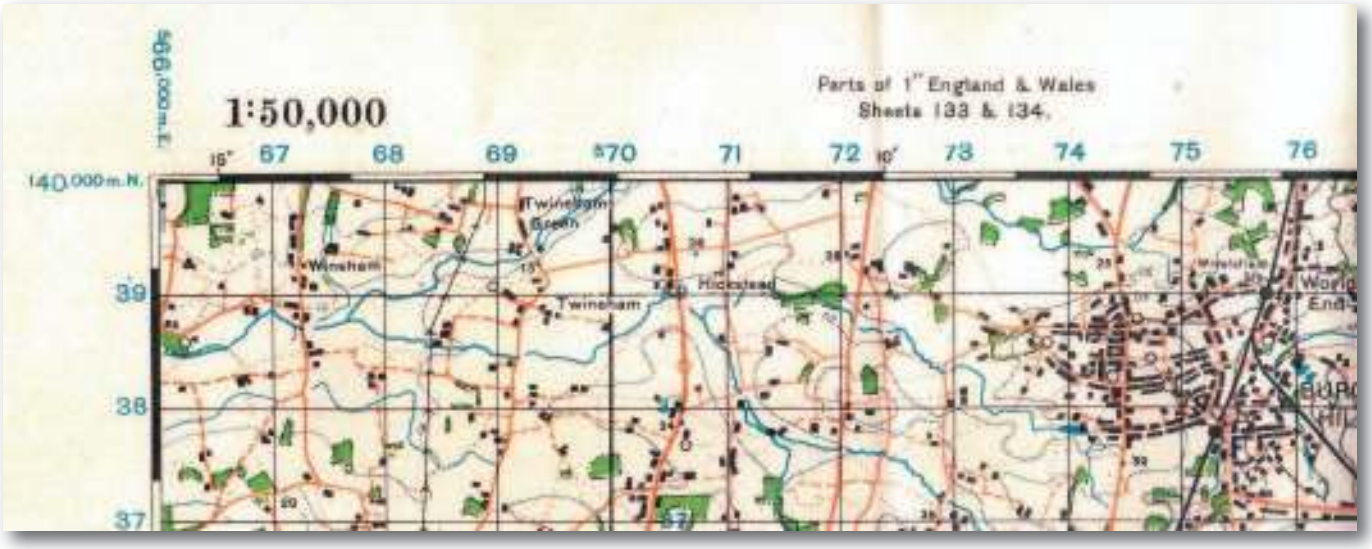
Series GSGS 4347 at 1:25,000 scale was also used by infantry but was conceived as an artillery map.

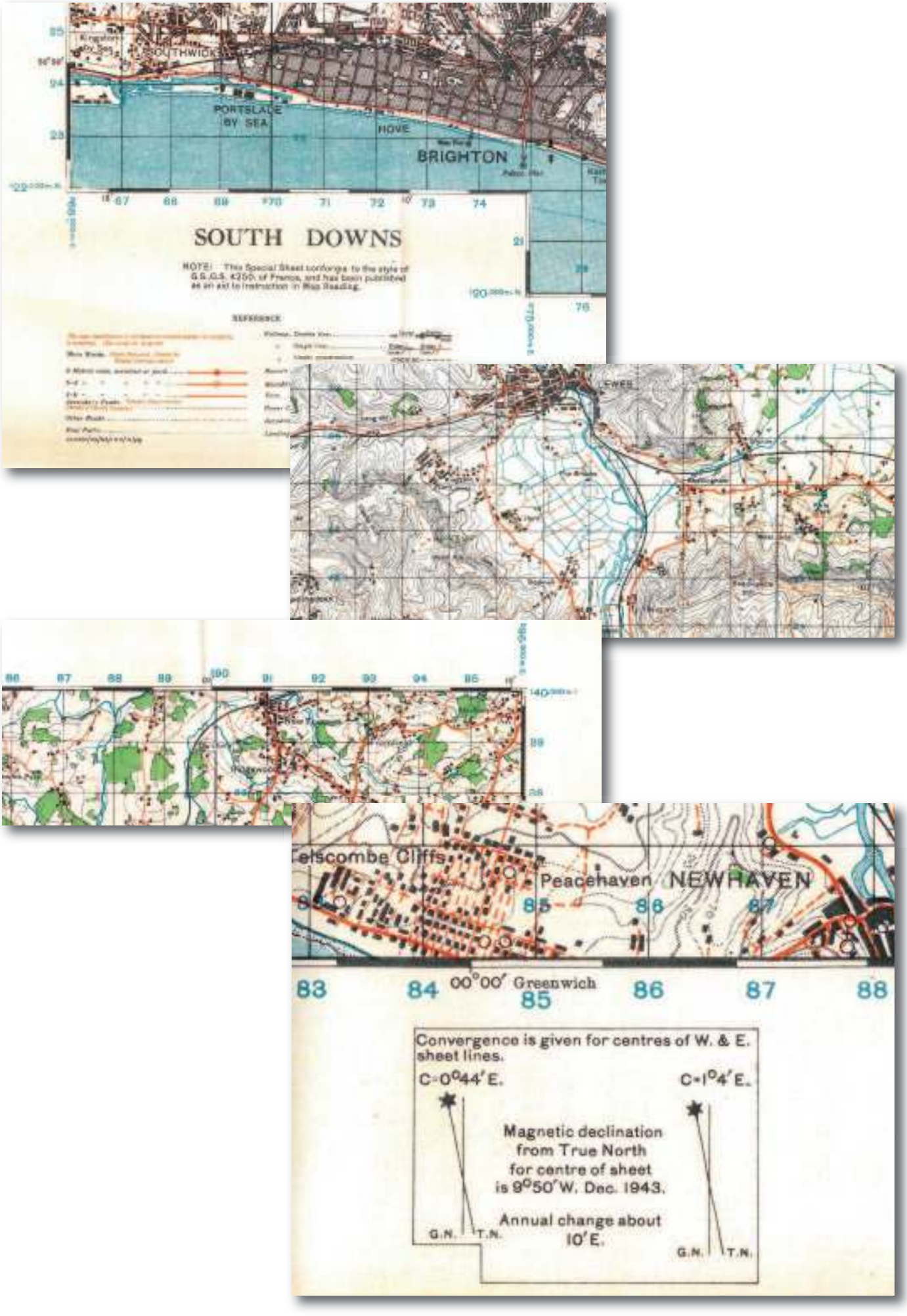
The South Downs map was produced as an aid to instruction in map reading on GSGS 4250 sheet lines covering 30 x 20 kilometres of ground on a sheet 76 x 55 centimetres overall, a sheet size which could be printed in the field on the Demy sized presses with which Field Survey Companies RE were equipped.

The symbols on the face and in the two Reference boxes were drawn to Series GSGS 4250 specification.

No grid data was given but THE GRID SHEET-CORNER VALUES AND 10-KM LADDER GRID ON THE GFACE CONFORMED WITH THE GSGS 4250 style. A GSGS 4250 type Convergence Data box was included.

The one example so far found has an imprint of 21,000/10/43/13 S/459, indicating that 21,000 copies were printed in October 1943.




SOUTHWICK
PORTSLADE BY SEA
HOVE
BRIGHTON
SOUTH DOWNS
NOTE: This Special Sheet conforms to the style of G.S.G.S. 4250 of France, and has been published as an aid to instruction in Map Reading.
REFERENCE
LEWES
Telscombe Cliffs
Peacehaven
NEWHAVEN
83
84
00°00′ Greenwich
85
86
87
88
Convergence is given for centres of W. & E. sheet lines.
C=0°44′E.
C=1°4′E.
Magnetic declination from True North for centre of sheet is 9°50′W. Dec. 1943.
Annual change about 10′E.
G.N.
T.N.
G.N.
T.N.

Mapping WWI for the Army Battlefield Guides

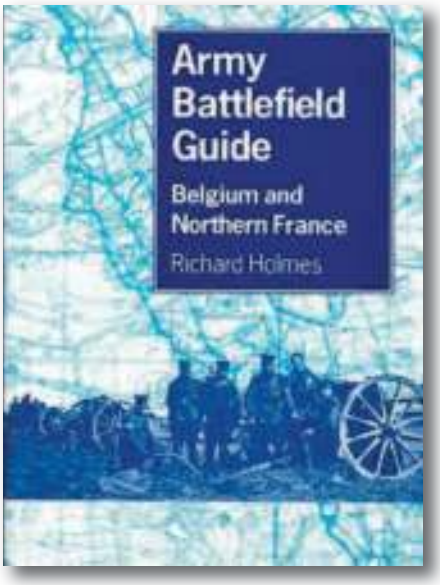
The Defence Geographic Centre (DGC)

By Barbara Taylor, DGC, Feltham (now retired)

By anybody's standards, the centenary of the First World War (or Great War) should be a significant marker in British history. It is certainly so for the British armed forces. This war saw great innovation in weaponry and equipment; light machine guns, tanks, aeroplanes and submarines are probably the most significant that spring readily to mind. The formation of Britain's newest arm, the Royal Air Force came about. Britannia still ruled the waves after the Battle of Jutland (31 May-1 June 1916) forever kept the Kaiser's pride and joy, the Imperial High Seas fleet, harbour bound for the remainder of the war.

The First World War is classed as the first 'modern' war and therefore provides an appropriate subject for the armed forces, particularly the army, to use as a study vehicle for the further education and training of tomorrow's leaders.

It should be no surprise therefore, that many regiments, albeit their much-merged successors in many cases, have been keen to go off on battlefield tours to see where their forbears both suffered and won many awards for helping to keep the enemy from gaining any more bits of France. There have been occasions over the last few years that DGC has been asked to advise on specific mapping for them to attain to take with them.



1995: Volume 1 Front Cover.

All centenary work on the First World War comes under the banner Operation (Op) REFLECT. By far the biggest project that DGC was tasked with was to produce bespoke mapping to illustrate a battlefield guide to the Western Front. In 1995, the British army published what was to be the first volume of a three-part guide to the battlefields of Belgium and Northern France. This was written by the late and sadly missed celebrated military historian, Richard Holmes. The project was never completed as the subsequent volumes were not funded.

On the initiative of Major General (ret'd) Mungo Melvin, until recently, President of the British Commission for Military History (BCMH) and the army's senior adviser for the First World War centenaries, the army decided to produce a new guide to concentrate on the battles fought by the British Expeditionary Force (BEF) including Imperial and Dominion forces. It was designed to provide a compact source of reference to major battles and other significant actions on the Western Front. While the primary target audience is all those involved in commemorations and learning events, such as battlefield studies, it should reach out to a much wider readership. General Melvin also edited this volume.

Bearing in mind the interdependence of British and French forces throughout (after all, the majority of the Western Front was on French soil) the battles of Second and Third Artois and Verdun are included, along with the Nivelle Offensive and the Second Battle of the Marne. Additionally the battles fought by US troops once they had joined the war effort on the side of the Allies are described.

The original selection of 24 battlefields was governed by whether the battle concerned would figure in national or international centenary commemorations and would additionally be of significance to Scotland and Ireland (both unionists and nationalists). These were designed to give an overview of the major battles in terms of strategic context, the ground, the planning and deployment of the principal forces engaged; the major actions and consequences. The casualties are also listed, not least to remind us of the huge human endeavour, cost and sacrifice involved. Additionally, to provide further background, six thematic essays concluded the volume, focussing in particular on the technologies involved and on maritime and air support. The final chapter details the work of the Commonwealth (originally Imperial) War Graves Commission (CWGC).

This richly-illustrated book is in A4 format and is comprised of separate chapters to describe the individual battles. Each chapter was written by a prominent military historian, many of whom are members of the BCMH. The authors also included retired or serving officers of the British, French and United States armies and the heads of the three Service historical branches. Each chapter is illustrated with at least one map, which is where DGC came in.

2015: Volume 1 Front Cover.

The maps are bespoke, fit for purpose sketch maps but produced in colour. They have not been produced using specialist mapping software, such as ARC GIS partly because they do not need to be geo-referenced and partly because modern base mapping is more of a hindrance than a help. The infrastructure is not usually the same as it was 100 years ago, even in rural France. We have modern highways and motorways running near to the main battle areas; but fortunately not through the middle as this has been largely resisted, because the whole area is pretty much a war grave. As many will be aware, it is quite a frequent occurrence for remains to be unearthed. In many cases rail lines have changed; not the main ones necessarily, but branch lines like many here have been removed. Also, many light railways were constructed during hostilities to aid the delivery of supplies to the railheads just behind the front lines by both sides in the conflict. With one exception they were removed during the reconstruction process following the war. Two DGC staff worked on this project and the maps were produced using PowerPoint, which may surprise some people, but it is extremely versatile, the author knows it inside out and can therefore produce results very quickly!

The ruins of Contalmaison Chateau.
© IWM (Q 2792)

The source material was in most cases, supplied by the chapter authors; at least the area that they wanted covered. By far the safest base mapping to utilise is the maps from the Official History of the War (OH) and the trench maps, which of course, the precursors of DGC produced in the first place.[1] The secret to producing this kind of bespoke mapping, the whole point of which is to illustrate a particular battle in broad brush strokes, is what you leave off! Otherwise you might just as well tactically overprint a map. So only the most important geographical features need to go on. By the time trench warfare had taken a hold and laid waste to the landscape around the front line, even roads had generally ceased to exist. Only putting the main roads onto the maps was necessary for the sake of making sense of how places were linked to each other. Wherever possible, roads were repaired and kept going for supplies. On the Somme front, in particular there are many sunken roads, which were very handy to use as part of the trench system, so these take on an obvious importance to be shown. As for the villages, they were often only identifiable on the ground by sad piles of masonry, which the engineers sometimes marked with a sign or painted the name on a bit of wall that might remain. The individual chapters were read and all place names and other geographical features mentioned in the text that were essential to be shown on the maps highlighted to make certain that they and any prominent trench names etc. were shown. Relief was shown where necessary in a very simple form. It is a

Map 0.1 – The Western Front, 1914-1918.

[1] See The Ranger Winter 2014; The Defence Geographic Centre and the Centenary of the First World War by Dr John Peaty.

Map 12.1 – The Battle of the Somme: Initial dispositions, 1 July 1916.

misnomer that the Western Front was totally flat, so that any elevation available took on huge importance in domination over the enemy. Sadly, it was the Germans who usually had the advantage of the higher ground over the allies. Supplementary information needed to complete the maps was drawn from books, articles and open source information.

The most important military information is displayed using NATO APP-6 symbology, which any rank of the British military forces should be familiar with; friendly forces shown in blue, enemy in red. An extensive general key to all symbols and abbreviations of all regiments depicted was included at the beginning of the book. In 2016, at the original time of writing this article, we were right in the middle of the centenary. I think it appropriate, therefore to use as my specific map example, the Battle of the Somme. Even those who know little of the war have heard of this!

This project was instigated by the current CGS and has had his full support ever since. The first edition came in at approximately 170 pages and used for the major staff ride that the army undertook in 2014, with some of our European partners. The book was very well received and as a result, it was decided to expand it for a second edition, which was published last summer. Four additional battle chapters were written, with a further four thematic essays, which included a chapter on mapping and survey, which was adapted from Dr Peaty's 2014 Ranger article. This extended the book to 230 pages. Further to this, it was agreed to produce a second volume to cover the other theatres of war that involved British and Dominion troops: *The Forgotten Fronts*.

This second volume was edited by Col (ret'd) John Wilson and is different in that it deals with campaigns rather than individual battles and covers the war in all other theatres. This includes army operations and occupations up until 1922; for example, the Irish Civil War and the Iraqi Revolt. Volume 2 was published at the end of 2016.

Further Somme specific mapping work arose from this as the army prepared for what was another major and very successful, staff ride to the Somme in September 2016.

To the uninitiated the First World War may seem irrelevant to contemporary warfare and the problems of today. CGS and the army would beg to differ. There is still much to learn from this conflict, not least how to how to fight a 'peer competitor'. In its short existence, the Battlefield Guide – as a unique educational and training resource – has gone from strength to strength. During the writing of this article in 2016, I learned that yet another unit, 42 Engineer Regiment, would be using this Guide as a basis for their battlefield study to the Somme. Many others are likely to follow.

This volume has met with universal praise from all who have had occasion to use it. DGC should be proud of its association with the Battlefield Guide project and support to Op REFLECT. There is still over a year of commemoration ahead of us; not least the 100 days campaign of 1918 when the BEF was arguably at the peak of its game. So there is still much for the army of today and tomorrow to learn from this conflict and therefore, further opportunity for DGC to 'shine'!

GALILEO – The European Global Navigation Satellite System

By Jim Starbuck

Introduction

Galileo is the European Union's Global Satellite Navigation System (GNSS), providing accurate positioning and timing information. The programme is under civilian control and its data can be used for a broad range of applications. It is autonomous but interoperable with existing satellite navigation systems such as the US Global Positioning System (GPS) and the Russian GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (GLONASS). At the time of writing, the Galileo constellation consists of 18 satellites.

Once fully operational the signals emitted by Galileo satellites will provide users with access to the following services:

- An open service, which is free of charge to the user, that provides positioning and synchronisation information for civil, commercial and scientific applications;
- A commercial service for the development of applications for professional or commercial use by means of improved performance and data with greater added value than those obtained through the open service;
- A public regulated service restricted to government-authorised users, for sensitive applications which require a high level of service continuity.

In addition Galileo will contribute to the Search and Rescue support service (SAR) of the COSPAS-SARSAT (COSPAS (COsmicheskaya Sisteyama Poiska Avariynich Sudov) is a Russian acronym for Space System for Search of Distress Vessels and SARSAT means Search and Rescue Satellite-Aided Tracking) system by detecting the location of distress signals transmitted by beacons and relaying messages to them.

A Brief History

The history of European involvement in satellite navigation began when the European Commission, following a proposal made at the Transport Ministers meeting held on 14 Jun 1994 in Luxembourg, adopted and published a communication to the Council and the European Parliament stating that *"The time has come for the European Union to contribute to the development of a global satellite navigation system for civil applications"*.

Courtesy ESA: Satellite separation.

Following the communication the Council invited the Commission to launch the necessary activities, based on a two-step approach. The first step was development of a smaller infrastructure to provide an augmentation service for GPS and GLONASS (GNSS-1). The second step (GNSS-2) consisted of the development of a global satellite navigation system under civil control, Galileo.

GNSS-1 was first implemented in 1994 as a European Space Agency programme with financing from several sources. It was initially intended as a demonstrator, but gradually it was decided to convert it into a pre - operational and then an operational programme.

A formal agreement was concluded in June 1996 between the European Community, Euro Control and the European Space Agency for the development of GNSS-1, which would later become the European Geostationary Navigation Overlay Service (EGNOS), a satellite-based augmentation system aimed at augmenting GPS to improve air navigation operations. GNSS-2 would later become Galileo.

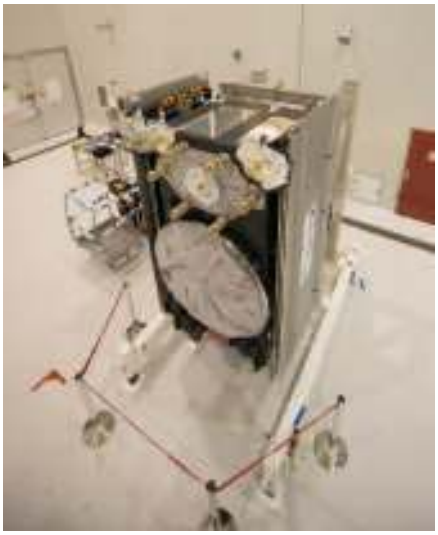
Courtesy ESA: Galileo Control room.

In 1995, at the time the GNSS-2 programme was being outlined, GPS declared its Full Operational Capability, and the U.S. Government committed to provide GPS signals to the civil user community, although the selective availability, a functionality to intentionally degrade GPS position accuracy was still implemented. It was in this context, that in 1998, the European Commission's Communication *"Towards a Trans-European Positioning and Navigation Network - including a European strategy for GNSS"* launched a serious debate for Europe to develop its own GNSS.

It was former European Commissioner for Transport, Neil Kinnock who first came up with the idea of naming Europe's satellite system after the famous astronomer Galileo. Kinnock pushed the idea that the Union should not depend on America for future satellite-guided transportation and unveiled the plans for Galileo in February 1999, with what turned out to be rose-tinted expectations on timing and cost. *"The investment needed, less than 3 billion euros, is not unbearable since it would be spread between 15 Member States over 10 years,"* he said at the time. *"The returns would be immense."*

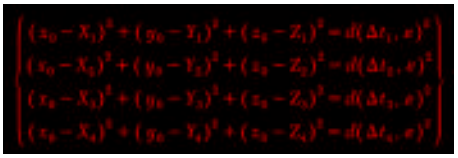
In 1999, the European Commission, with the support of the European Space Agency prepared the Communication *"Galileo—Involving Europe in a New Generation of Satellite Navigation services"* that was pivotal in the GNSS programme development in Europe. The communication listed three reasons for the European Union to develop its own system:

- To increase control on satellite-based safety-critical navigation systems.
- To ensure a positioning service for European users in the long term, not subject to the risk of potential U.S. policy changes affecting GPS.
- To support EU industry competitiveness in the global market of satellite navigation and grant access to the system's technological developments.



Courtesy ESA: Galileo satellite.

Prompted by European Space Agency and European Commission GNSS-2 studies, the communication proposed the development of a system comparable to GPS or GLONASS in order to minimise the technical risk and provide the highest value for money. In addition it was proposed that a signal structure as far as possible compatible and interoperable with GPS would be advantageous.



Position computation.

Once the political drive to build Galileo was clear, and its basic principles outlined, the European Union and the European Space Agency embarked on the first studies to define the Galileo mission and system requirements that would ultimately determine the Galileo system and receiver technologies.

In its communication of February 1999 the Commission presented an autonomous programme on satellite radio navigation, known as Galileo, to be developed in four proposed phases, including the definition phase due to be completed at the end of 2000.

- Development and validation phases (2001-2005)
- Deployment phase (2006-2007)
- Operating phase (2008 onwards)

It was Kinnock's successor as Transport Commissioner, Loyola de Palacio of Spain, and European Space Agency director Antonio Rodota of Italy who in 2000 cut the ribbon on a Galileo programme

office. That year, a blue-ribbon commission chaired by Carl Bildt, a former Swedish prime minister, offered a rather clunky declaration of independence for European space exploration: *"The driver of European space policy is to make Europe not dependent on non-European space infrastructure for any strategic and commercial applications."*

Following months of international negotiation agreement the radio frequencies allocated to Galileo were eventually agreed by the International Telecommunication Union in June 2000 at the World Radiocommunications Conference in Istanbul. The agreement granted of the protection of the filing until June 2006.

Courtesy ESA: Signal Task Force.

From 2002, the Signal Task Force, a small team of GNSS signal specialists, including two from the United Kingdom, worked to define the signals for the various Galileo services. In June 2004 after several years of negotiation the Member States of the European Union and the United States of America signed a Cooperation Agreement *"On the Promotion, Provision and use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications"* that set the framework for interoperability and radio frequency compatibility between both systems. The final touch to the Galileo signal plan was achieved in 2006 when the Working Group on GPS and Galileo compatibility and interoperability, under the auspices of the 2004 agreement, finally settled on a new modulation for the common signal in the E1/L1 frequency, namely the multiplex binary offset carrier, or MBOC for short. This decision was mainly driven by the efforts of the European side and fully recognised by the U.S. representatives.

Photo courtesy ESA: Galileo Lift-off.

In 2002 the Galileo Joint Undertaking, a public-private partnership, was set up by the European Commission and European Space Agency to manage the development phase of the Galileo Programme. In 2006-2007 funding for the Galileo programme through this route was brought into question by a breakdown of concession contract negotiations for the deployment and operation of the programme. The Commission responded by amending its proposed regulation on the implementation of Galileo and EGNOS to include Commission funding in an attempt to ensure the continuation of the project. As a result to Joint Undertaking and hence the public-private partnership were terminated.

On the 28 December 2005 the first Galileo satellite was successfully launched on a Soyuz rocket from the Baikonur Cosmodrome, Kazakhstan. GIOVE-A (Galileo In-Orbit Validation Element) was developed by Surrey Satellite Technology Ltd (SSTL) for the European Space Agency to secure the Galileo frequency filings agreed at the International Telecommunications Union three months before the licence expired.

Designed, built and tested in a rapid 30 month programme and launched on schedule the satellite played a crucial role as the test-bed for the Galileo payload units, providing a representative signal-in-space for ground-based experimentation with Galileo signals as well as characterising the radiation environment for the Medium Earth Orbit used by all future Galileo satellites. On the 2nd May 2007 GIOVE-A successfully transmitted the first European navigation message from space, containing the information needed by users' receivers to calculate their position. GIOVE-A was designed and sized for a 27 month mission and although still operational, it was officially retired on 30th June 2012, having been successfully operating for more than double its design life. The spacecraft has continued to be used for testing.

Courtesy ESA: GIOVE-A.

The next step towards the deployment was made with the launch from Baikonur cosmodrome on the 27 April 2008 of the GIOVE-B satellite, carrying one of the most accurate atomic clocks ever flown into space. The 500 kg satellite was built by a European industrial team led by Astrium GmbH (Germany), with Thales Alenia Space (Italy) performing integration and testing in Rome. Like its predecessor, GIOVE-B carried two redundant small-size rubidium atomic clocks, each with a stability of 10 nanoseconds per day. In addition GIOVE-B carried a Passive Hydrogen Maser clock, with stability better than 1 nanosecond per day, the first of its kind ever to be launched into space. The satellite incorporated a radiation-monitoring payload to characterise the space environment at the altitude of the Galileo constellation, as well as a laser retroreflector for high-accuracy laser ranging. Signal generation units provided representative Galileo signals on three separate frequencies broadcast via an L-band phase array antenna designed to provide signal coverage to the visible earth below the satellite.

Following a successful launch and subsequent early orbit operations and platform commissioning, GIOVE-B's navigation payload was switched on and for the first time, transmitted the GPS-Galileo common signal using a specific optimised waveform, MBOC (multiplexed binary offset carrier) in accordance with the agreement of July 2007 between the EU and the USA for Galileo and the future GPS III. The Rutherford Appleton Laboratory Chilbolton Observatory and its 25 metre antenna contributed to the test campaign by analysing the characteristics of GIOVE-B signals with great accuracy and was able to verify that they conformed to the Galileo system's design specification.

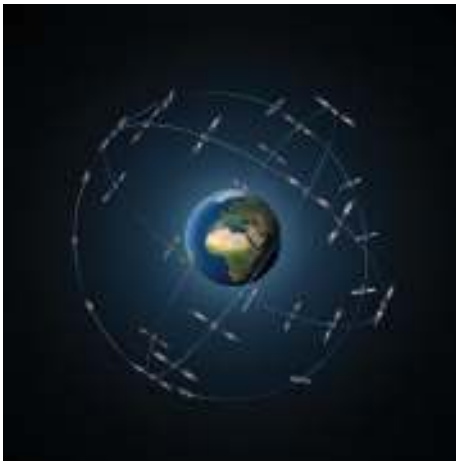
After more than four years of service as a Galileo test-bed satellite, GIOVE-B was retired on 23 July 2012. Its navigation transmitters were switched off and the satellite's height was subsequently raised in a series of steps to place it in a so-called "graveyard" orbit where there will be no danger of it interfering with the operational Galileo satellites or other spacecraft.

In September 2011 the European Commission launched a painting competition with the first name of the winner from each Member State being used as the name of a Galileo Satellite to be launched in alphabetical order of the Member State. The satellite named after the United Kingdom winner, 10 year old Patrick, is hopefully to be launched post 2019.

Courtesy ESA: IOV Satellite Launch.

On 21 October 2011 a Soyuz rocket launched two satellites from Kourou, French Guiana, with two more following on 12 October 2012. These first four Galileo In-Orbit Validation satellites were representative of others that were to follow and served to validate the system's design in advance of completing and launching the rest of the constellation. On 12 March 2013, at the European Space Agency's Navigation Laboratory the Netherlands, Galileo's space and ground infrastructure came together to perform the first determination of a ground location. The generation of the Galileo navigation messages enabled validation of the entire Galileo system with a wide variety of tests being carried out in Belgium, France, Germany, Italy, the Netherlands, Spain and the UK.

The first of the Full Operational Capability satellites were launched together on 22 August 2014. Unfortunately due to a technical hitch they ended up in an elliptical rather than a circular orbit. Both satellites have been moved as far as possible into orbits with less eccentricity and their navigation payloads have been switched on. Despite being in an elliptical orbit they have been deemed useable for search and rescue purposes and potentially could be used for navigation purposes. The deployment of the Galileo satellites constellation resumed with a launch of two satellites on 27 March 2015, 11 September 2015, 17 December 2015 and 24 May 2016. The first 4 satellite launch by Ariane 5 took place on 17 November 2016. Further Ariane 5 launches are scheduled in the near future.



Courtesy ESA: Galileo Constellation.

Space Segment

The Galileo space segment comprises of satellites deployed in a Medium Earth Orbit Walker Delta 56°:24/3/1 constellation. This means there are 24 satellites in 3 planes inclined at 56 degrees to the earth's equator, and by differences of 120 degrees on Right Ascension of the Ascending Node, therefore spanning the 360 degrees around the equator. The "1" defines the phasing between the planes, and how they are spaced. Each plane will contain eight operational satellites and several spares equally spaced. The Galileo constellation has been optimised and its orbital parameters are chosen in such a way that it provides continuous global coverage. The orbit altitude of 23,222kms (compared to for GPS 20,200kms and 1,100kms for Transit Doppler) results in a constellation repeat cycle of ten days during which each satellite will have completed seventeen revolutions, approximately 1 orbit every 14 hours.

Each satellite consists of two main elements, the payload and the platform. The payload, delivered by Surrey Satellite Technology Ltd is made up of the payload core, the clock and the antenna modules. The platform, delivered by Otto Hydraulik Bremen (OHB) consists of a core, a centre, propulsion and solar generator modules. OHB integrate the payload into the platform and perform a series of tests confirm successful integration. When each satellite is completed it is dispatched to the European Space Agency Test Centre in Noordwijk, The Netherlands, where it undergoes acceptance testing to ensure its readiness for space.

Testing includes checking that each satellite's centre of gravity and mass is aligned, ensuring that the antennas perform correctly and the performance of a simulated launch, which includes vibration and shock tests to ensure that the satellite can survive the launch and separation from its dispenser. Each satellite is switched on and placed inside a thermal vacuum chamber for a few weeks to test it in a space-quality vacuum and temperature extremes representative of what would be experienced in orbit.

Courtesy ESA: Navigation payload.

Once the satellite has passed all these tests it is placed within its protective air-conditioned container ready to be flown to Europe's Spaceport at Kourou, French Guiana. Kourou lies at latitude 5 degrees north making it ideally placed for launches into geostationary transfer orbit as few changes have to be made to a satellite's trajectory. Galileo has used two launch vehicles, Soyuz Fregat capable of carrying 2 satellites and Ariane 5 capable of a four satellite launch.

Courtesy ESA: Galileo Lift-off.

When ready to launch, the Galileo satellites are fuelled, then attached to a launch dispenser, encapsulated within a protective payload fairing. The launcher is transferred to the launch zone and raised into the vertical position. Finally the payload is encapsulated within the launcher fairing and hauled to the launch pad to be placed on top of the launcher. Once all checks have been carried out the lift-off commences. At about 9 minutes after lift-off the three lower stages of the launch vehicle have separated from the launcher and fallen back to Earth leaving the launcher's upper stage and the satellite dispenser containing the Galileo satellites. The upper stage then fires its engine, taking the satellites into an intermediate orbit prior to dispensing them, using a pyrotechnic separation system, in opposite directions, approximately three hours, fifty minutes after launch dependent on the launcher used.

If all goes according to plan the Launch and Early Operations (LEOP) phase controlled from ESA's Space Operations Centre (ESOC) in Darmstadt, Germany begins. Any tumbling of the satellites as a result of being pushed away pyrotechnically must be corrected and their position stabilised. Next the satellites deploy their solar panels to ensure a steady flow of power. All satellite systems are switched on, one by one, to ensure that they have endured the launch and are in working order. The phase takes about a week before control of the satellites is handed over to the Galileo Control Centre

Courtesy ESA: Satellite Deployment.

in Oberpfaffenhofen, Germany. An in-orbit testing campaign with support from ESA's Redu Centre in Belgium then measures the accuracy and stability of the satellites' on-board clocks, as well as assessing the quality of the navigation signals. Once the in-orbit testing has been successfully completed the satellites can be declared operational and begin transmitting live navigation signals to users for at least the next twelve years.

Ground Segment

The Galileo Ground Segment consists of two Ground Control Centres one in Fucino, Italy and the other in Oberpfaffenhofen, Germany. Each Control Centre comprises of a Galileo Control System responsible for satellite constellation control and management and a Galileo Mission System responsible for the determination and uplink of the navigation messages needed to provide the navigation and UTC time transfer service to users. Supporting the Control Centres are five Telemetry, Tracking and Control stations, nine Mission Uplink Stations, a global network of Galileo Sensor Stations and the European GNSS Service Centre.

Courtesy ESA: Fucino Control Centre.

Sited around the world are, on territories of European Member States, the network of five Telemetry, Tracking and Control stations, nine Mission Uplink Stations and a global network of Galileo Sensor Stations. The ground sensor stations, including those sited in the Ascension and the Falkland Islands, collect data from each satellite whilst they are visible from their location. The collected data is transmitted back to the control centres and used to correct the satellite orbits where necessary and to enable the calculation of corrections to the satellite ephemeris.

In addition to the ground infrastructure there is the European GNSS Service Centre in Torrejón (Spain) which acts as the interface between the Galileo Open Service and Commercial Service user communities and the Galileo system.

The User Segment

The Galileo user segment is composed of any receiver which is able to collect and process the Galileo Signal-in-Space and compute a location and/or time. The interest and use of Galileo is growing with several multi constellation GNSS receivers and mobiles phones on market which are Galileo compatible. There is no doubt that in the not too distant future most devices that current use GPS will also be taking advantage of the satellites provided by the Galileo Constellation. Initial Services are available today with Full Operational capability expected from 2020.

End note

I have been providing the UK Space Agency and its predecessors with technical support with respect to the Galileo programme for almost 10 years and have found it to be not only one of the most frustrating but also one of the most rewarding programmes I've been involved in. I am generally travelling to Europe on almost a weekly basis for meetings and have as a result built excellent and close working relationships with colleagues from many Member States, the European Commission, European Space Agency and Galileo GNSS Agency to name but a few.

Bio

Jim Starbuck joined the army at Chepstow as an apprentice in 1970 and trained as a Field Surveyor. Following a varied and well-travelled career Jim retired in 2008. Following retirement Jim joined the Defence Science and Technical Laboratory, Porton Down as a Senior Navigation Engineer.

Courtesy ESA: Ground Station Svalbard.

The Evolution of The Aircraft Sextant

By David Pike

Celestial navigation frequently requires measurement of the angle between a heavenly body (the body) and the celestial horizon. For two and a half centuries seamen have accomplished this using the double reflection marine sextant. The purpose of this article is to explain how, in the relatively few years the sextant was used by airmen, the aircraft sextant came to look so different from its maritime cousin.

A Hughes MkIX Aircraft Sextant of 1940 compared to a Hughes Marine Sextant of 1941 (DP).

The maritime sextant measures the angle between the body and the visual sea horizon. A correction must be made for 'dip', the small angular difference between the celestial and the visual horizon.

The Artificial Horizon

The airman found use of the visual horizon much more difficult. It might have been night-time; the aircraft might have been above cloud, or over land with mountainous horizons. Height alone wasn't the problem, because the dip tables, which vary as the square root to the observer's altitude, still work to high altitudes. The problem was knowing the aircraft's true height. The crew relied upon pressure altimeters, which required knowledge of the surface pressure below the aircraft, and this wasn't always available. Moreover, the higher you went the greater the chance of the horizon being beyond visual range. Clearly some sort of artificial horizon incorporated within the sextant was required.

Some of these problems were not unique to airmen. They also applied to mariners and overland explorers, so it's not surprising that some of the solutions had been tried before. The simplest solution was to bring the body into coincidence with its reflection from a tray of suitable liquid. Quicksilver in an iron tray was popular with land travellers. Amundsen used such a method to prove he really did reach the South Pole1. The method would have been totally impractical in an aeroplane. Much shuffling around is required to get everything lined up, and the consequences of a mercury spillage in an aluminium aeroplane are frightening.

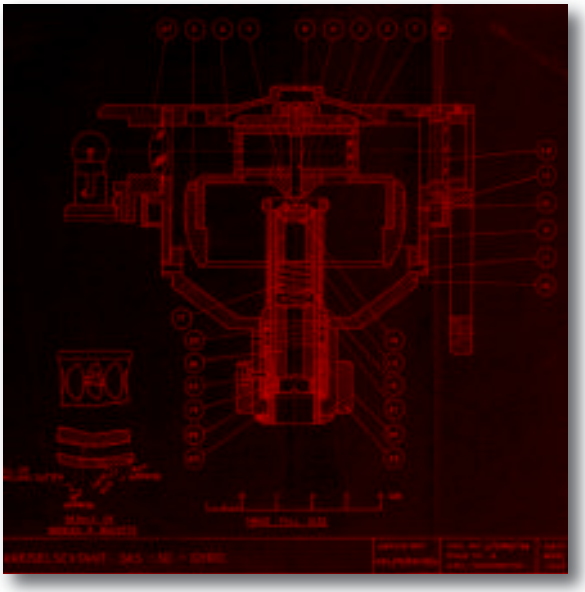
Pendulous Horizons

Devices incorporating pendulosity go right back to the astrolabe. They were never part of the basic marine sextant, but devices were introduced for use at night. As early as 1837, Lt Becher RN was describing his pendulous horizon, which could be attached to a marine sextant ahead of the horizon mirror2. This and similar devices don't seem to have gained popularity on land or at sea although it's interesting that later Mks of Smith's and Kollsman periscopic aircraft sextants employed much refined pendulous reference systems.

An RAF Smiths Mk2b Pendulous Reference Periscopic Sextant with the view to the Observer inset (DP).

Gyro Horizons

Gyro horizons were also tried. A spinning, bottom-heavy gyro will erect with its spin axis vertical. If the gyro has a flat top, then the position of the top defines the horizontal. The German Plath SKS 3D used such a system3. While the U-Boat arm found it useful towards the end of WW2, when they were restricted to surfacing only by night, tests in the UK and USA in 1945 concluded it would never replace the marine



sextant under more normal conditions. Despite initiatives, particularly in the USA4, there's little evidence of gyro-sextants being used regularly in the air.

Plath SKS 3D Gyro-Sextant Gyro Mechanism (From Admiralty Research Laboratory Report 1945).

Bubble Horizons

This brings us to the most common artificial horizon source, the bubble. Such devices have been around since the 19th century. However, you can't just strap a spirit level onto a marine sextant and start taking sights. Light from the body is focussed at infinity, whereas the bubble will be no more than six inches in front of your face; eyes don't like that. Therefore, you have to install collimating lenses to make it look as if the bubble is also at infinity. A double reflection marine sextant is not affected by tilt in the direction of viewing. This is not so with a spirit level and the bubble must be kept in line with fiduciary marks. This problem can be overcome as described below.

Although the marine sextant is impervious to tilt in the direction of observation, it is affected by lateral tilt. The mariner corrects for this by rocking the sextant gently and taking a reading when the body is at its lowest point and just kissing the horizon. You can't do this with an artificial horizon comprising a single spirit level in the direction of observation, so a second spirit level at right angles to the first was often installed. The Admiral Gago Coutinho sextant is a prime example. Maintaining the body in the longitudinal bubble, possibly between fiduciary marks, while keeping the lateral bubble correct, was quite a task for eye and brain. The solution was the 'bubble chamber', proposed by Louis Fave in 1906 and patented by Booth and Smith from RAE in 1919, comprising a single bubble in a circular chamber. If the body is to move with the bubble when the sextant is tilted, the radius of curvature of the roof of the chamber should be equal to the focal length of the collimating lens5. However, the size of the bubble varies with temperature and pressure, so to ensure the bubble could be adjusted to the ideal size as the aircraft flew higher or into different climates, a bubble making diaphragm controlled by a screw had to be included adding to the complexity.

The ubiquitous WW2 RAF MkIXA Bubble Sextant with an additional bubble chamber and the observer's view inset (DP).

Acceleration Errors

Unfortunately, all gravity controlled artificial horizons suffer from acceleration errors. E.g. if the body is ahead of the aircraft and the aircraft accelerates, the liquid surrounding the bubble is thrown rearwards. Consequently, the bubble is thrown forwards inducing a measuring error. Similar effects are experienced with deceleration and turning. Such errors are best reduced by taking a number of shots close together and averaging the result. The earliest methods involved scoring marks on a drum geared to the index mirror when the observer felt the aircraft was steady and the body was lined up. The median of the score marks was taken as the height of the body. This was far from ideal; the median value might not have corresponded with mid-time for the observations, and the human sense of balance is easily fooled. A very steady turn can feel like straight and level to a blindfolded person.

Averaging Mechanisms

The answer was to add an automatic averaging mechanism. Typically this might record 1/60th of the height of the body every two seconds for 120 seconds. The angle finally recorded was the mean value, and the time was the mid-time of the shot. Later, more than one timing length was added, so that the shot length could be chosen to best match a whole number of cycles of the aircraft's phugoid or Dutch roll.

The clockwork 'mean' averager of the RAF MkIXA compared to the score-mark 'median' averager of the USAAC Mk10a sextants (DP).

The Astrodome

In the early days, airmen shot astro from the open cockpit, but as speeds and heights increased, it soon got too cold and windy for them. After going through a phase of using optical glass windows, the most practical idea was to introduce a Perspex dome on the top of the aircraft through which the bodies could be observed, "the astrodome". Unfortunately, it was almost impossible to manufacture a Perspex astrodome that was of equal thickness from top to bottom, so tables were introduced to correct for "standard dome refraction".

Valetta T4 Airborne Classroom with six!! Astrodomes (Jerry Hughes).

The Periscopic Sextant

As aircraft got even faster, flew even higher, and became pressurised, the astrodome became an embarrassment. It reduced the top speed, increased the fuel consumption, and there was always the danger that the pressure difference might make it blow out taking the navigator with it. The answer was the peri-sextant, which went up through a small hole in the aircraft skin only when necessary. One advantage for navigators was that they no longer had to be able to identify every navigational star in the sky, because they could only see one or two at a time. The problem now was where to point the sextant. Therefore, special mountings had to be developed upon which a body's azimuth and aircraft heading could be set. Pre-computing of the body's height and azimuth became almost essential. Introducing the peri-sextant to the outside air from a pressurised aircraft risked problems similar, but opposite to, flushing the loo in a submarine. To prevent the navigator accidentally depressurising the aircraft, Smiths introduced a complex system of interlocks for their peri-sextant mounting, but Kollsman didn't bother. To be fair the Kollsman hole was of significantly smaller area although there are apocryphal stories of the mounting being used with a tube attached as a vacuum cleaner.

Almost the end of the line – a Kollsman pendulous reference periscopic sextant with its mounting. (DP).

So we see why in the relatively few short years that sextants were used in aircraft they came to look so different from their marine cousins.

References:

1. Amundsen's original South Pole Station.
http://www.southpolestation.com/trivia/igy1/polesurvey1.html

2. Minutes of the Royal Astronomical Society Vol4 12May1837 p. 81 & Journal of the Franklin Institute of the State of Pennsylvania Vol3 1842 p. 398 (a better description plus diagram)

3. ADMIRALTY RESEARCH LABORATORY Examination of German Gyro-Sextant SKS – 3D. 1945
http://fer3.com/arc/imgx/arl-report-gyro-sextant-plath.pdf

4. Deborah Warner Celestial navigation aloft: aeronautical sextants in the US
http://www.artefactsconsortium.org/Publications/PDFfiles/Vol5Mil/5.07.Military-Warner,SextantsGr75ppiFFFWEBF%20-%20Copy.pdf

5. Francis M Rogers. Precision Astrolabe. P161 & 162
http://www.fer3.com/arc/imgx/Bubble-sextants-Precision-Astrolabe.pdf

The Canadian Geo Techs

Master Corporal to Sergeant Course (QL6A)

By Captain Henry Parsons, Exchange Officer to Canada

During the period Apr-May this year, The Canadian GeoTechs' QL6A course was run. It is roughly equivalent to the Class 2-1 run at the Royal School of Military Survey in Hermitage. This is the Canadian Forces School of Military Mapping's premiere course. The school of military mapping is a squadron sized organization similar to RSMS; it is a part of the Mapping and Charting Establishment which, in Canada, fulfils the roles held by 42 Engineer Regiment (Geographic) and Defence Geographic Centre. In my capacity as the UK Exchange officer to the Mapping and Charting Establishment, I was asked to attend the final Exercise as the "UK Engineer Squadron Commander." It aims to prepare trainees with the leadership skills required to assume the role of senior geo technician in a small theatre which may have an untrained chief geo officer. The objectives are established to develop and test the following:

- Command a Geomatics Support Team.
- Management of geospatial data.
- Directing advanced geospatial analysis.
- Presenting geospatial products.

Being a GeoTech's leadership course, there is a strong focus on management, as opposed to technical, skills. Enrolment is required to promote to Sgt as a GeoTech in Canada (Sgt's are employed as section commanders here). During my participation in the exercise I interviewed the Deputy Commandant, Canadian Forces School of Military Mapping, Captain Casey Anderson to gain a better understanding of the focus of the course and exercise. I will now cover some of the key areas developed and tested by the course, and hopefully demonstrate how these work towards meeting the objectives stated.

Task and team management/leadership is a key focus. The trainees are split into syndicates of three; two trainees and a junior GeoTech as a team member. The trainees switch between being the team commander, and a team member throughout the exercise. Unless there is a particular skill set that only the team commander at the time has, they are expected to be delegating work and focusing on the bigger picture of managing the tasks given and ensuring they understand the operation.

Briefing skills are key, this being the first geo course they will have completed focusing on briefings. Of those I saw, most were good, but a few resulted in a re-show. A significant risk, to be avoided by all, is stating as fact something that the briefer does not know, rather than having the confidence to delay the response in order to give time to find the answer.

The ability to recognise when trainees should refer up/reach back for support is tested. This is important as following the completion, many of the graduates will be employed as the senior in-theatre GeoTech on small deployments. This is part of the wider critical thinking element which is emphasised throughout. A plethora of techniques for development and testing of this skill are employed and subsequently tested. This is done through trainees finding solutons to problems posed, ensuring effective application of resources, and querying clients to ascertain their real need.

Throughout the exercise, a battlegroup Operational Planning Process (7 Questions) is being conducted in the background by the staff. This gives the trainees an extra strain on their timetable, and they have to make decisions over what they can attend, and what is not possible; simulating an operational reality. Trainees are expected to have a good understanding of the commander's intent and operation as a whole, not just focusing on the tasks issued to the Geo Cell.

The course started with ten trainees, including two New Zealand GeoTechs.

Having not yet been posted to 42 Engineer Regiment (Geographic) at RAF Wyton, I am not in a position to state the difference in the GeoTechs qualify from the QL6A course in Canada, against the Class 2-1 course in the UK. However, I will say that the Canadian GeoTechs I've worked with in the

last 9 months are highly professional, have a keen interest in their subject area, as proven by regular debate/discussion, and meet the demands placed on them by the Canadian Armed Forces time and again.

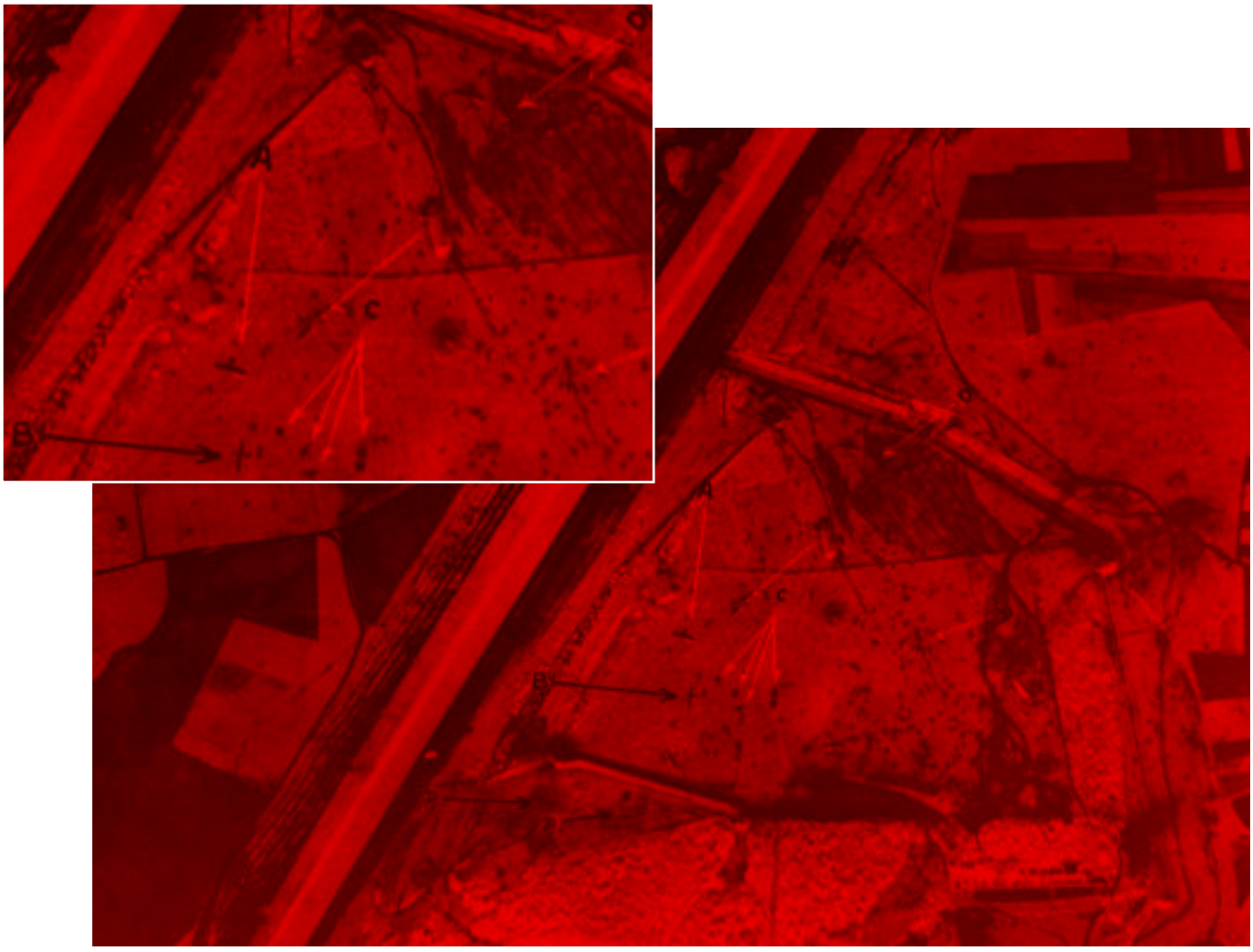
When the New Zealanders re-joined the Five Eyes community, they recognized their tradecraft had suffered in isolation. A visiting team surveyed each of the Allies' approach to geomatics support. They chose a Canadian-influenced model. In 2015 a Sgt and two Cpls from their Geomatics Troop completed the Canadian Qualification Level 6A (QL6A) on a course of 14 candidates. Their course Warrant Officer described them as follows:

"There were 14 students on this year's course, including three members of the New Zealand Defence Force (Kiwi). The New Zealand Geomatics Trade has a total strength of nine NCMs. The Kiwis (not to be confused with Aussies!) were highly experienced and skilled, as they placed second, third, & fourth on the course. The Kiwis demonstrated their proficiency at GIS by briefing technical instructions on Bump Mapping to Enhance Vegetation Visualisation, Applying a Mosaic Dataset Functions in ArcGIS, and Creating a 3D Fly-Though Product in Arc Globe."

Four more Cpls completed the courses in 2016 and 2017. In all, seven Canadian-trained QL6A Geo Techs in an establishment of nine soldiers is a substantial influence within the NZDF geomatics community.

Mystery Air Photograph

What is this air photo detailing? - Answer in next edition of Ranger.



Maps for Commando Raids and The SIMNEL Map Code

By Mike Nolan

Simnel cake is a fruity cake traditionally baked at Easter but the origin of the use of the codeword SIMNEL is not known. Like many World War Two codenames it was probably just a randomly selected word on the list of potential operation code names. It was clearly in use prior to Operation Overlord, possibly earlier than Operations Rutter and Jubilee, the raid on Dieppe in August 1942 but no instructions on its use have been found for this early period. It does seem to have been used more than once for Survey aspects of operations.

First Use of Simnel

Prior to the commencement of the Benson Project for D-Day 1:25,000 scale mapping for the invasion of the continent, the expertise of the Canadian Field Survey Company in photogrammetry was being utilised for the production of 1:12,500 scale maps of the French coast suitable for use on Commando raids. The 1:12,500 scale was to be used again for the Baby Benson project of mapping of the beaches north of Caen for D-Day.

On **24 January 1944**, 3 Cdn Repro Company RCE received instructions to commence re-drawing and re-printing of "Simnel", a 1:12,5000 scale map project produced by Canadian Survey in 1942 for Commando raids.

Only brief indications of the work of that period on this project can be found in the war diaries of 1 Cdn Fd Svy Coy RCE for 1941 and 1942. Relevant verbatim extracts follow if only to demonstrate the difficulties of research from unit war diaries! :-

On **27 December 1941**, Major MacDonald to Corps H.Q. to receive details of secret French coast jobs. All Photogrammetry personnel working this Saturday afternoon and until jobs completed. Working three shifts on the epidiascopes.

On **28 December 1941**, The Photogrammetry people (No. 2 Topo and Draughting Sections) working this Sunday on "Ault" and "Hardilot" both French coast jobs.

On **29 December 1941**, First "Pulls" were made for "Hardilot" and "Ault" sheets and on the 30th the Ault sheet was completed together with the preliminary print of "Hardilot".

On **31st December 1941**, Still running night shifts on French Coast jobs,

On **1 January 1942**, Most of Company working today rush on French Coast jobs, "Hardilot". Night shift on the compilation.

On **3 January 1942**, Work completed on compilation of "Hardilot" at 0330 3 Jan.

On **9 January 1942**, No. 2 Topo and Draughting Sections working on Sheets 01 and 02 (south of Le Touquet).

On **12 January 1942**, French coast jobs proceeding.

On **25 January 1942**, Draughting personnel working today, Sunday in final, frantic effort to arrive at proper datum for sheets 01 and 02.

On **26 January 1942**, Work still proceeding on French Coast; eight sheets in various stages of completion now.

On the **25th April 1942**, Sheet 02, the first of 12,500 series compiled by Company published. It looks like an excellent job.

On **29 April 1942**, Sheet 1, 1/12,500 series being printed.

On **30 April 1942**, 300 copies 1/12,500 sheet 1 delivered to AD Survey.

On **1 May 1942**, First Proof Sheet 2, 1/12,500 series pulled today.

On **2 May 1942**, AD Survey 1 Cdn Army and Director of Surveys, G.H.Q., Home Forces called this morning to discuss shift in position of town of Le Touquet in our compilations. We win.

On **4 May 1942**, Finished printing of sheet 2 "Dannes", 1/12,500.

On **11 September 1942**, No. 1 Topo engaged on French series.

On **17 September 1942**, Camera Section making ZPL's of Boulogne sheet and experimenting on production of Kodalines from pencil originals.

On **18 September 1942**, Boulogne sheet completed.

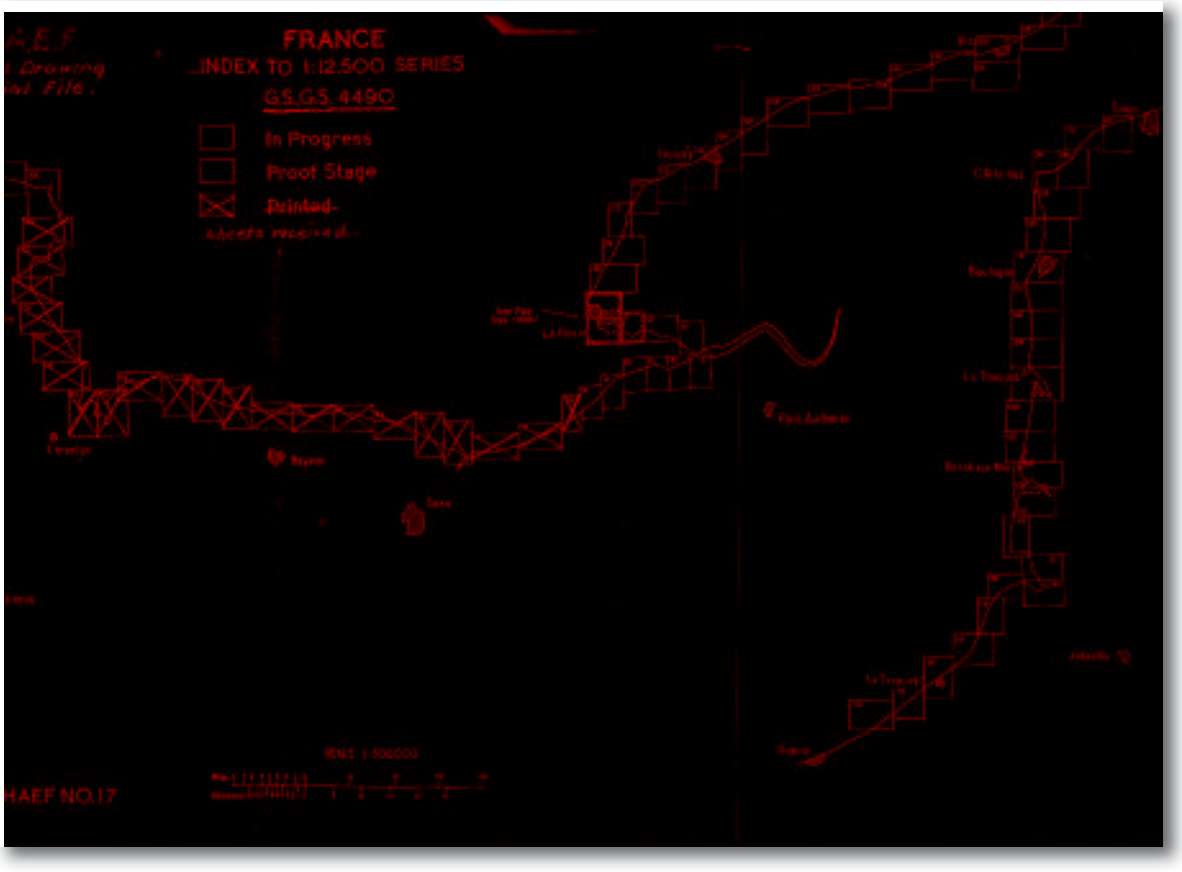
On **20 September 1942**, Repro Sections on production of basic grey's of our French 1/12,500 series.

On **23rd September 1942**, Repro. Sections complete basic greys of sheets 01, 02, 1, 2, 3, 4, 5 of our 12,500 French Coast Series.

On **25 September 1942**, Col. Elkington, A.D. Svy SECO visited Coy referencing grey sheets of France for overprint (Appendix 8).

Finally, on **21 November 1942**, First proof of Sheet 6 SIMNEL (Wimereux).

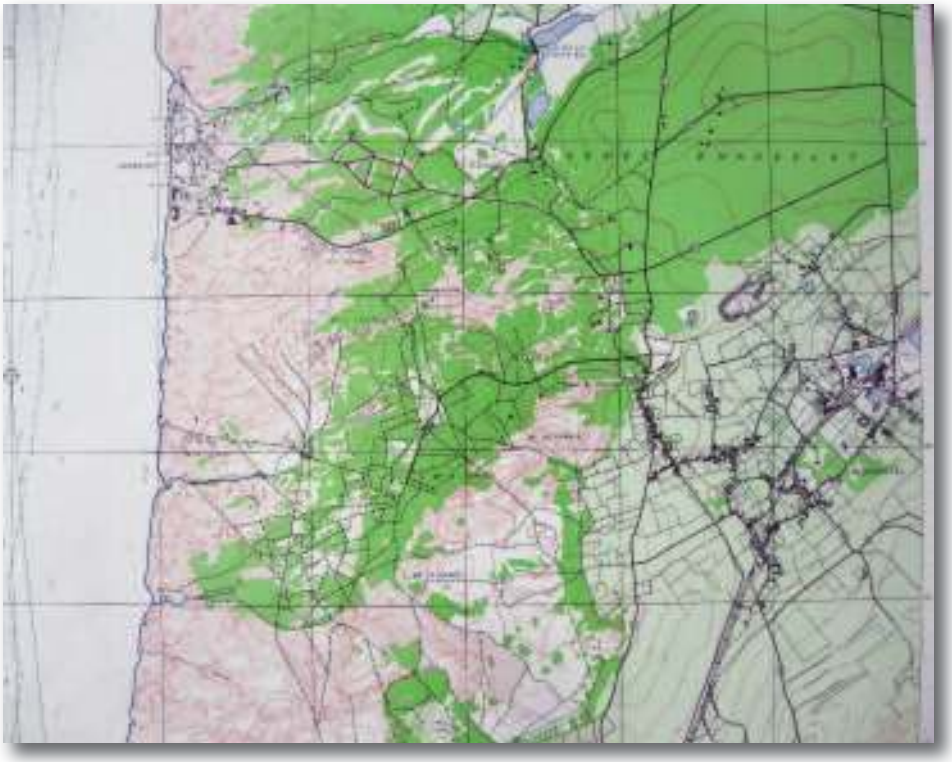
This note is illustrated by an index of 1:12,500 coastal sheets of France which can fairly safely be assumed to show the maps in question but it does not show the sheet-names referred to above and neither do the sheet-numbers mentioned above correspond to those on the index.



Index of the commando raids area sheets

Later use of Simnel

When these sheets were examined on 25 January 1943 it was revealed how far air survey had progressed since 1942. It was considered that the new sheets (Sac I) would be greatly superior in clarity and accuracy. Over the next four days the task was discussed and preparations made with regard to both Sac I and to Benson sheets. Since little air photo cover had been received it was decided to colour-separate Simnel, re-draw, revise topography from existing aerial photographs and revise from all available resources. The main task being colour-separation the main effort would fall on the Repro Section.



Sample of the Hardelot sheet, it shows a cruder road depiction than on the later Baby Benson editions of the Overlord area.

On **31 January 1943** process work on Sac I was commenced, the photo-writers and litho-draughtsmen being put on a 24-hour working basis for seven days.

On **1 February 1943** Sac I was being held up through lack of adequate aerial photo cover. Steps were to be taken by DD Survey 21 Army Group.

By **3 February 1943** the preliminary repro work had been completed, comprising reproducing Simnel in forms of ferro-prussiate prints and gum-reversals in red-stain, together with changing scales of photography and preparation of negatives.

On **4 February 1943**, further aerial photography was received for the Sac I area which cancelled work already done, mapping from scratch having replaced revision as the approach to be taken.

By **6 February 1943**, both Map Photo Sections of 3 Repro Company were put on the Sac I project to speed reproduction.

On **7 February 1943**, the Sac I operational mapping project of "part of Europe" was held up by a delay in obtaining photographs.

On **8 February 1943**, only 7 days remained for completion of the printing. 4 Air Survey Company was falling behind schedule and it was doubted that acceptable maps could be produced in that time. Registration was a problem later solved by not making a screen kodaline but by exposing original kodalines in contact with a screen.

By **10 February 1943**, the first photos of Sac I received and a proof produced.

On **11 February 1943**, the O.C. 3 Company visited DD Svy 21 Army Group with Sac I proofs but these were found contrary to the general style of the series. It was decided to check the style and re-check the interpretation before printing but the proofs were found to be adequate for planning the operation so a delayed final delivery date was accepted.

On **29 February 1943** Lt Gill, RCE, delivered the seven sheets of Sac I base maps, GSGS 4490 to DD Svy 21 Army Group.

(The above notes above are taken from the war diary 3 Cdn Repro Coy R.C.E.)

Thus, the use of the designator Sac I finally becomes clear.

Reference to "S.A.C. No. 1 Sheets 1, 3, 6, 7, 8 and 9" may also be found in the production notes and imprints of Series GSGS 4490, the 1:12,500 scale "Baby Benson" sheets of the D-Day landings area of Normandy, the sheets concerned being Ouistreham, Bernieres-Sur-Mer, Port-En-Bessin, Colleville-Sur-Mer, Vierville-Sur-Mer, St. Pierre du Mont, and Grandcamps-Les-Bains.

No other examples of Sac-designated or S.A.C.-designated maps, presumably maps initiated by Supreme Allied Command, have been found.

Final use of simnel

In the context of the final operations in North-West Europe, involving map series of the western part of Germany, on the 17 March 1945 Col A.W. Heap, D.D. Svy Second Army, issued a Top Secret Technical Instruction, No. 83, concerning the SIMNEL Map Sheet Code.

In this instance, the SIMNEL code was simply a means of securely referring to map series and individual map sheets within a series. The instruction covered the following series: -

Series	Area	Scale	Series Code	No. of sheets (Indexes)
GSGS 4346	Germany	1:250,000	RF	1
GSGS 4416	Central Europe	1:100,000	UH	1
GSGS 4507	Germany	1:50,000	21/GX	3
GSGS 4414	Germany	1:25,000	21/GM	3

It was designed for use primarily in phone conversations. It could also be used in R/T or signal messages but it was only to be used in emergencies. Its publication did not imply that map orders should normally be made by telephone. In using the code, the Series code letters were always to be quoted as well as the sheet code letters/numbers.

In the case of Series GSGS 4507 and 4414 the prefix "21" only needed to be used in correspondence outside 21 Army Group.

In the case of Series GSGS 4507 & 4414, the code for which was a combination of letters and figures, the numbers for the horizontal rows were to be quoted first followed by the letters for the vertical columns.

In the case of Series GSGS 4414 only those sheets likely to be of interest to Second Army were included.

Accompanying this instruction was a set of Top Secret foolscap sized map series indexes which had Second Army series designations and which were overprinted in red with the SIMNEL code letters.

Indexes so far noted are tabulated below. The SA designator referring to a Second Army product: -

These indexes also show the sheet-lines of Series GSGS 4379 Denmark 1:250,000 and GSGS 4210 Denmark 1:100,000 but sheets in these series did not carry SIMNEL code letters.

For operations in World War Two it was probably only necessary for Commands simply to issue current map indexes for the few standard operational scales in use at the current "front", whether it be in the Western Desert, North Africa, Sicily & Italy, North-West Europe, or other theatres.

Series		Scale	Index Sheet	Index Designation
GSGS 4346	Germany*	1:250,000	2	SA/7/2895
GSGS 4416	Central Europe*	1:100,000	2	SA/7/2904
GSGS 4507	Germany	1:50,000	2	SA/7/2916
GSGS 4507	Germany	1:50,000	3	SA/7/2917
GSGS 4414	Germany	1:25,000	5	SA/7/2892
GSGS 4414	Germany	1:25,000	6	SA/7/2893
GSGS 4414	Germany	1:25,000	7	SA/7/2894

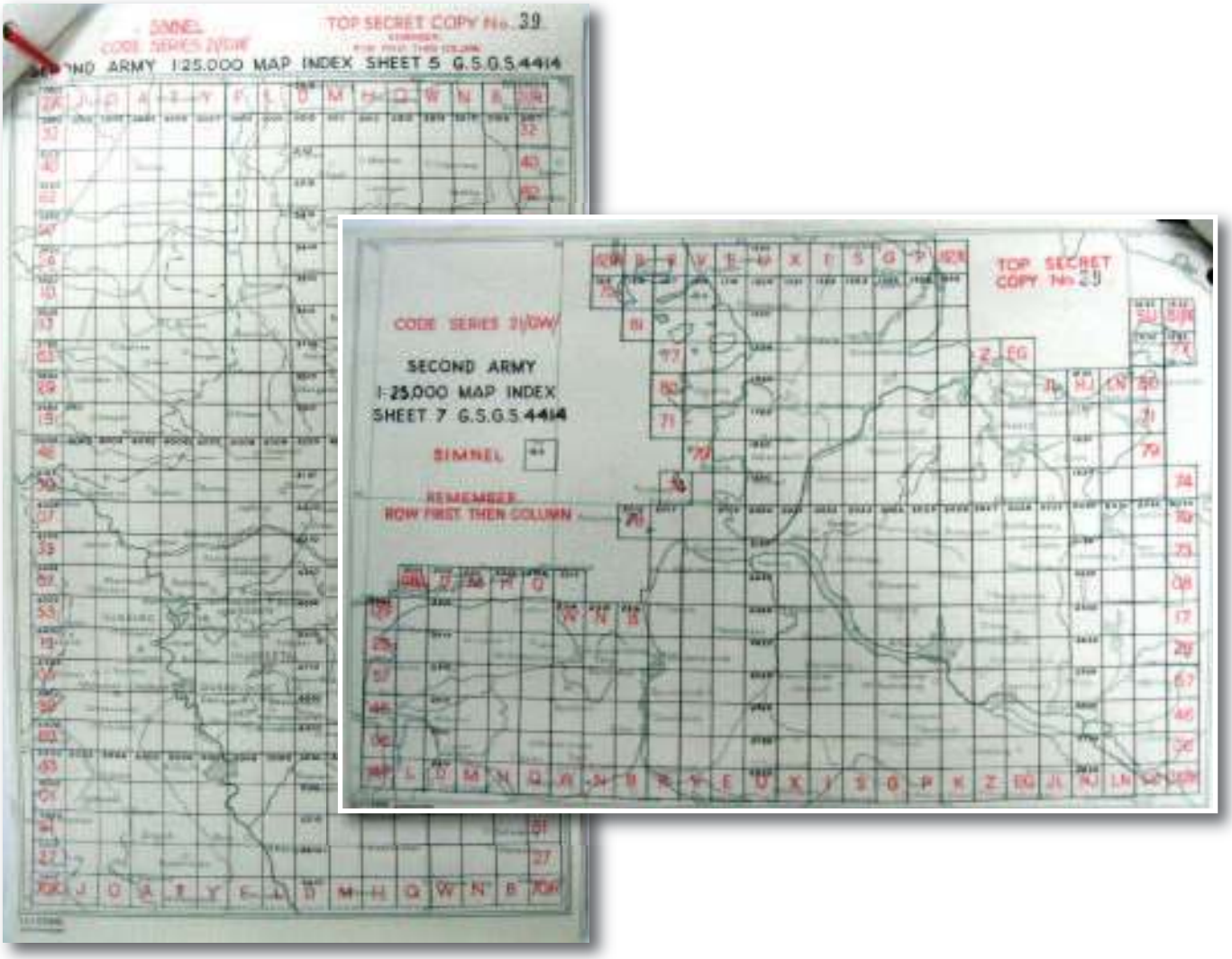
How revised editions of sheets were introduced into operational use is another matter the answers to which are not known, but ensuring that all units of multi-national forces in the Italian Campaign were always working on the same edition, for instance, must have been a survey staff problem of some concern in that multi-national allied armies.

The series designator SA7 was also used for other Second Army map indexes.

See also: -

Technical Services – The Corps of Engineers – The War Against Germany, Washington, 1988 in which is quoted: -

OCE ETOUSA Historical Report 5 Intelligence and Topography, pp 41, 49, 60, 65 and app. 26.



The Westminster Dragoons' Survey Section in the M.E.F. & E.E.F.

By Mike Nolan

Photos shown throughout are of The Survey Party on The Western Desert, July 1916

On the outbreak of the Great War the personnel of the Survey Companies R.E. were mobilised and drafted to Field Companies, the exception being 19 Company which became a training company at Southampton. As the Survey Companies evolved on the Western Front, efforts were made to draft surveyors back into them but not always with success and many who joined the Survey Companies had little relevant experience.

In 1916 when Major Wood RE, late of the Survey of India, and command of a Survey Company on the Western Front, took command of the 8th Field Survey Company in Salonika. The situation was so bad that he resorted to getting drafts of experienced Indian plane-tablers sent to Salonica from the Survey of India to carry out the plane-table survey of the Macedonian front.

In Egypt, the Mediterranean Expeditionary Force, later the Egyptian Expeditionary Force, was fortunate in being able to call upon the trained surveyors of the Survey of Egypt who formed the nucleus of the new 7th Field Survey Company RE.

The following account of a most unusual survey party is taken from the book *"2nd County of London (Westminster Dragoons) Yeomanry – The First Twenty Years – A Summary"* by Major Edward Rowe, M.C.

Tomb.

In this, Rowe leaned heavily on an account by Lt Sanderson but wrote for readers with probably little interest in survey. In this edited version therefore the compiler of this article has taken the liberty of inserting some of the material from Sanderson's undated draft account which was passed to Rowe as source material for *"The First Twenty Years"*. The DSA acknowledges with thanks the use of the Sanderson draft from McMaster University, Canada, and the photographs provided by the Westminster Dragoons.

The Regimental Survey Section of 1915-1919 evolved from the Scout Section trained in the years prior to the outbreak of war in 1914 by Sergeant H. Sanderson of 'D' squadron (Lord Howard de Walden's). The outstanding work at Gallipoli, the Western Desert of Egypt from Dabaa to El Sollum and then through Palestine to Aleppo in Syria in which this section was involved received recognition in high quarters and was an achievement well worthy of record.

The first effort in map making was a matter of urgency at Gallipoli, where there were no maps sufficiently accurate for plotting the British and Turkish trench lines and machine gun posts. In this situation Captain Gerald Horlick (Gloucester Hussars) Divisional Machine-gun Officer, asked 2nd Lieutenant Herbert Sanderson (commissioned only two hours before leaving Cairo for Gallipoli) to map the front line, because if his guns worked to their full traverse they would, as our line was a re-entrant, probably be a danger to our own men. Sanderson and "Dicky" Bird got to work with compass and an artist's sketch-block ruled with one-inch squares and produced a plan of the trenches from Asmak Dere to Green Hill, at 1:3,600 scale which showed clearly full justification for Horlick's request. A start then was made on plotting enemy trenches and machine-gun posts, but Sanderson, having got tired of dysentery, went down with jaundice, as did do many others, and was packed off to a hospital ship.

The next activity was on the Senussi front in the Western Desert of Egypt, after the famous retreat from Jemaima. There the party was more organised, and strengthened with Harold Hicklin, Norman V. Sadler and N.V. Fortescue. As at Gallipoli, the small-scale map of the area was almost useless; having very few place-names and most of those shown in the wrong spots. Warned of enemy preparations for an attack, O.C. Dabaa, at the railhead of the Khedival Railway from Alexandria,

Tapping in.

needed a detailed map of the coast line, railway, local features and the positions he was holding in defence of the lines of communication. This map was also required by the captain of the cruiser standing off Dabaa in the event of being called on for supporting fire. Sanderson's party got to work and with the aid of more sketching blocks, compasses and a contraption of their own invention composed of three hinged pieces of wood (a perfect devil to pinch one's fingers) and a carpenter's spirit level, the last named being used for observing heights, albeit inaccurately. They worked hard and with much enthusiasm and produced sketch maps of defence positions and the surrounding country. All agreed it was preferable to doing stables in a dust storm. However, the threatened attack was not made; Ja'far Pasha, the Senussi's Commander-in-Chief, having recalled the force with their mountain and machine-guns on learning that Dabaa was held in strength.

When the first two sheets were finished, Lieutenant Sanderson took the maps to Intelligence at G.H.Q. in the Savoy Hotel, Cairo. At the Intelligence Office, he interviewed 2nd Lieutenant T.E. Lawrence, afterwards famous as Lawrence of Arabia, and asked if the Survey Department would print copies for the garrison at Dabaa. Lawrence replied *"Certainly, they will be ready for you tomorrow morning"*. In the interval Lawrence, impressed by Sanderson's maps, had seen his Chief, General Sir Archibald Murray, and asked that Sanderson should not return to regimental duty but that his party should proceed, as a fully equipped section attached to Army Survey, to map the coastal route from Dabaa to Sollum. This led to Captain Montague (R.E. and Egyptian Survey) going up to Dabaa with complete equipment for such a big job. Here started the break with the regiment which was to last throughout the war. Captain Montague arranged for camels and native chainmen and these arrived at the first camp at Geleila. With Sudanese to take care of the riding and pack camels, and Egyptians, who carried equipment and did general camp fatigues, the party was by now of considerable size. The switch-over at Geleila from horses to camels had its anxious moments, as, to quote, *"....by X whose camel suddenly unfolded and started off at a gallop"*. Camels have a great advantage over horses – they are less tiring to ride; moreover, the rider is 10 feet off the ground so feels the heat less. The Marconi party liked camels for the same reason.

Plane table work - Sadler & Hicklin.

Sanderson recalled *"Camels were found to be astonishing animals*". The member of one party who made the first essay to ride one thought so too. He was no sooner on the animals back than it unfolded and galloped off at full speed. An admiring onlooker thoughtfully remarked *"I wonder what old -- -------- is thinking now" "I expect"* replied a learned topographer, *"he is wondering if he is going to fall inside or outside the triangle of error"*. From Matruh we mapped right along the coast to El Sollum."

Rowe on a fast trotting Hageen.

The regiment did not lose touch with Sanderson's party, as an escort troop was needed during the months of their necessarily slow progress to Sollum. Escort duties entailed much work, but the break from the routine of line of communications was very welcome, particularly when in the Mersa Matruh area where the hospitable O.C. Troops, Brigadier-General Sir Joseph Laycock, K.C.M.G., D.S.O. (father of Commando General Sir Robert Laycock, K.C.M.G., C.B., D.S.O., famous for his exploits on that same front some twenty-five years later), considered all as his guests during their stay. At Juka, Bird left the party and returned to Dabaa to take charge of the Regimental Scout Section, and Sergeant Rowe of the West Kent Yeomanry (then at Matruh) joined the party. Thus, Hicklin, Sadler, Fortescue and Sanderson carried on with Capt Montague.

On completing the work of mapping the coastal area through Sidi Barrani to El Sollum the party moved back to Matruh to await orders. At most places the bathing was excellent and, working under conditions of great heat and occasional sandstorms, much indulged in. Breaks in the routine were the periodical relief escort troops bringing the mail accumulated at regimental headquarters. At Matruh the escort troop had an easier time as there were large forces in the area, and the chief pastime was bombing for fish. It was an unlucky day when they spotted a shoal alongside a hospital ship in

the bay and caused an explosion which those on board imagined to be a torpedo. The strafe which followed put a stop to that easy method of augmenting rations: *"... most unfortunate as we sometimes got as many as 120"*. In January 1917, when just short of Sollum the escort troop returned to the regiment, then at Zeitoun.

The maps produced by this survey were used many years later when our armies went forwards and backwards, and forward again, over the El Alamein-El Sollum area. And very accurate maps, we heard afterwards, they were. But then, Montague was a first-rate surveyor with a first-rate team.

At Matruh Montague was sent to the Sinai zone and Fortescue went sick and was evacuated to hospital and ought to have died but didn't. Hicklin, Sadler, and Sanderson were left to stick to survey till they finished in the neighbourhood of Aleppo well on in 1919. Sergeant Rowe of the West Kent Yeomanry joined the party at Matruh.

Hicklin & Sadler.

Soon after, the survey party left the Western Desert and joined the Egyptian Expeditionary Force at Deir el Belah in Palestine; becoming members of the 7th Field Survey Company, R.E. Here they divided into two sections: Hicklin and Sadler joining Captain Meldrum, D.S.O., in front of Gaza on the coastal sector, with Sanderson and Sergeant Rowe joining Captain Montague at the other end of the line at Tel el Fara on the Beersheba flank. Sanderson recalled that he thought they *"had the best of it, for we took part in all the reconnaissances towards Beersheba. Sometimes Hicklin and Sadler came over and lent a hand, and on one occasion we nearly lost Hicklin. As usual we camped overnight at Essani and the troops moved out at 4 a.m. and we soon followed, each of us making for the piece of country he was to map. Hicklin was soon at work and got along finely when he noticed some cavalry passing close by who looked a bit odd. He scrutinised them through his glasses; right enough they were Turks; fortunately, too busy with their own affairs to pay attention to him. Then another problem arose, what attitude would the Australians adopt when they came along, indeed, they were just appearing over the hill. It was painfully obvious that his party of natives and camels would look very like Turks and the Australians were apt to act promptly on hasty conclusions. So, the only thing was to go on working away in as prominent a position as possible, a thing the Turks would not be likely to do. Fortunately, the advance guard did think twice. That was the worst problem – the only bad one – of our job. You couldn't help making yourself conspicuous, because you had to work on tops of the highest hills. Its outstanding advantage, after the absorbing interest of the work, was that you couldn't possibly work in the dark and there were no night duties except perhaps some tracing or computations to do"*.

Rowe recalled that *"Survey under war conditions can be a little exciting at times. Most of the work, such as triangulation and plane-tabling, must be done on the tops of hills and sometimes within range of enemy fire, but as long as the stay is not too prolonged it is pretty safe. Troops invariably hide themselves as much as is possible, so if your enemy sees three or four gentlemen in shirt-sleeves playing games on the very top of a hill, he no doubt thinks they are harmless lunatics. It is probably several minutes before it dawns on him that it might be as well to shoot at them; by which time they have finished and are disappearing over the crest of the hill. We were lucky, for during the four years no Westminster Dragoon of the Survey Section was a casualty"*.

The restricted area of 'no-man's-land' on the Gaza front gave little opportunity for survey but Sanderson's mainly open country south and east of Beersheba offered plenty of opportunity. Added to survey duties this sector had many officer reconnaissance parties to deal with in the seven months leading up to the operations against Beersheba. These officer reconnaissance towards Beersheba must have appeared equally quaint to the Turks. There were a lot of officers being shown what would be their line of advance when the great day came, and for miles around hill tops were crowned with little groups of men with fluttering maps. The Turks were evidently fairly stumped to know what on earth it could all mean. You could see them in their trenches gazing through their glasses at the weird sight. Coupling this map-waving with the movements in front of Gaza, the Turkish Command must have been confirmed in their belief that General Allenby would attack Gaza, for surely, if Beersheba was in his mind, it would not be so openly advertised. No, it must be just a piece of bluff.

Our butcher.

On the fall of Beersheba on 31st October to the Anzac mounted troops galloping in from east over the enemy-manned trenches, General Allenby's advance along the coast,

following the capture of Gaza on 7th November, was too rapid to allow of much in the way of mapping, and the next stop of any length was on the Jaffa-Jerusalem line at the end of November. Little survey was possible until after the capture of Jerusalem on 9th December 1917. Sanderson recalled *"Whilst the army is on a fixed position surveyors are generally dodging up and down the front-line mapping that and the country as far as possible; fixing prominent objects such as trees, mosques, houses, road crossings, trenches & ascertaining heir heights, so that the aeroplane photographs may be accurately scaled and the intimate detail drawn from them. When the final advance was made on Sept 19, 1918, which crushed the Turks, we had mapped in this way an average depth of 15 miles behind the Turkish position and it was known that no detail was more than 50 yards out of place. Nearly all to very much closer limits".*

"Vetting" a camel - Montague and his Bisherins.

Advanced some twenty-five miles north of the city the line remained in a state of active defence, during which period several infantry battalions and cavalry regiments were moved to France – being replaced by Indian troops. These were months of activity in mapping, and when the final advance began on 19th September 1918 the whole line from coast to the Jordan had been surveyed to a depth of 15 miles behind the Turkish lines, details being filled in with the aid of aerial photographs. It was afterwards found that no point was more than 50 yards out of place. It is strange that the Turks themselves had no good maps; an embellished copy of Kitchener's Survey of 1878, excellent for travellers but of little use to artillery, was all they had.

Sanderson, again, *"When the infantry go over the top and the real advance begins the surveyors gracefully retire and watch with bated breath from a safe distance. As soon as the army is fairly on the move they hare along behind with the triangulation, so as to be ready to map the front line again when a pause is made".*

Perhaps I ought to mention what triangulation is. A triangle is a rigid figure and if you know the length of one side and measure the angles from each end of it to the apex you can compute the length of the other lengths of the two sides. So, in Survey, you measure very carefully a "base", set up marks at each end and then the third angle of your triangle on a previous position (a hill top, from which you can see the country round), measure the angles with a theodolite and compute the lengths of the two sides. Then with one of these sides as a base you carry on and measure a second triangle, and so on, covering the country with a network of triangles, each corner of which has a "mark" set up on it to a nice straight tree stem. It is best not to use a pole of too great value as firewood. I remember on one occasion observing with the theodolite on to a mark about five miles off and, whilst I was looking through the telescope of the instrument aligning on to the mark, a ****** Australian climbed to the top of the hill, contemplated the mark I was peering at, scratched his head, and forthwith rooted it up and walked off with it. I wished ardently the telescope had been a six-inch gun. The degree of accuracy obtained with the modern theodolite is remarkable. After triangulating from Dabaa to beyond Matruh – a distance of 100 miles a fresh base was measured and the accumulated error was 1.5 yards in 5000.

The network of marks fixed by the triangulation plotted on the plane table provides the framework on which the map is drawn in detail as you see it in the printed copy.

During the advance to the Jaffa-Jerusalem line the parties crossed over. Capt Meldrum with Hicklin and Sadler surveying/doing the inside berth/bush and going to Jerusalem, Capt Montagu and his party to Jaffa. They mapped orange groves and sea coast whilst Hicklin and Sadler played on the hills round Jerusalem and the Jordan Valley.

North of Jerusalem the coastal and inland sections made an exchange: Sanderson and Rowe (West Kent Yeomanry) working near the coast and Hicklin and Sadler in the hills about Bethlehem and Jerusalem, this bringing them within the patrol area of the regiment. This move gave Hicklin and Sadler an experience worth recording. Sanderson did a certain amount of work in the hills too; and certainly, walking up and down those rocky thistle-covered precipices was not amusing. "Give me a nice flat plain and a horse every time. Though, I have no doubt, the Jordan Valley is very interesting and it is something, to have bathed in the Dead Sea and in Jordan. When the final push came Hicklin and Sadler came and joined us and we were together from that time till the end. We followed the advance to Nazareth, past the Sea of Galilee, where we were boiled, to Kuneitra on the other side where we were frozen and on to Damascus. From Tiberias, we visited Capernaeum on the Sea of Galilee.

In February, after the enemy attempt in January to recapture the City of Jerusalem, these two made a rendezvous with Rowe in the Jordan Valley. Having a day in hand they decided to set off early for the Dead Sea some 10 miles to the south. Within a mile of the Sea, as they emerged from some broken ground, they saw ahead two armed men watching the Moab shore. As Jericho had not the been taken, they were most likely Turkish irregulars. Unarmed except for one revolver between them – for which they risked a court-martial – the only thing to do was to rush the post. Waving sticks and the revolver the 'enemy' were disarmed, but at that moment two more were seen to the right and two more ahead. Armed with knives taken from the first pair our heroes separated and were going for the two posts when yet another two men appeared. One of these was carrying an authority for 250 men of Lawrence's Arab army to meet a British Intelligence officer on the shore of the Dead Sea who would approach from the Moab Hills that night at 22.30 hours. Months later the episode was being related to Colonel Lawrence when he quietly observed *"I know all about it. I was there"*. Hicklin and Sadler pushed on and got their bathe in the Dead Sea and afterwards one in the Jordan River.

The two survey sections, now again enlarged, moved with Allenby's advance in September to Nazareth, on past the Sea of Galilee and other places of biblical interest to Damascus. There a Ford van (Model T) was acquired, this being the first piece of mechanical transport the Survey Field Party had.

Sanderson recalled, *"It was an awful job getting the triangulation across the Jordan Valley at Galilee: the hills on the other side were a terrific way off. Our longest observation was a distance of 36 miles on to a helio. We were not expert signallers and the blighter at the other end in charge of the helio could not, or would not, keep it on properly. No doubt our helio was just as aggravating for him"*.

By now the Turks had surrendered and promptly two-thirds of the party (including the O.C. Captain Montague) went down with a bad attack of 'flu. At the same time, a signal from H.Q. (near Jaffa) ordered the party back to Haifa for "work of great importance". Waiting long enough to see something of the wonderful city of Damascus and to recover a few of our men from hospital, the party trekked back to Haifa, and a very pleasant trek it no doubt was, particularly with two days' rest by the Sea of Galilee not far from Capernaum.

"Vetting" a camel - Montague and his Bisherins.

Sanderson :- "*However, there was no enemy to fight; the Syrians were our friends, for we had delivered them from the Turks, so the party took 10 days to organise"*. Sanderson decided he was not going to move his party into the mountains of Syria without four blankets apiece for both British and Egyptian personnel; his Egyptians having had a taste of what it was like with one blanket. Moreover, they were to be British blankets and not Egyptian. *"This meant disobeying regulation, but what are regulations for, if not to be broken? This reminds us of a somewhat similar irregularity when an instruction was issued from Whitehall after the Armistice requiring all cash balances to be handed in. Fortunately there was in the regiment a prominent member of the banking fraternity whose views did not coincide"*.

Back the party went, by the coast road through Tyre and Sidon this time, to make for variety, to Beirut and over the hills to Damascus. Here they were given the job of survey through Rayak to Aleppo, a distance by road of about 350 miles but considerably more in the diversions of survey; the route included Baalbec, with its wonderful ruins, Homs and Hama and down the Valley of the Orontes to Aleppo. On the 120 miles to Hama an escort was provided by the Middlesex Yeomanry, being replaced there by Indian cavalry.

Sanderson again *"By the time we got to Damascus two thirds of the party including Capt Montague, were down with sickness and we had a signal message that we were to proceed to Haifa. We waited long enough to recover some of our sick and see the sights – well worth seeing – and back we went to Haifa: a ten days trek, but quite a pleasant one this time"*. Arrived at Haifa, on the 11th of November, Sanderson phoned H.Q. and reported arrival. *"Where are you?"* he was asked *"At Haifa"*. *"Oh, I want you at Damascus"*. "*No, that was a mistake: you must get to Damascus as soon as you can"*. However; we stopped to refit and then padded away to Beirut. There we refilled some more – did ourselves quite proud for once – and then trekked up into the hills.

Our job was to survey right up the valley of the Litani and through Rayak, where the French have recently had a scrap with the Arabs, to Baalbek with its wonderful ruins of the temples of Jupiter

Bacchus and Venus where in its days of prosperity, the appropriate rites used to be observed, and down the valley of the Orontes to Aleppo. On this expedition we had an escort of Middlesex Yeomanry and one or two Westminster Dragoons were among them. We just missed having Sergt Betterly as one of our protectors.

Though we groused a lot at having to carry on survey when we ought to have been returning home like conquering heroes to a country fit for heroes to live in, we really rather enjoyed that winter. It's a fine country and we did not work too hard. At Hama our Middlesex escort left us and was replaced by Indians. After this there was some fun. The inhabitants are expert thieves and love the sport. The Indian cavalry was very dashing and some nights the camp was a blaze of musketry. No one was ever hit, not even one of ourselves for which we were duly grateful and the thieving went on as usual until we held some of their best horses as hostages.

Survey party group.

At Hama, Sanderson left for England, but Hicklin and Sadler carried on to Aleppo where, in May 1919 they packed up and returned to England jointly to farm a large area in Kent. Sadler's splendid record of service in the Second World War has been recorded elsewhere.

It must not be thought that it is nothing but survey all the time. For instance, there was a bit of a row between two villages in Syria and a man was unlucky enough to have his belly slit open. It seems that the tubular arrangements inside are quite tightly packed and, given half a chance, protrude in clusters. They pit the patient on a donkey, told him to hold up the cluster closely with his hands in case they became unravelled, and brought him to the village where they heard there were two Englishmen who, no doubt would be able to put everything right again. The two unfortunate Englishmen were Hicklin and Sadler. Luckily they had a 'housewife' and some permanganate of Potash. Sending an urgent message back to camp asking the doctor to come out, they called for boiling water; they boiled the needle; they boiled the thread and washed in permanganate. Proceeding to operate, they found how extraordinarily difficult it is to get the tangled mass of tubes back into the body, close the slit and sew up. Bits would poke out and refuse to be pushed in again. Even with the encouragement of the patient who watched the performance with great interest it was no go. At last the doctor arrived. Under an anaesthetic, it was quite easy – when done by the doctor. The patient lived happily to a ripe old age, it is hoped. At any rate, what was known was that he made a good recovery.

The importance of competent survey to a commander-in-chief and his subordinate commanders cannot be over-estimated, and the regiment can take satisfaction in having been so well represented during 1915-1919.

We have but one regret. When we saw the splendid regiments on their return march through the packed and enthusiastic London crowds, we felt out of it. Why didn't we the 7th Field Survey Co. R.E. have a full-dress parade through London? I can assure you, there would have been nothing like it. Horsemen, surveyors, on horseback and camels and on mules, pack mules, baggage camels, G.S. wagons, native chainmen of all shades and dogs. Yes, we certainly regret that.

From: The European Staff First Field Season South Nigeria Survey Handbook. Depicting Mr D.R. Meldrum - back row.

Photo-Mapping Italy in World War Two
By The 941st Engineer Aviation Topographic Battalion

By Steve Lloyd

Introduction

The following notes have been condensed from a small pamphlet produced at the end of World War Two entitled *"Photo-charts and Photo-maps by the 941st Engineer Aviation Topographic Battalion"*, a copy of which is held by the Air Historical Branch at RAF Northolt, in order to bring the activities of this unit to the attention of the DSA membership and also to ensure that this little-known aspect of the story of Military Survey in Italy in World War Two is not overlooked.

The Defence Surveyors' Association now holds a photocopy of the complete document and scans of the graphics contained in it kindly provided by Air Historical Branch. This assistance by the Air Historical Branch is most gratefully acknowledged.

This brief account is published here because there is no mention whatsoever of the activities of this unit in the official monograph on Military Survey in World War Two, *"Maps and Survey"* by Brigadier A.B. Clough C.B.E., M.C., although the existence of the unit is shown under 12th Air Force with A Company under 15th Air Force of Mediterranean Allied Air Force in the Map and Survey Organisation, Mediterranean Theatre of Operations 1944-1945 facing page 304. It is perhaps not surprising that mention of the work of this American unit was not made by Brigadier Clough.

Period of Development

The 941st Engineer Battalion was activated on 1 April 1944 with the responsibility of producing Photo-charts for the Air Forces and Photo-maps for the Ground Forces. The Engineer Aviation Topographic Engineers arrived in the Mediterranean Theatre of operations trained to do tri-metrogon aerial charting but because adequate air charts already existed, their mission evolved into the production of target charts and briefing charts for bombing, the essential element of which was the photo-mosaic, which required rapid production at short notice.

Responsibilities

Photo-charts were first produced by the 951st Engineer Topo Company and later by the 954th Engineers under the direction of A-2, XIIth Air Force and, later, the North African Photographic Reconnaissance Wing (NAPRW). The scale of mosaics, which were laid down from un-restituted contact prints, varied from 1:10,000 to 1:20,000. When activated, the 941st Engineer Aviation Topographic Battalion absorbed the 951st, 953rd, 954th and 956th Engineer Companies and from then on there were continual changes in photo-chart production. The use of restituted, or rectified, prints and 6-inch photography was introduced for the production of 1:63,360 scale and other larger scale products. There was no fixed specification, as new requirements evolved and new methods and techniques developed, new target material was produced.

Although American pre-war plans expected photomaps to be produced by ground force topographic units, the greater part of the photo-maps used in the theatre was produced by Air Force units, commencing with the mosaics of Cape Bon, Tunisia produced by the 3rd Photographic Reconnaissance Group. Mosaics of Sicily, parts of Southern Italy, Pantellaria, Rome, the Volturno and Sangro Rivers and other vital areas followed.

The Aviation Engineers, in conjunction with the Photo Technical Squadron, were concurrently laying down 1:50,000 scale photomaps. In the autumn of 1943 a large 1:50,000 scale photo-mapping programme of Northern Italy was commenced by NAPRW, the 953rd and 956th Engineer Topographic Companies (Aviation) laying the mosaics. In the winter of 1943 NAPRW moved to Italy and became the Mediterranean Allied Photographic Reconnaissance Wing (MAPRW). The British establishment of the Wing operated a photographic laboratory and mosaic section in conjunction with the two Photo Technical Squadrons. Despite the stable tactical situation which developed during the winter of 1943, demands for mosaics increased.

In March, 1944 MAPRW decided that, properly, the Engineers should take over responsibility for mosaic production which had been carried out by the Technical squadrons and the British

Establishment. Thereafter, all photomaps produced at MAPRW were laid by the Aviation Topographic Engineers with the exception of some miscellaneous mosaics.

Techniques

The earliest mosaics were laid with contact prints but by the summer of 1943 Saltzman projection printers were being used to make prints at the required scales. Initially prints were edge-matched but later were laid to fit map detail.

In the stabilised front of the 1943 winter the 953rd and 956th Engineers took the first steps to improve accuracy by fitting prints on the mosaic board to detail traced from 1:50,000 scale maps. Where only 1:100,000 scale maps existed, the map detail was first enlarged through a reflecting projector. Later, a restitutional printer was procured, a set of empirical tables was produced after a series of tests, a scaling section was organised to address the problems of scaling and computing the tip and tilt of photos.

Until March 1944, at the insistence of users, all photo-maps were contact prints despite the Engineers repeatedly trying to introduce lithographic 133-line half tones. In the summer of 1944, 300-line half-tone screens and coated paper were procured for producing glossy half-tone lithographic photo-maps. These the Air Force accepted but the Ground Forces still demanded contact prints for some time.

Also in early 1944, in an effort to introduce some standardisation, 1:25,000 scale mosaics were produced corresponding in area to sheets of the 1:25,000 scale map series GSGS 4228. These had an arbitrary 1,000 metre grid and principal features and spot heights were annotated. These were almost identical to captured German photo-maps of north-central Italy, the only difference being the use of the Military grid on German products.

The next development occurred in January 1945 when 5th U.S. Army ordered a series of 1:12,500 photo-maps, designated Series GSGS 4224, tied to plan control with maximum horizontal errors of 100 metres.

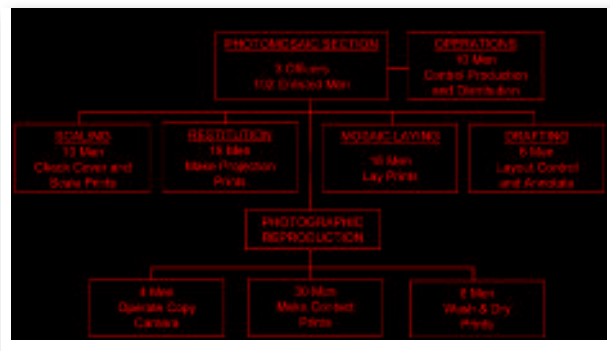
Map of Europe Showing Areas Covered by Photomaps.

The 941st first scaled the photos and produced restituted prints. These restituted prints were laid directly on zinc plates bearing an ink-albumen image of the enlarged quadrant of the Series GSGS 4228 1:25,000 scale sheet. Geographic annotations, contours, spot-heights and the military grid were included and the photo-maps were produced as 300-line half-tones, the quality of which meant that contact prints were no longer demanded by units. Sheets were produced by the 941st, a South African Engineer Company and a U.S. Topographic Company. The work carried out at 1:50,000 and other scales is shown on the map.

Organization

The establishment tables for Topographic Companies did not include photo-laboratory technicians but the Lithographic reproduction Platoons of the Companies provided some photographers as a nucleus to develop a photo-laboratory and the Photo-mapping and Geodetic Platoons provided those with mathematical and photogrammetric skills for the scaling section.

Once the companies were reorganized into the battalion, equipment, including 2 x washers, 3 x print dryers, 5 x restitutional printers, 6 x 20 x 24-inch contact printers, was obtained through Air Corps channels. The Photo-mosaic Section was established within the Reproduction Company which also included a small drafting detachment from the Photo-mapping Company so that the entire process was integral to one Company. The Photo-mosaic Section organisation finally totalled 102 men.



The production of Target Photo-charts was more complex, the compilation of target information was done by a Target Chart section in Battalion Operations and the drafting and annotations of selected information was done by the Photo-mapping Company.

From 1 March 1944 to 1 October 1944 weekly production averaged 9833 contact prints 20 x 24 inches, 2650 projection prints, 97 copy negatives and 40 mosaics. From 1 October 1944 the Battalion was required to establish two operational units. The Photo-mosaic Section was divided, one section supporting the Strategic Air Force, the other supporting the Tactical Air Force and elements of the Ground Force.

Map Showing Locations of Target Chart Mosaics Produced in the Mediterranean Theatre of Operation.

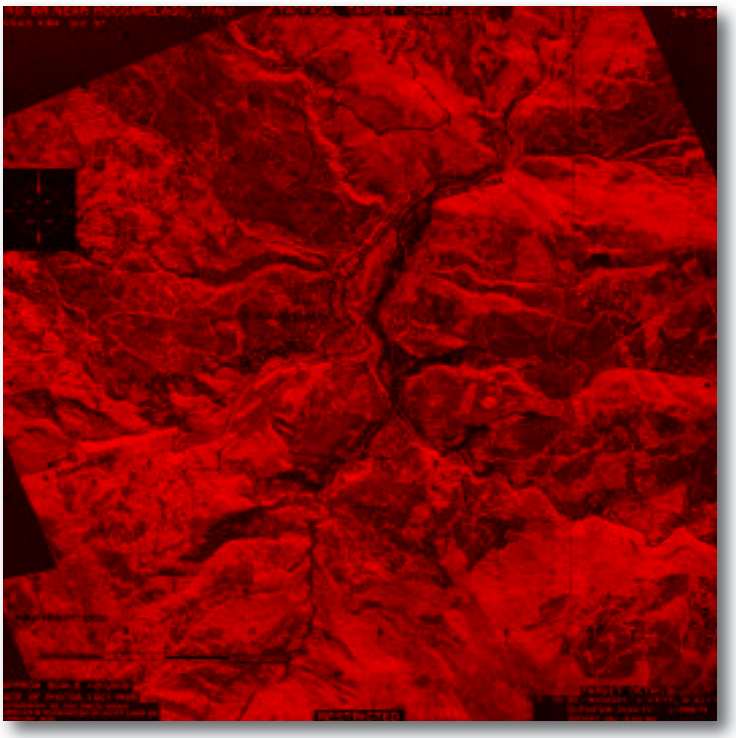
Operations Section 10 Men - Production control and distribution.
Photomosaic 3 Officers, 102 Men
Scaling, 10 Men - Check cover and scale prints.
Restitution, 18 Men - Make projection prints
Mosaic Laying, 16 Men - Lay prints
Drafting, 6 Men - Laying control and annotation
Photo Reproduction
4 Men - Copy camera operation
30 Men - Contact print making
8 Men Washing and drying prints

General Procedures

The work flow was as follows. On receipt of a mosaic demand, the Operations Section, responsible for the control of production, passed the task to the Photo-mosaic Section who carried out a cover search in the Print Library. If necessary, further reconnaissance was ordered. Otherwise, prints were analysed for tilts, restitution arranged and the restituted prints laid to match existing map detail. Annotations on the face and marginalia were then added and a continuous-tone or half-tone negative made on a process camera. Final hard-copy was either by contact prints or by half-tone lithography.

Laying a mosaic on a zinc plate holding an albumen image of the map.

1:20,000 scale Tactical Target Chart T4-306 – Road Bridge near Roccapelago, Italy.



Selecting the Photographic Cover

Photographic cover was selected from a series of index maps of the various focal length sorties drawn on tracing linen. A user trace was then provided for the mosaic layers.

Scaling Section

The scaling section was responsible for determining tip and tilt and scale of all photos used in mosaics. Scaling was based on conventional map/photo comparisons. Relief displacements were not possible. Correction of tilt displacements was attempted based on scaling lines through the principal point or along the line of flight. The amount of tip was determined by comparing photo distances on consecutive prints.

A second method was to use a reflecting projector, matching the photo image to a map on the base board.

Due to the urgency of operations the standards laid down in existing American manuals, TM 5-230, FM 21-26, TM 21809-5, TM 5-240 were relaxed and the methods adopted resulted in acceptable mosaics for 5th and 8th Armies in Italy and 7th Army in Southern France.

Restitutional Printing

This was done on either the B-9 Air Corps machine or the Engineer RP-6 machine.

Assembly of Mosaics

Mosaics for target charts were assembled from the centre outwards, allowing errors to accumulate towards the edges. Where overall accuracy was required, for photomaps and special purpose mosaics the prints were cut on selected match lines and feather edged, then laid in approximate position. When all were laid adjustments were made to distribute errors and edges fastened in place by scotch tape before being fixed permanently with gum Arabic.

Masking and Drafting

Completed mosaics were masked to desired final size and annotated with standardised marginal information with lettering by Wrico or LeRoy lettering tools. For photomaps, annotations were drawn on the final mosaic, for tactical target charts on a film positive overlay. When contours were required on photomaps, traces from a map were made and fitted as well as possible, black being used in preference to white.

Reproduction

Photomaps and special target map bromides were often reproduced by contact printing on Air Corps A-2 Vacuum Printers using argon glow lamps but half-tone lithography using 133, 150 or 300 line-screens was more usual using the Harris 20 x 22.5 inch press.

National Centre for Geospatial Intelligence

By Brigadier Ben Kite OBE - Head of National Centre for Geographical Intelligence

Over the past 18 months, the Chief of Defence Intelligence (CDI), Air Marshall Phil Osborn, has led Defence Intelligence through a significant transformation programme. During this process, the critical value that Geospatial Intelligence (GEOINT) provides to the UK was fully recognised and the requirement for a national capability was agreed. The model of a national GEOINT organisation was woven into the wider changes within Defence Intelligence and the National Centre for Geospatial Intelligence (NCGI) was formed on 1st December 2016. The NCGI combines the former JARIC, Defence Geographic Centre (DGC) Feltham, No.1 Aeronautical Information Documents Unit (AIDU), HQRE Geo and 42 Engineer Regiment (Geographic) under a 2-star led organisation, headed by Major General Jim Hockenhull and managed day to day by myself. It is the authority for GEOINT delivery in the UK and a major step forward for the UK's GEOINT community.

Pathfinder Building, RAF Wyton.

As we near the end of the second decade of the 21st century, GEOINT remains critical to the UK military and its partners across government and allies. It continues to underpin the other intelligence disciplines within the UK intelligence community, and enables situational awareness and safety of navigation at all levels from global to tactical, in both home-based and deployed capabilities. NCGI draws on rich and varied heritage, from the early days of photographic reconnaissance in World War 1 and the expansion of our imagery analysis capabilities at Medmenham during World War 2 and thereafter, as well as the long history of Military Survey in all its guises. Many things have changed over the years, but the need to innovate and apply the latest developments in technology to meet decision makers' demands for information, insight and foresight in an ever-changing geo-political environment remains a constant.

The NCGI is organised into three output functional areas: Analysis (NCGI-A at RAF Wyton led by Group Captain Stewart), Foundation (NCGI-F at Feltham, West London and RAF Northolt led by Mr Ian Spencer), and Deployable (NCGI-D at RAF Wyton, led by Colonel Roly Cockwell). The organisation combines the expertise of 1200 military and civilian imagery analysts, geographers and geospatial analysts in a mutually supporting organisation. The NCGI Foundation function now includes oversight and funding of all Defence support provided by the UK Meteorological Office and the UK Hydrographic Office, and the intelligence analysis function has been enhanced by embedding specialists from both of these areas. NCGI Deployable has functional responsibility for all the Royal Engineer geo detachments embedded in units across Defence as well as 42 Engineer Regiment (Geographic) which is based at Wyton.

NCGI continues to train and develop its analysts with a complementary range of bespoke training courses which builds on their foundation training from the Royal School of Military Survey, which is part of Joint Intelligence Training Group and includes IMINT Wing. NCGI analysts start their careers in their respective specialist fields and through improved career management have the opportunity to expand their skillsets and gain experience working in a range of intelligence or geospatial teams or within different organisations.

The intelligence community has reaped the benefits of access to this more integrated specialist GEOINT capability; much of the GEOINT analysis component is operating within the new Pathfinder building at Wyton. NCGI analysts working within the Defence Intelligence Mission Teams are able to produce innovative and dynamic products that are available to an increasingly broad community of interest. National GEOINT Officers (NGOs) are deployed to a variety of partner and defence

Khan Shaykhun – Alleged CW Attacks on 4 Apr 17.

organisations. Their GEOINT skills, authority and ability to reach back into NCGI and our international GEOINT partners are increasingly recognised as a force multiplier in intelligence terms.

Our enduring long-term relationships continue to strengthen and will form the cornerstone of the future of GEOINT within the UK. We have embraced the digital age, bringing greater capacity and speed and putting advanced imagery and geospatial analysis techniques at every analyst's finger tips. These technical and analytical advances have made us better able to support our decision makers and customers in a timely manner.

The Future

Within Defence and Defence Intelligence, NCGI will continue to evolve and be recognised as a truly national capability, celebrating and developing the ethos of organisations that have preceded it and harnessing the best of the RAF Int Branch, RE Geo, Int Corps and Civil Servants who comprise the core staff. In doing so, NCGI will be able to support a range of Foundation GEOINT and intelligence activities and provide GEOINT expertise and advice across all of Government.

Assessment of damage to infrastructure within Anguilla following Hurricane IRMA, developed jointly by both Imagery and geospatial analysists.

Working ever closer with our allies, and with a growing number of commercial, academic and other partners, we are increasing our technical expertise and better utilising a range of emerging technologies thereby increasing the capabilities of our future analysts. As a result, our analysts and systems have an increasing capability to deal with the constant demand to answer challenging and complex problems.

A snapshot of a 3D model, created from multiple stills taken by a small COTS UAV currently being trialled by 42 Engr Regt (Geo) (image courtesy of Pix4d).

Access to an expanding number of traditional and non-traditional sensors and data sets will provide the breadth and depth of information needed to allow NCGI analysts to provide accurate and timely foundation and intelligence products. The integration of all the national GEOINT capabilities, along with our partners' capabilities, will give NCGI the competitive edge to meet current and future challenges.

NCGI is the heart of UK's cross-Government GEOINT activities and will continue to deliver timely and effective GEOINT to decision makers, planners, and operational units in the UK and on deployed operations.

A Short History of The Royal Australian Survey Corps - 1915 to 1996

By Lt Col R F (Bob) Skitch (Retd)

(The 1st July 2015 was the 100th anniversary of the formation of Royal Australian Survey Corps when celebrations took place in Canberra and Bendigo. In Canberra they were based mainly at the Australian War Memorial and in Bendigo in the grounds of 'Fortuna Villa' once the home of the Army Survey Regiment and other locations well known to the soldiers who served there.)

Introduction

Military Mapping in Australia began in 1907 as a part time activity of the Australian Intelligence Corps (Citizen Forces). In 1910 the Survey Section, Royal Australian Engineers, was created and raised as a full time unit within the Permanent Forces to cope with increased mapping tasks. This unit initially consisted of two Australian draughtsmen – Honorary Lieutenant Raisbeck and Warrant Officer Constable, plus one corporal and three sappers on loan from the British Royal Engineers.

Formation

On July 1st 1915 the Australian Survey Corps was raised as a unit of the Permanent Military Forces in an Order-in-Council which proclaimed that all members of the Survey Section Royal Australian Engineers be transferred to the new Corps with their present rank and seniority. The unit was commanded by Lieutenant Quinlan with Lynch appointed Lieutenant on 9 July and Vance on 13 July. It is of interest to note that the extract of this Order-in-Council also carried what became the Corps Motto - *'Videre Parare Est'*, formally adopted in 1965, meaning *'to see is to prepare*'.

World War 1

Of the three officers and 17 other ranks that constituted the Australian Survey Corps in 1915, all but three other ranks enlisted in the Australian Imperial Force (AIF) and saw service in France, Belgium, Egypt or Palestine. Two members, Lieutenant Murray, and Sergeant Stafford, were awarded the Distinguished Conduct Medal. The first use of air photos for mapping was made during World War 1. Photography was also used to plot trench detail on existing maps compiled by laborious field plotting methods (about 1 sq. km per day).

Between the Wars

In 1921 the Survey Corps lost its separate Corps status to become the Survey Section – Engineers (Permanent) but was re-established as the Australian Survey Corps in 1932. Limited military mapping continued throughout that period. In 1927 the RAAF commenced flying aerial photography for mapping purposes and the first map produced using aerial photographs was of Albury at a scale of one inch to a mile. When the Corps reformed in 1932 the total strength was fourteen but it increased steadily and by 1935 it stood at thirty five.

World War 2

The Corps entered World War 2 with nine officers and forty one other ranks. Total strength reached a peak of 1,700, with some 5,500 men and women being engaged on mapping tasks during the war period. Corps members served with distinction in the Middle East, the Australian mainland, New Guinea, Pacific Islands and Borneo. It was in Borneo where HQ 1st Australian Corps praised the efforts of the Survey Corps by recording that *'...never in this war have Australian troops been so well provided with accurate maps, sketches and photo reproductions ...'* their tasks culminated in the production of the Japanese *'Instrument of Surrender'*. At the end of the war the Corps had 862 all ranks serving overseas which together with mainland personnel had produced a total of 1,419 maps of various scales.

The map production factory of the Corps was in the gold mining city of Bendigo, Victoria where the previously Melbourne based Cartographic Company was relocated in 1942 within the mansion and associated mine buildings of *'Fortuna'* previously the home and headquarters of George Lansell, Bendigo's mining magnate. Fortuna was to continue in that role as the home of the AHQ (later Army) Survey Regiment until the demise of the Corps in 1996.

Post War Development

By mid-1947 Corps strength had declined to 430. In 1948 the Australian Survey Corps was granted the prefix 'Royal' in recognition of its service during the war. That same year saw the initial establishment of the Army School of Survey at Balcombe, Victoria, on the Mornington Peninsula. In the late 1940s Corps surveyors undertook exploratory surveys for the Snowy Mountains hydro-electric project, hydrographic surveys in Flinders Gulf (South Australia) and later the Woomera Rocket Range and at Maralinga, the site of the British atomic weapon testing. Anaglyphic stereoplotting equipment was introduced into the Corps in 1952 and was used extensively for over 10 years.

Despite the efforts of pre-war Corps surveyors, in 1950 the Australian continent could only be described as being very poorly mapped. At that time mapping consisted of inch to the mile mapping of some limited coastal areas and emergency maps at four miles to an inch produced by civilian agencies, mainly state lands departments during the war. These four mile maps were based on existing property surveys and what are commonly called ‘traveller’s tales’ and had no or limited height information. Many were of dubious accuracy. Both national development and defence demanded better.

In 1957 the decimal map scales of 1:50,000, 1:100,000 and 1:250,000 replaced the imperial scales. At about this same time scribing replaced conventional pen and ink draughting methods. In 1957 helicopters were first used for mapping by army surveyors in Western Australia. 1957 also saw the introduction of electronic distance measuring (EDM) equipment to field surveying superseding traditional methods of triangulation. Direct station to station EDM progressed to the aircraft based master station measurement allowing lines or up to 50 kilometres to be measured without the need for terminal station intervisiblity. This gave rise to the concept of ‘trilateration’ alongside of traditional triangulation.

In the early 1960's map compilation from aerial photography was greatly expedited by the use of electronic computers for analytical photogrammetric processes replacing slotted template assemblies. Survey for mapping programs in the then Territory of Papua and New Guinea commenced in 1954 with ship based surveys of New Britain (1954) and New Ireland (1956/57). These were carried out conjointly with the United States Army Mapping Service providing logistic support. From 1961 through to 1979 mapping surveys were undertaken annually on the mainland of Papua New Guinea, finally providing total map coverage at the scale of 1:100,000 and culminating in the presentation of a three volume atlas to the Prime Minister of Papua New Guinea Sir Julius Chan on the 26th June 1980.

The School of Military Survey moved from the Mornington Peninsula south of Melbourne to Bonegilla in northern Victoria on the banks of the Murray River late in 1965. Also in 1965 *‘Wandering the Kings Highway’* was adopted as the Corps marching song.

Geodetic and Map Control Surveys

From the early 1950’s until the disbandment of the Corps in 1996 extensive geodetic surveys and mapping operations were undertaken in all mainland states of Australia as part of a national mapping program leading to the development of the Australian National Spheroid replacing the Clark 1856 Spheroid and the adoption of a central Australian origin replacing the Sydney Observatory origin. Co-participants were the various state and federal mapping agencies the latter principally the Division of National Mapping of the Department of National Development. Coordination of all survey and mapping operations was achieved through the National Mapping Council the members of which included the Director of National Mapping, the Director of Military Survey, the Naval Hydrographer the Commonwealth Surveyor General and the Surveyors General from each of the States. Most of the Council members had served in the Australian Survey Corps during World War 2 and over the life of the Council a remarkable level of cooperation and coordination was achieved without the need for legislative support. The National Mapping Council came to an end in 1986 being replaced by an intergovernmental committee with lesser functions.

The Corps’ specific area of responsibility was north of the Tropic of Capricorn but included other substantial areas in all States. Total map coverage at the scale of 1:250,000 had been achieved by 1965 and a 300 kilometre band of 1:100,000 mapping around the coast by 1980.

Defence Cooperation Program

From 1970 to 1996 the Corps participated in Australia's Defence Cooperation program. Survey operations and mapping programs were undertaken in Indonesia and later the South West Pacific island nations. The first of the Indonesian mapping projects in 1970 was of West Kalimantan codenamed *'Mandau'* and was conducted conjointly with British surveyors from 84 Survey Squadron RE, then based in Singapore. Over a ten year period mapping control surveys with aerial photography flown by the RAAF provided total coverage of all of Sumatra, Maluku and most difficult of all Irian Jaya (later West Papua)

Vietnam

In 1965 the 1st Topographical Survey Troop was raised to provide direct mapping support to military operations. In 1966 a detachment of the Troop, later re-designated 'A Section', was deployed with the 1st Australian Task Force to Phuoc Tuy Province in South Vietnam based at Nui Dat and saw continuous service through to 1971.

Technology

In its final three decades the Corps developed into a highly professional and technical organisation employing advanced mapping systems and equipment. Examples in field survey include the use of the satellite positioning system and airborne laser terrain profiling; in map production, computer based analytical photogrammetry to produce photo control for stereo plotting of map detail, computer-assisted cartography, orthophoto mapping equipment and in map printing; a large format computer controlled cartographic camera and computer controlled lithographic colour printing presses.

Changing Times

Although one of the smallest army corps, the Royal Australian Survey Corps retained a position of seniority in the corps listing being preceded only by Armoured, Artillery and Engineers. The strength of the Corps in the mid-1980s stood at approximately 650 all ranks, including 100 officers.

On completion of 1:250,000 and 1:100,000 mapping programs of Australia the Corps commenced a program of 1:50,000 mapping of areas of tactical significance. While the Corps entered its most productive time in map output, two successive reviews of defence mapping and charting capabilities were to decide the future of the Corps. The Baker-Byrnes Review of 1988 refocussed the Corps to a more operational role in direct support of the Australian Defence Force. Much of the Corps' field assets were rationalised and the 1st Topographical Survey Squadron was raised in Brisbane to support the 1st Division.

The advent of the Wrigley report was to signal the end of the Corps when sweeping government reform resulted in the civilianisation of many Defence activities. The mapping activities of the Corps were handed over to public service organisations. The operational assets of the Corps were considered too small to exist as a separate corps and on the 1st July 1996 the Royal Australian Survey Corps was disbanded. A geomatic trade of approximately 120 all ranks was raised within the Royal Australian Engineers to provide topographic support to the Army.

The achievements of the Survey Corps were threefold. It supported our forces overseas in three of the major conflicts of the 20th Century, it made a major contribution to the mapping of Australia and surrounding countries essential to their defence and development and finally, it achieved a reputation as a world standard technical mapping organisation. This last achievement is evidenced in the pride that marks the character of any ex-serving member of the Royal Australian Survey Corps.

For further information see: http://en.wikipedia.org/wiki/Royal_Australian_Survey_Corps

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Nevin W. Gillmor - 956th Topographic Engineer Company & 941st Engineer Aviation Topographic Battalion

By Nevin W. Gillmor

Nevin (Ned) was interviewed about his World War II experiences as part of an oral history project and shares some of his experiences here:

Personal History

Ned's family origin was Ottawa Ontario Canada although he was born in Ballston Spa NY in the 1920's, where his mother had family before returning to Canada during the 'depression' for better employment opportunities. Ned returned to the Glen Falls area in the early 1930's. He enjoyed design and drawing, the skills he inherited from his father and grandfather who were builders and contractors in Ottawa.

Ned enlisted on 19th August 1942 in New York State Guard and underwent Basic Training at Fort Dix New Jersey, including rifle marksmanship. Assigned as a draftsman to 956th Topographic Engineer Company, Bradley Field, Connecticut and attained rank of Technician Grade Four (T/4).

In August 1943 deployed with 956th to Tunisia as part of the Mediterranean Allied Tactical Air Force (MATAF). Ned was involved in the preparation of line maps and photomaps in support of Allied Air Force. On its formation on 1st April 1944, the 941st US Army Engineer Aviation Topographic Battalion absorbed the 956th and moved with the 941st to Italy. Ned enjoyed his work drafting line maps, making photomosaics and terrain models – particularly proud of work supporting Ploiesti Oil Field bombing campaign. He was discharged in Dec 1945 and returned to Glens Falls, NY to work as design engineer for the Sandy Hill Corporation, designing and manufacturing paper mill machines, retiring in 1985.

WWII – AS I RECALL

I must go back a few years before I enlisted in 1942 to when my father died in 1938. This was during the depression and my brother Hugh was bed ridden about 85% of the time. My sister Marj had a job as a clerk at Central market on Cooper Street where the Price Chopper is now, and as I recall, earned about $9.00 a week. This was the normal wage for a girl at the time. I left school mid-way through my senior year to go to work at Armours Meat Co on Lawrence St and by working four hours overtime each day I took home about $19.00 a week, along with some meat once in a while.

Every night after I went to bed, Hugh and I would talk about the war and all the fellows that were being drafted. I heard that the ones who enlisted got a choice of what kind of an outfit you would like to go into. Also, you could make out an allotment to send home and the government would add the same amount to it, which would help a lot at home. We both felt that sooner or later I would get drafted so I would be better off enlisting, which I did on August 19th 1942. I went to Fort Dix, New Jersey from Albany by steam train for basic training. My serial number was 12137669.

Most of military life was second hand for me as I had joined the New York State Guard at the Glens Falls armoury about a year and a half earlier and had lots of close order drill. I was on the rifle team (and had the next to top score) under Lt. Weaver. We also had two weeks field manoeuvres down at Peekskill, N.Y. We left from the Glens Falls Train station, which at that time was where the Post Star building is now on the comer of Lawrence and Cooper streets.

After a couple of months of basic training at Fort Dix, a group of us was singled out and shipped by train to Windsor Locks, Connecticut, a very small town with a paper mill. It was some time in the wee hours of the night and there was a string of G.I. Trucks waiting there to take us up to Bradley Field a few miles out of town. It was a relatively new air base and the barracks were spotless compared to what we had just come from. The next day we found out that we were located about halfway between Hartford, Connecticut and Springfield, Massachusetts - not far from home. This was the beginning of the 956th Topographical Engineers. Most everyone in the group had experience in photography, drafting, printing, or that sort of thing, and all were a great bunch of guys.

As soon as we were settled in, we started our training on how to make maps. I was issued a set of brand new drafting tools, which, incidentally, I still have today. What a thrill it was to finally get started on the job we were trained to do. We also worked with aerial photographs that had been taken in long strips at three second intervals to give the proper amount of overlap so we could trim them, glue them on to a heavy board, and make one huge picture of the landscape. These were to be used by the troops before landings, etc. My main job was drafting the maps for the Air Force as approach charts and bombing charts. Each one was made up of three sheets for the three colours and had the match marks for correct alignment during the printing process. It was a very demanding job and I loved it.

After a couple of months had gone by, a notice was posted on the bulletin board asking for volunteers to man the 50 Calibre. Anti-aircraft (A-A) guns we were to get very soon. I was the first name on the paper and I talked my two buddies, Tom Hill and Walt Lewis into signing up as well. I sure was glad later on that I had made this decision. The days and weeks flew by. It was fairly easy to get evening passes and the three of us spent many of them in Hartford. Everyone was so thoughtful with free food and soda at most churches and dancing at many. At one place, the Red Cross ladies gave little gifts, and that is where I got my sewing kit made at the Red Cross Chapter in Clay County, Missouri which I used all the time I was overseas, and I still do.

That was one of the coldest winters I ever experienced and the heavy wool GI overcoat we were issued was a wonderful thing, especially when we pulled guard duty! In the spring, we were moved off the field and into an old CCC camp (Civilian Conservation Corps) outside of Westfield, Massachusetts. The barracks were pretty run down, but the grounds were like a well-kept park and we enjoyed it there. One day the Inspector General came and discovered that our C.O. (commanding officer) was always making sure that we were lacking in some part of our training to prevent us from getting shipped overseas, where he did not want to go. Well, they snapped him out and sent in a replacement. Did we ever make up for lost time with forced marches across states, etc? I was in good shape then but some of the older fellows really suffered and many had to be trucked back to the base. On the first night there, we were put through a swamp in Torrington, Connecticut without lights of any sort. In the pitch black, there were many sprained ankles and the sharp end of a broken branch stuck in one fellow's eye.

While we were camped outside town, I met a very nice older man who gave me a beautiful knife he had made out of a file. It was about 10 inches long and had a great leather sheath, which he had also made. I still have the sheath, but the knife broke in half when I was practicing throwing it, which we all did from time to time. By this time, I had attained the rank of T4 which is technical sergeant and that made me feel pretty proud.

It was sometime in August of 1943 that we got orders to box up all our equipment and be ready to ship out. It was the day we were beginning to think would never come, as we were all trained and ready to go. We went by train from Windsor Locks, Connecticut to New York City and trucked to the pier where the *Thomas H. Barry* troop transport was waiting.

USAT Thomas H Barry on 12th March 1942.

We hauled our duffle bags and backpacks up the gangplank under floodlights, as it was quite late by this time. As soon as we arrived at our assigned deck and claimed a bunk, we unloaded our entire duffle and were promptly notified over the loud speaker that the chow line was to form at the stairs and go down two decks for anyone that wanted to eat. Naturally, there was one grand rush. After the meal, we bunked down and when we woke up, we were out to sea. It was fairly calm and beautiful. The only one thing that really bothered us was the saltwater showers. The only thing they accomplished was to cool us off.

We were headed to North Africa. After we were out about three days the Lt. in charge of the 50 calibre machine guns asked if any of us wanted to volunteer to help the Navy 20 mm. gunners on the way over for the experience. This meant that if any action took place, we would not be herded below with the rest of the troops, but instead, we would be up 'with the navy gun crews and we could eat any time we felt like it. Both of these items were very important to me. First of all, I am a little claustrophobic, and secondly, since I never got sea sick, I was starving and spending most of my time standing in the chow lines!

This was a great experience, and I really enjoyed it, especially the practice firing the 20 mm guns. We helped to pass the ammunition up to the gun turrets and I traded my Army Engineer cap for a

sailor's hat, which I had for a long time after we landed in North Africa. At one point when we were about half way across the ocean, I saw up ahead what looked like a huge gray wall that stretched from one horizon to the other. This turned out to be a huge fog bank. We were part of a very large convoy and when we meld into the fog, I watched the other ships gradually disappear from one end to the other, and then the foghorns started to blare and they continued all night long. When morning came, I went on top and it was clear and beautiful but not another ship in sight. Evidently, we had lost the convoy. We continued on a zigzag course and eventually connected up with them.

A day or two before we sighted Africa we had a submarine attack, and one of the Navy sub chasers went full steam up our left side and cut across in front of us laying depth charges all the way. We never heard any details of what happened. All the way over the sea was a lot smoother than I thought it would be and so full of life. The porpoise were almost continuously jumping right in front of the bow of the ship and in the evening the surface was just florescent from the wings of the flying fish. Some of the guys still did not have their sea legs. A young boy from Boston got sick as soon as he walked up the gangplank and spent most of the trip in sickbay.

The same day that we were to get our first sight of Gibraltar, I was sitting in one of the gun turrets when I noticed a very odd-looking little cloud off to the north of us. I watched it for a while. About the same time that I drew it to the attention of the guys around me, one of the convoy ships in that direction started shooting flares up. As it turned out they were JU-88s and ME-109s and this was to be our first introduction to them. There were so many ships in the convoy I felt they could not miss such a target but with one exception, all they got was a lot of water. The back end of a sub chaser got blown off and with all the depth charges stored right there, it was really a miracle that all the crew got picked up out of the water. Their ship went straight down.

One of the navy gunners started to laugh and motioned for me to take one of his intercom ear sets and listen. Some of our escort ships were British and there was a pretty hot debate going on between them and the American high command as to who would get credit for how many of the planes that were shot down. You would think it was some sort of a game; it was hard to believe. We helped the crew pick up all the spent 20mm shells and then went below to get something to eat and talk about all that we had seen. After that, it seemed so calm. There was a beautiful warm breeze and a smooth placid sea all the way into the Mediterranean. It was just about dusk when we arrived at a place called Bizerte in Tunisia, which, from the ship, looked, like a beautiful little city with white-washed buildings. We were all anxious to get off the ship, but it seemed like hours until we got the order to pack our entire duffle and haul it down about five flights of decks to get out onto a gangplank and into the landing barges. It was soon very apparent why we had to anchor so far out. The harbour was literally full of sunken ships, some completely submerged and others with parts still protruding above water and all mangled.

The sailors had to weave the barges through the tangled mess, but they had done it so many times there was no problem. When we got close enough to see the buildings, I doubt if there was even one that had not been blasted. It would appear that the white wash was about the only thing holding them together. At this point it was simply a military depot with not a single non-military person in sight. After a short wait, a fleet of trucks came to pick us up and take us to the proper staging area.

The trip across the Atlantic was great but it sure seemed good to be back on land again even riding in the back of a GI truck that didn't seem to have any springs. After riding for about an hour and a half the convoy came to a halt and we could hear a lot of loud voices and arguing up ahead. We were all instructed to get out. This was our spot according to our commanding officer; how he could distinguish one sand dune from another I can't imagine. The head officer of the trucking outfit told him this also, I am sure he had made this run many times and knew exactly where we were. Our commander was a stubborn old nut and when the trucks had driven off we were told to grab our duffel bags, rifles and, believe it or not, our heavy wool overcoats. They wanted to confuse the enemy as to where we were going, I guess. Well, we started to march and march, until I thought I could not take another step. Once we got past that point, I couldn't feel my legs moving any more, and then I thought I didn't care if they went all night.

I remember the young fellow ahead of me dropped his rifle and I picked it up then he dropped his duffel bag and I told the follow behind me to pick it up, the same thing with the silly overcoat. Sometime later he came up, reminded me about it, and thanked me. That is when I found out that he had just been released from the hospital after an appendix operation and was assigned to our outfit as a fill-in. We lacked one man and he was it. Some of the guys were cussing the commander and that is as close to mutiny that I ever care to come. The commander had made a big goof and everyone knew it!

Finally, we came to a halt and this was the spot the commander wanted! Whatever brought him to this conclusion was beyond us as it was pitch black and not a landmark of any kind anywhere. Before I let myself down I looked around for something to prop my feet on as they were swollen inside my boots and I felt it would help to get them up on a little old scrub brush that was there. I loosened my backpack so I could pull it up for a pillow and let myself down just the right distance from the bush for my feet. After all this preparation, there was a rock almost the size of my fist under my chest on the right side. I do believe I laid there for over an hour trying to decide if it would be easier to move over a little or put my hand in and pull it out. You know, I don't remember which I did. This taught me a good lesson that a person can take a lot more then he believes he can, and just don't give in when you know you have to go on.

When we woke up the next morning there was beautiful blue sky from one horizon to the other. As I recall we were dealt out K rations which wasn't very thrilling but we were hungry and no one complained. From where we were located, it was only about 100 yards over a big sand dune to the big blue Mediterranean. Once we were given the okay to go for a dip we were down to our shorts by the time we hit the shoreline. I think the Old Man was trying to butter us up after that long hike the night before.

We were there a couple of days waiting for the rest of our equipment to catch up to us. On the morning of the second day, some of the shore ant-aircraft started to shoot up and one of the old timers said, "Well, we will get it tonight." It seems that it was a German reconnaissance plane and the anti-aircraft (A-A) fire was just to keep him up high while taking his pictures. It was a successful run for him as the convoys had been coming in so there were ships as far as we could see. What targets, and sure enough, late in the afternoon they started coming over in waves. Our 50 calibre guns were still packed in cosmolene, so all we could do is watch. My buddy Tom Hill (from Troy NY) and I didn't want to miss anything, so we ran down to the top of the last sand dune and sat down to watch. As the planes got closer, the sky just turned red with all the tracers and A-A going up from the ships and shore batteries. We noticed all the A-A shells were exploding behind the bombers and we were hollering for them to give more lead, like we were at a football game or something. The next day we found out why this happened; the German planes were trailing tin foil that throws our radar-trained guns out behind them somewhere – a pretty trick manoeuvre.

Once we found out about this, our Air Force did the same thing. After they made the first pass, dropping their bombs from fairly high, they kept going inland. All was quiet until suddenly they came back just hedge hopping right over our heads. They were so close we could see the rivets on the bottom of the planes and feel the backwash from the propellers! Once past the last sand dune, they dropped down to just skim the water and go in between the ships, skip bombing to hit them on the water line. In this position our ships could not fire at them very well without shooting towards the other ships. War is a game of tricks and skill. No wonder that harbour was so full of sunken ships. I never did hear the results after that attack, but we saw ships get hit and planes go down. When it was all over, Tommy and I went back to our area only to be challenged by the Captain. After we told him who we were, he asked where or slit trenches were. We were too busy watching everything and hollering directions to think about slit trenches so his order was to dig some trenches fast!

According to training, we take our helmet off and take the liner out which we put back on our heads and start scooping sand out with our helmets. I was in about the fourth scoop when I smelled something terrible. Of course, I had begun to dig right where there had been a latrine. So I moved to another spot and dug my trench. When I got back to my pup tent, I noticed a hole a couple of inches long on one side and later found a pretty good-sized piece of shrapnel in my bunk. I saved it and still have it in one of my boxes of junk.

That was the limit of the excitement at Bizerte, Tunisia because the following morning a fleet of trucks came and after loading all out duffle on, we took off for the city of Tunis.

7169 "Photo-charts and Photo-maps by the 941st Engineer Aviation Topographic Battalion"

This is Ned, he and his wife have been married for 67 years. The helmet he is holding he picked up on the beach at Bizerte - he painted the swastika on top of helmet. He landed in Africa and went up through Italy till end of war. He has made models of all the German and Italian fortifications from pictures.

One aspect of life in 42 Survey Engineer Regiment 1957-1959 - *Part One*

By Colonel D.V. Hutchinson MBE (Retd) (Late RE)

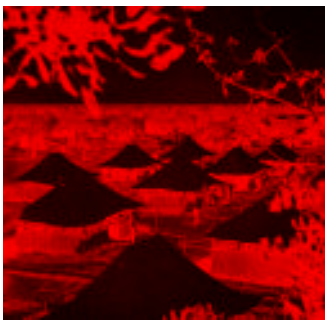
My story starts on New Year's Eve 1957 with me flying out from Stanstead Airport to Cyprus on posting. I thought at the time that only the Army could wrench a man from the bosom of his family on New Year's Eve but having made enquiries about the timing of the posting and having been told that my presence in Cyprus was "urgently required for operational reasons", I philosophically accepted the position and did my duty. I had already let out my home and put my wife and three small children into temporary accommodation in preparation for them to fly out after me in 2 or 3 weeks time when I had found the family a place in which to live at my destination. It was a freezing cold flight for me because the aircraft's heating system was malfunctioning but, having touched down at Malta for a warming breakfast, I arrive at Nicosia at about midday the following day.

I had been posted to 42 Svy Engr Regt and a vehicle from the unit was at Nicosia Airport to collect me. I arrived at the Regiment in the late afternoon on New Year's Day 1957. It appeared that the whole Regiment was then recovering from a massive hangover receive from the previous night's celebrations, and far from me being "urgently required for operational reasons" I was about as welcome as the proverbial "whore at a christening". I took over the appointment of Second in Command of the Regiment and whilst my predecessor had vacated the appointment and returned to the U.K. prior to the recently passed Christmas, there was in my opinion no factor of urgency which required me to fly out at such an inconvenient time. Nevertheless I buckle down to the job finding there was plenty of work to do at first in bringing some degree of comfort and interests to members of the Regiment, particularly those living at the Regiment's location.

The Regiment was located at the small port of Zyyi, which is on the southern coast of Cyprus about 25 miles east of Limassol, just off the main Limassol to Nicosia and Limassol to Famagusta road. The road at that time was a narrow, sinuous alignment and meeting vehicles, except for the very small ones, had to pull off the tar macadam surface onto the gravel berm to avoid each other.

Zyyi at that time was no more than a small group of some twenty houses with a small jetty out to deep water. It was used mainly for the export of the local carob crop but in the years immediately following the Second World War it had been used as a staging point on the route of mass migration of Jews from Europe to Palestine (as it then was). Jews travelling by sea from the southern ports of Europe were temporarily disembarked at Zyyi, medically examine, credentials checked and documented before travelling on to Palestine. For this purpose a number of substantial stone accommodation blocks with tiled roofs and ancillary services had been erected just behind the village in which the migrants were temporarily housed. It was these buildings and infra-structure which formed the core of the regimental lines. However additional blocks were built later to provide technical air survey and drawing offices, workshops for the lithographic printing machines and Messes for the Officers, Warrant Officers and Senior Non-Commissioned Officers.

Zyyi Village.



Carto tent lines

It may be necessary to remind the reader that at this time – the beginning of 1957 – the "Suez Crisis" and debacle had just passed. The Regiment prior to its move to Cyprus had been stationed in the Suez Canal Zone and had been somewhat hastily evacuated just before the "crisis" arose. Therefore when I arrived in the Regiment, although it was fully operational, it was still settling in and trying to make itself comfortable in a very primitive and somewhat isolate location. There were no social or cultural facilities in Zyyi village such as shops, or places of entertainment, or places of interest, the only local facility which attracted the troops was the local stony beach and the sea in which they could swim or on which a few might sail.

But again it may be necessary to remind the readers that in 1957 civil trouble was rife throughout Cyprus. This arose from the Greek element of the population claiming "enosis" (union) with Greece whilst the Turkish element of the population and the British-backed Cyprus Government fiercely resisted the claim. This resulted in the sad fact that troops were not allowed outside their camps or barracks unless they were armed or, if arms could not be carried, such as when swimming, armed guards protected them. The nearest places where the troops could go shopping or find bars or places of entertainment were Limassol (25 miles) or Nicosia (35 miles) away. Even in these heavily populated areas troops had to carry personal arms.

One serious disadvantage in having the Regiment located at Zyyi was the fact that there were no married quarters, or accommodation suitable for use as such, in the locality. Therefore, all married members of the Regiment having their families in Cyprus had to live in the Limassol area in private accommodation, or in a special, protected village constructed by the military authorities about one mile outside Limassol called Berengaria. Even so there was an acute shortage of suitable accommodation for military families in the area. This meant that all married Officers, NCOs and men of the Regiment had to make a round trip each day of about 50 miles between married quarters and the unit. The Officers normally travelled in Land Rivers, or their own private cars, and the other ranks generally travelled in a thirty-two seater bus, unit trucks or again, their own cars. The road from Limassol to Zyyi was, as I have said, narrow, rough and tortuous in alignment, passing through a mixed countryside of rocky outcrops, arable fields, wild sage bush, vineyards, karob and olive groves. It was ideal country in which terrorists could operate with innumerable opportunities for them to ambush vehicles. However, times of travel to and from the Regiment were varied as much as possible compatible with getting the married men on first parade in the morning and returning them home at the end of the day's work.

During the heat of the summer the Regiment worked mornings only but, on the other hand, shift work inclosing night work was often required for operational map production. No travel was allowed for members of the Regiment during the hours of darkness necessitating at times married soldiers staying the night at the Regiment. This also meant that families attending night time regimental functions – wives and children – had to be specially accommodated within the unit. The perimeter of the unit's camp consisted of a barbed wire security fence patrolled by armed sentries day and night, and access to the camp was restricted to pass-holders only. However, despite the vulnerability of the Regiment in its remote location and more particularly of the married personnel and the ration and mail staff who daily had to use the Limassol road, there was no serious attack made by terrorists on the camp or personnel of the Regiment during the whole of the three years I was in Cyprus. There were, unfortunately a number of serious road accidents, but no fatalities, involving members and vehicles of the Regiment but traffic accidents were a prevalent occurrence throughout Cyprus at that time.

During the period that I was with the Regiment, that was January 1957 to December 1959, it operated under the technical control of the Deputy Director of Surveys, GHQ, Middle East Land Forces locate at Episkopi, Cyprus, and was under administrative control of HQ Limassol District located at Polhemedia Camp just outside Limassol. The Regiment consider of four squadrons, namely – HQ Squadron (commonly known as the "Bumff and Bully Boys"), 19 Topographical Squadron, 22 Cartographic Squadron and 32 Lithographic Squadron.

I personally found that the appointment of Second in Command of the Regiment, whilst being a busy and interesting job, was not particularly challenging or demanding because I had a very efficient and active Commanding Officer, Lt Col B St G Irwin. Therefore, having been some twelve months in the job, I let it be known that I would welcome a change of employment to technical work. There was only one other Survey Officer II appointment outside the Regiment in the Middle East and that was in GHQ, so I appreciate that the opportunities to effect a transfer were fairly constrained. However, the fates were on my side, or so I thought, and I was offered the appointment of OC 19 Topographic Squadron. This pleased me very much. I think my greatest achievement whilst at Zyyi was to organise the troops, scrounge the materials and build a large gymnasium cum concert hall. It proved to be a very useful building.

After twelve months in Cyprus I had found that life on the island under the conditions imposed by the terrorist activities was very restricted to the point of being claustrophobic. Cyprus overall is of a size such that from any point on the island one can reach by car and other point and return to one's start point within the day. From Limassol one could get to Famagusta, Nicosia, Kyrenia, Morphou, Paphos, or Troodos and back in the day. It became necessary to force oneself to stay away for the

night or move although in terms of distance from home to stay away was not essential. In view of our relations with the Greeks and the Turks, military personnel stationed in Cyprus were not allowed to visit either Greece or Turkey on holiday. The only nearby countries which we could safely visit were Lebanon and Israel – and in respect of the latter country "safety" was somewhat relative as in those days Jews and Arabs were already at each others' throats. Families therefore took leave in Beirut and Jerusalem as a welcome break from the disturbances in Cyprus.

Cyprus had its compensations however. There were the innumerable sandy beaches on which one could lie and soak up the hot sun or swim in the clear blue sea. There were the Troodos Mountains where in winter skiing was possible and in summer one could walk through the cedar forests inhaling the fresh, pine-scented, air and find in a north-facing gully the remnant drifts of the winter snows. Cyprus is the only place I know or have been stationed, where it is possible pleasantly to play in the snow and swim in the sea on the same afternoon in December. Then there were in my day many extensive, interesting and exciting archaeological sites of Roman and Greek architecture completely open and unguarded – towns, temples, amphitheatres and baths, where one could grovel for the odd denarius or its minute Greek equivalent. So, whilst it was very regrettable that there was the friction between the resident Greeks and Turks, who for centuries did not know they hated each other until told so by the trouble-makers in Greece and Turkey, there was much to enjoy in Cyprus.

My wife and children whom I had left in England at the beginning of 1957, to follow me in a number of weeks by air, were caught up in a change of policy regarding family travel. Instead of travelling by air they had to travel by troopship and instead of arriving in Cyprus some two weeks after me they did not arrive on the island until about 2 months later. For my wife and children having to live out of a suitcase for 3 months instead of 2 weeks and then having to take a long, rough sea voyage in winter instead of 6 hours flight by air sorely tested family concord.

Initially I rented for my family a very nice, new bungalow in the suburbs of Limassol. It was structurally very well finished with modern fittings. It looked very substantial but at the first earthquake it shook like jelly and the dining room table and chairs scuttered across the bare polished wooden floor. Fortunately there was no structural damage. Then a wild "pie-dog" had a litter of pups in the under floor space and so fiercely defended them that she would not let any member of the family into the garden. The council dog-catcher had to come and take bitch and puppies away. The owner of the property, a Greek, lived in a meagre little bungalow on the opposite side of the street from us and helped us through the settling-in problems. We in turn allowed him to graze his cade lamb in our garden. The children grew very attaché to the animal and it used to follow them about. Imagine our horror when without warning at Easter he publicly slaughtered the beast in his front garden as part of the Greek Orthodox Pasehal ceremony. Nevertheless I was please that the owner lived as near to us as he did because I thought he would probably receive early warning of terrorist action which might involve his new bungalow and my family and which would probably harm his family also, and that he would warn me of impending damage.

After about six months in Limassol my family qualified for an army quarter in the military village, Berengaria. The quarters were simple, straight blocks constructed of frame corrugated asbestos panelled walls and roofs; they looked like and were called the "railway sidings" because of their train-like appearance. Whilst they were not as splendid as our bungalow in Limassol they were quite adequate as temporary accommodation and the security of the village which was fenced and guarded, outweighed the disadvantages. Within the village were shops, churches, clubs, a cinema and sports facilities. There was also an army school but it was so overcrowded that the infants had to hold their classes in the playground. There was a small NAAFI shop in the village adequate to meet the day to day needs of the families but there was a much larger NAAFI store and clubs at Episkopi some 20 miles away.

19 Topographic Squadron was, at the time I was posted to it, on detached operations in Iraq. I had visited the squadron previously on two or three occasions on "administrative inspections" and I was greatly attracted to the freedom of being on remote detachment and to the field work and to the country itself. Travel between the Regiment and the Squadron was always by air with a one-night stopover in Beirut. Heavy and bulky equipment and vehicles were sent to the unit by sea to Basra on the Persian Gulf and thence by rail or road to the squadron headquarters at Habbaniya, which is about 30 miles to the west of Baghdad.

I think I should say here a few words about Iraq in general, and Habbaniya in particular, to lead to a better understanding of the troubles which beset this part of the world and specifically Iraq in 1958 and which are revisiting the area at the present time (1990/91) if in reality they ever went away.

During the Mesopotamian Campaign of World War I the whole of this part of the Middle East had been in turmoil with national and tribal loyalties set one against the other. The triumphant supervisory powers, the British and French Governments, decide to reconstitute the international structure of Mesopotamia and the adjoining countries in order to bring stability to the area. They redefine the eastern boundary of Turkey and established as new independent states the Republic of Syria, the Hashemite Kingdom of Jordan and the Kingdom of Iraq. The first appointed kings of Iraq and Jordan were the sons of Sheriff Hussein of Mecca, members of the Hashemite family claiming descent from the Prophet Mohammed. The Sheriff's Arab Army had fought with Lawrence of Arabia against the Turks. The allies reaffirmed Palestine as a separate state and brought recognition to several strong and independent emirates along the western coast of the Persian Gulf including Kuwait.

To assist them in unravelling the mammoth problem that the post-war situation presented, the British and French Governments called upon the services and advice of the most remarkable woman of the era. She was Miss Gertrude bell a supreme traveller, historian, archaeologist, linguist, ethnologist and diplomat. She was born in 1868 of wealthy and indulgent parents and through her family connections all of the British Embassies and many foreign embassies in the countries she visited were opened up to her. She first went to the Middle East (Persia) in 1892 and apart from two global tours and the odd excursion through Europe she spent the rest of life in one Middle East country or another until her death in Baghdad in 1926. At the height of her career she was acknowledge to be the most powerful woman in the Middle East. She travelled widely by plane and spoke all the major languages and principal dialects current at the time in the Middle East. She understood the Arabs, their inter-tribal relationships and customs, and was indifferent to danger. She championed the cause for the sons of Sheriff Hussein of Mecca to be enthrones as kings in the newly formed Kingdoms of Iraq and Jordan, and when King Feisal I and King Hussein I were crowned as Kings in these respective countries she earned the soubriquet of "Kingmaker". In 1915 she had joined the Arab Bureau in Cairo, a British Intelligence organisation set up as a contemporaneous "think-tank" to clarify British policy objectives in the Middle East. She became a close friend and confidant of King Feisal and spent the last three years of her life in Baghdad as Iraq's Director of Antiquities. She had spent the previous four years as Oriental Secretary to the British High Commission. And so Iraq was born as an independent kingdom – King Feisal I was crowned in 1921 and the state was internationally recognised in 1922.

Whilst the advice to the supervisory powers had been given by the experts with the best of intentions, subsequent events have shown that the decisions taken by them did not have sufficient regard to the topography, or to tribal boundaries, or to the fundamental wealth-creating resources of the newly formed states. The intense patriotism and religious sectarian fervour of the inhabitants of the former tribal areas then being carve up was seriously underestimated.

A cursory glance at a map of the area will reveal how the new international boundaries often run as straight as compass bearings across country arbitrarily cutting, and with little regard to, topographic features or ethnic considerations. The headwaters of the Euphrates and Tigris, the lifeblood of Iraq are in Turkey and the Euphrates flows for a considerable distance through Syria both of which countries have envious eyes on the water available to them to irrigate their waterless wastelands. Kurdistan a former nation of considerable importance, extent and influence is now split between Turkey, the USSR, Iran and Iraq. The Iraqi Kurds occupy the northern, mainly mountainous region of the country which also includes parts of the valuable Kirkuk/Mosul oilfields. These Kurds are seriously disaffected towards the government in Baghdad who are historically, culturally and in matters of sectarian Mohammedism their lifelong enemies. Iraq has no seaport; Basra (Al Basrah) the country's only port, apart from the oil pipeline terminals, is a river port some 50 miles from the open sea up the Shatt-al-Arab. Kuwait, lying between the main part of Iraq and the Persian Gulf, excludes Iraq from the coastline and this has been a major irritant to Iraq since it has burgeoned as a potentially wealthy nation base on its landlocked oil resources.

Kuwait has always been a rich and powerful emirate and at the time of the 1922 treaty it was fairly easily identifiable as such, and thereby retained its independence which became absolute in 1922. Many similar strong maritime emirates on the western side of the Persian Gulf retained their independence as Trucial States such as Bahrein, Qatar, Abu Dhabi, Dubai, Sharjah and Oman. A number of them have however now coalesced into the United Arab Emirates, recognising, as part of

their evolution to full democratic nationhood, the need for close co-operation and amalgamation in order fully to exploit their resources, and for security reasons. Kuwait on the other hand has remained a lone emirate. Therefore until some of the problems previously describe, which seriously inhibit Iraq's free and natural growth to full nationhood, can be resolve there will be continuous unrest within Iraq itself and between Iraq and its neighbours. These are not problems which can be solve by Iraq alone but will require external international assistance and debate.

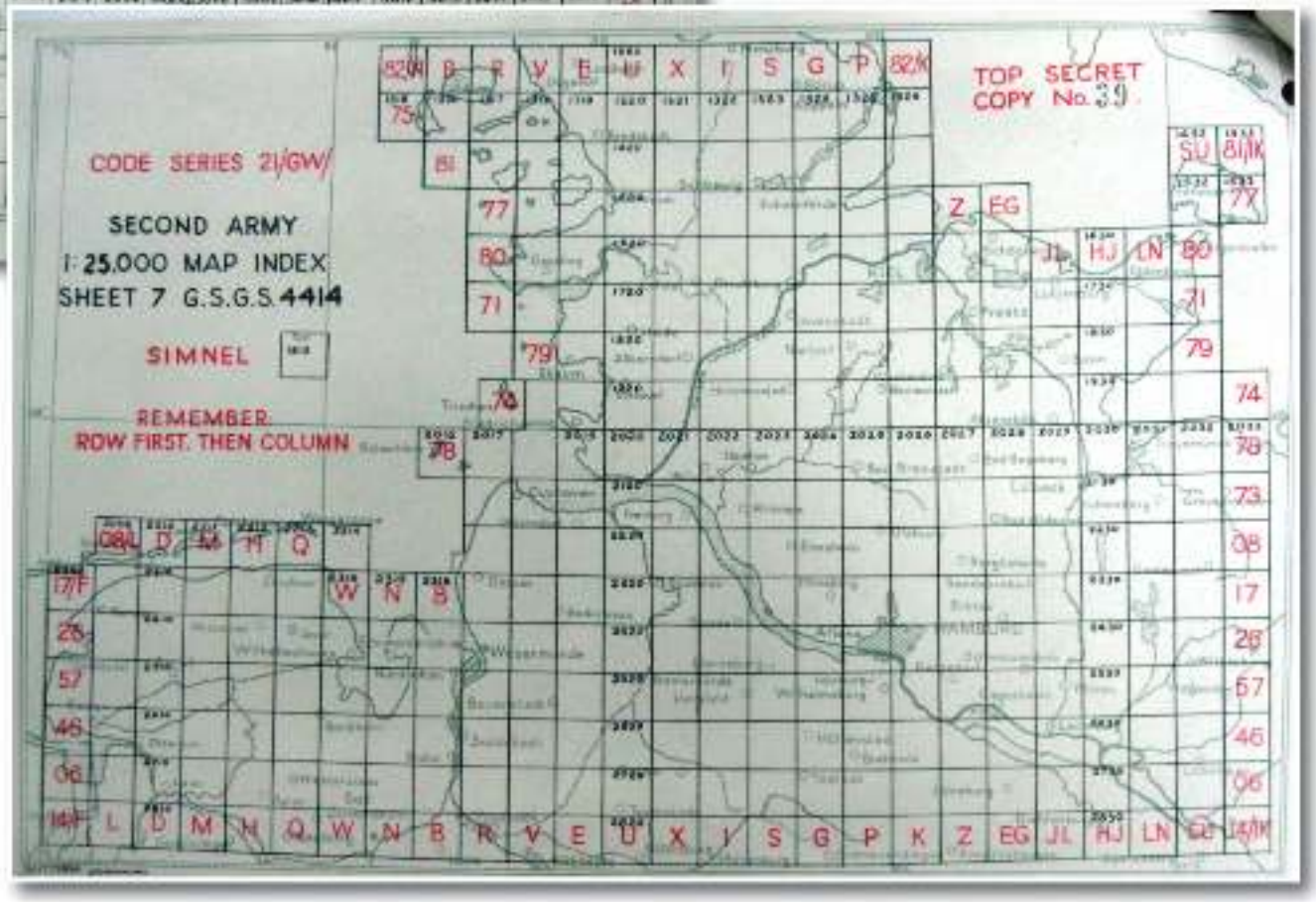
Now to turn to Habbaniya. It is a man-made "oasis" lying in the desert about 30 miles west of Baghdad, just off the Baghdad to Amman (Jordan) highway and just west of the Euphrates River. It has always been in its entirety a military air force station; the "oasis" being formed to support the military installation. It was first established as a military airfield during the Mesopotamian Campaign of World War 1, and grew rapidly and extensively between the two World Wars. Once in 1942 Habbaniya was besiege by Iraqi forces under instructions from the pro-German Iraqi Prime Minister Raschid Ali. It was relieve by a motorise column "Habforce" sent from Palestine. After World War 2 the Royal Air Force by agreement with the Iraqi Government remained in occupation of Habbaniya and the whole facility was use until 1958 mainly in the training of the Iraqi Air Force in flying, aircraft maintenance and air traffic control, and also as an alternative staging post to Bahrein for global military air traffic.

Entrance to HQ RAF Habbaniy.

The military installation consisted of a fully paved airfield, control tower, land aircraft servicing and maintenance hangars, together with associated barrack accommodation, married families' quarters and military offices, and all the normal support infra-structure such as messes, clubs, churches, a cinema/theatre and all forms of recreational and sporting facilities. The whole cantonment was self sufficient and could function independent of local civil undertakings such as electricity and water supply and sewage disposal. The military facilities were stylishly grouped throughout a luxuriant date-palm "oasis" of about 2 miles by 2 miles in extent adjoining the airfield. This "oasis" had been very cleverly designed and carefully laid out to enable the whole complex to be irrigate by shallow inundation every 2 or 3 weeks from gravity flow open ditches fed with water pumped from the Euphrates. This enabled the whole of the vegetation, sports fields and lawns to be kept in a very verdant condition even in high summer. The intensive irrigation brought in its wake two problems, namely, mosquitos and very high atmospheric humidity. The former was kept under control by the weekly spraying of all open spaces and buildings within the "oasis" with insecticide and the latter problem with the lavish provision of air-conditioners and fans in all buildings. Part of the "oasis" was occupied by Iraqi civilians, a practice which had originated from the days of the Iraq Levies, a quasi-military force which operated between the wars in support of the RAF in Iraq. These civilians had a semi-privileged status and were allowed to share in and benefit from the common-used facilities and services. Some of them ran shops, hairdressing salons, the local post and telegraph office, local taxi services and other non-military services and they remained loyal and loving towards the British at all times.

Despite its isolated location and harsh surroundings Habbaniya was in many ways an idyllic "oasis" with its own leisurely pace of life away from the hubbub, the haste and the heat of the rest of Iraq. Nevertheless, in preparation for the day when the Iraqis would no longer require the services of the RAF, the British Government had on two occasions prior to 1958 started to hand over Habbaniya in its entirety to the Iraqis. The latter, unfortunately for technical and financial reasons, mainly the lack of both, had been unable to maintain the operational and administrative skills necessary to keep the station in good order and so the British had had to take back again the running of the station. That was the situation when I arrived in Habbaniya in 1958.

To be continued



Maps extracted from article "a piece of cake".

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