



The Ranger 2025

Journal of the Defence Surveyors' Association



Limited Edition DSA Members

Registered Charity No: 221816

December 2025

Defence Surveyors' Association

In 1927, a group of officers who had contributed to the tremendous 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 comrade's 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. In 1997, the Field Surveyors Association was renamed the Defence Surveyors' Association, more appropriately to reflect the multi-disciplined changing nature of Geographic Intelligence support to the three Services.

The DSA aims to promote an understanding and appreciation of defence surveying, mapping, charting, and geospatial intelligence in historical, current, and future contexts and keep past and current community members in touch. Members come from the defence, industry, academia, and private sectors.

The Council of the Defence Surveyors' Association
extends their good wishes to all members, present
and past, for 2026 and onwards.



The Council	2025-2026
Chairman	Christopher Nash
Secretary	Carl Calvert
Treasurer	Chris Barrington-Brown
Membership	John Banfield
Member	James Prain
Member	Merryn Walters

The Ranger 2025 Contents

Article	Page
Editorial	2
From the Chairman	3
Exercise Benchmark Owl	4
Worshipful Company of Scientific Instrument Makers	6
DSA Spring Event	10
The New Forest in World War 2	15
German 1:25K Mapping	25
Gun End of a Baseline	33
The 2025 SDR and Geospatial Intelligence?	37
Israel Has Created a New Standard for Urban Warfare"	44
Changes to Geospatial Training	46
Defence Innovation and Staying Ahead of the Game	51
The geographical section of the CEF in Italy	57
Some Memoirs of a Deep-Sea Navigator	69
DSA September Seminar – Operation Granby	74
The Congo Border	79
Ray Bennett - Farewell	Inside Back Cover

Editorial

Once again, Ranger has a collection of subjects covering the past, present, and future. While most members began their careers in the analogue era or at the beginning of the shift to the digital era, the military today focuses on and has the capabilities to embrace emerging technology. This year, the government unveiled the Strategic Defence Review 2025, and within it, though not explicitly stated, lies the crucial role of geospatial intelligence (GEOINT) in shaping future warfare and defence strategies. GEOINT is poised to significantly improve situational awareness, targeting, logistics, and navigation. As battlefields become increasingly complex and reliant on advanced technology, the capability to gather, analyse, and act on detailed spatial information provides military forces with a vital operational advantage. The primary articles focus on the perceived significance of GEOINT, paired with insights into the reorganisation of GEOINT training.

Innovations in AI, unmanned aerial and ground vehicles, and robotics are set to reshape the battlefield. To adapt to these changes, effective collaboration between the military and industry is essential. Emerging regional clusters are playing a key role in fostering this collaboration, and the article “Defence Innovation and Staying Ahead of the Game” explores the latest developments in this area.

Reflecting on history, we delve into the role of the French Geographic Service in Italy during World War II, following an earlier article that examined the organisation in France in the 2024 edition. Building on discussions from the April DSA Seminar, additional pieces include “The New Forest in World War II” and a look at the German 1:25,000 maps. While the DSA September Seminar focused on Operation Granby, only a brief review is included, as several articles on Granby have previously appeared in previous Ranger editions.

In the context of Military Survey history, boundary commissions have played a pivotal role. An article focusing on the Democratic Republic of the Congo-Zambia boundary highlights the history of this border, citing the Anglo-Belgian Survey from 1911 to 1914 and the involvement of various military surveyors.

The 135 Geographic Squadron has undertaken practical work that serves national interests; details are in an article from 135 Squadron. Additionally, due to its long-standing relationship with The Worshipful Company of Instrument Makers, an article that loosely links the company to the Squadron's endeavours is included.

Exploring the challenges of navigating the deep sea, the article “Deep Sea Navigator” offers insights into this demanding task. Meanwhile, the broader digital realm is evolving rapidly, showcasing advancements beyond the Geographic domain.

Looking to the future and the probable closure of the DSA in 2027 (The Centenary), the Council proposes producing two more Ranger journals, with articles from the past highlighting significant events. Nevertheless, articles from contributors covering subjects from the past, present and future will be welcomed.

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



From the Chairman

The past year has been busy for the Council. Two very successful seminars have taken place, and planning is already underway for 2026. A potential theme for a future seminar could be "Yesterday, Today, and Tomorrow," which begins at the transition into the digital era rather than exploring the distant past.

We are currently in a digital age defined by spatial intelligence, and the future promises even more advancements in space technology. For our major mid-year seminar, the Council aims to attract a diverse group of participants, including current military personnel specialising in geospatial intelligence, to hear from speakers from both industry and academia.

In contrast to past events, we are considering shifting away from visits to places of interest with a couple of speakers. Instead, for 2026, we are exploring the possibility of hosting an afternoon tea event. Our outline plan includes inviting a speaker to set a pleasant tone for the occasion, followed by an enjoyable tea experience. To conclude the event, we will have a final speaker. This change emphasises socialising over simply disseminating information, reflecting suggestions from some Council members. It is still early in the planning process, and as always, we welcome suggestions from everyone.

As we approach the centenary, members need to be able to comment on and shape the DSA's future. Over the past two years, the Council has maintained a steady course while examining various options. Broadly speaking, we are investigating establishing a trust to support the DSA's primary aims. This trust will need to be administered, and currently, the Royal Engineers Association, which administers several trusts, is the frontrunner for this role.

Furthermore, we need to address the materials published on the DSA's website and elsewhere. Most of this content is not primary or secondary sources, but it should still be of interest and value to future researchers of the Military Surveyors' history. Therefore, we are looking to create a digital library archive. While this archive would be distributed widely, there needs to be a "master" copy. We are actively pursuing the structure and administration of this digital library and invite members to contribute materials of interest. However, the DSA will not retain ownership of the source materials and will return them with a digital copy. Several challenges remain, including how to promote the digital library to a wider audience and who will be responsible for the "master" copy.

The DSA's proposed trust and the digital library highlight our commitment to "heritage." Over the years, we have had preliminary discussions with Geo at Wyton, but to date, nothing concrete has emerged. There is still time to plot a new course, but the initiative should come from the serving Geo community.

On the assumption that you received your copy of Ranger before Christmas, on behalf of the DSA Council, I wish you a very happy Christmas and best wishes for the future.

Christopher Nash

EXERCISE BENCHMARK OWL



On Saturday, 15 March 2025, 135 Geographic Squadron established the first Ordnance Survey Benchmark since 1999 to mark its 70th anniversary at the Ewell Army Reserve Centre, highlighting its historic links to Ordnance Survey and its community connections. While Benchmarks are a common feature on buildings and other permanent structures across the British Isles, with an estimated 500,000 still thought to exist, only the 190 Fundamental Benchmarks have been maintained. The last Benchmark to be established was a survey bolt in Plymouth harbour in 1999.

With Ordnance Survey providing a brass 'Flush Bracket' Benchmark, the squadron conducted a levelling exercise in January using other Benchmarks in the local area to establish the height of the new Benchmark. This task was overseen by a squadron member who is a former RE Geo Surveyor and is employed as an Ordnance Survey surveyor. For comparison, the Benchmark height was also established using GNSS, utilising the current Ordnance Survey parameters. The Benchmark information has now been added to the Ordnance Survey "MasterMap" database.



Mercator House Benchmark

The CEO of Ordnance Survey, Nick Bolton, unveiled the Mercator House Benchmark, Nick Bolton at a ceremony attended by the Mayor of Epsom and Ewell (Councillor Steve Bridger), the Master of the Worshipful Company of Chartered Surveyors (Mr David Reynolds), the Commander Royal Engineers Geographic and the Commanding Officer of 42 Engineer Regiment (Geographic) with members of the squadron on parade.

The Corps of Royal Engineers has a long history with the Ordnance Survey, dating back to 1791 and

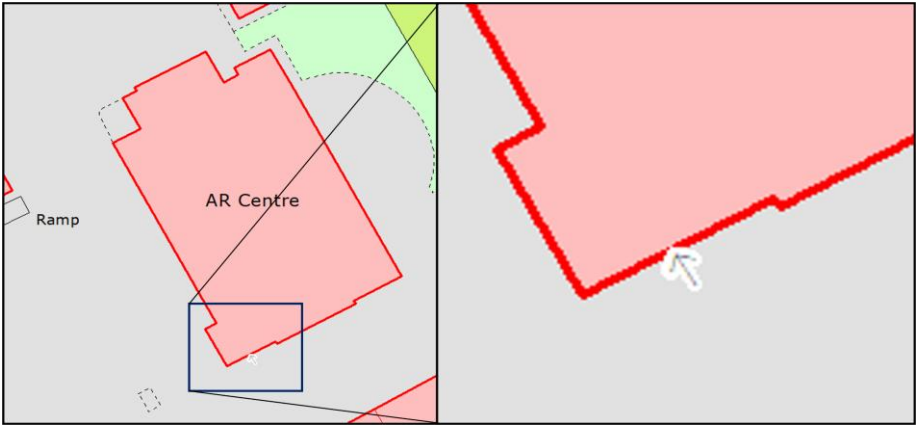
continuing through the appointment of the first civilian Director General of the Ordnance Survey, Walter P. Smith MBE, in 1977. The squadron also has specific connections to the Ordnance Survey. Walter P. Smith was a former Commanding Officer of the 135 Survey Engineer Regiment between 1957 and 1960. Colonel Vanessa Lawrence CB is also a former Director General and CEO of Ordnance Survey (2000-2014). Furthermore, with the establishment of the 135 Survey Engineer Regiment (Territorial Army) in 1948, two of the Regiment's three squadrons were initially recruited from Ordnance Survey cartographers (338 Squadron, Southampton) and surveyors (337 Squadron, Chessington). The Regiment moved to the Ewell Army Reserve Centre in 1955 and was later reduced to squadron size in 1967.

Benchmark Detail

Levelled Height 36.476	GPS height 36.372
Datum: N	Order 3
Type of BM: FL BR	Description: FL BR BLDG MERCATOR HO 3.7M NE ANG SSE FACE
Height above ground 0.408	Levelling date 18 Jan 2025



135 Squadron Benchmark Unveiling



Mercator House Master Map

THE WORSHIPFUL COMPANY OF SCIENTIFIC INSTRUMENT MAKERS

By Tony Keely



The Arms of the WCSIM Sir Isaac Newton and Michael Faraday

The 'Worshipful Company of Scientific Instrument Makers', you may ask? As usual, like everything I've been involved in, I stumbled upon it by accident. In 2001, after retiring from the Army, I became the Training Adjutant at the Royal School of Military Survey, Hermitage, an RO post. I knew Hermitage well, having completed the Army Survey Course there in 1977/78 and subsequently returning as a Major to run the Cartography and Aerial Survey (Photogrammetry) department. Well, one of the duties (perks) of the post was to attend the annual awards dinner at the Worshipful Company of Scientific Instrument Makers (WCSIM) at Glaziers Hall in London.

This history dates to the 1995 affiliation between the WCSIM and the Corps of Royal Engineers. The Corps then delegated this affiliation to the Royal School of Military Survey (RSMS); consequently, each year, an award was made by the WCSIM to RSMS for the top officer on the Army Survey Course (now with MSc accreditation) and the top soldier on the Class 1 (Geo Military Engineer) Hence the dinner came as a job lot: Chief Instructor, Training Adjutant and the two prize winners, in the good old days travelling to London by staff car. So, for about 14 years, I had a free supper! Then, in 2015, it was intimated to me that perhaps I should become a Liveryman, and I was 'Clothed in the Livery' at a ceremony in October of that year. However, for one reason or another, I did not take the oath as a Freeman of the City of London until 2024, as prostate issues, Covid, etc., intervened.



The Clerk and Myself at the Freedom Ceremony

The Freedom Ceremony at the Guild Hall was quite impressive. I was expecting it to be a quick oath and signature, but we had a half-hour slot that included a history of the event—I can now drive my sheep over London Bridge! The ceremony was conducted by the Clerk, assisted by the Beadle—important bods get the Chamberlain! I also drove ‘my sheep’ over Southwark Bridge in September 2025 – well, along with a dozen other Liverymen, a Sheriff and five sheep. My drive was North to South at 1128 hrs – the poor sheep going backwards and forwards on the bridge all day! Other quirks of being a Freeman involve electing the Lord Mayor (Lady Mayor this year), the Sheriffs and the ‘Ale Conners at the Guildhall. The Common Hall is packed with upwards of a thousand Liverymen, and we all put up our hands to signify we agree with the nomination!

Now, a little about the Company: it was initially formed in 1956 but not granted Livery Status until 1963, making it one of the Modern Livery Companies, with an order of precedence of Number 84. Its rationale is the same as that of the original livery companies/guilds, i.e., the furtherance of the science and industry of scientific instrument making (not many fishmongers in the ‘Fishmongers’!). Early on, that interest included extensive involvement in electrical and mechanical instrumentation, but it increasingly shifted toward physics and medical topics. Almost all current liverymen are involved in this sphere. We share a hall with the Glaziers and Launderers. Unusually for a livery company, the hall is on the south side of the river and, along with the Gunmakers, the only two Livery Companies outside the City of London – though we do have a superb view of the Thames! Typically, the company has a strong charitable ethos, giving grants to its apprentices, who are now undergraduates. I’m now an ‘Apprentice Master’ and am currently mentoring one apprentice, having mentored one previously until she was admitted as a Freeman. (Apprentices are usually 6th formers or just starting university.

The programme for the year includes two dinners, a banquet, the Lord Mayor’s Show and various other activities. One year, I represented the Master at a STEM (Science, Technology, Engineering and Maths) event at Sandhurst! Also, the Master organises a weekend of social activities, depending on the venues’ affluence, from the Calgary Stampede in Canada to Spain, and Oxford and Usk in Wales, the latter of which was visited in 2023. The event in Usk, which lasted over three days, seemed to involve travelling from one meal to another by coach, accompanied by copious quantities of wine.

In June 2023, the Banquet was held at the HAC (What's this Sappers consorting with Gunners!). It was a magnificent spectacle in the middle of London, complete with its own cricket pitch. This is always a white-tie event. On one occasion, I was leaving a banquet and couldn't get a taxi, so I did feel a little 'visible' on the tube—lots of curious looks!



Angela and I at the Banquet



The Master and Warden, with the ceremonial escort of the HAC



Myself, Prize Winner, Master, Senior Instructor

At the awards dinner, I now have the duty of hosting the military prize winners from Hermitage. On October 23, the Soldier candidate was unable to attend, and a Senior Instructor represented the Chief Instructor.

This year's fun event on 8 November was the Lady Mayor's show (the 3rd Lady to be mayor out of some 640 Mayors, but the

first to use the term 'Lady

Mayor'). Various other scientific organisations also joined us. It was quite an event, a long day from forming up at 0930 hrs and not falling out till 1530 hrs (to walk the course usually would be a little more than an hour and a half – but we are all used to 'Hurry up and wait')

Being a Liveryman is enjoyable, with the added benefit of supporting charity. However, COVID-19 had one positive outcome—the passing of the communal 'Loving Cup' at dinners, with its distasteful content, has been kicked into touch!



The Lady Mayors Parade

DSA Spring Event 2025

By James Prain

On Tuesday, 8th April 2025, the DSA held its Spring Seminar at the Rifles Berkshire and Wiltshire Museum in the Cathedral Close, Salisbury. The venue is colloquially known as The Wardrobe, a name that reflects where the choir members would dress before processing into the Cathedral.

Although the DSA could use the main room, the rest of the Museum was closed during major refurbishment.

The DSA has previously used the Wardrobe for its AGM on 30th October 2010. On this occasion, the President, Maj Gen Patrick Fagan, awarded prizes to Anthony Borkowski (Boris) (The Royal School of Military Survey), Sgt Simon Thayer (RAF Air Cartography), Sue Ilsley (Defence Geographic Centre) and Paul Marks (The United Kingdom Hydrographic Office) (see p4. *The Ranger Summer 2011 Vol 3 Number 2*).

The event involved approximately 40 people, including DSA Members, partners, guests, and friends from affiliated organisations. Having primed ourselves with tea and coffee, our Chairman, Christopher Nash, formally opened the seminar.



Our first speaker was Mark Heighway, a businessman living in the New Forest, who has been fascinated by the events of World War II and the artefacts that remain. Amongst the highlights are the craters at Ashley Walk (near Fordingbridge and Godshill) that were the result of testing Barnes Wallis' Grand Slam bunker-busting bomb. Then there was the pillbox built inside a picturesque, thatched

summer house in Beaulieu village, constructed as part of a plan to turn this location into an anti-tank island. Moving east, at the Beaulieu Road railway station, there was a site to construct landing craft that had been delivered as 'flat-packs'. Then, on the edge of Southampton Water, just north of Hythe, are spare 'Beetles'. These were the floats for the

causeway used in the Mulberry Harbour linking the pier head, 'Spuds', to the shore and enabling the causeway sections, 'Whales', to flex with the tide. Mark's enthusiasm shone through, and we were treated to a marvellous tour of the New Forest, which should have stimulated future visits by members of the audience.

Our second speaker was Merryn Walter, a writer with a keen interest in military history, particularly German mapping of WW2. She gave a nuanced critique of the German mapping organisation, in particular the significant contribution made by Lieutenant General Gerlach Hemmerich, Director of War Mapping and Surveys. The expertise and professionalism of those involved in surveying and mapping were overshadowed by bureaucracy, organisational infighting, and rivalry. With her lively style, Merryn kept us entertained, a topic many outside our community would have found rather



esoteric. It was impressive when she rattled off the names of the various German organisations and institutions – a long string of German nouns such as:

Abteilung für Kriegskarten und Vermessungswesen.

Then, over the excellent buffet lunch, the Museum's map curator, Martin (Mac) McIntyre, showed us a selection of maps from the archive. Photo mosaics of 'Long Kesh', the internment prison in Northern Ireland, are not standard fare for us but reflect the geospatial items soldiers on the ground had to use.

After we had devoured the buffet, studied the maps and exchanged anecdotes with old friends and colleagues, our guest, Philip Whitmore, took some of us on a conducted tour of the Cathedral. Philip is an official guide and was delighted to give us an exclusive tour. He had a career in the military and has a passion for maps, so he was pleased to support our event.



1The Rifles Berkshire and Wiltshire Museum

The New Forest in World War 2



At the DSA Seminar in Salisbury in April 2025, Marc Heighway gave a presentation on the New Forest during World War II. **Hidden in Plain Sight: Reminders of WW2 in the New Forest.** This article is a summary of the presentation by a member of the DSA audience.

Introduction

During the Second World War, the New Forest area experienced significant activity and played a crucial role in military operations. It served as an essential hub for military infrastructure and training, particularly in preparation for the D-Day landings. The New Forest was home to various airfields, training areas, D-Day camps, an embarkation point, a secret spy school, and a POW camp. Additionally, it was the site where the largest bomb ever dropped on UK soil was detonated.

Wartime demands significantly altered the landscape, particularly through extensive cutting of mature conifers for timber. Many local buildings, including manor houses and hotels, were requisitioned to serve as military headquarters, field hospitals, and training centres. The New Forest transformed into a sprawling encampment where Allied troops awaited deployment to Europe.

Today, modern research has identified numerous World War II sites within the New Forest. The landscape still bears visible scars from that time, with preserved bunkers and memorials honouring the sacrifices and operations that contributed to its wartime significance. The New Forest stands as a living memorial, with many sites open to visitors eager to explore its rich and impactful World War II history.

Airfields

Within the forest, twelve airfields were constructed, including essential sites such as Beaulieu, Stoney Cross, and Holmsley South. These airfields supported both the Royal Air Force and the United States Air Force, launching heavy bombers and fighter-bombers on missions across Europe and serving as staging areas for the Normandy invasion.

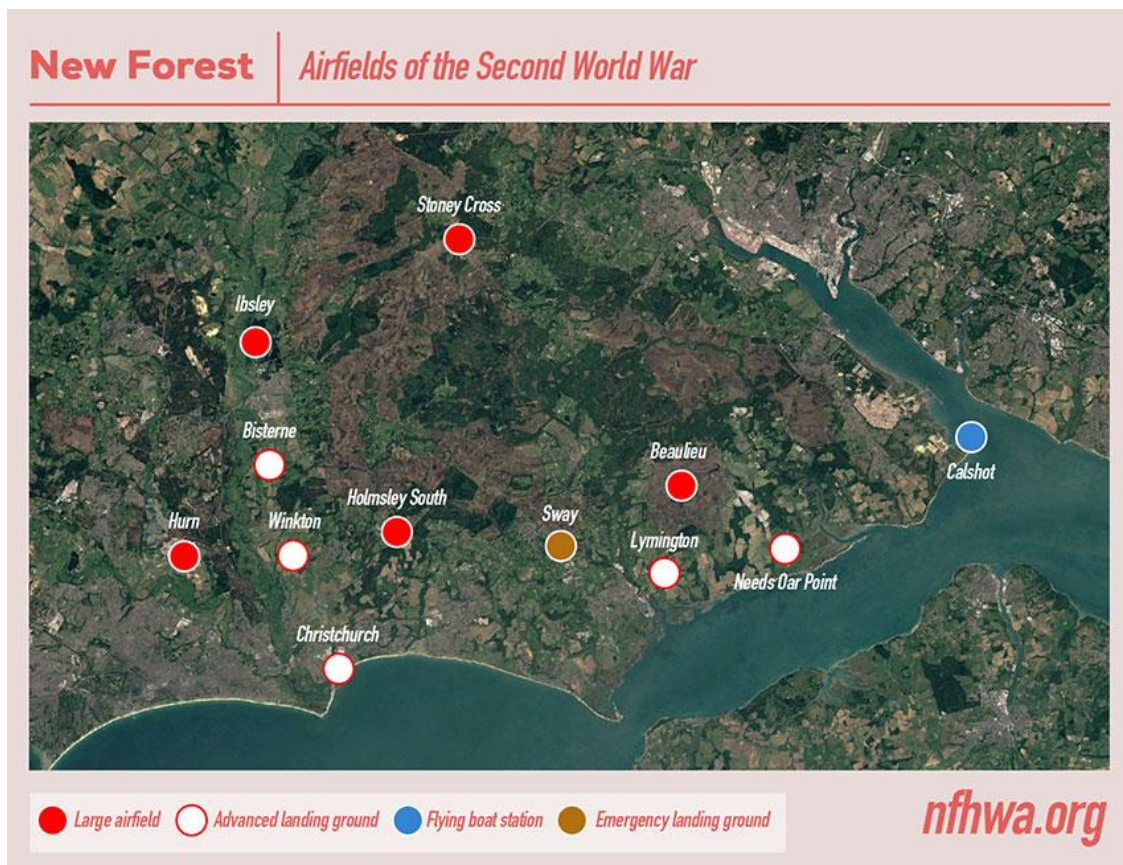
Additionally, the Ashley Walk Bombing Range, encompassing around 5,000 acres, became a testing ground for experimental weapons, most notably the "bouncing bomb." Today, remnants of this extensive wartime activity can still be observed, featuring chalk targets and bomb craters scattered throughout the landscape. Continuing archaeological surveys reveal bunkers, air raid shelters, and other historical remnants scattered throughout the forest.



RAF Ibsley WW2 is now derelict

The major airfields in the New Forest used during World War II were a combination of permanent and temporary sites built for operations, training, and support for D-Day. These airfields were vital for both RAF and USAAF units, with several directly involved in fighter, bomber, and transport missions over occupied Europe.

These airfields collectively provided crucial infrastructure for the Allied air campaign, support for D-Day, and operations across Europe. Remnants and memorials at these sites are still visible today across the New Forest.



Major Airfields in the New Forest (WWII)

Airfield	Notes and Usage
RAF Beaulieu	Opened 1942; used by RAF & USAAF. Fighters & bombers flew missions for D-Day and the Normandy invasion.
RAF Stoney Cross	Opened 1942; key bomber and fighter base for RAF & USAAF; extensive runways; major operations.
RAF Holmsley South	Major bomber airfield; strategic D-Day roles; postwar temporary housing for locals
RAF Ibsley	Fighter base; Spitfire operations; advanced radar (Huff Duff) installation for bombing-raid detection.
RAF Lymington	Temporary advanced landing ground for D-Day; mostly USAAF fighters
RAF Needs Oar Point	Temporary D-Day advanced landing site for fighters and troop carriers
RAF Bisterne	Temporary USAAF fighter strip for D-Day
RAF Winkton	Temporary USAAF fighter field; D-Day operations
RAF Calshot / RNAS Calshot	Flying boat/seaplane and maintenance base; significant role in maritime patrol & repair.
Sway Emergency Landing	Grass strip, used for emergency landings and as a decoy against the Luftwaffe
RAF Hurn	Just outside New Forest, a key bomber/fighter base, now Bournemouth Airport
RAF Christchurch	Outside the modern park boundary, operationally integrated with the New Forest mission.

Preparation for D-Day

Extensive D-Day preparations were staged across the New Forest, transforming it into a secretive marshalling area for thousands of Allied troops, vehicles, and equipment.

The dense tree cover of the New Forest provided an ideal setting for temporarily hiding thousands of Allied troops, vehicles, and equipment stationed in anticipation of the D-Day assault. The Special Operations Executive (SOE) utilised this strategic landscape to train

covert agents for their dangerous missions behind enemy lines. Exbury House, which was later renamed HMS Mastodon, operated as a secret Royal Navy base, organising landing craft and troops for the D-Day landings in Normandy.

The forest's proximity to major ports was essential for the logistics of the invasion and the defence of the southern coast. Beaches like Lepe emerged as vital embarkation points during D-Day, equipped with the necessary infrastructure to launch invasion forces and produce military hardware.

Key Locations and Military Activities

Woodland Camps

Troops and vehicles were hidden under the forest canopy spread throughout Brockenhurst, Stubbs Wood (Beaulieu), East Boldre, Setley Common, and Cadland Estate (Fawley). These camps were designed for concealment from enemy reconnaissance and housed men and materiel in the days leading up to D-Day.

Road Infrastructure

Roads and bridges were widened and reinforced to withstand heavy military traffic, ensuring quick, efficient movement to the marshalling and embarkation points.

Airfields

Sites such as Stoney Cross, Beaulieu, and Holmsley South provided logistical support, troop transport, and fighter cover, with aircraft taking off the night before D-Day to support the airborne landings.

Training and Rehearsals

Soldiers practised amphibious landings, obstacle demolition, and beach defence under realistic combat conditions; engineers and assault teams refined their techniques for the Normandy invasion.

Lepe Beach and Foreshore

Lepe became an embarkation point, with temporary piers, slipways, and large concrete platforms constructed for the famous Mulberry Harbour units, vital for the Normandy landings. Army huts, barracks, and anti-aircraft positions lined the cliffs and shoreline, with HMS Mastodon (formerly Exbury House) serving as the coordinated command centre for naval operations.

Key Camps and Their Units

Cadland Estate (Fawley) – Camps B1 and B2: These adjoining camps held 3,328 men and 430 vehicles, likely from divisions designated for landings at Gold Beach. They formed part of Marshalling Area B, which covered much of the New Forest.

Penerley/Little Honeyhill: Camps B3 and B4 at Penerley (now identified with Little Honeyhill) housed an additional 3,328 troops and 480 vehicles, comprising a significant portion of the forces mustering for Normandy.

Brockenhurst: The Balmer Lawn Hotel in Brockenhurst served as the headquarters for Marshalling Area B, hosting command and planning for the British 50th Infantry Division, which landed on Gold Beach on D-Day. Brockenhurst and the surrounding areas also supported Commonwealth and Canadian units, commemorated at memorials like Bolderwood.

Stubbs Wood (Beaulieu), East Boldre, Setley Common: Large camp clusters for British and Commonwealth troops, positioned close to embarkation points at Lepe, Exbury (HMS Mastodon), Stanswood Bay, and along the Beaulieu River and coast. Embarkation Points and Division Links

Troops staged in the New Forest typically embarked for Normandy from nearby coastlines such as Lepe, Stanswood Bay, and the Beaulieu River for the assault on Gold Beach and Juno Beach, linking the camps to the British 50th Infantry and Canadian forces, among others.

The area also hosted various Commonwealth (Canadian) contingents—recognisable at Bolderwood’s Canadian Memorial—who gathered for church services and briefings before leaving for the Normandy coast, likely for operations at Juno Beach.

Summary Table

Camp/Area	Main Allied Unit/Division	Embarkation/Operation
Cadland Estate (B1/B2)	Gold Beach assault forces (mainly British 50th Inf. Div.)	Lepe/Stanswood, Gold Beach
Penerley/Little Honeyhill	Additional assault troops	Lepe/Beaulieu/Gold Beach
Brockenhurst (HQ Balmer Lawn)	British 50th Infantry Division	Command for Marshalling Area B/Gold Beach
Beaulieu, Stubbs Wood, East Boldre, Setley	British & Canadian Troops	Lepe, Exbury, Juno & Gold Beaches

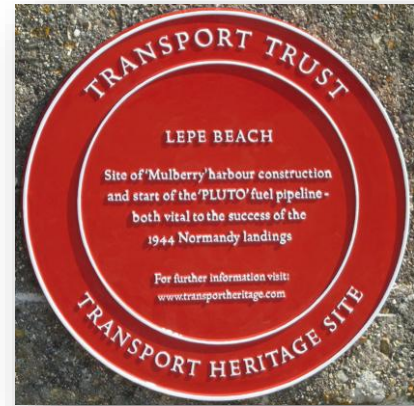
Although many other camps existed throughout the woodland and heaths, these sites had direct documented links to specific Allied divisions, particularly the British 50th Infantry Division and Canadian assault groups.

After D-Day

Most camp structures themselves were temporary and have vanished. Surviving features are primarily earthworks, foundations, and traces of wartime debris preserved in heath, woodland, or open spaces. This list represents the best-documented surviving physical features marking the New Forest D-Day camps B1 to B9.

Camp Code	Surviving Physical Features
B1 (Cadland Estate)	Concrete hut bases, earthwork foundations, remains of vehicle hard standings, interpretive plaques nearby.
B2 (Cadland Estate)	Similar to B1, which features ground depressions and partial hut footprints, there are also surviving trackways and vehicle parking areas.
B3 (Penerley/Little Honeyhill)	Faint earthworks, remnant vehicle bays partially visible; heavily wooded now, with preserved trackway lines.
B4(Penerley/Little Honeyhill)	Tent and hut outline impressions; scattered refuse heaps; informal visitor trails marking historic spots.
B5 (Stubbs Wood, Beaulieu)	Roadway remains, building foundations, and earthworks; proximity to the Beaulieu wartime museum enhances the historical context.
B6 (East Boldre / Setley Common)	Tank parking bays, large flat vehicle dispersal areas visible; remains of defensive structures, with local memorial plaques.
B7 (Brockenhurst A)	Depressions indicating former accommodation sites; Balmer Lawn Hotel HQ building survives; nearby woodland paths retain camp layout.
B8 (Brockenhurst B)	Ground markings of hardstanding and hut platforms, small memorials, and connections to Canadian troops with commemorative plaques nearby.
B9 (Setley Common)	Large visible tank tracks; vehicle parking and dispersal grounds; boundary fencing remnants; public access with information boards.

In addition to these, the embarkation points at Lepe Beach and Beaulieu River retain notable remnants of concrete Mulberry Harbour sections, slipways, and reinforced docks. Many camps have accompanying memorials or plaques that explain their role on D-Day, often installed by local heritage groups.



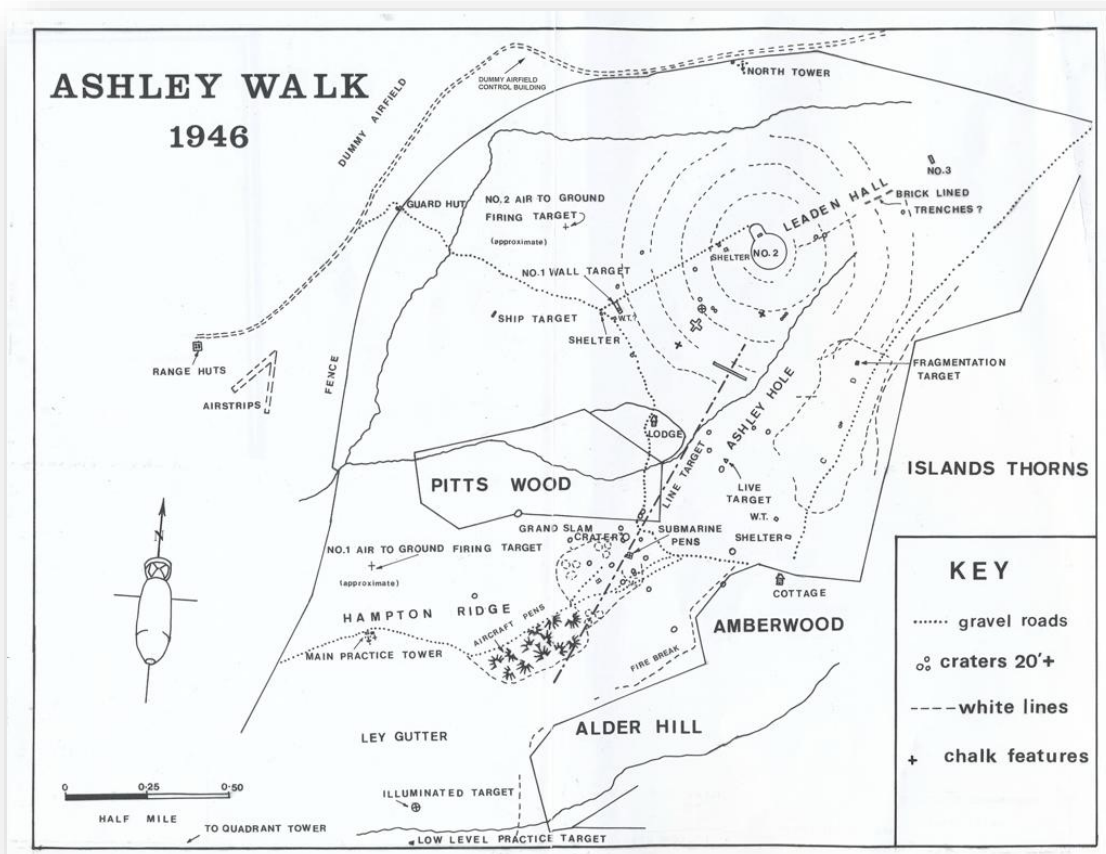
Lepe Beach Today



Bombing Range

The Ashley Bombing Range, also known as Ashley Walk Bombing Range, was in the northwest part of the New Forest, Hampshire, England. The range covered about 5,000 acres (over 2,025 hectares) and was situated approximately 5 miles (8 km) northwest of Lyndhurst and near the village of Godshill.

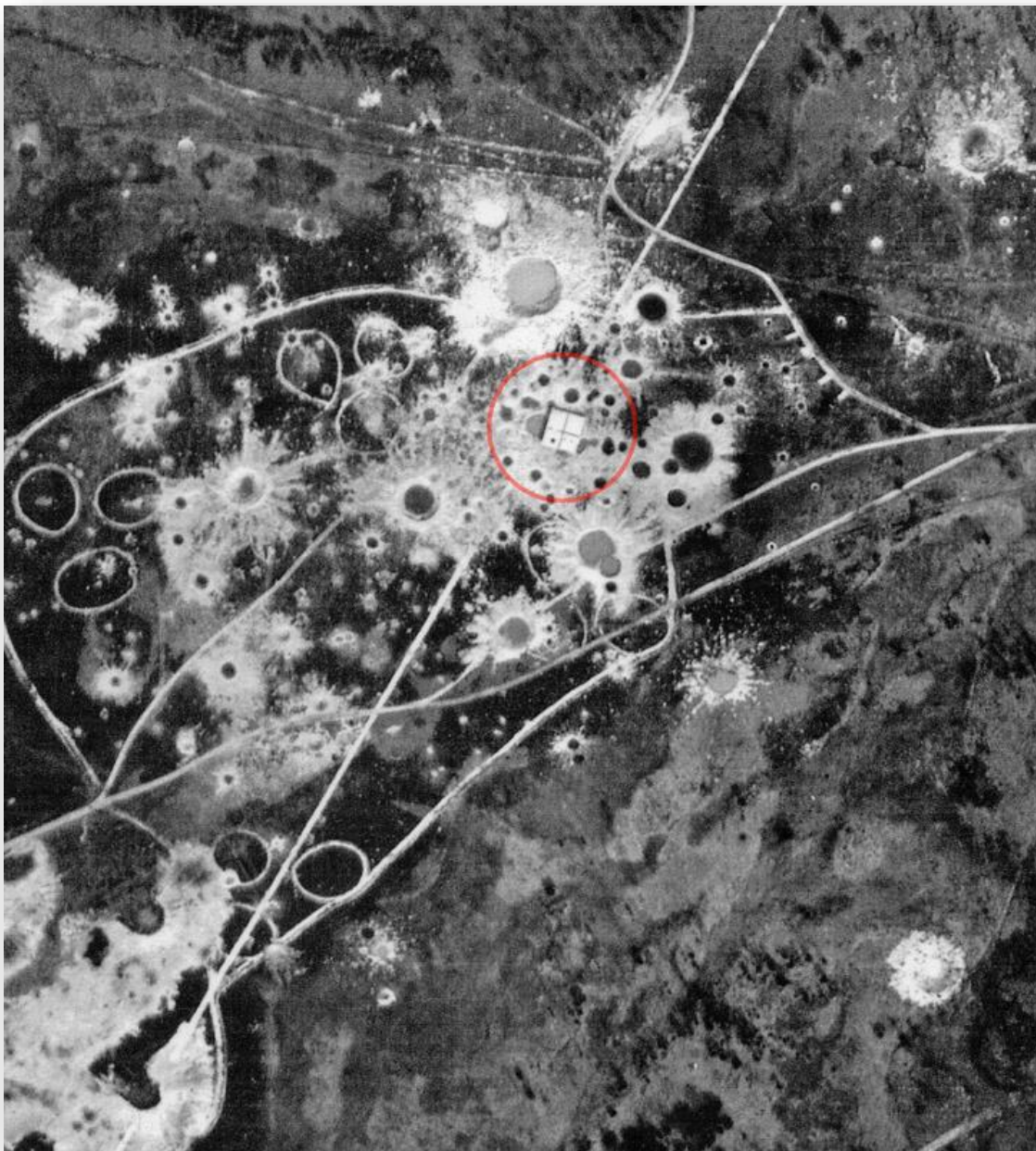
The main entrance was near Godshill cricket pitch, with perimeter fencing and additional access points around the site. Among the types of bombs tested were some of Barnes Wallis's largest and most innovative designs, including the Tallboy and Grand Slam "earthquake" bombs, as well as specialised weapons like the Highball "bouncing bomb." Both the Tallboy and Grand Slam were designed as deep-penetration or bunker-buster bombs. Today, the landscape still bears visible craters, chalk target markings, and remnants, including an observation shelter and an earth-covered Ministry of Home Security target bunker.



The Bombing Range

The Bombs

The Tallboy and Grand Slam "earthquake" bombs were primarily tested at the Ashley Walk Bombing Range located in the New Forest, Hampshire. This site was specifically chosen for full-scale live trials of these deep-penetration bombs, designed by Barnes Wallis. At Ashley Walk, several concrete target buildings were constructed, including a prominent structure known as the "Sub Pen," built to simulate German submarine pens for testing.



On March 13, 1945, the Grand Slam bomb was put to the test, creating a massive crater that measured 124 feet in diameter and 34 feet deep, demonstrating its remarkable ability to penetrate deep underground before detonating. The Tallboy bombs underwent multiple tests at Ashley Walk before they were operationally deployed against key strategic targets, such as the Saumur railway tunnel and the German battleship Tirpitz. The tests involved Avro Lancaster bombers from No. 617 Squadron, which were specially modified to carry these large bombs.



The Crater Today

In addition to the trials at Ashley Walk, these bombs were used in operations that targeted heavily fortified enemy infrastructure throughout Europe. This included coastal gun batteries, submarine pens, railway viaducts, and bridges in Nazi-occupied territories. Testing for aircraft modifications and bomb handling also took place at other locations, such as RAF Boscombe Down and Woodhall Spa, where equipment for bomb loading and handling was trialled. However, Ashley Walk stands out as the key site for ground tests involving live detonations and target structures for the Tallboy and Grand Slam bombs.

During World War II, both the Tallboy and Grand Slam bombs were effectively deployed against naval targets at sea. While their primary development and testing occurred on land at Ashley Walk, these bombs were also operationally used against heavily fortified German naval vessels and submarine pens. A notable instance was when a Tallboy bomb sank the German cruiser Lützow in a bombing raid in 1945. Additionally, Tallboys played a significant role in the sinking of the German battleship Tirpitz, which was one of the most critical maritime targets of the war.

Dropped from specially modified Avro Lancaster bombers, these bombs were engineered to penetrate heavily armoured structures, including concrete submarine shelters along the coast and the hulls of warships. Although the bombs were not specifically tested live at sea in dedicated ranges like Ashley Walk, their operational deployment included maritime bombing raids against German naval assets. This effectively showcased their deep-penetration capabilities and earthquake effects, successfully damaging or sinking ships close to or beneath the water's surface.

Civilians' Role

Residents were recruited for support roles, and many buildings were converted for military use or as war hospitals after the landings.

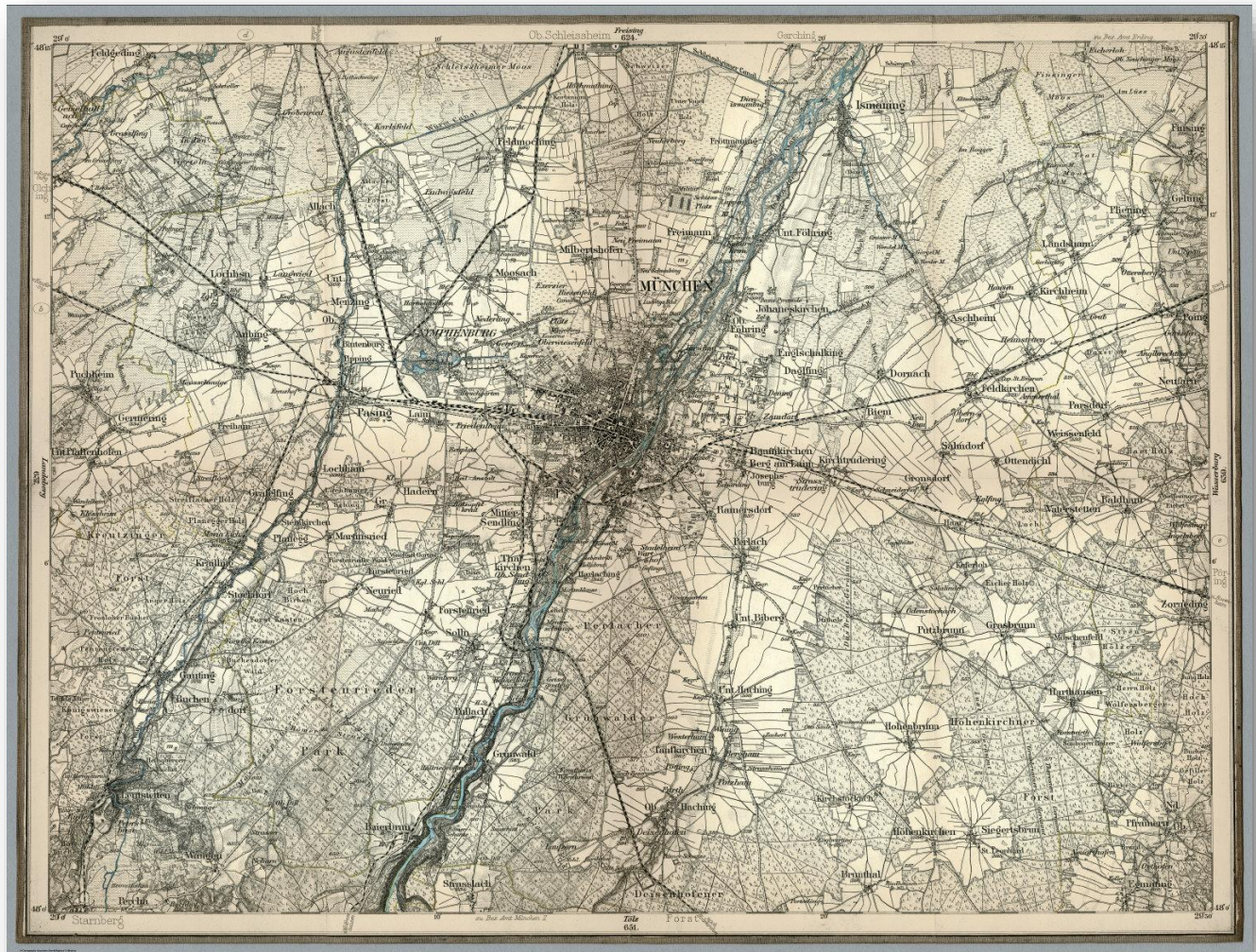


Legacy and Remains

Visible traces of this activity still exist—including Mulberry Harbour remains off Lepe Beach, concrete platforms, tank parking bays, old camp foundations, and commemorative plaques spread throughout the forest. The New Forest's natural landscape provided vital cover, proximity to Southampton and Portsmouth, and an accessible shoreline for launching D-Day, making it essential to the success of Operation Overlord.



The 1:25,000 German Messtischblatt (Meßtischblatt) Series and the Russian 1:21,000 Series in World War II



(Composite of) Sheet 638. München. Karte des Deutschen Reiches. Publication 1895

Introduction

In April 2025, the DSA held a seminar in Salisbury. One of the presenters was Merryn Walters, who gave an excellent presentation on German 1:25,000 mapping. This article is a brief overview of the German 1:25,000 series and the Russian 1:21,000 series. It is not a summary of the presentation.

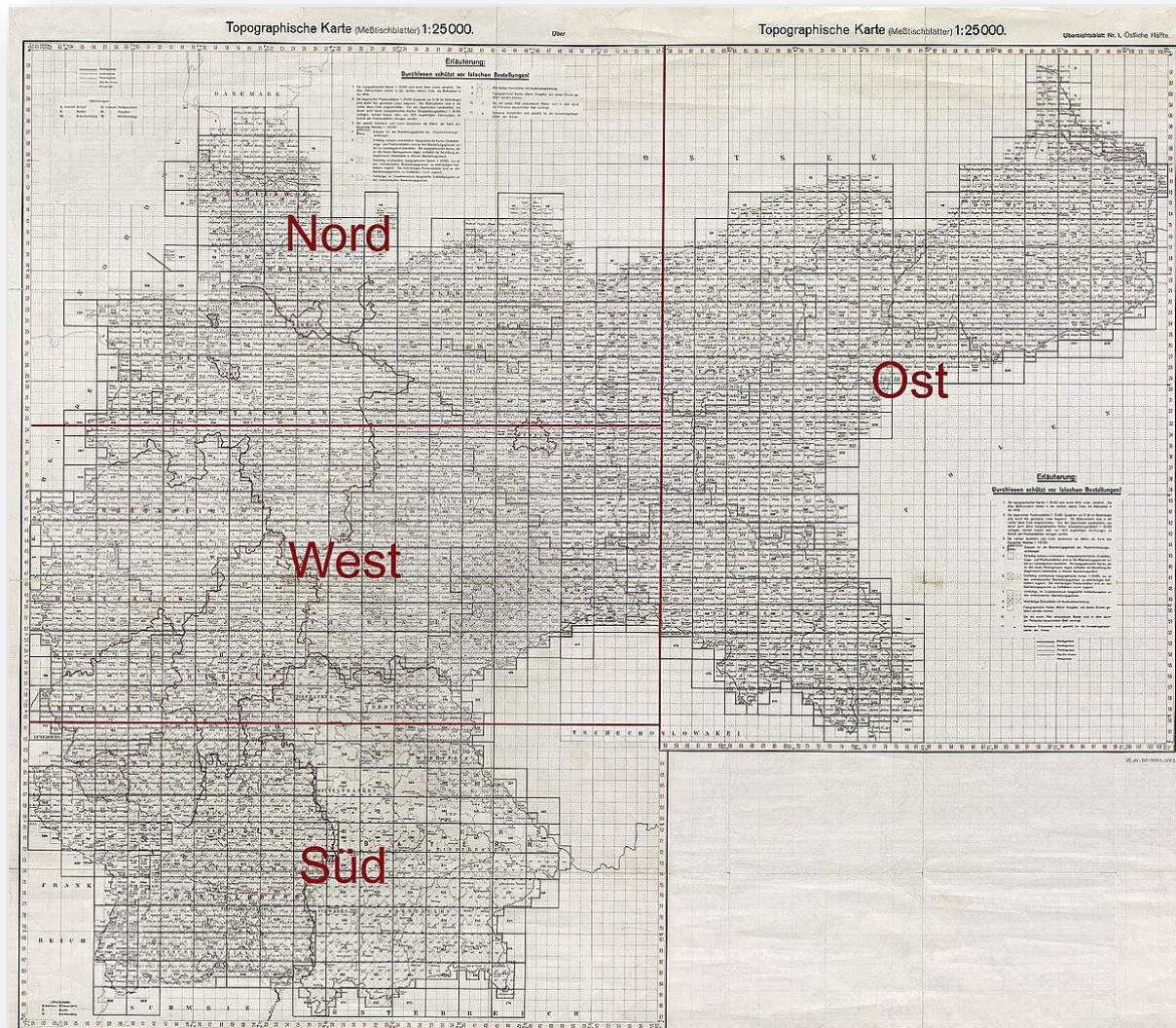
German 1:25,000 Series

Between 1920 and 1945, German topographic mapping at a scale of 1:25,000 was predominantly characterised by the production of the Messtischblatt (Meßtischblatt) series.

These maps served both civilian and military purposes, and during World War II, they were extensively updated and reproduced as "Topographische Karte" (TK25) for military use.

The Messtischblatt series originated in the late 19th century and was maintained and expanded throughout the interwar period and into World War II. By the 1930s, the 1:25,000 map grid covered the majority of Germany.

The German military relied heavily on these maps for planning and executing operations in both World Wars, as they highlighted crucial aspects such as terrain, populated areas, land use, and transport networks—all essential components of military strategy and logistics.



Index 1:25,000 Mapping

World War 2

Following the onset of World War II in 1939, new maps were rapidly produced or updated to encompass annexed and occupied territories, including parts of Poland, Czechoslovakia, the Baltic region, and other areas. In many instances, cartographic efforts involved reusing or revising earlier maps from Polish, Russian, or local sources, particularly in the areas annexed.

This process sometimes resulted in direct copies, composite maps, or "special editions" tailored for German military needs.

As the war progressed, these maps were frequently updated or overprinted with military information, including air grids and symbols for fortifications, which were crucial to the Wehrmacht and Luftwaffe.

The technical characteristics of these maps were interesting. Each standard sheet covered an area of 7.5 minutes of latitude by 15 minutes of longitude and was typically named after a principal town or reference point. The numbering system adhered to consistent conventions, but "quarter-sheet" divisions and dual naming systems based on population centres or grid references became particularly common in contested or rapidly mapped areas.

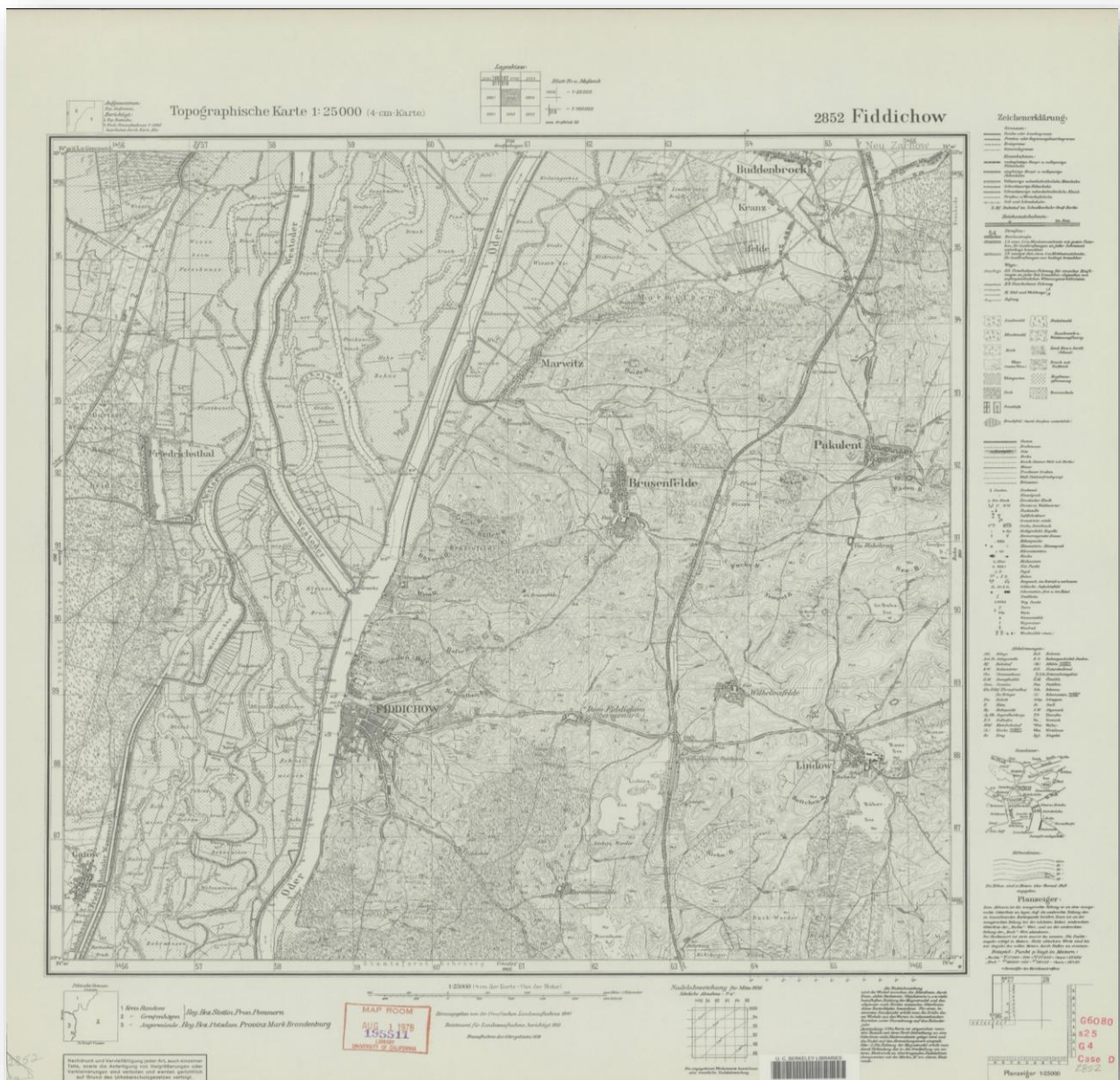
The content was rich in detail, depicting topography, vegetation, hydrography, and cultural features, with relief illustrated through contour lines, form lines, and spot heights. The production process evolved from single colour to multi-colour printing, especially in special military editions. These maps were mainly produced by the Reichsamt für Landesaufnahme (Imperial Office for Land Survey). Following World War I, the office worked to standardise mapping efforts across Germany.



The level of detail on the maps

Wartime Mapping Kriegskarten- und Vermessungswesens

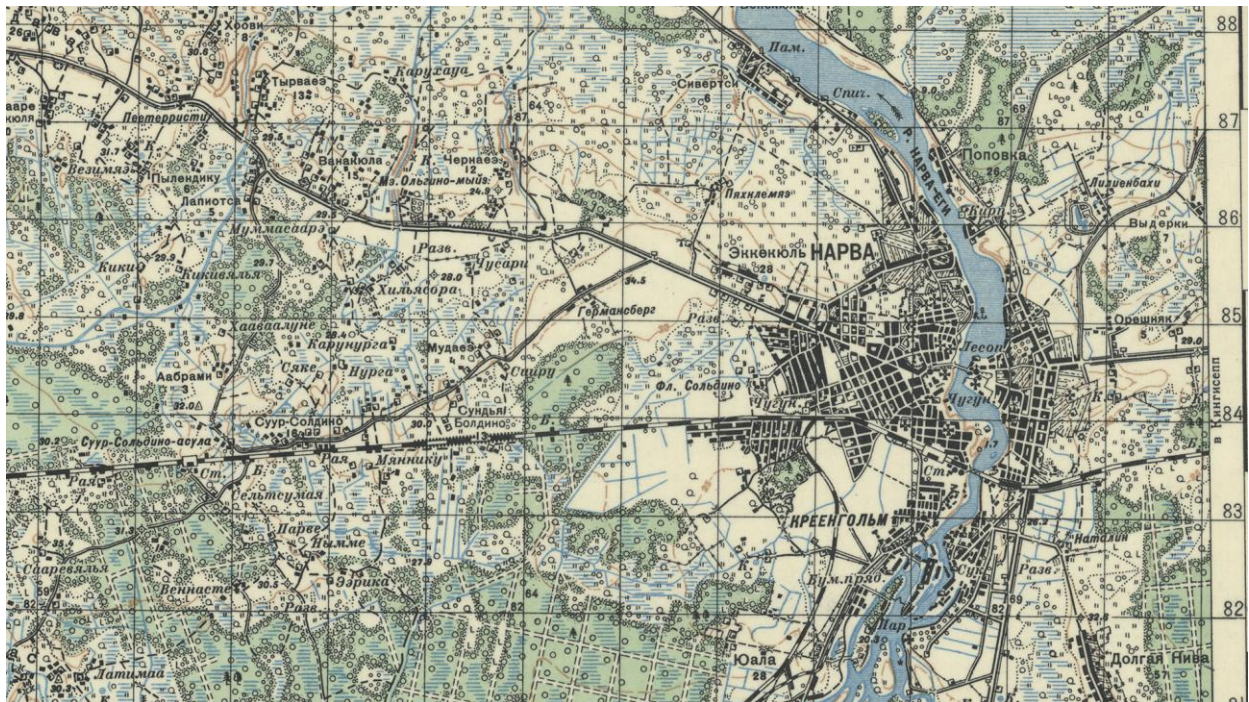
While the mapping process was managed by the Reichsamt für Landesaufnahme (RfL) for civilian purposes, the military editions and swift wartime updates fell under the oversight of



An Example of a monochrome 1:25,000 map with a river running north to south

the German Armee's Chef des Kriegskarten- und Vermessungswesens. Many maps produced during World War II feature overlays or stamps that indicate rapid field updates, the integration of captured source maps, or the incorporation of aerial photographs. After 1941, numerous sheets for Eastern Europe utilised existing Russian 1:21,000 maps—among other similar scales—by adapting them for German use and renumbering them to fit within the Messtischblatt system.

Russian 1:21,000 Maps



The Details on the Russian 1:21,000 Maps

The Russian 1:21,000 maps, commonly referred to as "half-verst" maps, played a crucial role in topographic surveys developed by the Russian Empire and were widely utilised during World War II. These maps were instrumental for military operations and surveying, initially focusing on Congress Poland in the 1880s before expanding into regions that are now Lithuania, Latvia, Belarus, and Ukraine, all of which were strategically important.

The term "half-verst" indicates that approximately 533 meters on the ground equate to 2.5 cm on the map. The first editions were printed in black and white, but subsequent updates saw significant improvements in precision and quality. By 1939, Soviet cartographers had adapted these maps for military purposes, producing revised versions and creating new editions in the 1:25,000 scale.

While the 1:21,000 maps contained similar information to the 1:42,000 variants, they stood out due to their greater detail and larger font size. Each sheet of this series represented a specific "quadrat," referenced to the Pulkovo meridian, featuring intricate depictions of terrain and infrastructure.

The Russian 1:42,000 Maps

Maps of the Russian Empire, known as the one-verst maps, were created at a scale of 1:42,000, equating to one verst per inch. Initially titled *Одноверстовая карта западного пограничного пространства*, or the "1-verst maps of the west border space," these maps were meticulously prepared and published from 1880 until the outbreak of World War I. Following this period, the Red Army's topographers continued to republish these maps with some updates up until 1940.

The primary difference between the half-verst and one-verst maps lay in the font size and line thickness; otherwise, the contents were essentially identical. Initially, these maps were

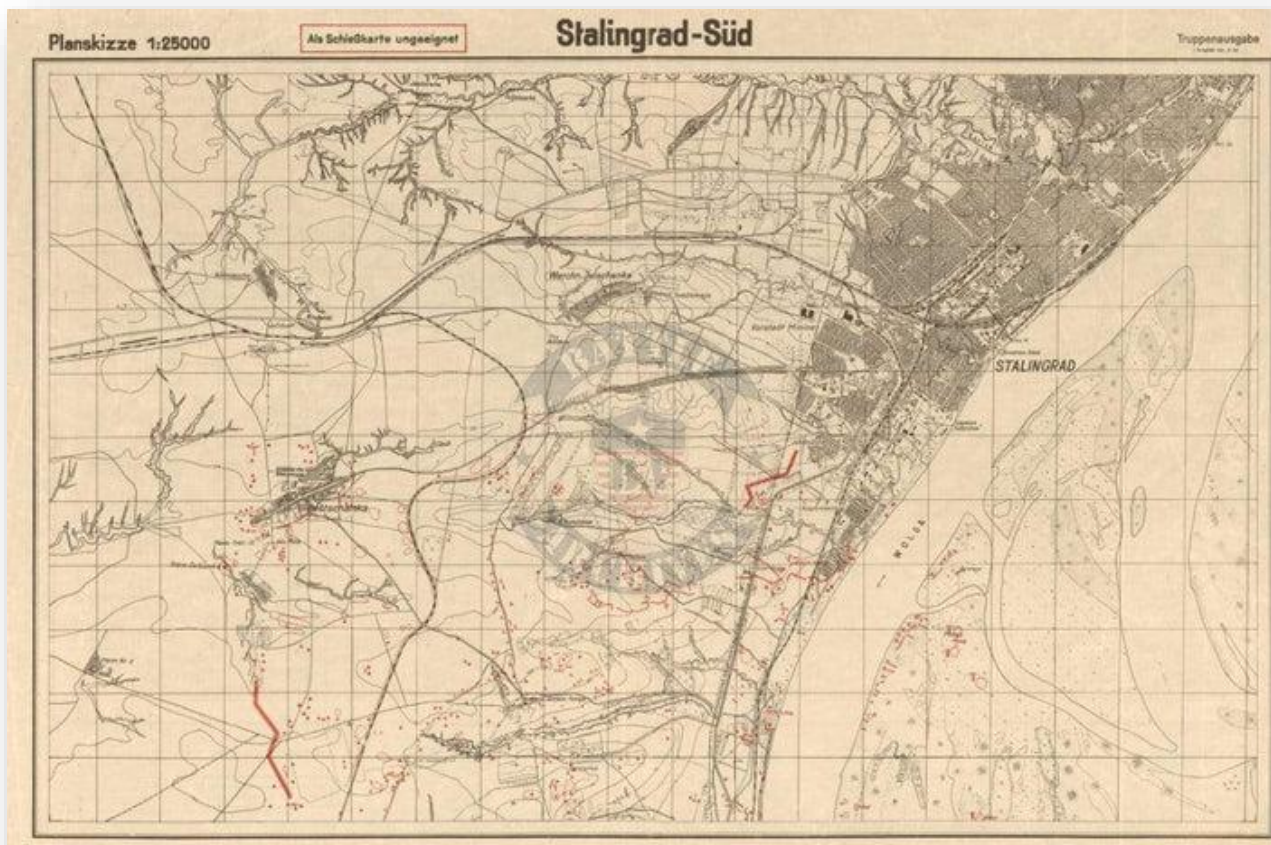
printed in black and white, but later editions—particularly those depicting the eastern regions—began to incorporate four colours.

Each one-verst map features both Roman and Arabic numerals. The Roman numeral indicates the latitude, while the Arabic numeral represents the sheet's position within its row. The name of each map sheet is derived from the largest settlement within the depicted area. Additionally, the frames of these maps indicate the year of the initial survey and any subsequent updates.

Even though the Soviet military transitioned to a standardised 1:25,000 scale after World War II, the 1:21,000 series continues to hold a significant place in both military history and cartographic heritage.

LXII-B Подубись Radubysis Podubis	LXII-B Радзивилицы Radviliškis Radziviliszki	LXII-A Шадов Šeduva Szadow	LXII-1 Новое Место Naujamiestis Nowe Miasto	LXII-2 Поневеж Panevėžys Poniewież	LXII-3 Мехишки Miežiškiai Miejszki	LXII-4 Вешинты Viešintos Wieszynty	LXII-5 Свядосцы Švėdasai Świadoście	LXII-6 Комаи Kamajai Komaje	LXII-7 Дусеты Dusetos Dusiaty	LXII-8 Новоалександ Zarasai Jeziorosy	LXII-9 Турмонт Turmantas Turmont	LXII-10 Кривооелье
LXIII-B Шидлово Šiluva Szydłowo	LXIII-B Шакоты Šaukotas Szawkoty	LXIII-A Гринкишки Grinkiškis Grynkiaski	LXIII-1 Кракиново Krakenava Kraków	LXIII-2 Рамигаля Ramygala	LXIII-3 Рогово Raguva Rogów	LXIII-4	LXIII-5 Оникшты Anykščiai Onikszty	LXIII-6 Ушопе Užpaliai Uzpol	LXIII-7 Довгели Daugailiai Daugiele	LXIII-8 Солоки Salakas Sofoki	LXIII-9 Дукшты Dukštai Dukaszty	LXIII-10 Дрисветы Drysčiai Dryświaty
LXIV-B Россиены Raseiniai Rosienie	LXIV-B Бетюгала Betūgala Betygola	LXIV-A Кроки Krokai Kroki	LXIV-1 Датново Dainava Datnow	LXIV-2 Погиря Pogiriai	LXIV-3 Толяны Tolūnai Towiany	LXIV-4 Коварск Kavarskas Kowarsk	LXIV-5 Скеманы Skeimėnai Skemiany	LXIV-6 Учяны Učėnai Uczana	LXIV-7 Таврогисы Tauragnai Tauroginy	LXIV-8 Говейканы	LXIV-9 Кочергишки	LXIV-10 Видзь Тверечь
LXV-B Гиртаколь Girkalnis Girtakol	LXV-B Эйрагала Ainagala Ejragola	LXV-A Ясвоини Jasvainiai Jaswojnia	LXV-1 Кейданы Kėdainiai Kiejdany	LXV-2 Шаты Šatai Szaty	LXV-3 Вилкомир Vilkomir Witkomierz	LXV-4 Видишки	LXV-5 Поззелья Želva Pozalwa	LXV-6 Малаты Malatė Malaty	LXV-7 Лабанары Labanarai Łabonary	LXV-8 Полуше Palūšė Polusze	LXV-9 Мелеганы Miegėnai Melegiany	LXV-10 Мелетяны
LXVI-B Велиона Veliūna Wielona	LXVI-B Средники Sėdaičiai Średniki	LXVI-A	LXVI-1 Вендагала Vandžiogala Wędzagola	LXVI-2 Яново Jonava Janów	LXVI-3 Гелваны Gelvonai Gielwany	LXVI-4 Ширвинты Širvintos Szyrwinty	LXVI-5 Гедройцы Gėdraičiai Giedroycie	LXVI-6 Интурки Inturkė Inturki	LXVI-7	LXVI-8 Свенцяны Sėdaičiai Święciany	LXVI-9 Лынтупы Lynčiai Łyntupy	LXVI-10 Годутишки
LXVII-B Шайки Šakai Szaki	LXVII-B Вилкис Vilkiškė Wilkiszki	LXVII-A Сапежишки Sapieškis Sapiejszki	LXVII-1 КАУНАС Kaunas Kowno	LXVII-2 Румшишки Rumšiškės Rumszyski	LXVII-3 Жосли Josėlis Zośle	LXVII-4 Мейшагала Mėišagala Mejszagola	LXVII-5 Подберезье Paberžė Podbrzeże	LXVII-6 Неменчин Nemenčinė Niemenczyn	LXVII-7 Коркожишис Karkazėškė Karkożyski	LXVII-8 Клюшаны	LXVII-9 Свирь Svir Świr	LXVII-10 Кобыльники
LXVIII-B Пильвишки Pilviškiai Pilwiszki	LXVIII-B Козлова Руда Kazlų Rūda Kozłowa Ruda	LXVIII-A Вейверы Veiveriai Wejwery	LXVIII-1 Дорсунишки Darsūniškis Dorsuniszki	LXVIII-2 Жижморы Jiežmariai Żyżmory	LXVIII-3 Стравеники	LXVIII-4 Евье Vievis Jewie	LXVIII-5 ВИЛЬНА Vilnius Wilno	LXVIII-6 Вилейка Vilėjka Nowa Wilejka	LXVIII-7 Быстрица	LXVIII-8 Михалишки	LXVIII-9 Вишнево	LXVIII-10 Спалл
LXIX-B Волковичи Vilkaviškis Wykowiczki	LXIX-B Мариамполь Marijampolė Mariampol	LXIX-A	LXIX-1 Прены Prienai Preny	LXIX-2 Стоклишки Stokliškės Stokliszki	LXIX-3 Высокий Двор Aukštadvaris Wysoki Dwór	LXIX-4 Новые Троки Trakai	LXIX-5 Рудомино Rudamina Rudomino	LXIX-6 Медники Medininkai Miedniki	LXIX-7 Островец Astravė Ostrowiec	LXIX-8 Солы	LXIX-9 Жодишки	LXIX-10 Нарочь
LXX-B Кальвария Kalvarija Kalwaria	LXX-B Лудвинов Ludvinavas Ludwinów	LXX-A Симно Simnas Simno	LXX-1 Олита Alytus Olita	LXX-2 Давги Daugai Dougai	LXX-3 Ганушишки Onuškis Hanuszyszki	LXX-4 Олькеники Valkininkai Olkieniki	LXX-5 Яшуны Jasūnai Jaszuny	LXX-6 Солечники Salčininkai Soleczni	LXX-7 Ошмяны Ašmėnai Oszmiana	LXX-8 Жупраны	LXX-9 Сморгонь	LXX-10 Заскавичи
LXXI-B Пунск Punkas Punskas	LXXI-B Лоздзье Lazdijai Łozdzie	LXXI-A Серей Sėirijai Sereja	LXXI-1 Немонайтис Nemūnaitis Niemonajcie	LXXI-2 Нединги Nedzingė Niedzingi	LXXI-3 Ораны Oranai Orany	LXXI-4 Эйшишки Eišiškės Ejszyski	LXXI-5 Стрельцы	LXXI-6 Девенишки Deveniškes Dziewniszki	LXXI-7 Граужиски	LXXI-8 Гольшаны	LXXI-9 Лоск	LXXI-10 Лебелёво
LXXII-B Краснополь Krasnopolė	LXXII-B Сейны Seinai Seinai	LXXII-A Вейсее Vėisiejai Wiejseje	LXXII-1 Друскиеники Druskininkai Druskieniki	LXXII-2 Мереч Mėrkė Merecz	LXXII-3 Конява Kaniava Koniawa	LXXII-4 Радунь Radūnė Raduń	LXXII-5 Вороново Voronava Woronów	LXXII-6 Липнишки Lipniškiai Lipnizski	LXXII-7 Трабы Trabai Traby	LXXII-8 Вишнево Vėšniavė Wiszniawo	LXXII-9 Воложин Voložyn Wołożyn	LXXII-10 Доры
LXXIII-B Августов Augustovė	LXXIII-B Микашевка Mikaszėvka Mikaszówka	LXXIII-A Ятвезь Jatvėzė Porzece	LXXIII-1 Поречье Porėcia Porzece	LXXIII-2 Бершты Berštai Bersztu	LXXIII-3 Собакины Sobakiai Sobakince	LXXIII-4 Заболотье Zabolotė Zabotocie	LXXIII-5 Лиды Lida Lida	LXXIII-6 Сыгары	LXXIII-7 Ивье Ivė Iwie	LXXIII-8 Забережь	LXXIII-9 Ивенец Ivanėc Iwieniec	LXXIII-10 Ивенец Ivanėc Iwieniec
LXXIV-B Штабин Štabin	LXXIV-B Липск Lipsk	LXXIV-A ГРОДНО	LXXIV-1 Верцелишки	LXXIV-2 Озеры	LXXIV-3 Острина	LXXIV-4 Василишки	LXXIV-5 Поречаны	LXXIV-6 Докудово	LXXIV-7 Вселюб	LXXIV-8 Любча	LXXIV-9 Налибоки	LXXIV-10 Хотова

Map Index



Revising and Updating the German Maps

By 1944, German topographic sheets at a scale of 1:25,000 underwent significant updates by incorporating aerial photography. This transformation was achieved through a meticulous process that blended photogrammetric techniques with field checks and images sourced from the Luftwaffe and the Air Ministry.¹ The outcome was a marked improvement in the accuracy of military mapping.

The Reichsamt für Landesaufnahme, the primary mapping agency, along with military survey units, utilised photogrammetry—a science focused on making measurements from aerial photographs—to refresh and redraw maps, particularly in areas where pre-war data had become outdated or incomplete. Initially, the emphasis on aerial imagery originated from scientific programs in the 1920s and 1930s. However, a pivotal decree issued in June 1943 empowered the Reichsamt and associated war-mapping agencies to requisition Luftwaffe images, even negating copyright constraints.²

The map update process involved both manual and semi-automated geometric corrections. Key features identified in overlapping aerial photographs were aligned with ground control points from existing maps. Photo-interpretation specialists played a crucial role in uncovering new roads, railways, buildings, and other landscape changes, often necessitating new contouring to represent the terrain accurately. Field teams augmented this aerial photo analysis, especially in regions where reconnaissance images were obscured by foliage or camouflage.

Maps produced through this updated process frequently displayed edition marks, marginalia, or notations indicating their origins as "photogrammetric" or "aerial update" maps. Those created after 1942 showcased the Deutsches Heeresgitter (German Army Grid) and sometimes featured overprinted communication grids tailored for targeting and artillery purposes.

The meticulous updates resulted in maps that provided much more accurate and current information, essential for rapid operational use by the German forces, particularly in artillery, logistics, and intelligence, as they retreated from and defended newly altered landscapes. A compelling example of this effort is the mapping of the Swiss-German border. The 1:25,000 series compiled between 1940 and 1944 was almost entirely enhanced using aerial images, yielding an exact set of terrain maps—a method replicated on other fronts wherever conditions permitted.³

Historic Interest

The intricate details of these maps made them highly sought after, as they unveiled not only the natural landscape but also cultural landmarks and infrastructure. They serve as remarkable records of Germany's historical geography and the evolution of land use over time. The existence of multiple editions and reprints showcases the shifting geographic and military landscape during this era.

Cgan July 2025

¹ Map Archive Wojskowy Instytut Geograficzny 1919 – 1939 WIG Map Archive (English) - German maps 1919-1945

² The Reichsamt für Landesaufnahme and the Ordnance Survey; a comparison of two mapping organisations between 1919 and the Second World War (part II) J L Cruickshank

³ Map Archive Wojskowy Instytut Geograficzny 1919 – 1939

Gun End of Baseline

By James Prain with contributions from Carl Calvert and Christopher Nash

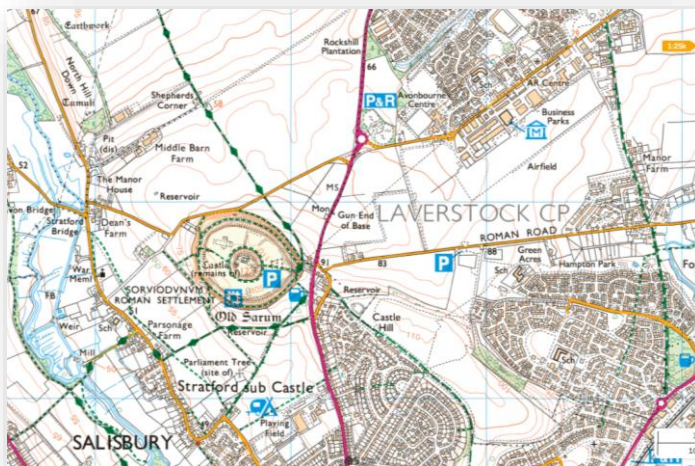
Introduction

If you have driven into Salisbury from the north on the A345, you will have passed a stone monument on the left-hand side (east) of the road as Old Sarum Castle looms on the right. This humble monument commemorates the tremendous achievement of our surveying forebearers.

The site is marked on today's OS Maps as 'Gun End of Base'. Though I have lived in Salisbury for 15 years, I must confess I only investigated this site in September this year. Just over the fence from the monument is the very gun barrel, planted muzzle up.



Gun End of Base Monument



Extract from OS Explorer Sheet 130

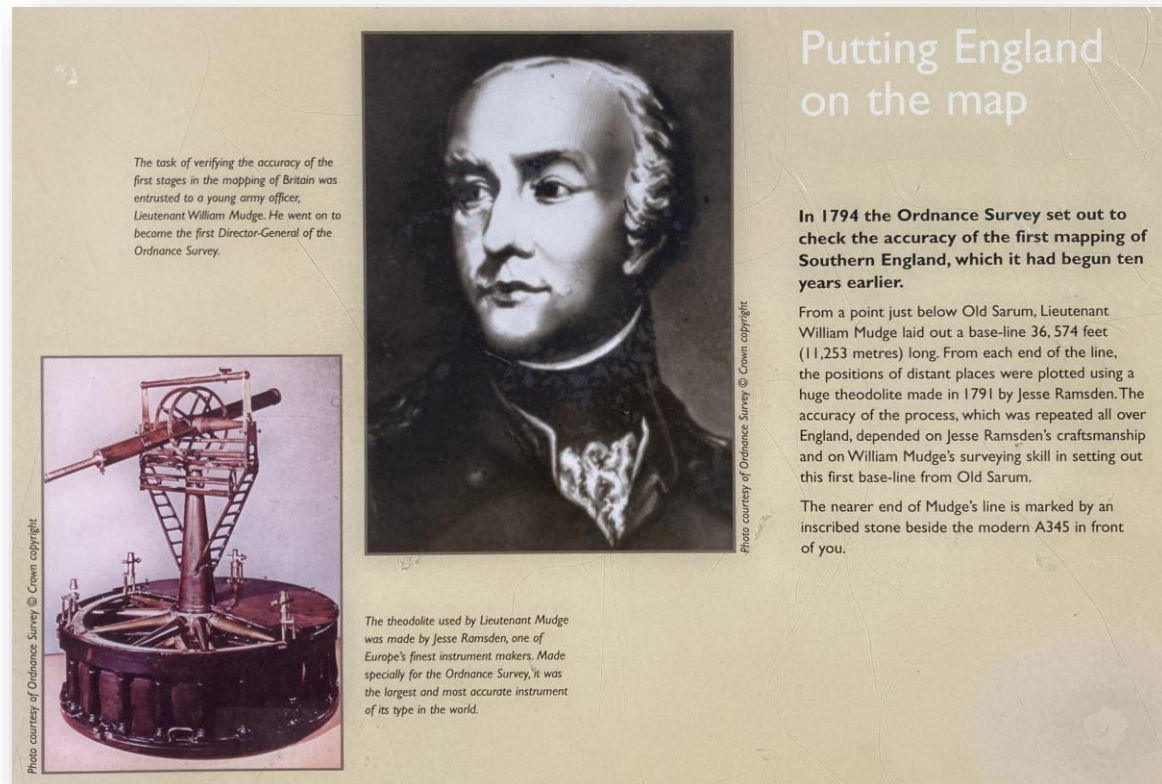
Crown Copyright



Gun Muzzle

So, what's the story?

Context



Plaque on the Old Sarum Castle Ramparts summarising the story

The Principal Triangulation of Britain was the first high-precision triangulation survey of the whole of Great Britain and Ireland, carried out between 1791 and 1853 under the auspices of the Board of Ordnance. The survey aimed to establish precise geographical coordinates for almost 300 significant landmarks, which could serve as fixed points for local topographic surveys from which maps could be drawn. In addition, there was a purely scientific aim: to provide precise data for geodetic calculations, such as the determination of the length of meridian arcs and the figure of the Earth. Such a survey had been proposed by William Roy (1726–1790) upon completing the Anglo-French Survey. Still, it was only after his death that the Board of Ordnance initiated the trigonometric survey, motivated by military considerations in the face of a threatened French invasion. Most of the work was carried out under the direction of Isaac Dalby, William Mudge and Thomas Frederick Colby. Still, the final synthesis and report (1858) was the work of Alexander Ross Clarke. The survey stood the test of time for a century, until the Retriangulation of Great Britain between 1935 and 1962.

Hounslow Heath Baseline

William Roy's Hounslow Heath baseline was measured in the summer of 1784. He laid it out between Hampton Poor House and King's Arbour, determining its length as 27,404.01 feet (8.352 km) with extreme precision.

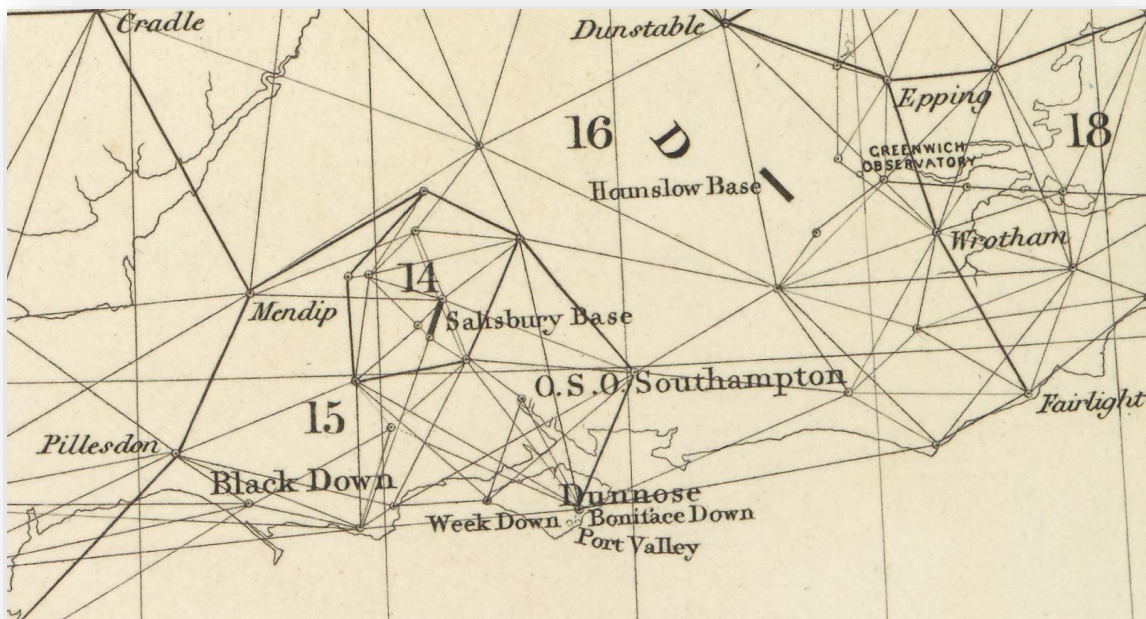
Beyond the date, a few technical highlights:

- Roy's first measurements used 20 ft wooden rods, which were vulnerable to moisture changes.
- He switched to one-inch-thick glass tubes to reduce variation, aligning ends to within a thousandth of an inch.

- Over 1,000 successive placements ensured continuity of the full length.
- After 1791, baselines were measured with 100 ft steel chains for greater stability.

When assessing Roy's work, it was realised that it lacked the accuracy achieved by other countries. The catalyst was the sudden availability of a new, improved Ramsden theodolite intended for the East India Company. The purchase of this instrument on 21 June 1791 by the Board is taken as the inauguration of the Ordnance Survey. The very next day, Charles Lennox, 3rd Duke of Richmond, as Master of the Board of Ordnance from 1782, appointed Isaac Dalby as its first employee, with a brief to extend Roy's survey. The following month, Richmond appointed two officers of the Royal Artillery, Major Edward Williams and Lieutenant William Mudge, as directors.

The Salisbury Base



Extract from the Principal Triangulation mesh 1860

Using an improved model of Ramsden's theodolite, Mudge (later promoted to Colonel) extended the triangulation eastwards towards London and Kent, where the threat of invasion seemed most incredible, and then along the coastal counties westward as far as Bristol and Cornwall.

As the survey proceeded westwards, Mudge decided to check its accuracy by measuring a new baseline between two points established by the triangulation. He chose Salisbury Plain, measuring between a point near Old Sarum Castle (51.0955°N 1.7984°W) and Beacon Hill, near Bulford (51.1835°N 1.7221°W), in June 1794.

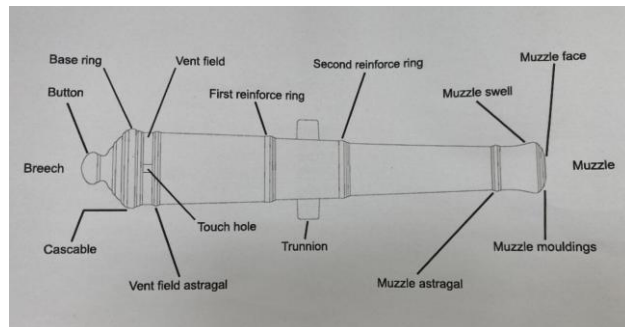
Mudge's entourage included twenty boxes of survey equipment and two calibrated chains. Over several careful measurements, he determined the baseline from Old Sarum to Beacon Hill, Amesbury, to be 36,574 ft, correcting for height differences and earth curvature. A cannon was buried at the Old Sarum end to mark the fixed point from which his principal triangulation began.

The difference between the distance calculated by triangulation and that established by measurement was less than one inch (over a length of more than seven miles). The result verified not only the accuracy of the triangulation, but also the measurement of the original

baseline on Hounslow Heath.[26] After remeasurement in 1849, the "Salisbury Base" (rather than the original base on Hounslow Heath) provided the baseline for subsequent triangulation. During subsequent triangulation, errors due to atmospheric refraction, deflection of plumb-bobs, temperature, and the spherical nature of the Earth (which can result in more than 180 degrees in a triangle) were all allowed for.

So why use a gun barrel? These were regularly used as boundary markers set in the ground with the muzzle up. These gun barrels marked the exact endpoints of the baseline, serving as enduring monuments to the survey process. The muzzles, set vertically upwards, were typically plugged with a cannonball or mortar to seal the bore. This prevented debris and water from entering, preserving the cannon's condition and ensuring the monument remained stable and identifiable in the landscape.

That said, it begs the question of why the gun barrel was not buried muzzle down, with the button protruding, and a centre punch mark to define the survey mark, thereby dispensing with the need to use a cannon ball, which could be removed.



For further information, go to:

Wikipedia https://en.wikipedia.org/wiki/Principal_Triangulation_of_Great_Britain

The Strategic Defence Review 2025 and Geospatial Intelligence

The Strategic Defence Review 2025 primarily focuses on the UK's defence strategy, warfighting readiness, deterrence, NATO relations, and technological innovation in defence, which includes drones and digital warfare. It also emphasises the growth of the defence industrial sector, but it does not explicitly address geospatial strategy.

The article's main argument is that the future of the UK's defence will be shaped by the integration of advanced intelligence, particularly geospatial intelligence, across all areas. AI, digital infrastructure, and international collaboration will support this integration. However, realising this vision will require overcoming significant technical, organisational, and interoperability challenges. Cgan July 2025

Introduction

The Strategic Defence Review, introduced in March 2025, marks a pivotal shift in warfare, underscoring an increasing reliance on cyber technology.⁴

However, disappointingly, Geospatial Intelligence is not explicitly mentioned. Nevertheless, Geospatial Intelligence (GEOINT) primarily fits within the domain of Defence Intelligence under the UK's Strategic Command. It is a fundamental enabler for operations across land, sea, air, space, and cyber domains. GEOINT contributes to situational awareness, targeting, navigation, and decision-making by integrating data from satellite imagery, aerial reconnaissance, maps, and geographic information systems.

Key players such as the Royal Engineers Geospatial Organisation and the Defence Geographic Centre are set to play vital roles in the future of defence. This article provides an overview of what lies ahead for defence, with the emphasis on defence intelligence and cyber systems. It's designed for the readers of The Ranger, rather than specialists in defence geospatial intelligence.



⁴ Ministry of Defence, *Strategic Defence Review 2025* (Ministry of Defence)
<https://assets.publishing.service.gov.uk/media/683dbe63d23a62e5d32680de/The_Strategic_Defence_Review_2025_-_two-pager.pdf> [accessed 7 July 2025]

Summary of the United Kingdom Strategic Defence Review 2025 and Geospatial Intelligence

The recent UK Strategic Defence Review (SDR) 2025 presents a comprehensive vision to enhance Britain's safety at home while bolstering its strength abroad. This review marks a significant pivot towards warfighting readiness, driven by the need to address evolving threats, including Russian aggression, nuclear risks, and cyberattacks.⁵

Among the key initiatives, the UK plans to create a "New Hybrid Navy." This naval force will be equipped with advanced submarines, including the Dreadnought and SSN-AUKUS classes, as well as state-of-the-art warships, revamped aircraft carriers, and autonomous vessels. The British Army is also set to transform, with ambitions to become "10 times more lethal." This will be achieved through enhancements in armoured capabilities, the integration of artificial intelligence and advanced software, the development of long-range weapon systems, and the deployment of land drone swarms. Additionally, the Army aims to increase its full-time troop strength to at least 76,000.

In the air, the Royal Air Force is planning to upgrade its fleet with F-35s, enhanced Typhoons, and next-generation fast jets through the Global Combat Air Programme (GCAP). The introduction of autonomous fighters is also part of the modernisation effort. To solidify its nuclear capabilities, the UK is investing £15 billion in a sovereign warhead program, which is expected to support over 9,000 jobs. Furthermore, up to £1 billion in new funding will be designated for homeland air and missile defence.

Recognising the increasing frequency of cyber threats, a new CyberEM Command will be established to defend against daily cyberattacks.⁶ On the financial front, defence spending is projected to rise significantly to 2.5% of GDP by 2027, with expectations for it to further increase to 3% in the next Parliament. This substantial boost underscores the government's commitment to strengthening the UK's defence capabilities.

The UK also aims to assume a leading role within NATO, with plans to implement all 62 recommendations from the review and to emphasise a 'NATO-first' defence policy. This strategic approach reaffirms the UK's dedication to international security and its readiness to lead within the Alliance. Ultimately, the review underscores the pivotal role of defence in driving economic growth, job creation, and enhancing export potential. By investing in munitions factories and long-range weapons production, the UK is not only improving its defence capabilities but also stimulating its economy and creating new job opportunities.⁷ The question is, "How will this impact the military geospatial world"?

SDR 2025 highlights the crucial role that intelligence and geospatial information will play in shaping the UK's defence landscape, with a particular focus on autonomy, artificial intelligence, and integrated multi-domain operations.

To effectively support the SDR, several key intelligence and geospatial information support requirements have been identified. First and foremost is the necessity for high-fidelity, timely intelligence capable of understanding and countering state adversaries, terrorism, and emerging threats. This intelligence requires rapid collection, analysis, and dissemination,

⁵ *The Strategic Defence Review 2025 - Making Britain Safer: Secure at Home, Strong Abroad* (Ministry of Defence, 2 June 2025), p. 144 <<https://www.gov.uk/government/publications/the-strategic-defence-review-2025-making-britain-safer-secure-at-home-strong-abroad>>

⁶ In summary, CyberEM is a comprehensive military approach that integrates cyber and electromagnetic spectrum operations to provide the UK armed forces with decisive advantages in modern multi-domain warfare.

⁷ Whiting, Russell, 'Strategic Defence Review-Key Points', *Global Campaign on Military Spending-UK*, 6 June 2025 <<https://demilitarize.org.uk/strategic-defence-review-key-points/>>

which can be made more efficient using AI and machine learning, particularly in managing large volumes of data and open-source intelligence (OSINT).⁸

Moreover, the SDR envisions establishing a standard digital foundation to enable secure, interoperable systems across the UK Defence, NATO, Five Eyes, and other allied partners. This interconnected framework aims to facilitate seamless intelligence sharing, especially during crises or conflict scenarios.

An enhanced geospatial awareness across all five operational domains—land, sea, air, cyber, and space—is also highlighted, with special attention given to the space and cyber-electromagnetic domains to support integrated force operations. Additionally, the development of a Defence Uncrewed Systems Centre by February 2026 is planned to advance the capabilities of autonomous and AI-enabled systems, which will rely on geospatial data for navigation, targeting, and situational awareness.

To address threats from hostile intelligence and insider risks, a Counter-Intelligence Unit (CIU) is proposed within Defence Intelligence. This unit will require robust geospatial and cyber intelligence capabilities to safeguard the integrity of operations.

The SDR further advocates, but does not commit to cloud-based, multi-classification hosting solutions to support AI models and scalable computational processes for intelligence analysis. This evolution is crucial for real-time analysis and informed decision-making. Additionally, a national-level OSINT strategy that leverages AI capabilities is proposed to harness the rapid growth of open-source data for intelligence purposes.

Recognising the complexities of modern threats, the SDR also emphasises the importance of training for senior decision-makers. This training will focus on understanding AI-enhanced intelligence, addressing the risks associated with misinformation and disinformation while ensuring analytical rigour and reliability in assessments.

In summary, the SDR calls for a transformative shift in intelligence and geospatial capabilities, advocating for the integration of advanced AI, secure digital infrastructure, and interoperable systems. This strategic approach aims to prepare a lethal, integrated force capable of responding to the complex challenges of the modern security environment ⁵.

How can Geospatial Capabilities support the future of Defence?

Geospatial information will play a crucial role in supporting the UK's integrated multi-domain operations (MDO) by providing a precise, shared understanding of the physical and operational environment across all domains—land, sea, air, cyber, and space. This shared understanding will enable coordinated and effective military action.⁹ Geospatial data is a vital component of command-and-control functions that facilitate the creation of the COP. By integrating sensor data from various sources — satellites, drones, ships, and ground forces — geospatial data provides real-time situational awareness. This is essential for synchronising actions across different domains and services, ensuring that all units work with the same information.

One of the key contributions of geospatial data is its ability to create a common operational picture. By integrating sensor inputs from various sources such as satellites, drones, ships, and ground forces, it delivers real-time situational awareness. This is essential for synchronising actions across different domains and services, ensuring that all units are on the same page.

⁸ In 2020 that CDI (Lt Gen Hockenhull) said (at DGI) that the intelligence community should use open sources first and only then augment with classified sources. James Prain.

⁹ [UK Geospatial Strategy 2030 - GOV.UK](#)

Moreover, geospatial data enhances information advantage. With accurate location data, forces can effectively support intelligence fusion, targeting, navigation, and threat detection. This capability enables them to capitalise on opportunities and mitigate risks in complex environments, providing them with a competitive edge in dynamic situations.

Geospatial insights are also vital for strategically positioning and configuring forces. By considering factors such as terrain, infrastructure, and adversary capabilities, military planners can ensure that forces are optimally positioned for specific operational environments.

The integration of space and cyber domains further amplifies the effectiveness of Multi-Domain Operations (MDO). Space-based geospatial intelligence provides global coverage and precision targeting, while geospatial data for cyber operations supports activities across the electromagnetic spectrum, which is crucial across all domains.

Driving interoperability and data sharing is another critical aspect of geospatial information. The UK's Geospatial Strategy 2030 emphasises FAIR principles—findability, accessibility, interoperability, and reusability—ensuring that foundational datasets are coordinated and easily accessible across defence and government agencies. This practice facilitates seamless collaboration among multiple agencies.¹⁰

Additionally, geospatial data significantly supports informed decision-making and effective crisis response. It informs planning, aids in resource allocation, and streamlines emergency responses. This capability enhances resilience and operational effectiveness in both military and civil contexts.

Lastly, the integration of advanced analytics and artificial intelligence with geospatial data drives innovation. This combination enables the rapid processing of vast datasets, enhancing predictive capabilities and the performance of autonomous systems within MDO frameworks.

In essence, geospatial information acts as the backbone for integrated multi-domain operations by delivering precise, timely, and interoperable location intelligence that enhances situational awareness, decision-making, and coordinated action across all operational domains.

Implementation

It is one thing to set out aims and ambitions, and another to ensure they are implemented. The SDR outlines specific measures to ensure the successful integration of artificial intelligence into military operations. Other aims and ambitions include: what challenges might the UK face in achieving its goal of increasing troop numbers to 76,000, and how will the collaboration between the UK's defence sector and NATO partners be enhanced under the new SDR?



¹⁰ The UK Geospatial Strategy 2023, more formally known as the UK Geospatial Strategy 2030, is authored and overseen by the Geospatial Commission. The Geospatial Commission is an expert committee established in 2018 within the UK government, specifically part of the Department for Science, Innovation and Technology. It is responsible for setting the UK's geospatial strategy and coordinating public sector geospatial activity. The strategy document does not attribute authorship to a single individual but rather represents the collective direction and plan of this governmental body.

The interest in geospatial intelligence organisations includes the AI Integration in UK Military Operations.

Under the Strategic Defence Review (SDR), several specific measures have been outlined to ensure the successful integration of artificial intelligence (AI) into the UK's defence framework. One of the key initiatives is the establishment of a Digital Targeting Web, which aims to deploy a secure and interoperable digital infrastructure by 2027.¹¹ This network will leverage AI to connect various sensors, decision-makers, and effectors across all domains, enabling real-time data analysis, rapid decision-making, and coordinated responses to emerging threats.

Another crucial development is the creation of a new Cyber and Electromagnetic (CyberEM) Command. This command will oversee the integration of AI into cyber operations, electromagnetic warfare, and information operations, thereby strengthening defence mechanisms and enhancing proactive threat mitigation strategies.

To back these advancements, a significant investment in defence innovation has been allocated, with at least £400 million earmarked for the UK Defence Innovation (UKDI) initiative. The SDR mandates that 10% of the equipment budget be dedicated to emerging capabilities, including AI, and introduces procurement reforms to accelerate the adoption of novel technologies.

Collaboration with industry and regulatory reform are other focuses of the SDR. The initiative commits to revising regulations related to intellectual property and security clearances by April 2026. This reform is designed to facilitate greater participation by start-ups and small- and medium-sized enterprises (SMEs) in providing AI solutions to meet defence needs.

A vital aspect of this integration is workforce upskilling. Plans are in place to establish a new “Digital Warfighter” cadre, alongside comprehensive training programmes, to equip personnel to operate and maintain AI-enabled systems effectively.

Lastly, AI models and data will be hosted in secure, scalable cloud environments. This cloud-based, multi-classification hosting will support the rapid development, testing, and deployment of various AI applications within the defence sector.

Concerns and Challenges

As ever, the Strategic Defence review sets an optimistic tone, seeking to “Make Britain Safer”. However, the devil is in the details. For example, integrating Geospatial Intelligence (GEOINT) into defence operations brings a host of challenges. One major issue is the lack of cohesion among systems, leading to inefficiencies and incomplete intelligence fusion. This fragmentation significantly affects the accuracy of insights delivered to decision-makers.

Another formidable challenge is information overload. The sheer volume of geospatial data collected from satellites and sensors can overwhelm analysts, increasing the risk that critical information may be missed.

¹¹ The Digital Targeting Web is, in essence, a battlefield operating system. It's designed to accelerate how UK forces identify, coordinate, and engage threats—linking sensors, platforms, and weapons across land, air, sea, and cyberspace into a single responsive network. Think real-time target handoffs between a satellite, an F-35, a drone, and a [cyber](#) operator—all in seconds, not minutes, the MOD explained.

This is likely the blueprint for how modern battles will be fought and won, Healey called out during a visit to MOD Corsham, the UK military's cyber headquarters.

According to the [MOD](#), the system will integrate AI, advanced sensors, space-based ISR (intelligence, surveillance, and reconnaissance), and cyber capabilities to enable rapid execution of the kill chain. In layman's terms: detect a threat, decide on action, and destroy it—faster than the enemy can blink.

Data integration is further complicated by the diverse formats and classifications across different sources, making seamless fusion a daunting task. Moreover, safeguarding sensitive GEOINT data from cyber threats is essential in maintaining operational integrity.

The intricate nature of analysing multi-source geospatial data necessitates advanced tools and adept personnel, which restricts accessibility. The demand for rapid, real-time updates in ever-changing environments often overwhelms existing systems, which can be overly complicated and tailored for specialists. This creates silos that hinder effective aggregation of intelligence.

These challenges highlight the pressing need for advancements in GEOINT integration and management to fully leverage geospatial data's potential. Integrating Geospatial Intelligence (GEOINT) into defence operations brings a host of challenges. One major issue is the lack of cohesion among systems, leading to inefficiencies and incomplete intelligence fusion. This fragmentation significantly affects the accuracy of insights delivered to decision-makers.

These challenges highlight the pressing need for advancements in GEOINT integration and management to fully leverage geospatial data's potential.

Given that the central pillar of the UK's defence is within NATO. The challenge is not simply integration with UK systems but also with NATO. With a strong emphasis on a "NATO First" approach, the UK spearheads initiatives in space domain awareness and intelligence sharing, strengthening collective security and interoperability. Key assets such as the SKYNET military satellite system facilitate secure global communication and real-time data exchange, both of which are crucial for joint missions.

Although the UK currently relies on US geospatial data, it is actively pursuing greater autonomy and investing in its own capabilities. Overall, the UK's Defence GEOINT strategy is centred on flexible IT architectures and efficient data-sharing platforms, all designed to support integrated operations across multiple domains.

Reorganisation of the Military Geospatial Services

How will this be done? The reorganisation will likely occur as the defence organisation is restructured.¹²

Currently, British Defence Intelligence heavily relies on geospatial intelligence (GEOINT), a crucial component of the National Centre for Geospatial Intelligence (NCGI). Operating under Defence Intelligence within Strategic Command, the NCGI serves as the national authority for GEOINT, providing critical data for the Ministry of Defence (MOD) and its partners. GEOINT involves the collection and analysis of geospatial data from various sources, essential for informed strategic, operational, and tactical decisions.

The 42 Engineer Regiment (Geographic) is integral to NCGI operations, linking field activities with Defence Intelligence. It offers capabilities such as terrain analysis, geodetic surveys, and geospatial intelligence exploitation to support operations. The regiment supplies deployable geographic technicians and aligns closely with Defence Intelligence's mission to collect and process geospatial information, making it the primary Army unit for GEOINT in the UK military and its allies.

Structural arrangements may adapt to meet growing demands for geospatial intelligence.

Sources

The sources will be included in the digital version of Ranger 2025

Cgan

¹² In this edition of The Ranger, there is an article on Geo training to meet future defence needs and demands.

“Israel Has Created a New Standard for Urban Warfare” by John Spencer

John Spencer is a retired U.S. Army officer and an expert on urban warfare, with 25 years of service and two combat tours in Iraq. He is the Chair of Urban Warfare Studies at the Modern War Institute at West Point and has authored several books, including "Understanding Urban Warfare." Renowned for his research and analysis, Spencer has advised military forces worldwide and conducted field research in conflict zones like Israel and Ukraine. He co-founded the Urban Warfare Institute, hosts the Urban Warfare Project Podcast, and has been featured in major media outlets such as The New York Times and Foreign Policy.



In an article in Newsweek, Spencer argues that "Israel Has Created a New Standard for Urban Warfare" in that the Israel Defence Forces (IDF) have established innovative strategies that prioritise minimising civilian harm in urban combat, surpassing even international law requirements. The IDF's proactive communication with civilians—through warnings, flyers, and various messaging channels—demonstrates a strong commitment to protecting non-combatants amid conflict. While these measures have substantially reduced civilian

casualties, critics point out that Hamas exploits its position, complicating the IDF's efforts.



<https://www.usatoday.com/story/graphics/2023/10/24/hamas-gaza-tunnels-visual/71303827007/>

Israel's departure from traditional military doctrine raises questions about the effectiveness of such transparency, as it may enable adversaries to evade action. Despite commendable efforts, the international community often overlooks these advancements in urban warfare due to geopolitical controversies surrounding

Israel.

Spencer highlights the differences between IDF tactics and U.S. urban warfare, noting that the IDF values civilian protection over surprise attacks. Through advanced technology and specialised units capable of underground operations, the IDF emphasises a cautious, responsive approach, challenging conventional military thinking in modern conflict and reshaping the dynamics of urban warfare.

Geospatial Intelligence and Urban Warfare – The Editor

Following the book review, in the context of the Middle East War, the extensive use of geospatial intelligence offsets adversaries' knowledge of local terrain, giving the Israel Defence Forces (IDF) a significant edge. This enhanced situational awareness enables



Urban Warfare Gaza: Washington Post

precise targeting, optimised resource allocation, and improved safety for troops engaged in intricate urban combat.

Key aspects of geospatial intelligence in the IDF's urban warfare strategy include the seamless integration of real-time data regarding troop movements, enemy locations, and terrain features. This coordination amplifies the effectiveness of ground, air, and naval units. Tablet-like devices keep small-unit commanders in the

loop, connecting them to drone surveillance, fighter jets, and other assets to support informed decision-making amid combat.

In subterranean warfare, ground-penetrating radar and drones are vital for detecting and mapping tunnel networks, which are critical to urban combat scenarios. AI-driven tools and advanced battle management systems accelerate the processing of geospatial and sensor data, enabling rapid target identification and coordination across operational domains.

Under the IDF's "Momentum" plan, a digitally connected force enhances communication and control, enabling more efficient urban operations and quicker responses to emerging threats. The capability to swiftly transition from detecting enemies to launching offensive actions is crucial for engaging time-sensitive targets, significantly boosting battlefield responsiveness and troop safety, particularly in densely populated urban areas. In this fast-moving and ever-evolving landscape, technology is shaping the future of military operations.



Berlin 1945

However, the war in Ukraine has significantly influenced the Strategic Defence Review 2025. There is a clear emphasis in British military thinking on drone warfare, heavily influenced by lessons learned from Ukraine, which has pivoted towards drone warfare, drawing lessons from the Ukraine conflict. The UK has increased its investment in drones and uncrewed systems to support Ukraine, focusing on versatile platforms for surveillance and strikes. The Defence Drone Strategy aims for the swift integration of drones into the armed forces, highlighting the effectiveness of mass drone use in Ukraine.

In Gaza, the UK has prioritised continuing surveillance through RAF flights that collect detailed intelligence in urban areas. This capability highlights the importance of geospatial intelligence in complex urban warfare, in contrast to Ukraine's larger manoeuvres.

UK military priorities have evolved according to operational contexts, with a strong emphasis on drone technology informed by Ukraine and an acknowledgement of the need for geospatial capabilities in future urban and hybrid warfare. This approach reflects a commitment to learning from different conflicts rather than adopting contradictory strategies.

Cgan

References

- Ahronheim, Anna, 'Meet the IDF Intelligence Unit of Elite Mapping Troops', *The Jerusalem Post*, January 2027 <<https://www.jpost.com/israel-news/article-694778>>
- Dunlop, Tom, 'UK Backs Homegrown Drone Defences and Deepens Ukraine Ties', *UK Defence Journal*, 17 October 2025 <<https://ukdefencejournal.org.uk/uk-backs-homegrown-drone-defences-and-deepens-ukraine-ties/>>
- Felstead, Peter, 'UK MoD Publishes Defence Drone Strategy, Building on Lessons from Ukraine', *European Security and Defence*, 22 February 2024 <<https://euro-sd.com/2024/02/major-news/36714/uk-defence-drone-strategy/>>
- Kennard, Matt, 'Revealed: UK Military Has Flown 200 Spy Missions over Gaza in Support of Israel', *Declassified UK*, 8 May 2024 <<https://www.declassifieduk.org/revealed-uk-military-has-flown-200-spy-missions-over-gaza-in-support-of-israel/>>
- Lappin, Yaakov, 'Israel's Urban Warfare Experience in Gaza Can Benefit Allies', *Israel Today*, 21 April 2024 <<https://www.israeltoday.co.il/read/israels-urban-warfare-experience-in-gaza-can-benefit-allies/>>
- Lappin, Yaakov, 'The IDF's Momentum Plan Aims to Create a New Type of War Machine', *BESA Centre Perspectives Paper No. 1,497*, 22 March 2020 <<https://besacenter.org/idf-momentum-plan/>>
- Ministry of Defence, *The Strategic Defence Review 2025 - Making Britain Safer: Secure at Home, Strong Abroad* (London, 2025) <<https://www.gov.uk/government/publications/the-strategic-defence-review-2025-making-britain-safer-secure-at-home-strong-abroad/the-strategic-defence-review-2025-making-britain-safer-secure-at-home-strong-abroad>>
- Molle, Andrea, 'Institutionalising Irregular Warfare: Inside DoDI 3000.07 (2025)', *Start Insight*, 6 November 2025 <<https://www.startinsight.eu/en/institutionalizing-irregular-warfare-inside-dodi-3000-07-2025/>>
- Spencer, John, *Newsweek*, 26 March 2024 <<https://www.newsweek.com/israel-has-created-new-standard-urban-warfare-why-will-no-one-admit-it-opinion-1883286>>
- The IDF's Momentum Plan Aims to Create a New Type of War Machine', *BESA Centre Perspectives Paper No. 1,497*, 22 March 2020 <<https://besacenter.org/idf-momentum-plan/>>

Transforming Geospatial Training in UK Defence

From: Headquarters Royal Engineers Geographic



Background

The character of warfare is evolving rapidly, driven by technological innovation, multi-domain integration, and the increasing complexity of the operating environment. In this context, geospatial intelligence is no longer a niche capability—it is a critical component of situational awareness and operational planning. The Royal Engineers' Military Engineer Geographic (ME Geo) specialists, recruited by the Army and trained by Defence Intelligence, form the backbone of this capability.

Their mission is clear: *enable commanders and forces to understand, plan, navigate, and target with precision.*

The ME Geo soldier's expertise lies in analysing the operating environment, leveraging the "**Where**" and "**When**" to understand the "**Why**" and "**What next**." This unique skill set allows them to support decision-making and operational success across a wide range of military contexts.

The role of the ME Geo soldier is multifaceted and includes the following key responsibilities:

- Planning and executing precise and assured geodetic surveys in the land environment, ensuring accurate spatial data for operational use.
- Acting as Geospatial Intelligence (GEOINT) analysts, held at readiness to deploy and provide critical geospatial insights in dynamic and complex environments.
- Enabling access to a comprehensive range of GEOINT capabilities, including fostering interoperability with allied and partner nations.
- Visualising the operating environment to ensure that deployed forces operate cohesively and effectively, often described as ensuring all forces "operate off the same map."
- Delivering location-based web services that enhance understanding and support informed decision-making at all levels of command.

Current ME Geo Training Pathway

The pathway to becoming a fully trained and qualified ME Geo soldier (*Figure 1*) is progressive, spanning from initial soldier training to advanced specialist courses. Key stages include:

Army Basic Training (14 weeks): Foundational soldiering skills.

Combat Engineering Training (12 weeks): Core engineering competencies.

Driver Training (~12 weeks): Operational mobility.

ME Geo Courses:

- **Class 0-2 (~9 months):** Introduction to geospatial principles.
- **Class 2-1 (~9 months):** Advanced technical skills.



Figure 1. Initial soldier to fully trained and qualified ME Geo soldiers training.

Beyond these, soldiers undertake specialist and leadership courses, ensuring they can operate as both technicians and leaders. The current geospatial training aspect of the curriculum (*Figure 2*) focuses on the following skills:

- Principles of Geospatial Support
- Acquisition, Management, and Exploitation of Geospatial Data
- Presentation and Dissemination of Geospatial Information
- Geospatial Systems Support

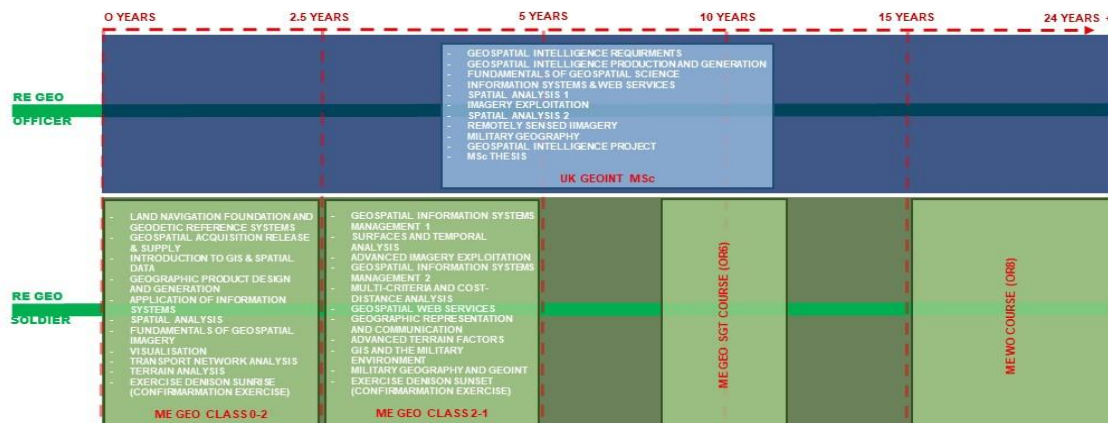


Figure 2. The current geospatial training pathway for ME GEO soldiers.

This pathway has produced highly skilled technicians, but its length and structure have become increasingly misaligned with operational tempo and technological change.

Geospatial Training Evaluation

The geospatial training pathway for ME Geo soldiers had not been reviewed for a significant period, despite the rapid pace of technological advancements and the changing requirements of modern military operations. A training evaluation was initiated to address these challenges and ensure that the training provided to ME Geo soldiers remains fit for purpose amid evolving demands. The evaluation was conducted on the current course content and its alignment with the skills and knowledge required for contemporary and future geospatial support. The evaluation identified several key areas for improvement, including:

- **Focus on GEOINT Fundamentals:** The need for a greater emphasis on the fundamentals of geospatial intelligence, shifting the training approach towards problem-based learning to better prepare soldiers for real-world challenges.
- **Reduction in Training Duration:** The length of the ME Geo Class 0-2 and Class 2-1 courses was identified as an area for improvement, with recommendations to streamline and reduce the time spent in training without compromising the quality of education.
- **Through-Life Training:** The importance of providing continuous training opportunities throughout a soldier's career, ensuring they remain up to date with the latest developments in geospatial technology and practices.
- **Role-Specific Training:** Several modules in the current training pathway are not essential for all ME GEO soldiers. Tailoring training to specific roles within the trade would enhance efficiency and relevance.
- **Alignment with Job Skill Profiles:** Align job skill profiles with the training pathway to ensure that soldiers are equipped with the skills and knowledge required for their specific roles.

- **Integration of Emerging Capabilities:** A structured research framework to ensure that emerging capabilities and technologies are seamlessly integrated into the training cycle, keeping ME Geo soldiers at the forefront of geospatial innovation.

Future ME Geo Geospatial Training Pathway

In response to the training evaluation findings, a new geospatial training pathway for ME Geo soldiers has been developed (Figure 3).

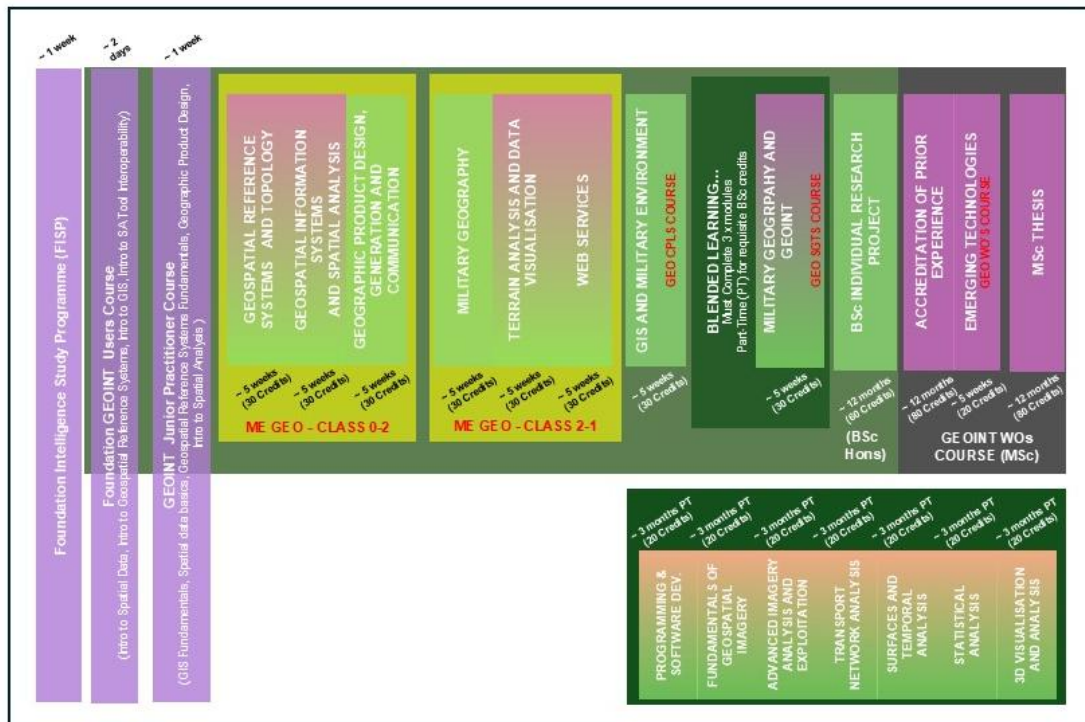


Figure 3. The future geospatial training pathway for ME GEO soldiers.

This revised pathway introduces several significant changes designed to address the identified training gaps and better prepare soldiers for the challenges of modern military operations. The key elements of the future geospatial training pathway include:

- **Integration of Intelligence Fundamentals:** The new training pathway will incorporate formal instruction in intelligence fundamentals, ensuring that ME Geo soldiers have a strong foundation in this critical area. This will enhance their ability to analyse and interpret geospatial data in support of operational decision-making.
- **Modular Training Approach:** The revised pathway will adopt a modular training structure, allowing soldiers to complete specific modules at different stages of their careers. This approach provides greater flexibility and ensures that training is delivered when it is most relevant to the soldier's role and responsibilities.
- **Reduced Training Duration:** The duration of the ME Geo Class 0-2 and Class 2-1 courses will be reduced, streamlining the training process while maintaining its effectiveness. This change will enable soldiers to transition more quickly from training to operational roles, increasing the availability of trained personnel.

- **Distance Learning Opportunities:** To support professional development, distance learning modules will be made available outside of formal training periods. These modules will provide soldiers with the opportunity to gain university accreditation, such as a Bachelor of Science (BSc) degree, enhancing their qualifications and career prospects.
- **Reformed Promotion Courses:** Promotion courses will be restructured to provide rank-specific skills that are directly relevant to the responsibilities of each rank. These courses will also offer university accreditation, further supporting the professional development of ME Geo soldiers.
- **Opportunities for Advanced Qualifications:** Warrant Officers will be allowed to pursue an MSc qualification, recognising their expertise and providing them with advanced academic credentials.

Conclusion

The transformation of the ME Geo Soldier Geospatial Training Pathway represents a significant step toward ensuring that the training provided to ME Geo soldiers aligns with the demands of modern military operations. By focusing on GEOINT fundamentals, modular learning, academic accreditation, opportunities for advanced qualifications, and problem-based approaches, ME Geo soldiers remain adaptable, innovative, and operationally decisive. These changes will enable ME Geo soldiers to continue delivering critical geospatial support to commanders and forces, ensuring operational success amid evolving challenges.

Defence Innovation and Staying Ahead of the Game

The Oxfordshire, Buckinghamshire & Chilterns Regional Defence & Security Cluster

Editor's Note: In October, 8 Brigade held a study day at Ripon to look at innovation. The first part covered innovation in war, examining the Crimean War, the American Civil War, and World War I. The second half looked to the future. This article highlights some of the work being undertaken by a regional cluster in seeking to support industry and innovation.



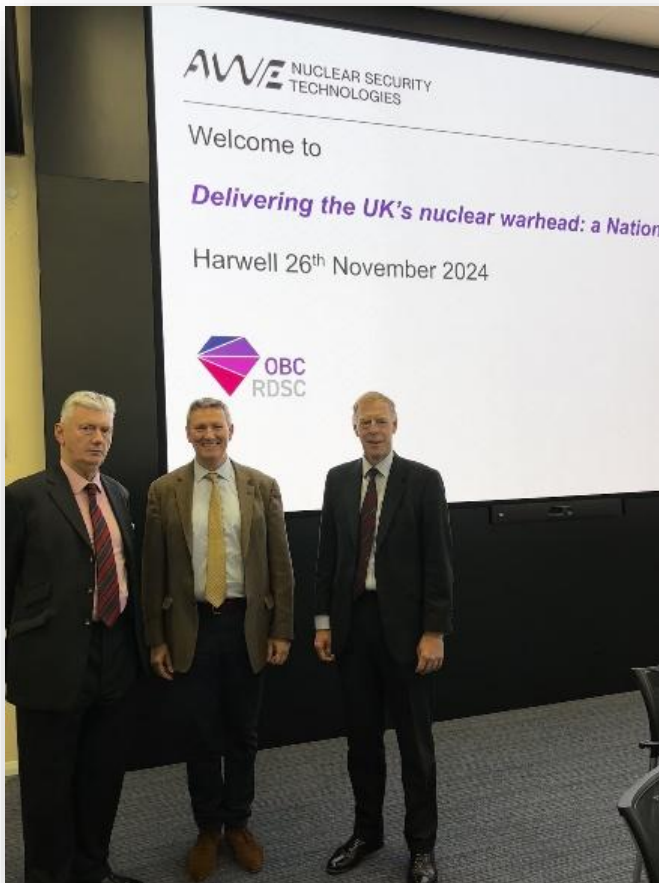
The Government set out its intent to support the creation of Regional Defence and Security Clusters (RDSCs) in the UK Defence and Security Industrial Strategy (DSIS) 2021, and this initiative was further outlined in the recent Strategic Defence Review 2025 to 'turbocharge defence innovation'. The purpose is to enhance understanding of the opportunities, implications, and choices that arise from continually evolving technologies, and to access, develop, and exploit them at a pace that enables staying ahead of current and emerging threats. The Clusters should encourage innovation, support understanding, and help to promote regional prosperity.

The MOD's lead behind the Regional Defence and Security Cluster stems from the Defence and Security Accelerator. (DASA). The RDSCs are nationwide: some are more advanced than others. South West was the first, followed by the '3 Counties', and others followed.

The Oxfordshire, Buckinghamshire and Chilterns RDSC is run by a steering group of volunteers, comprising veterans and individuals from industry and universities. The Science and Technology Facilities Council at Harwell underpins some of the financial aspects and supports the OBC RDSC (Regional Defence and Security Cluster) website, which outlines current activities.



The boundary is not accurate and is intentionally kept vague, allowing companies to join from outside the area if they so wish.

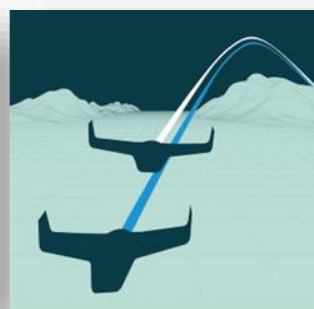


Mark Burrows, Nick Elliott, Carew Wilks and at the AWE event.

The OBC RDSC was launched on 16 April 2024 at the Rutherford Appleton Laboratory at Harwell. There were around 130 different organisations, including the University of Oxford. Cranfield University, in the academic strata, is represented by representatives from the UK Atomic Energy Agency, the Science and Technology Facilities Council, and the Satellite Applications Catapult, which represents government science. A host of high-tech SMEs and several key Defence Primes, notably Airbus, which has offices at Harwell, and Thales, which has a presence in Reading, are also in attendance. UK Defence was well represented with staff from the key Commands, DASA and the Defence Equipment and Support organisation from Abbeywood.

Since the launch, the OBC RDSC has held several events. The first, located at Westcott, focused on unmanned systems, including those for

sea, ground, and air applications. The advantage of Westcott was that it had an airfield and a licence to test remotely piloted aircraft, as well as a well-presented explanation of how such systems could be linked and managed. aerial systems. And, working on the principle that everything happens somewhere, ESRI gave



Drones, Robotics, Autonomy

2The Chairman, Maj Gen (Retd) Carew Wilks CB CBE, is communicating with a terrestrial unmanned system called "dogbot"

This was followed by an event at Oxford Brookes University that focused on decision-making and cognitive understanding. A further event in November also had an AWE focus. The CEO of AWE, Nick Elliott CB MBE (former RE), opened the event, and he went on to describe the 'National Endeavour' – to replace the Trident system. AWE cannot undertake this task alone and needs to embrace technologies from other external organisations, including SMEs.

Continuing, the RDSC held an event on quantum technologies in February 2025 at Begbroke Science Park, followed by a further event at Cluham, focusing on Robotics. At Culham and other nuclear facilities, robots are required to access areas within atomic reactors, and potentially, these types of robots could have military applications. The 11 EOD&S Regt RLC participated, while Oxford Dynamics from Harwell expressed interest in their AI-driven capabilities. More recently, a significant event occurred in the motor racing industry at Silverstone. The overall aim was to investigate which technologies and suppliers from the sector could be brought into Defence. A key area that merits further investigation is additive manufacturing and the use of metamaterials, both of which Defence has identified as needs.

All the events have been well attended, with between 70 and 120 delegates, the majority of whom come from the region's SME base. The events over the past 18 months have attracted a diverse range of speakers from the MOD, Government, academia, defence prime contractors, and regional SMEs. We have covered the breadth of MOD by bringing in representatives and speakers from the Front-Line Commands, including Cyber and Specialist Operations Command, Space Command, the main acquisition communities (DE&S and Defence Digital), and the science and technology community (DSTL). This has helped the cluster membership develop a comprehensive understanding of Defence and establish networks.

The RDSC is helping the wider academic and SME communities understand the routes to the Defence Market, which is a complex and challenging area to navigate. We have created a "mind map" to help our members.

Some might ask whether this Cluster concept produces any results, the answer is 'yes', even

though the team have only been operating for 18 months. Oxford Dynamics Ltd has won several Artificial Intelligence-related contracts with the RAF, DE&S, and BEA Systems. Another Harwell-based company, Kognitiv Spark UK Ltd, has secured a Virtual Reality contract with one of the key commands, and lonech Ltd has won a contract for battery charging in maritime systems. The aim is that more should follow suit in the months to come.

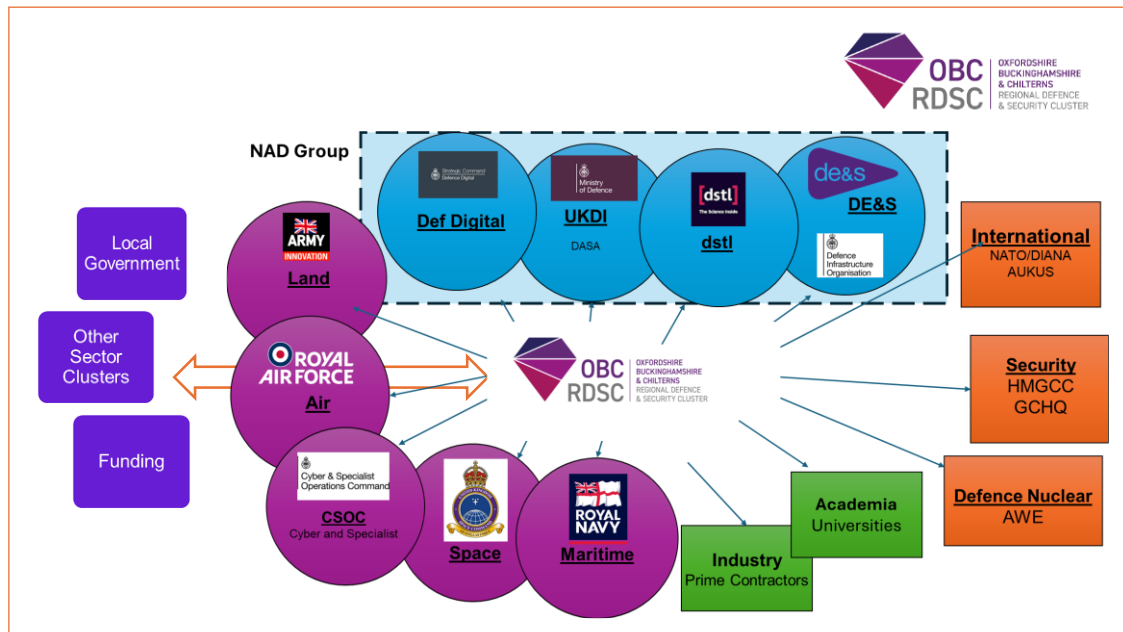
As a result of all this strength and capability, we can help the MOD (and others) to get the technology



Carew with Karl Kjelstrup-Johnson, Director, DASOBU

they need; educate them about technology they didn't even know existed; and in both cases, pull the technologies through quickly and enable them to be purchased in this country rather than having to buy abroad.

If you are interested in contributing or becoming a part of the Oxford Buckinghamshire and Chilterns RDSC, then please get in touch with mark.burrows@stfc.ac.uk



Mike Lawton, CEO of Oxford Dynamics, and Steve Ringler

Mark Burrows

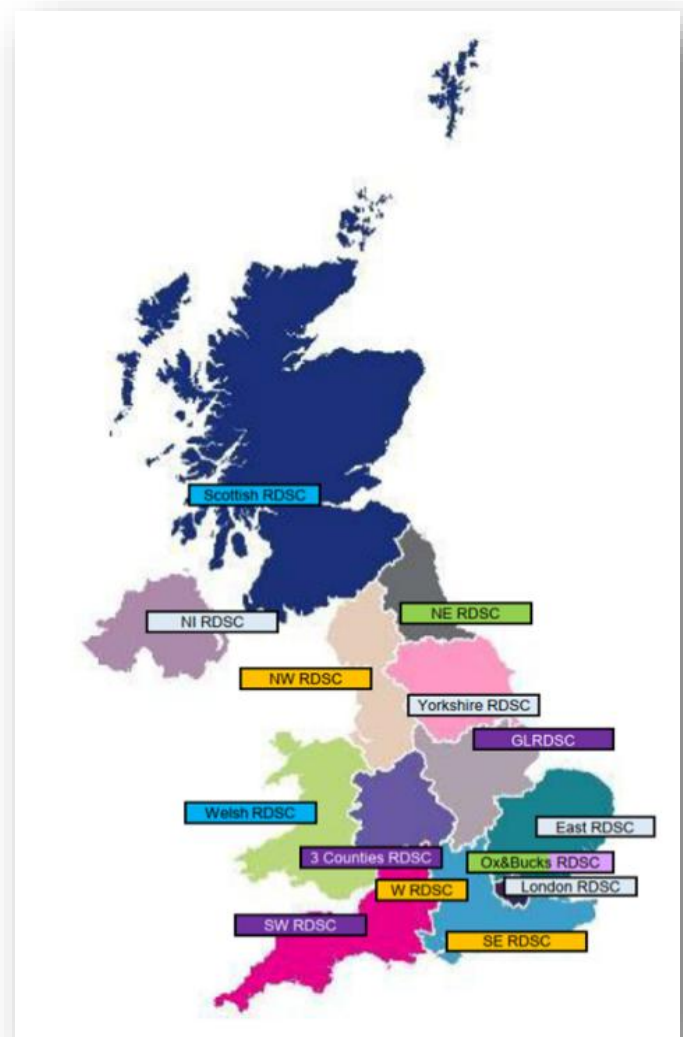


The East RDSC is of particular interest to DSA members. RAF Wyton and Huntingdon are notable locations within the East Regional Defence & Security Cluster (East RDSC), part of the UK's national defence innovation and collaboration strategy.

RAF Wyton: Roles and Regional Importance

RAF Wyton, situated near Huntingdon in Cambridgeshire, is home to the National Centre for Geospatial Intelligence (NCGI) and serves as a base for various Reserve Forces units, including the 135 Geographic Squadron (Reserves) of the 42 Engineer Regiment (Geographic). This establishment serves as a vital hub for defence intelligence and geospatial analysis, fostering collaborative operations among the Five Eyes and NATO communities. It undertakes various activities, covering both conventional and cyber defence initiatives.

The strategic co-location of RAF Wyton with intelligence fusion and decision-support facilities positions it as a model centre for bilateral and multilateral



The Regional Defence and Security Clusters

intelligence sharing and data-driven operations. This capability significantly boosts the effectiveness of military operations and strengthens partnerships among allied nations.

The East Regional Defence Support Centre (RDSC) unites key defence, technology, and academic partners across several counties, including Cambridgeshire, Bedfordshire, Hertfordshire, Essex, Suffolk, and Norfolk. Launched in mid-2025, this initiative aims to drive innovation in the defence sector, stimulate economic growth, and facilitate knowledge transfer among small and medium-sized enterprises (SMEs), academia, and the Ministry of Defence (MOD). Ultimately, the cluster aims to open new doors for local suppliers and non-traditional companies to enter the defence market.

Collaboration in the Huntingdon and RAF Wyton area reinforces these goals. The region regularly hosts networking and skills-building events centred on geospatial intelligence and applications in defence technology. Its proximity to prominent defence intelligence units enables the area to leverage regional expertise in analysis, simulation, mapping, and command and control support, amplifying its role in the defence landscape.

Editor

The geographical section of the CEF in Italy

(La section géographique du CEF en Italie)

In 2024, The Ranger published an article by Samuel Partris, “The 31e et 32e Compagnies Géographiques”. He has kindly followed up with this article. The Defence Surveyors Association thanks Samuel Partris for his contribution and continued interest in and support of the DSA.

Formation and Deployment of the SGL

In preparation for the dispatch of an Expeditionary Force to Italy, Service Memorandum 3045 EMGG/I dated September 25, 1943, ordered the creation of an SGL (Light Geographic Section).

The personnel designated to constitute this SGL belonged to the SGMA (Military Geographic Service in Africa), commanded by Colonel (temporarily) Adrien Charvet. Among the officers and non-commissioned officers, some came from the SGA (Army Geographic Service), which later became the IGN (National Geographic Institute) in 1940, before being remilitarized after the landings in North Africa. The rest of the personnel were recruited locally in North Africa.

The section was transported to Italy between late November and early December 1943 aboard several ships. A first detachment under the command of Lieutenant Alphonse Bernard (in charge of cartography) left Algeria on November 12th for Tunisia, embarking at Bizerte on November 19th, and arriving in Naples on November 26th, 1943.

A second detachment, commanded by Major Paul Melia with Lieutenant Georges Paillot as his deputy, embarked at Mers-el-Kebir on November 28th aboard the LSI(L) MV Llangibby Castle, disembarking in Naples on December 2nd.

The section arrived in Italy with minimal personnel and resources. It had been partially re-equipped with American equipment but was not as well-equipped as the Allied units already present in the theatre. It utilised topographical and cartographic equipment from the SGMA (General Survey of French Military Information and Communications Technology), originating from the IGN (Institut Géographique National) in North Africa. For map development and

printing, it had a 30x40 photographic studio and a Dorel studio, allowing for limited print runs and lower quality than with an offset press.¹³

The SGL was composed of a mixed Geodesy-Topography brigade responsible for fieldwork and a cartographic element. The actual strength in November 1943 is unknown, but according to Provisional Instruction No. 3690 EMG/1-0 of October 11, 1943, on the organisation and operation of the Army Geographic Group, the theoretical strength of an SGL was 21 men: the section leader, 12 cartographers, and eight men for the mixed Geodesy-Topography brigade.

The cartographers were integrated into the 2nd office of the CEF staff, then based in Maddaloni. Battalion Commander Pierre Daillier commanded the 2nd Bureau, and General Carpentier headed the headquarters.

French and Allied Geographical Units in the CEF Sector

At the US Fifth Army level, there was a South African topographic company of the SAEC (South African Engineer Corps) belonging to the British Tenth Corps, the 46th Survey Company of Major G.E. Marriott, with a large force, including two Geodesy-Topography groups under Captains J. Hill and A.R. Simpson, and a map production group commanded by Captain P.F.F. Banyard. This company carried out triangulation work and was responsible for the reconstruction of the 1st Order, the formation of the 2nd Order, and, in part, the 3rd Order.¹⁴ It had 12 brigades, plus auxiliary personnel necessary for transport, signalling, and related tasks. This company has been working on a major map revision program since it arrived in Italy in October 1943. It has also prepared accurate maps from aerial photographs, updated existing Italian and other maps, and produced specially gridded aerial photographs for the American forces.

Its cartographic section features map reproduction trucks and modern mobile printing equipment, including offset presses.

At the CEF level (army corps level), there are:

¹³ Dorel gelatinography process with image transfer via special heliographic paper.

¹⁴ For a geodesic canvas, we have several orders of points distributed regularly and connected to form chains of triangles. For the 1st order, we have one point per map at 1/50,000, for the 2nd order 15km on average between points, 6km for the 3rd order, 2.5km for the 4th order, the 5th order corresponding to a complementary triangulation to increase the number of points.

- The 1st Brigade Geodesy-Topography Detachment of the SGL (2 brigades from March 1944), intended in principle to replace the American platoon described below.
- An American topographic platoon (Survey Platoon, H&S Company of the 649th Engineer Topographic Battalion), placed at the CEF's disposal and responsible for the rest of the 3rd Order, 4th Order, and eventually the 5th Order, comprising 13 brigades plus auxiliary personnel and transport. It provides support points for the 13th Field Artillery Brigade.



3Staff Sergeant Mathieson hands the finished plate to Sergeant Walker for printing on the mobile printing machine. 46 Engineers Coy - Venafrò Aand Sessa Aurunca area. March 13, 1944.

IWM NA 12843

This platoon, due to the derisory resources of the French detachment, will remain in the CEF sector. The 1st Field Artillery Observation Battalion, under the command of Colonel Ellerson, worked exclusively for the artillery (13th Field Artillery Brigade) and was responsible for the artillery layout itself.¹⁵

¹⁵ The Battalion received the Croix de Guerre with silver star on June 22, 1944, from General Juin for its role in supporting the CEF artillery during the winter and spring campaigns.

Role of the SGL

During the winter campaign, the section provided intelligence situation maps and topographic support points to the artillery in the French sector.

Within the 2nd Bureau, in addition to Major Melia, who led the SGL and ensured liaison with other staff entities and the Allies, the mapping staff consisted of one officer, two non-commissioned officers, and three enlisted personnel, all stationed in two pyramidal tents and one wall tent. They were responsible for fulfilling the studies of the "terrain" section. They were called upon both to edit the completed master plans and to reproduce various base maps, which limited the work of the "operations" section's draftsman to colour overlays. These base maps were periodically revised during significant fluctuations on the front or a change of sector, such as the passage from Abruzzo to Garigliano.

They were also responsible for ordering, storing, and distributing maps resulting from orders



4Sapper Walker is fixing the plate to the printing machine. 46 Engineers Coy – area, March 13, 1944. IWM NA 12844

or operational projects handled by the 3rd Bureau. Most of the maps used by the CEF were

produced by the British, Americans, and South Africans, who had extensive printing facilities at their disposal.

Since the SGL lacked a photo-interpreter to process aerial photos produced by the Tac/R (Tactical Reconnaissance) or the PRU (Photo Reconnaissance Unit) for cartographic product development, this mission was entrusted to the SIP (Photographic Interpretation Section).¹⁶ The SIP, essentially composed of a British officer seconded from the PRU and two French photo-interpreting officers, had no organic equipment except for a truck fitted out for the British officer. It was the SIP that developed master plans based on lists provided by the PRU, thus giving the command an overview of the depth of the enemy defence system.



Sergeant Chef Soyer, a surveyor of the Section Géographique, waits as a map of a freshly surveyed sector is rolled off the light printer Dorel. On the left is Sergeant Chef Martin Sessa Aurunca, April 4, 1944.

A Lack of Resources and Necessary Reinforcements

It was quickly realised that resources within the SGL were insufficient due to its understaffing. Therefore, Colonel Charvet, Director of the SGMA based in Algiers, submitted a proposal for reinforcements in Note No. 3282/SGMA-S dated January 17, 1944.

¹⁶ The Tac/R and PRU personnel were British or American, and the photo-interpreting officers were British.

According to the archives of the 1st Bureau of the General Staff of the CEF, the proposal was accepted, and the 1st Bureau of the EMGG ordered the dispatch of reinforcements, particularly in topography and geodesy, in note No. 749/EMGG-I.¹⁷

As of February 1, 1944, the SGL was renamed Geographic Section (reinforced type) No. 1.

The reinforced SG No. 1 was planned with a theoretical strength of 42 men (4 officers, 13 non-commissioned officers, 25 enlisted personnel). Still, according to various reports, it would be reduced from one to two Geodesy-Topography brigades instead of the three planned in its theoretical composition.

The reinforcement detachment, under the command of Captain Henri LALLEMANT, embarked in Oran on February 26, 1944, and arrived in Naples on March 10.

On March 12, this detachment joined the rest of the geographical section in Venafrò at the CEF headquarters.

The Geodesy-Topography detachment, with the reinforcement personnel and the few elements of the section already on site, was formed.

Between March 14 and 23, the detachment operated for several days in support of the artillery in the Acquafondata-Viticuso region, a heavy artillery deployment zone approximately 10 km from Venafrò. At the same time, Major Jean Turnier, from the 3rd RSM (3^e régiment de spahis marocains), headed the 2nd CEF bureau. He succeeded Major Pierre Daillier, who had been assigned to the 4th RTT (4^e régiment de tirailleurs tunisiens).

Despite reinforcements, the CEF's contribution in terms of geographical units remained low. In a memo dated April 3, 1944 (No. 3728EMGG/1), Colonel Higgins of AFHQ (Allied Force Headquarters) requested a French geographical company. Note 3718 EMGG/1 from the 1st office specified that the 31st Geographic Company would be ready by June 15, 1944.¹⁸

Preparation of the Spring Offensive by Cartographers

The CEF established its headquarters at Sessa-Aurunca on March 29, 1944, when General Juin assumed command of this new sector.

¹⁷ General Staff War

¹⁸ In the order of battle of the 3rd Bureau dated July 4, 1944, this company is stationed in Rabat. It will not be deployed to Italy.

Starting on April 11, 1944, the first two master plans, drawn by SG No. 1, were printed by the South African 46th Survey Company using modern printing equipment.

In the second half of April, a new set of master plans was produced, and the final plan was delivered on May 7, four days before the attack.

Further cartographic work, including six 1:25,000-scale master plans covering the future area of operations, was carried out by the SIP based on aerial photographs.

*French officers work closely with Lieutenant Colonel Loth, head of the "3eme bureau", who chairs the meeting.
Sessa Aurunca. April 4 1944. IWM NA 13733*

Missions of the Geodesy-Topography Detachment



Before the Offensive

On March 23, 1944, with the CEF's change of sector, the detachment received orders to move and set up in San Clemente, north of Sessa Aurunca, 6 km from the Garigliano.

Before the Spring Offensive, from March 24 to May 11, the detachment operated in conjunction with the 46th Survey Company and the 1st FAOB in the CEF sector. On its wings, it also worked with the divisional artillery of the 4th DMM (4^e division marocaine de montagne). The operators worked almost daily in the artillery deployment area or further forward, under the same conditions as the artillery observers.

The stations were distributed in the area between the front and the line marked by Monte Trocchio (5 km southeast of Cassino), Monte Maggiore, Monte Camino, Monte San Croce, Monte Massico (south of Sessa-Aurunca), the Mediterranean coast, Minturno, and Tufo.

The Spring Offensive and the Pursuit towards Siena

From May 11th and the launch of the major spring offensive, the Geodesy-Topography detachment, under the command of Captain Lallemand, followed the advance to the Frosinone region towards Rome:

- on May 13th in the San Giorgio del Liri region (1st DFL sector);
- on May 14th at Monte Maio and Monte Ornito (Aurunci Mountains) in the sector north of Castelforte, then continuing towards Monte Calvo and Vallemaio. From the 17th, the fighting was in the southern sector of Pontocorvo, where the town was captured.



Commandant Melia, chief of the Section Géographique, in Italy

The advance continued from May 27th to 29th, southwest of Ceccano.

From the 31st, the detachment arrived in the Patrica region, southwest of Frosinone.

By this time, the speed of the advance had become such that the detachment was reduced to following the movements of the CEF HQ while maintaining liaison with the 46th Survey Company and the 1st FAOB.

On June 6th, it was located at Prima Porta (north of Rome), then moved west of Lake Vico around June 10th.

On June 16th, it reached Acquapendente, north of Lake Bolsenna, and operated intermittently in the Radicofani–Monte Amiata region.

From the last days of June, the detachment worked in direct and close collaboration with an equivalent detachment of the 46th Survey Company. From June 28th to July 3rd, the detachment participated in operations in the San Quirico d'Orcia-Montalcino, Buenconvento, Poggio Cerrete-Montroni area.

From July 5th to 14th, it operated in the northeast and especially northwest of Siena (Monte Maggio, Casole d'Elsa).

Finally, from July 15th to 20th, it was stationed between Colle Di Val d'Elsa and Monte Riggioni during operations in the Colle Di Val d'Elsa – Poggibonsi – San Gimignano area.

Summary of the results obtained

According to Captain LALLEMANT's reports, the Geodesy-Topography detachment was unable to fulfil its assigned missions due to a lack of resources. It worked at a slow pace incompatible with operational requirements. The reasons for this were the loss of time in liaison due to overcrowding, insufficient personnel in the field, and the lack of auxiliary personnel needed for related tasks. The average age of the force, unlike that of the Allied field units engaged in Italy, was too high, and the demanding work in Italy's very rugged terrain would have required younger personnel.

Despite this, the detachment, composed of highly skilled personnel, performed admirably and contributed to the CEF artillery's remarkable success.

As for the cartographic detachment, it lacked modern printing equipment throughout the campaign and relied on Allied resources for printing. This modern equipment would not arrive

in North Africa until the summer of 1944 to equip the 31st and 32nd Geographic Companies of Army B, which had landed in Provence.

Withdrawal from Italy

At the time of the CEF's withdrawal, the topography/geodesy detachment of SG No. 1 was directed to embark in Brindisi on August 3, 1944, to participate in the landings in Provence. Upon landing in the Bay of Saint-Tropez on August 17, 1944, it was joined by elements from Algeria to become the Geodesy-Topography Section of the 31st CG.

The other elements of SG No. 1 were transported in stages to France to join the 31st CG or other geographical formations.

Major MELIA was assigned to the French Army B Headquarters. He embarked in Taranto on August 5 and landed in Provence as head of cartography, before taking command of the 31st CG on October 23, 1944.

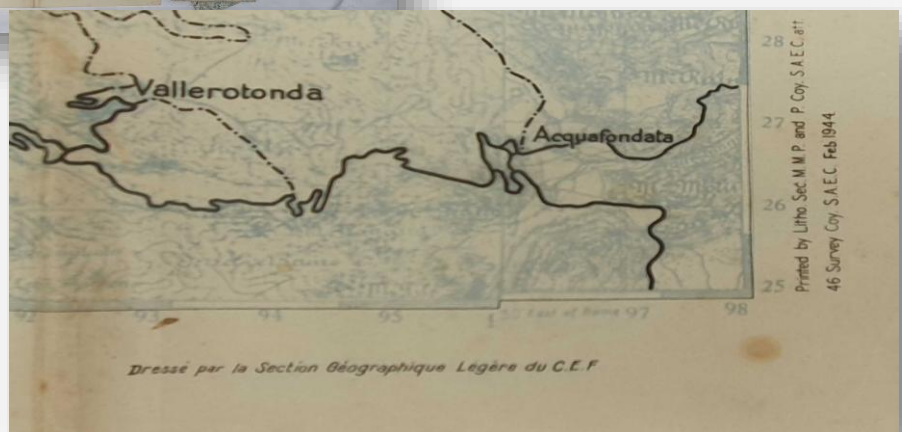
Maps from the Campaign

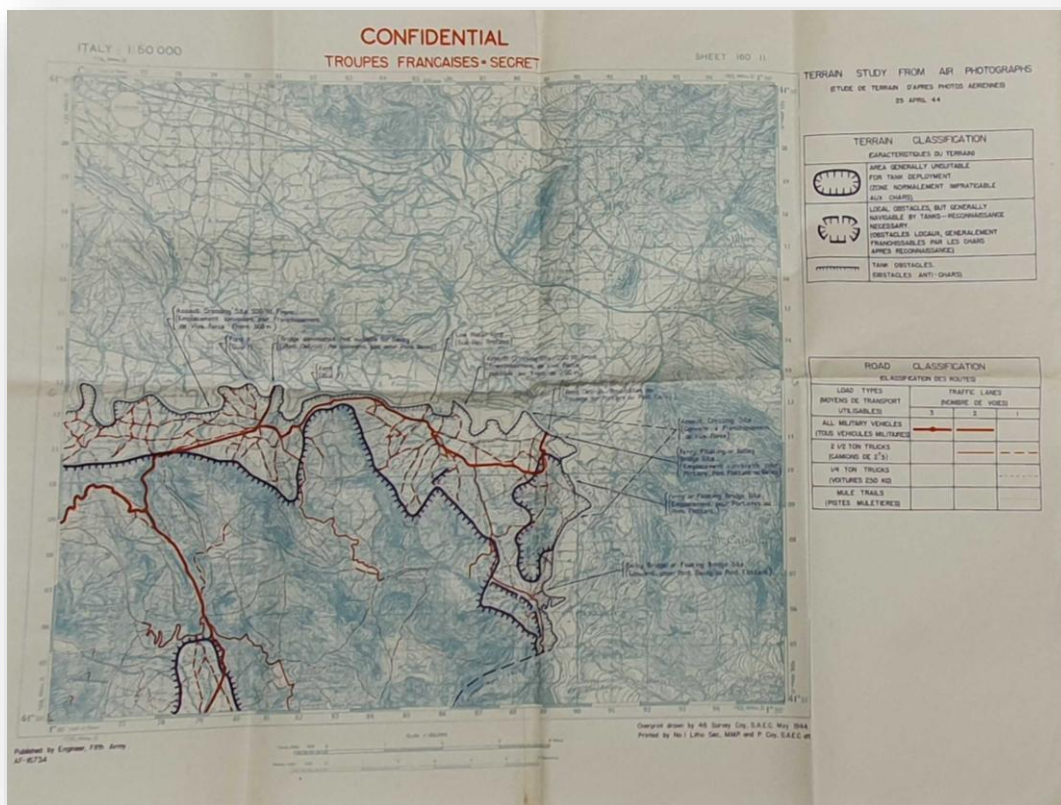
Examples of Maps from the campaign follow this article.



Examples of maps from the French Sector in Italy

Intelligence situation map February 1944 of Belvedere, Mont Cairo sector (North of Cassino)

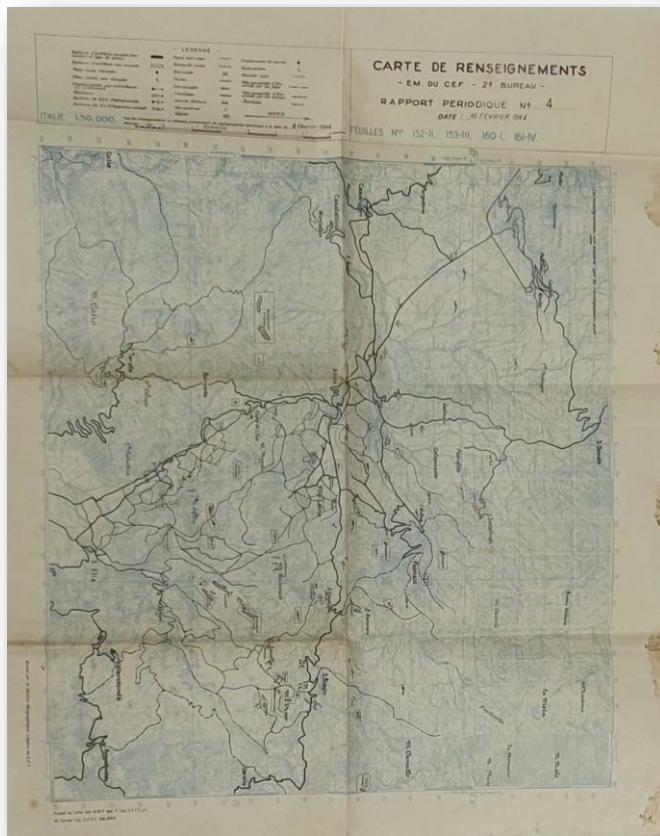




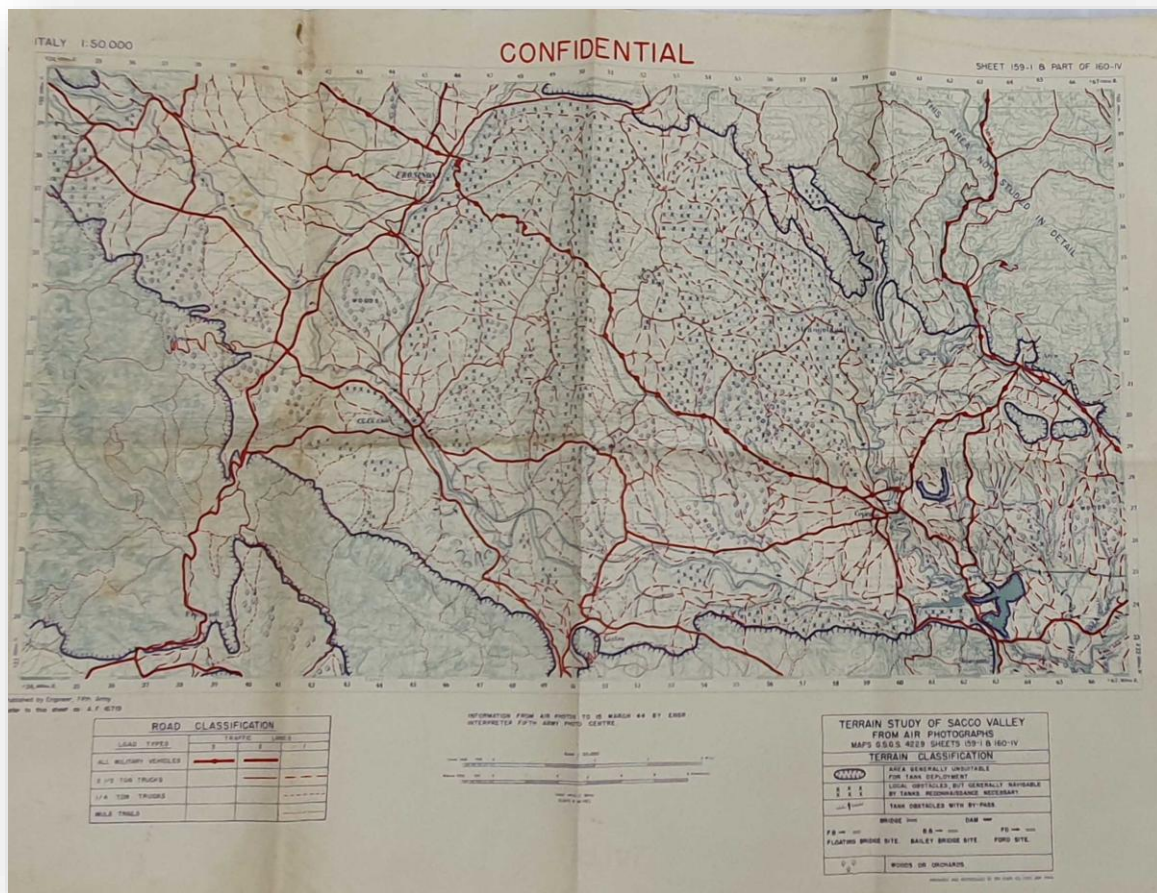
Terrain study drawn by 46 Survey Coy SAEC and printed by SAEC



5 Intelligence situation map in Garigliano valley sector



6 Intelligence situation map in Monti Aurunci sector



Map of the French sector printed by 5th Army US

Some Memoirs of a Deep-Sea Navigator

In this article, John Banfield presents a series of practical experiences and observations on marine navigation, highlighting the challenges and intricacies of modern and traditional navigational tools. Drawing on firsthand accounts, it underscores the importance of reliable equipment, accurate chart reading, and the continuing need for vigilance and expertise in maritime operations. Editor

John Banfield

Following my reading of an issue of Navigation News about the demise of printed charts and the delivery of some leisure vessels without a compass, I have shared some of my personal experiences with navigation and other navigation memories, trusting they will be of interest to readers.

The Fluxgate Compass

One motor yacht had the fluxgate compass sensor unit in a cupboard where the owners had stowed a cylinder vacuum cleaner. The compass was much more helpful when we had removed the vacuum cleaner. Another one had had a fluxgate fitted but not initialised, which fell to me. We read the instructions and followed the procedure, but the compass proved little help. Therefore, we repeated the procedure with the same result. This time, the detector was in a galley cupboard with a metal teapot. Those units were good at sorting out the deviation, but not at coping with very close-by ferrous objects.

Like the traditional magnetic compass, the more modern fluxgate compass also detects Earth's magnetic field, but it measures it electronically rather than merely pointing in the direction of the field. On today's cruising boats, most digital heading data, whether from the autopilot or the masthead wind indicator, is from a fluxgate compass.



A Basic Fluxgate Compass

I saw a more expensive unit at a Workboat Show at Port Solent. The unit could be spun around on a small turntable, and it would automatically correct its position. Knowing how to correct a compass binnacle impressed me. However, when the demonstrator put his Swiss Army Knife on the turntable, the readings were all off. So, he initiated the swing procedure again, and to my amazement, the unit accommodated the Swiss Army Knife!

The Eastbourne Lifeboat had a Gyro Stabilised Fluxgate Compass that was about the size of a box of “After Eight Mints”. I think they were developed for armoured fighting vehicles. These experiences highlighted the challenges with magnetic and fluxgate compasses, emphasising the complexity and intricacy of navigation tools.

In Oman

On an Omani LCM, I decided to try the emergency steering. Another skipper came too. We found an area clear of fishing gear and attempted to steer from the emergency steering position using its magnetic compass. That turned out to be hopeless. The position was over the Port generator. With the Port Gen. running, the compass would indicate between 240°C (Compass) and 270°C if we went in a full circle, while the Starboard Gen. would run between 230°C and 260°C. (We used to work in True, Magnetic, Compass, or Gyro. True being referenced to True North, Magnetic to Magnetic North, Compass being what the Magnetic Compass read due to Deviation, and Gyro was what the Gyro Compass read. By applying Mag Variation to a True Course, the Magnetic Course could be found, then using the Deviation for the heading, and the Compass Course could be found. Deviation is the residual uncorrected error of the compass in the binnacle.

Encountering the need for a gyro repeater to resolve a steering issue was an interesting experience. We had shut it down at night and started it up in the morning. One time, we received an order for something, started the boat up, then moved to the loading ramp to take on the cargo. Upon arriving at the landing ramp, the Electrician asked for the heading so he could process the Gyro to the correct heading. As we were going to be there long enough for



the Gyro to sort itself out, we agreed to let the Gyro do its own thing. The Electrician did not look too happy about the idea, but of course, the Gyro had sorted itself out by the time we sailed.

Beachy Head Day Trips

When I worked on the boats that ran trips to Beachy Head Lighthouse from Eastbourne Beach, we had a magnetic compass in case of fog, but usually used landmarks and the mark one eyeball for navigation. One day, the Owner was with me and accused me of being on the wrong course. So, I politely asked him to remove his mobile phone from under the compass, and we found that we were indeed on the correct course.



Beachy Head Boat Trips and a DUKW

A few years later, the MCA decided we must have our compasses corrected, so they were duly corrected, and all the headings we were used to had changed, some bright idea that was! These experiences underscored the significance of accurate chart reading and correction, reminding us of the weight of responsibility and the importance of our role in navigation.

Rough Water

In the Pacific, on the way to Panama on a 30,000-ton deadweight tanker light ship, we were pounding so much that the Gyro, which was in the steering pedestal, was nodding so much, and the card was swinging about quite a bit; the autopilot could not steer as the heading was changing too much in the waves. We were heading about due East, so we were pretty much lined up with one axis of the gimbal. That meant hand steering had to be used. So Sparks, Radio Officer, with quite a small bit of assistance from me, came up with a way of damping the Gyro nod using a six-inch metal scale, a pencil eraser, and a bulldog clip. There was a suitable frame in the steering pedestal that, with the eraser cut in half and the two halves sandwiching the steel scale, and the bulldog clipped to the frame, allowed the other end of the scale to be positioned to stop the Gyro from going down when the bow slammed down onto the sea. That enabled the course to remain steady enough for the autopilot to steer again.

A Zero Intercept

Years later, a Yachtmaster Ocean student asked if I had ever had a zero intercept when working a sight by Marcq St. Hilaire.¹⁹ I did not remember doing so, but I looked through my old sight books out of interest. We used to take three sights, compare the time interval, and work out two of them. With someone taking the time, it was possible to take sights with 3-minute-of-arc intervals, so, timewise, it was quite a small interval. To my surprise, I found that the two sights had an intercept of 0.1 Away and 0.1 towards. I expect someone to explain why this is not the case, but I like to think the Dead Reckoning Position was spot on. The odd thing is that I do not remember being excited about it at the time.

On one VLCC, I was Third Mate from 12 to 4. One afternoon, I realised I could take a sight of Jupiter on the Meridian at about 15:15 and a Sun sight and have another two sight fixes to plot a few hours after the Noon Sun run. So, after working that little lot out and showing the captain when he appeared about 16:00, I was a little let down when all he said was, “Why would you bother doing that?”

How to Run Aground (Almost)

Another time, the captain — a different one — was not that impressed. He was with a cargo of jet fuel for Nassau. When we arrived, they were not ready to receive the cargo, so we went around to the South side of the island, to South West Bay, I think, to anchor. I arrived on the Bridge at approximately 11:45 LMT for my watch, and the 3/O informed me of the situation and showed me where we would be anchoring. When I saw the chart was black-and-white and had no fold, I was worried. Upon inspecting the Title Block, my worry was proved justified: the chart was in feet, not fathoms. So, our 30-foot draught ship was heading for six feet of water, not the expected 36 feet. So, I communicated to the captain that the chart was in feet, not fathoms, and we went off to drift about until shoreside was ready for us, and not another word was said about what might be called a near miss.



A 30-foot draught!

¹⁹ The **Intercept method**, also known as the **Marcq St. Hilaire method** after the French Navigator who devised it in 1875, is a method of establishing a fix by measuring the altitude of a celestial body from the true position and comparing this with the calculated altitude at the [DR position or the EP](#). The difference between the two altitudes will be equal to the distance between the two positions and this distance is known as the intercept.

Things Happen

I remembered an occasion when we were initiating a pipeline that ran along beside the Suez Canal. I say 'initiate,' as our 270,000 tonnes were needed to fill the pipeline and push part of the Crude Oil out at the Mediterranean end; ours was the third cargo required to do so. I have been wondering whether the pipeline was somehow sectioned off with no return valves, or whether a pipe-cleaning pig was used to separate cargoes, as in 'Octopussy,' where 007 gets someone across the border using a pipeline pig. During discharge, we had been adding ballast and stopped the ballast pump, having warned the Engineers on watch first. However, the ship then blacked out. The emergency generator kicked in very quickly, but I still hurried to the gyro room to see if the pins needed to be inserted into the gyros to prevent them from toppling. They were ok, so that was fine, no issue there. On the way back to the cargo control room, the Second Mate and I encountered one of the Junior Engineers explaining to someone that they had blacked out the ship by running both washing machines and both spin dryers at the same time. It was more believable when the Second Engineer explained that, when we stopped the ballast pump, a small amount of excess steam remained in the system, which caused the steam turbine alternator to overspeed and trip out. Interesting times!

A Happy Ending

Then there was a magnetic compass with a tinted Perspex dome. The tint had been baked out by the Sun beating down on it, so the compass bowl tended to overheat and form an air bubble. Some of the alcohol boiled off and escaped during the day, and air was drawn in as it cooled overnight. This had been going on for a while, so a massive bottle of medicinal alcohol was kept on the bridge. So after a bit of a close look at the dome, I realised that the fittings on the dome lent themselves to adding some sections of old chart to form a paper parasol inside the dome to keep the bowl a little cooler, with the fluid topped up from the alcohol bottle, we and the compass were all much happier.



The Boyhood of Raleigh - John Everett Millais

I hope that you, the reader, have found some of my reminiscences of interest. John Banfield

DSA Seminar September 2025

Operation Granby

On Tuesday, 23 September 2025, the DSA Hosted a seminar at Newbury, Berkshire, with the focus being on Operation Granby. The venue was the Newbury Rugby Club.

Operation Granby was the codename for the British military operations during the 1991 Gulf War, aimed at liberating Kuwait following Iraq's invasion in August 1990. It marked the UK's most significant military deployment since World War II, involving 53,462 personnel across land, sea, and air operations.

The event had a great turnout, with all the excellent speakers sharing diverse insights and experiences related to Operation Granby. The program addressed many aspects of the operation, all presented by participants. The DSA appreciates the presenters for their valuable contributions and thanks the attendees for their support and active participation in the discussions throughout the day.



The Presentations

The DSA Chairman, Christopher Nash, opened the event by discussing how the initial battle plan for an amphibious landing along the East Coast was revised. An intelligence assessment by Military Survey and the Royal Engineers revealed that this plan faced serious risks due to the obstacles and defensive structures erected by Iraqi forces. Consequently, the offensive strategy was adjusted after consultations with the British Permanent Joint Headquarters, CENTCOM, and U.S. forces to employ a "left hook" approach, targeting Kuwait from the west. Considerable mapping effort was required from the Defence Mapping Agency and the Military Survey teams to support this joint initiative, with Ian Spencer from the Mapping and Charting Establishment later outlining these efforts.



Nick Rigby

Nick Rigby, who commanded the 14 Independent Typographic Squadron stationed in Germany at the outbreak of the war, shared valuable insights about the squadron's deployment to Iraq, where they established a defensive position in the forward area. As news of the survey squadron's presence spread, awareness of its diverse capabilities and support roles increased significantly, highlighting the crucial function this unit served in the operation. This heightened demand led to the deployment of two survey semi-trailers (print and guillotine) that were initially destined for a museum, thereby enhancing production capabilities. The experience underscored the importance of forward deployment for survey support.



General de la Billière is greeted by 14 Squadron's OC, Nick Rigby, during a visit to the unit's desert base. Photo: Nick Collins.

Nick Fickling

The coalition troop deployment saw British forces increase from a brigade to a division, and the Royal Air Force's essential role required better coordination between the UK and U.S. mapping agencies, leading to the establishment of a joint geographic cell in the theatre of operations. Nick Fickling, deployed from the UK, quickly resolved a navigation issue faced by the U.S. Air Force, thereby avoiding being labelled “just another Royal Engineer.” Rather than delivering a formal presentation, Nick shared his personal experiences in a relaxed manner through a series of questions and answers, emphasising that effective geographic support requires integration at all levels of the command structure to comprehend challenges, identify needs, and provide efficient assistance.

Mike Shrives

Mike Shrives highlighted the Royal Navy's significant contributions during the conflict. While the Army and Air Force often dominated media coverage with their dramatic visuals and the noise of attacks, the Navy played a critical role, particularly in mine-clearance operations. Mike drew attention to the dangers faced by divers who had to swim close to mines, place explosives, and retreat quickly, all while hoping the mine wouldn't detonate. Their professionalism and bravery were truly commendable.

The Royal Navy's influence during the conflict was evident, primarily through its Westland Lynx helicopters, which effectively dismantled much of the Iraqi Navy at the Battle of Bubiyan, helping to secure coalition operations. Royal Navy minehunters cleared mines in the vicinity of Kuwait, allowing U.S. Navy battleships like the Wisconsin and Missouri to bombard Iraqi positions. Furthermore, HMS Gloucester successfully intercepted an incoming Iraqi Silkworm missile, demonstrating the Royal Navy's air defence capabilities. Additionally, Royal Fleet Auxiliary ships, such as RFA Argus, played a vital role by providing medical assistance for injured personnel.

On a broader scale, the Navy was crucial in keeping sea lanes open for logistics and combat operations while enforcing the coalition embargo against Iraq through naval patrols and maritime interdiction, thus limiting the flow of goods and military supplies to Iraqi forces.



Chris Finn

During Operation Granby, Chris Finn was stationed at the Coalition Air HQ in Riyadh, overseeing air operations for "Operation Desert Storm." This operation, which commenced on January 17, 1991, involved a large-scale aerial bombing campaign targeting Iraqi military installations and infrastructure in both Iraq and Kuwait. The main goal was to disrupt Iraqi command and control systems, air defences, and missile sites.

The offensive included stealthy strikes by F-117 Nighthawk bombers and cruise missile launches from B-52 bombers, as well as naval vessels, all supported by electronic warfare aircraft.

In total, over 100,000 sorties were conducted, successfully establishing air superiority that facilitated precision bombing and limited the operations of the Iraqi Army.



Ian Spencer

Ian Spencer joined Military Survey shortly before the Gulf War. He emphasised the challenges of meeting the mapping demands during the conflict. Initially, as the war began, mapping was insufficient for full-scale operations; while Kuwait was well mapped, Iraq had significant gaps in its mapping. The use of different spheroids and grid systems further complicated the situation.

As combat aircraft were deployed, the focus shifted to creating the necessary air charts. By September 14, the demand for mapping had increased significantly, necessitating the production of 1,200 map sheets at a scale of 1:50,000 and 85 sheets at a scale of 1:250,000. The UK committed to supporting the US production of enough maps for coalition forces, ultimately producing over 80,000 copies of some sheets.

By leveraging a variety of resources, including apprentices and commercial printers, map production soared to more than 14.6 million sheets within four months. This effort showcased the professionalism of the Mapping and Charting Establishment and its associated organisations.

The Presenters

Nick Rigby

Nick Rigby commanded 14 Topographic Squadron in the Gulf. He was commissioned into the Corps of Royal Engineers in 1977 after studying at King's College London and University College London. He served in what was known as 'Military Survey' (now RE (Geo)), with a career marked by a mix of command and staff roles during the Cold War. Key highlights include resolving boundary issues in the Kuwait/Iraq region in 1990/91 and spending a year in Bosnia Herzegovina in 1996 to implement the Dayton Peace Agreement. His final years involved alternating tours in the US, Germany, and the UK MoD, culminating in a role commanding surveyors in Hermitage, Newbury. He spent his last 10 years in Defence Intelligence.

Nick Ficklin

Nick retired in 1996 after a 26-year career in the Royal Engineers and Military Survey. Following Iraq's invasion of Kuwait in 1990, he was seconded from the School of Military Survey to the Allied Joint Headquarters in Riyadh, Saudi Arabia. There he served as SO1 Joint Geo in both General de la Billiere's Op Granby HQ, under ACOS J3 (Ops), and in General Schwarzkopf's Op Desert Storm HQ (USCENTCOM), under BG Leidi the COS J2 (Int). Joint Geo was in the old Gulf Cooperation Council Building in Riyadh, on the floor above the UK Op Granby HQ, and conveniently located next door to Wendy's Burger joint. On his team were officers and soldiers from the UK Military Survey, US CENTCOM, the US Defence Mapping Agency, and, occasionally, officers from the Saudi Military Survey.

Mike Shrives

Mike Shrives retired from the Royal Navy in 2007 as a Commander after a diverse career. He served 17 years as a ship's diver, followed by 3 years in the Submarine Service, before transitioning to the Fleet Air Arm as a pilot. He participated in the Falklands War, commanded the mine-countermeasures vessel HMS CATTISTOCK during the Gulf War, and received a Mention in Dispatches. His final flying role was as Senior Pilot of the Lynx Helicopter in Maritime Counter Terrorism. He later served as Aviation Commander at the Admiralty Interview Board and gained a Master's degree in Defence Studies at King's College, London. His last position was as Chief of Staff for a NATO assignment in Norway.

Chris Finn

Chris Finn joined the RAF in 1972 as a navigator, flying mainly the Buccaneer and specialising in electronic warfare and tactics. During Operation GRANBY, he served as the UK's "SO1 Bucc" in the Coalition Air HQ in Riyadh after being promoted to Wg Cdr. His last flying tour was as Officer Commanding the Navigator and Airman Aircrew School. A graduate of the Joint Services' Defence College, he earned an MPhil in International Relations from Cambridge University in 1999 and later became the Director of Defence Studies (RAF). From 2005 to 2015, he was a Senior Lecturer in Power Studies at the RAF College Cranwell. Chris is an Accredited Battlefield Guide specialising in airpower and combined operations and frequently lectures on RAF history while also volunteering with the BBMF and CWGC.

Ian Spencer

Ian Spencer has been the Director of the Defence Geographic Centre (DGC) since 2015, overseeing multi-domain Foundation Geospatial Intelligence and collaborating with organisations such as the UK Hydrographic Office and the Met Office. He is also the Departmental Head of the Government Geography Profession at the Ministry of Defence. A geography graduate from Royal Holloway, Ian is a Chartered Geographer, Chartered Manager, Fellow of the Royal Geographical Society, and holds an MBA from Imperial College. He began his career as a Mapping and Charting Graduate Trainee in 1990 and has over 35 years of experience at DGC, contributing to mapping efforts during Op GRANBY.

The Congo–Northern Rhodesia (DRC–Zambia) Boundary



CENTRAL AFRICA 1903 – The Congo – BASC (Northern Rhodesia)

The Congo–Northern Rhodesia (DRC–Zambia) Boundary

Part 1: Introduction and Summary

“[we] have been engaged in drawing lines on maps where no white man's foot ever trod; we have been giving away mountains, rivers, and lakes to each other, only hindered by the small impediment that we never knew where the mountains and rivers were and lakes were.”²⁰ Lord Salisbury, 1890:

The boundary's positioning was heavily influenced by economic interests, especially in copper mining, and reflected the priorities of colonial governments rather than the needs and concerns of local populations. The work of these commissions laid the groundwork for the modern DRC-Zambia border and set a precedent for boundary demarcation across Africa.

The formal establishment of this boundary began with a series of colonial treaties and commissions initiated in the late 19th century, particularly the Berlin Conference of 1884–1885, which sought to regulate European colonisation and trade in Africa. Additionally, the 1894 Anglo-Congolese Treaty was significant in shaping the region's political landscape.

The boundary between what is now the Democratic Republic of the Congo (DRC) and Northern Rhodesia—now known as Zambia—was not simply a result of geographic considerations but was primarily shaped by imperial ambitions, economic interests, and the advancements in technical mapping and surveying. However, this demarcation was also influenced by the ambiguities and conflicts that arose during its establishment.

The legacy of these colonial decisions is still felt today in the modern borders of the DRC and Zambia, reflected in enduring challenges of boundary management and state-building that affect many African nations.

The Boundary Commissions

Early boundary-making processes were often characterised by a heavy reliance on mapping and theoretical lines, frequently overlooking the complexities of local realities and tribal divisions. Boundaries were commonly drawn using natural features such as rivers and lakes, or by straight lines, yet these demarcations were not always physically marked on the ground.

First Anglo–Belgian Commission (1911–1914)

The initial Anglo-Belgian boundary commission operated from 1911 to 1914, focusing mainly on surveying and mapping the region. This effort resulted in the installation of only 46 boundary markers, spaced far apart. Unfortunately, many of these markers were only temporary. They could be easily removed or damaged by residents, leading to disputes and administrative complications stemming from unclear boundary lines—especially in economically vital areas rich in copper.

The markers erected did provide clarity on maps, but were not readily identifiable on the ground due to their sparse placement. Challenging terrain, limited resources, and various logistical difficulties hampered the surveying process. Additionally, the outbreak of World War I disrupted the commission's activities, leaving several sections of the boundary unmarked.

²⁰ 1 H.S. Wilson, *The Imperial Experience in Sub-Saharan Africa Since 1870* (St. Paul: University of Minnesota Press, 1977), 95

British Military Surveyors played a crucial role in this endeavour, utilising advanced geodetic techniques available at the time for surveying and mapping activities.²¹ Personal accounts, such as those from Stewart Gore-Browne, reveal the frustrations, bureaucratic delays, and lack of consideration for local realities that characterised the boundary-making process, highlighting the complexities involved in such colonial enterprises.

Second Anglo–Belgian Commission (1927–1933)

A second, more comprehensive Anglo-Belgian commission operated from 1927 to 1933 and made significant efforts to improve the boundary's visibility and permanence. This commission marked the border with concrete pillars every 500 metres, making it the costliest colonial boundary demarcation project in Africa at the time. The commissions faced substantial logistical challenges, including rugged terrain, limited resources, and the need for large teams of surveyors and labourers. Additionally, maintaining the boundary markers proved to be problematic.

The commission undertook some of the earliest geodetic surveys in the region, establishing triangulation networks that would serve as the foundation for future mapping and boundary maintenance. The Katanga triangulation was an integral part of larger geodetic networks, significantly improving the accuracy of territorial divisions. The maps and documentation generated from these surveys have been carefully preserved in archives, where they continue to stand as vital historical records.

Part 2: At Last - The Belgian Congo - Northern Rhodesia Boundary 1894-1914

The Congo-Northern Rhodesia border is approximately 1,493 miles (2,388 kilometres) long. This boundary extends from the tripoint with Tanzania in the northeast to the tripoint with Angola (Congo and Northern Rhodesia) in the southwest. It follows a combination of straight lines, rivers, and watersheds.²²

Maps Over Marks – The Boundary Commissions

The 1911-1914 Anglo-Belgian Boundary Commission was one of Africa's last British colonial boundary commissions before World War I. However, the commission prioritised mapping over marking boundaries.

For anyone standing by one of the 46 pillars erected by the 1911 -1914 Anglo-Belgian Boundary Commission, determining the exact location of the boundary could be challenging. While a narrow path was initially cleared for surveys, it soon became overgrown and difficult to navigate. However, on a map, the boundary appeared as a clear line connecting recognisable pillars. This concept of the boundary as a fixed point was mainly accessible to those skilled at reading maps.

There was no national or international standardisation for boundary marking. Many commissions received little guidance on constructing boundary marks. For example, the 1898-1899 Anglo-German commission was instructed to build beacons as permanently as possible with available materials, resulting in wooden posts approximately three meters tall, surrounded by stone heaps.²³

²¹ “Military Surveyors is not specifically Royal Engineer Military Surveyors but includes others with a survey background.

²² Democratic Republic of the Congo–Zambia Land Boundary | Sovereign Limits.
<https://sovereignlimits.com/boundaries/drc-zambia-land>

²³ The 1898-1899 Anglo-German commission in Africa was a diplomatic negotiation that arranged colonial territorial adjustments involving German and British spheres of influence, particularly concerning Portuguese colonies, to prevent conflict and facilitate expansion of their respective empires in Africa.

Similarly, the Congo-Uganda boundary commission in 1910 was instructed to use stone pillars numbered for map purposes despite challenges posed by a lack of stone. The British War Office encouraged the use of temporary beacons.

Boundary pillars set up by early commissions were often crude and unlikely to last long. The iron pipes favoured by the Anglo-Belgian commission were repurposed by local people into tools, prompting their removal. Cairns of stones were also popular, yet locals often dismantled them not as a protest, but to use the stones for building kraals and sharpening tools. The least durable markers were tree trunks marked or “blazed” with a distinctive mark.

Early colonial boundary commissions often deviated from the original treaty boundary descriptions due to limited time and resources, opting to save costs by erecting fewer pillars. For example, in 1908, Sir W.E. Goschen suggested that the Nigeria-Cameroon boundary should follow natural features, such as rivers, citing the advantage of requiring fewer boundary markers. He recommended that the frontier line align with the Jeï River rather than be set further east, emphasising the challenges of marking boundaries in unexplored tropical regions.²⁴

Major E.H. Hills summarised the British approach to colonial boundary demarcation in a 1906 article, emphasising that the focus was on identifying a boundary that could be surveyed within a set timeframe and budget rather than selecting the best possible line.²⁵ Natural features like rivers and watersheds were preferred because they were seen as linear, fixed, and visibly identifiable.

Congo Northern Rhodesia Boundary

The boundary between the Congo (now the Democratic Republic of the Congo, DRC) and Northern Rhodesia (now Zambia) is a product of late 19th and early 20th-century European imperialism. Its creation was deeply influenced by the Berlin Conference of 1884–85, which set the rules for the European partition of Africa. The conference established the principle that colonial powers were permitted to claim African territories only upon demonstrating effective occupation. This led to rapid land appropriation and boundary delineation, often without regard for local conditions.

Before colonial rule, most African boundaries were undefined, with only a few exceptions in settler territories such as Algeria, Morocco, and Basutoland. The Congo–Northern Rhodesia boundary, stretching approximately 1,493 miles (2,388 km) from the Tanzania tripoint in the northeast to the Angola tripoint in the southwest, was defined by a combination of straight lines, rivers, and watersheds.

Treaty Foundations

The 1894 Anglo–Congoese Treaty was the first formal attempt to define the boundary between the Congo Free State (later Belgian Congo) and British-controlled Northern Rhodesia. The treaty relied heavily on natural features such as rivers (notably the Luapula), lakes (Mweru, Bangweulu, Tanganyika), and watersheds, but these features did not always correspond to the realities on the ground or to the territories of local communities.

The Congo Free State, under King Leopold II, and the British South Africa Company (BSAC), led by Cecil Rhodes, were the main colonial actors involved. Both sought to secure their

²⁴ In 1908, E. W. Goschen held the role of British Ambassador to Germany. He began this position in 1908, succeeding Sir Frank Lascelles, and served as ambassador until the outbreak of the First World War in 1914. His advice was based on his lack of knowledge of the countries or surveying techniques. While natural features provide visible and seemingly logical boundary markers, their physical variability, legal ambiguities, and disconnect from human realities make them problematic as stable, uncontested boundaries.

²⁵ Major E. H. Hills was a principal member of the Anglo-Belgian Boundary Commission (1911-1914) that surveyed, negotiated, and physically demarcated the boundary between Northern Rhodesia and the Belgian Congo, helping to resolve complex territorial disputes arising from ambiguous natural boundaries in the region.

territorial claims through treaties and, when necessary, through military expeditions and negotiations with local leaders.

Early Commissions and Practical Challenges

The first Anglo–Belgian boundary commission (1911–1914) was tasked with surveying and marking the boundary. However, its work was hampered by rugged terrain, limited resources, and logistical challenges. The commission focused more on mapping than on physically marking the boundary, erecting only 46 widely spaced markers. These markers made the boundary clear on maps but left it ambiguous on the ground, especially for local populations.²⁶

A Boundary Commission at Last

After several unsuccessful attempts, the demarcation of the Belgian Congo–North East Rhodesia boundary gained momentum in the summer of 1910. The British South Africa Company (BSAC) directors met with L.A. Wallace, the acting administrator of North Western Rhodesia, to discuss the "delimitation" of Northern Rhodesia's boundaries.

Wallace emphasised the importance of demarcating frontiers based on latitude and meridian lines. Until this was done, officials would lack accurate knowledge of their territorial limits, potentially leading to friction between neighbouring administrations and unrest among local populations.

On June 28, 1910, the BSAC formally appealed to the Colonial Office (CO) for assistance in boundary demarcation. They specifically requested the demarcation of the boundary between Lakes Mweru and Tanganyika and the Congo–Zambezi watershed, as these areas were not distinct.²⁷

Brodie's letter distanced the BSAC from earlier boundary discussions, clearly stating the government's responsibility for survey and demarcation. He proposed appointing an International Commission, involving British officers.

Wallace also likely established influential contacts with officials from the Colonial Office, Foreign Office, and War Office during discussions in 1905, including Major Charles Close, a former boundary commissioner poised to become the Director-General of the Ordnance Survey in 1911.²⁸

In March 1911, the British Treasury approved funding for the commission, with the British South Africa Company providing some escort support. Ongoing negotiations between the British and Belgian governments culminated in a meeting on September 1, 1911, at the Congo–Zambezi watershed, where the commission divided into two groups to focus on different sections.

The commission's main task was to survey and map the borderland area, focusing on two controversial endpoints: "Cape Akalunga" on Lake Tanganyika and the Belgian town of

²⁶ (2010). Marking Territory: Demarcation of the DRC–Zambia boundary from 1894 to now. <https://core.ac.uk/download/85414.pdf>

²⁷ While there is limited archival material explaining the immediate impact of the BSAC's request, it may have been influenced by L.A. Wallace's capabilities, demonstrated through his published survey of the Luapula River in 1907.

²⁸ Major Charles Close had significant involvement in Africa primarily through his work as a surveyor and British official in the late 19th century. In 1895, Close was transferred to Africa, where he surveyed boundaries in previously unmapped bush areas. He returned in 1898 as a British Commissioner, continuing his work on surveying and administration in the region.

His African service was part of a broader military and surveying career, including postings in India and Nigeria, where he worked on topographic and boundary surveys. His African boundary surveys were crucial in defining colonial borders, notably between British and German territories, such as the border with German Cameroon

Mpweto on Lake Mweru, both to be mapped at a large scale. Only the watershed section was marked for demarcation, leaving the meridian section unmarked for potential future adjustments. Detailed topographic survey instructions were provided, but guidance for demarcation was less specific. Boundary pillars were to be erected along the ideal watershed, with the boundary deflecting by no more than 2 kilometres around any villages to keep all land in one territory. The only guidance on pillar construction stated that frontier posts would be made of masonry or cement and numbered for inclusion in maps and protocols. This emphasis on mapping rather than actual demarcation reflects a broader trend among British colonial boundary commissions in Africa.

The Belgian and British sections of the commission worked separately along three boundary sections (watershed, meridian, and Lake Mweru-Tanganyika), which complicated efforts to form a comprehensive narrative of their work. The primary sources for the British section's activities include Major R. Walker's 1914 reports, E.A. Steel's 1917 article in the *Geographical Journal*, and recollections from Sir Stewart Gore-Browne, published in the *Northern Rhodesia Journal*.²⁹

The commission began its work in September 1911 but was frequently delayed due to a shortage of local carriers in Northern Rhodesia. With only one rail link available, local manpower was crucial for field supplies, and the armed escort primarily maintained discipline among the porters.

Mapping remained the commission's primary focus. In autumn 1912, the commission began surveying triangles from the northernmost point of the 30° E meridian. Both parties communicated regularly and constructed beacons together. By February 1913, the commission split into two groups: one worked on the Mweru-Tanganyika section, while the other moved to meet the Anglo-Portuguese boundary commission at the tripoint with Angola.

Boundary demarcation became a topic of discussion by the end of February. On February 28, Belgian Ambassador Lalaing suggested that local officials manage the demarcation, with commission members marking only the more difficult areas. However, Sir Edward Grey countered this view, insisting that the boundary commissioners were essential for mapping the frontier and marking it with pillars due to their technical expertise, which local officials typically lacked. He believed that local officials could only identify prominent geographic features.

The Border Surveyed

In July 1910, the British Foreign Office proposed an Anglo-Belgian mixed commission to survey the boundary between the Belgian Congo and Northern Rhodesia, beginning where a new railway crossed the watershed. The British request for demarcation to allow for adjustments was vague. The Belgian government agreed but suggested marking the entire boundary from the tripoint with Portuguese West Africa (Angola) eastward. Brigadier Wilson, who drafted the proposal, prioritised the eastern sections due to administrative and railway concerns, estimating the survey would take two years.

Part 3: The Second Boundary Commission and Technical Advances - Renewed Efforts and Economic Motivations – 1927 to 1933

By the 1920s, disputes over the boundary persisted, particularly in mineral-rich areas such as Katanga and Northern Rhodesia. The economic stakes were high, with both British and

²⁹ Some of the archive material related to the 1911-14 Anglo-Belgian boundary commission kept in the British Public Records Office (now the National Archives) may have been destroyed during the Second World War. The records of the boundary commission are also held in files CART 2071, 2073 and 2078 (B15) at the African Archives of the ex-Ministry of African Affairs, Belgian Foreign Affairs, Brussels

Belgian authorities eager to secure access to valuable copper deposits. Mining companies and colonial administrations pushed for more precise demarcation to protect their interests.

In response, a second Anglo–Belgian boundary commission was established in 1927. This commission operated until 1933 and was notable for its comprehensive and expensive approach to demarcation. Unlike the earlier commission, it placed boundary markers every 500 meters, making the boundary much more visible and permanent. In 1927, Brigadier Winterbotham undertook a tour of survey departments throughout the British Empire, and his itinerary included a visit to the Anglo-Belgian boundary commission in the field. When reporting back on his visit, he suggested that the commission would require an additional four to five years to complete demarcation, stating in his report to the Colonial Office: ‘It is to be remembered that we are considering a new type of demarcation, so close as to resemble that of Europe.’³⁰

Surveying and Mapping Innovations

The commissions conducted some of the earliest geodetic surveys in the region, establishing triangulation networks that served as the basis for later mapping and boundary maintenance. The Katanga triangulation, for example, was integrated into broader geodetic networks, enhancing the accuracy of territorial divisions. These surveys used advanced (for the time) techniques, including the Clarke 1866 ellipsoid as a reference, and established fundamental triangulation points that linked the Congo and Northern Rhodesia geodetic networks.

Maps and documentation from these surveys were meticulously created and have been preserved in various archives, including the UK National Archives. They remain essential historical records, illustrating the surveyed boundary, the locations of boundary markers, and the relevant geographic features determined by the commission’s findings.

Logistical and Environmental Obstacles

The commissions faced significant logistical challenges. The terrain was often remote, rugged, and difficult to traverse, with dense forests, rivers, and seasonal weather (rains, mists, and smoke from field burning) complicating the work. The need for large numbers of surveyors, officials, and labourers made the undertaking both time-consuming and costly.

The maintenance of boundary pillars became another pressing issue. With little to no upkeep, many markers were lost or damaged, creating ambiguity and disputes in subsequent years.

Political and Economic Tensions

Economic interests, particularly copper mining, heavily influenced the boundary’s location. British and Belgian authorities prioritised mapping and control of mineral resources over the interests of local populations. Mining companies, such as the Rhodesia Congo Border Concession Ltd. and Minerals Separation Ltd., lobbied for more precise demarcation to secure their concessions and avoid disputes.

Disputes persisted, especially in mineral-rich areas, due to differing interpretations of maps and to the region’s economic importance. The lack of clear demarcation sometimes led to administrative problems and local conflicts, as colonial officials and local communities struggled to navigate the ambiguous border.

Human Dimension and Personal Accounts

Personal accounts from participants in the commissions, such as Stewart Gore-Browne, provide insight into the human dimension of the work. Gore-Browne described the commission’s work as slow, bureaucratic, and often frustrating, with disregard for local tribal boundaries and difficult working conditions. He recounted the challenges of working in remote, uncharted territory, the personal conflicts among officers, and the impact of the work on local communities.

³⁰ Journal of Historical Geography, Volume 34, Issue 3, July 2008, Pages 471-493

Lasting Effects on African Borders

The boundary demarcated by the commissions remains the basis for the modern DRC–Zambia border. The process set a precedent for boundary demarcation in Africa, influencing later colonial and postcolonial boundary work. The transformation of boundaries into fixed, bilateral, and linear entities was critical in establishing modern state sovereignty, as European powers imposed these delineations upon the African landscape.

Despite the commission's efforts, some disputes and ambiguities persisted, mainly where natural features were used as boundaries. The complexities of economic interests, especially in mineral-rich areas, further exacerbated boundary-related tensions and negotiations, which continued long after the commission concluded its work.

Technical and Institutional Legacy

The work of the Royal Engineers and other technical experts provided the foundation for modern surveying and mapping in the region. Their efforts established geodetic networks, produced detailed maps, and set standards for future boundary commissions. The technical legacy of these surveys continues to influence land administration, mining development, and international relations in the region.

Reflection on Colonial Boundary-Making

The Congo–Northern Rhodesia boundary exemplifies the broader patterns of colonial boundary-making in Africa: the imposition of artificial borders, the prioritisation of imperial and economic interests over local realities, and the enduring consequences for postcolonial states. The story of this boundary is not just a tale of lines on a map, but a reflection of the complex interplay among geography, politics, economics, and human experience in shaping modern Africa.

A Premature End?

From 1913 to 1914, the boundary commission surveyed the watershed, finally reaching the tripoint with Angola at the 24° E meridian in early spring 1914. The survey was challenging due to the flat terrain west of Ndola, which required the construction of wooden beacons and platforms. This demand for manpower, along with seasonal rains and transport issues, significantly slowed progress.

After establishing the tripoint with the Anglo-Portuguese commission, the Anglo-Belgian commission erected 35 boundary pillars (numbered BP 11–BP 46) along the watershed. Most pillars were made from iron piping, contrary to the original instructions for concrete or masonry, which were not readily available in the needed quantities. Some pillars consisted of iron rails set in concrete bases.

By April 1914, demarcation to BP 11 was complete; however, the contract period for many carriers had already ended. Without adequate transport, the British contingent faced a three-month wait to recruit new carriers from elsewhere in Northern Rhodesia. Major Steel, a British commissioner, had received complaints about his treatment of local carriers.

With the outbreak of World War I, the War Office was hesitant to have British officers remain idle in Africa for three months to demarcate a short colonial boundary, considering it of little importance. Nonetheless, the British government proceeded with the work.³¹

³¹ By 1914, the partition of Africa was virtually complete. The only boundaries that remained to be drawn were: 1) those in the Sahara, 2) the outstanding subdivisions of colonial Africa, and 3) adjustments arising from the First World War. These boundaries were eventually mainly resolved by strategic decisions. The subdivisions of the French empire came and went; for example, Upper Volta appeared in 1922, disappeared in 1932, and reappeared in 1948. Boundaries between French

The British government agreed with Belgian recommendations to mark the remaining portion of the watershed boundary. Since the watershed had already been surveyed and the coordinates of the Mpanta meridian (29° 48' 52.75 E) were established in 1912, there were no objections to a Belgian survey team finishing the demarcation from Boundary Pillar 11 to the meridian. In June 1914, this team erected ten boundary pillars, including BP 1 at the meridian turning point.

The reasons for the uneven spacing of the pillars, which varied from 5 to 25 miles, remain unclear, with an average distance of about 15 miles. Some triangulation beacons were accepted as boundary pillars, while many were not integrated into the triangulation network, complicating accurate positioning. The British contingent was eager to complete the demarcation quickly after returning from the Angola tripoint. Still, actual boundary marking was a low priority compared to the critical task of identifying and mapping the watershed. This mapping required the expertise of an imperial boundary commission.



Rhodesia-Congo Boundary

Date: 1911-1942 Reference: WO 408/43 (13) Creator: War Office, Armed Forces, Judge Advocate General, and related bodies Catalogue context: Original Survey Sheets: register of compilation material, mostly relating to international boundary commissions and air surveys

Part 4: An Account of the 1911 to 1914 Border Survey - Stewart Gore-Browne's Disappointment

Personal accounts from participants in the commissions, such as Stewart Gore-Browne, provide valuable insight into the human dimension of the work. Gore-Browne described the commission's work as slow, bureaucratic, and often frustrating, with disregard for local tribal boundaries and difficult working conditions. He recounted the challenges of working in

territories were never fully completed, leaving some issues unresolved after independence, particularly between Algeria and Morocco.

remote, uncharted territory, the personal conflicts among officers, and the impact of the work on local communities.

Stewart Gore-Browne

Lieutenant Colonel Sir Stewart Gore-Browne DSO (3 May 1883 – 4 August 1967) was a British soldier, pioneer settler, builder, politician, and supporter of Zambian independence. Known as "Chipembele" (the rhinoceros) by the local Bemba people, he founded the Shiwa Ng'andu estate in Northern Rhodesia (now Zambia), turning it into a self-sufficient English-style estate.

Born in London to a prominent family, he was educated at Harrow before joining the Royal Field Artillery in 1901. He briefly served in South Africa and participated in boundary mapping in the Belgian Congo and Northern Rhodesia.

During WWI, he served with the British Army, fighting on the Western Front and earning the Distinguished Service Order (DSO) for his bravery in battle. After the war, he resigned from the army in 1920 to further develop his estate.

Although an aristocrat and settler, Gore-Browne stood out for his sympathetic engagement with African political aspirations. He advocated for racial equality and became a respected ally of emerging African leaders, including Kenneth Kaunda and Harry Nkumbula. Upon his death in 1967, he was buried at Shiwa Ng'andu with full honours by the newly independent Zambian government — one of the few white settlers accorded a state funeral in Zambia's history.

Gore-Browne's account of the Anglo-Belgium Commission 1911 – 1914³²

The Anglo-Belgian Boundary Commission had been disappointing, despite his enjoyment of outdoor life and hunting. It was bogged down by bureaucracy and the petty egos of other officers. Within three months, Captain Everett, the second-in-command, was killed by a lion, marking a grim beginning.

Major Gillam, who led the Commission, spent most of his time in a haze of whisky, issuing and rescinding orders, until the isolation of the African bush drove him into a complete breakdown. Major Steel, his senior officer, pocketed the finishing bonus for the natives, prompting Gore-Browne to send an angry letter of complaint to Lord Herbert Gladstone, the British High Commissioner in South Africa. However, given his low regard for colonial officials, he doubted anything would be done.

He was dismissed from the Border Commission for 'wilful disobedience' after he complained about Major Steel, his superior, cheating the natives out of their final wages and refused to do the same.

The work of marking out the border had been exasperatingly slow. The 1894 agreement between Britain and Belgium's King Leopold was vague, simply stating that the border was to run south from Lake Bangweulu to its junction with the watershed separating the Congo and Zambezi rivers, continuing along this line for 550 miles until it reached the Portuguese frontier.

"The King of Italy had drawn the boundaries some years before—he'd been chosen as an impartial arbiter," Gore-Browne told the *New Yorker* years later. "I suspect he simply ran his thumb across a map."³³ He was dismayed by the disregard for tribal borders, writing in an

³² The article "*The Anglo-Belgian Boundary Commission, 1911–1914*" was written by Sir Stewart Gore-Browne and published in *The Northern Rhodesia Journal*, Volume V, No. 4 (1964), pages 315–318.

³³ The Italian State came into being in 1864.

Italy's colonial ventures were met with significant resistance from indigenous populations, leading to prolonged conflicts and human suffering. The Italian colonial rule often strained relations with other European powers and resulted in diplomatic tensions.

unpublished memoir of his experiences, “It was, and still is, by no means uncommon for half a tribe, including the paramount chief, to be on one side of an international border, with the rest on the other side.”

They lacked proper instruments, and there was too much sitting around waiting for the rains and mists to clear or for the smoke from Africans burning their fields for planting, so they could take sightings to establish high points between the two great rivers and erect wooden beacons on the hills to mark the border. The beacons, which were thirty feet high, needed to be visible from three other locations to triangulate for the mapmakers.

The terrain was rugged and mostly uncharted, so isolated that many porters or hunters had to carry most of their supplies. He was eternally grateful for the lessons in shooting rabbits and wood pigeons from his late uncle Godfrey during the summer he turned sixteen.

During long waiting periods, they organised races among the Africans and took bets on the outcomes.

Eventually, on New Year’s Day 1914, they reached the end, meeting with the Anglo-Portuguese Commission to mark the border between Angola and Northern Rhodesia. They toasted with champagne, standing triumphantly with one foot on Britain and the other on Portugal or Belgium, cigars in hand. “Another few parcels of Africa squared off on the map,” Gore-Browne wrote in his diary.

When he was born in 1883, Europe had colonised less than a tenth of Africa; by 1914, more than ninety per cent of the continent was under European rule. Despite his frustrations with the work, his doubts about colonial governance, and his dislike of the Belgians, the vast skies and intensity of Africa captivated him. “I never imagined that the feeling of being surrounded by sun—behind, around, and reflected in everything until one almost felt one could drink it, could feel so good,” he wrote to his Aunt Ethel.

He loved venturing into the bush where perhaps no white man had ever set foot, feeling enveloped by untamed nature and travelling like a king, with fifteen or twenty bearers carrying his personal belongings and another hundred handling supplies and equipment. Villagers would prostrate themselves at his feet. He liked the Africans, particularly the Bemba, who were masculine, proud, loyal, and enjoyed hunting. After struggling with sports at Harrow, he discovered he was good at something. One day, he realised with surprise that he wanted to make his home there.³⁴

Cgan March 2025

•

³⁴ Lamb, Christina. *The Africa House: The True Story of an English Gentleman and His African Dream* (pp. 10-12). Penguin Books Ltd.

Photographs taken by Stewart Gore-Browne



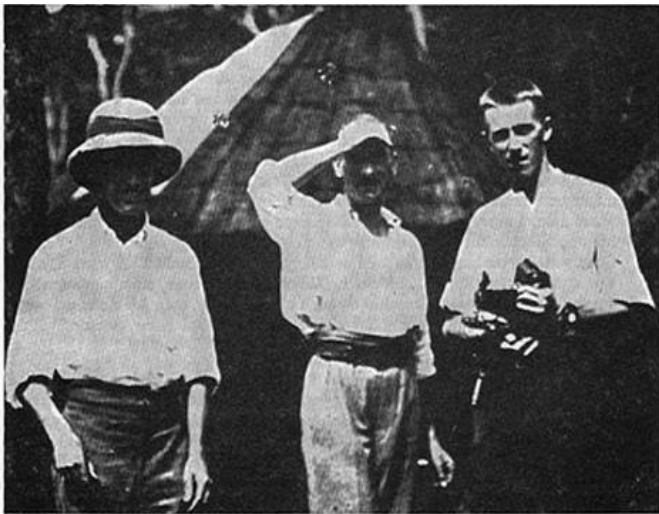
Sir Stewart Gore-Browne in
later life - NPG



Major Gillam



Muwa Beacon, 1912



(Left to right)—Dr. Edington, Medical Officer to Commission; S. Gore-Browne;
Watson, Assistant Native Commissioner who died of sleeping sickness shortly afterwards



Capt. Steel and his beacons, April-October, 1912



Xmas Day, 1911 at Kafulafuta Camp. (Left to right)—Le Poivre (Belgian); Dr. Edington (white helmet); Lt. Cussans, N.R. Police; Gendarme (Belgian); — Watson A.N.C.

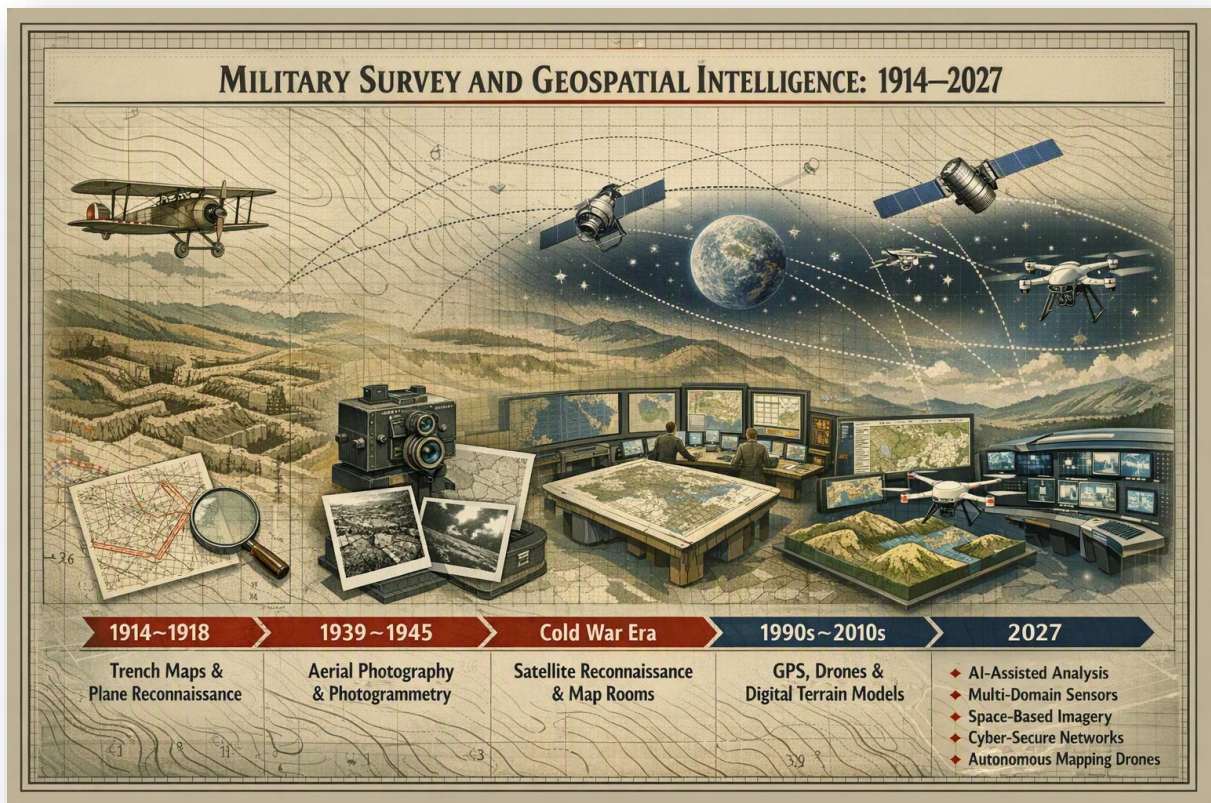


Escort, N.R. Police

The Ranger 2026



<https://defencesurveyors.org.uk>



Produced by *Cgan*

Printed and Distributed by The Alpha Xperience