

CHAPTER XIII

DOMINION AND COLONIAL SURVEY UNITS

SECTION I. CANADA (*see* Sketch Maps Nos. 11 and 12)

Formation

On 3rd September, the day on which war was declared in Europe, recruiting began in Ottawa for a Corps Field Survey Company R.C.E. When a strength of close on 90 all ranks had been reached recruiting ceased temporarily, and training began under the direction of the G.S.G.S. in Ottawa.

Recruiting restarted early in January, 1940, and ceased on 15th January, when the unit reached its full strength of seven officers and 137 other ranks.

Move to the United Kingdom and early training activities

The unit, under the command of Major W. J. Baird, R.C.E., sailed from Canada on 29th January, 1940, and after four weeks' military training at Aldershot, moved to Southampton where it underwent technical training in map reproduction and printing, and in field topographical surveying. Opportunity was taken to attach printing personnel to the Ordnance Survey for practical work. To allow of training in the use of mobile printing equipment, the War Office provided two double-demy hand-fed lithographic presses mounted in trailers, similar to those being used at that time by survey units with the B.E.F. in France.

Survey Directorate

In accordance with current British practice with regard to survey units and their control, during the winter of 1939-40 a Survey Directorate was formed at H.Q. Canadian Corps, with Lieut.-Colonel E. B. Elkington, R.E., as A.D. Survey. The Canadian Field Survey Company operated under his technical control as corps troops. In June, 1941, Lieut.-Colonel Elkington was succeeded by Lieut.-Colonel (later Colonel) H. L. Meuser, R.C.E.

Later on, when the build-up of Canadian Forces in the United Kingdom made it possible to form the First Canadian Army, this Corps Survey Directorate was reorganized as an Army Survey Directorate, with Colonel Meuser as D.D. Survey, an appointment which he filled with great distinction throughout the whole war. From then onwards, the survey control and operation of the survey units was on an army, instead of a corps, basis.

The compiler of this survey history who, as D. Survey successively with G.H.Q. Home Forces, 21 Army Group, and finally S.H.A.E.F., was privileged to work in close contact with Colonel Meuser and his Canadian survey units, is glad to take this opportunity of expressing his appreciation of their superlative achievements and co-operation during the period of training and preparation for the Normandy assault, and subsequent operations on the Continent.

Reorganization of the survey unit and training activities (1940-42)

After Southampton, and a short stay near Stratford-on-Avon, the company moved in August, 1940, to Cobham, Surrey, where it remained until August, 1942.

While at Cobham, the unit was reorganized and became the 1 Canadian Field Survey Company R.C.E., coming directly under Army control. It thus conformed to the change in War Office policy whereby Field Survey Companies R.E. ceased to work on a corps basis and became army troops units. Now under the command of Major W. K. McDonald, R.C.E., it numbered approximately 160 all ranks and consisted of:—

- H.Q. Section.
- 2 Topographical Sections.
- 1 Drawing Section.
- 2 Reproduction Sections.
- 1 Camera Section.

It had now been equipped with the new-type mobile printing and photo-mechanical lorries which replaced the trailer-borne presses. The equipment comprised two printing lorries (with demy-size, single-colour, full automatic feed Crabtree presses), and two photo-mechanical helio lorries for plate-making, proving, etc. Later on, these were replaced by stronger chassis to stand up to the strain of bad roads and active service conditions.

Training, both military and technical, continued in all branches of their work.

Further reorganization (1943)

Increase in strength. In the late summer of 1942, the company moved to Ripley, Surrey. Here it was increased in strength by the addition of special increment sections which were attached to the topographical, drawing, and reproduction sections of the unit for training. At this time, also, the camera section received its mobile lorry fitted with an auto-focussing camera. A static-process camera was also acquired and this at all times proved to be of great value.

Formation of Field Survey Depot. In April, 1943, the 1 Canadian (Army) Field Survey Depot was formed to cope with the problem of map storage and supply, and for holding and issuing to survey units stocks of expendable survey stores. The establishment of this unit was at first based on the British standard type of Field Survey Depot R.E. with one officer, 18 other ranks and one 3-ton lorry. The map stocks and survey stores held and issued by the depot were controlled directly from the Army Survey Directorate.

There was, however, a change in War Office policy as affecting the establishment of a field survey depot serving an army. Mainly as a result of experience gained with Eighth Army in North Africa, where it was found essential for Survey to assume responsibility for distribution down to divisions, a new and larger type of unit was approved. The Canadian Army conformed to this change, and in January, 1944, the depot was enlarged to three officers and 63 other ranks, with one car (light), three trucks (15-cwt.), and 16 3-ton vehicles.

This enlarged depot was organized so as to form a main depot and a depot section (advanced). Arrangements were also made to attach to the H.Q. of each corps and division under command a sub-section consisting of one

storeman, one driver and a racked 3-ton lorry for holding map stocks. Allowance was made for two corps and five divisions.

Formation of three separate companies. In June, 1943, the Canadian Army found it necessary to increase the strength of its survey troops, and it was decided to adopt a new type of organization. In the British Army, the survey strength considered necessary to support an army in the field was provided by allocating two or more standard-type Field Survey Companies R.E., each of which was technically and administratively self-contained, and capable of carrying out limited amounts of field survey, map compilation, drawing, and map reproduction and printing. In addition, a corresponding number of General Field Survey Sections were usually added, which were trained primarily for field survey and air-photo mapping work. With this organization there was always one self-contained survey unit (more if necessary) which could be detached at a moment's notice to support a special Task Force for a specific operation. On the other hand, the D.D. Survey could at any time, if he so wished, brigade together sections of similar type from two or more of the companies for mass production work, whether for field survey, mapping or printing.

The Canadian reorganization broke up the original all-purpose field survey company, and substituted three separate and independent units, one being for field surveys, one for map reproduction and printing, and the third for air survey and mapping. An Air Survey Liaison Section was also formed.

A few remarks on these types of units are given below:—

2 Canadian Field (Topographical) Survey Company R.C.E.

This was organized for carrying out all forms of field surveys, with special emphasis on the rapid supply of trig data to assist the artillery on the army front. It consisted of a headquarters and six topographical sections. The unit was very mobile, and the field parties were provided with jeeps instead of the 15-cwt. trucks used previously, thus enabling them to drive practically anywhere and quickly.

3 Canadian Field (Reproduction) Survey Company R.C.E.

This unit was organized for map reproduction and printing as under:—

H.Q.

4 Reproduction Sections	} With mobile equipment.
2 Map-Photo Sections	

(Note—At a later stage one of the Map-Photo Sections was transferred to No. 4 Canadian Field (Air Survey) Company.)

4 Canadian Field (Air Survey) Company R.C.E.

This unit was formed in June, 1943, to specialize in mapping work, more especially the production of new maps, and the revision of existing ones, from air photographs. Air survey methods had been used a great deal in Canada before the war, and it was therefore natural that the Canadian military survey organization should have a decided trend towards these methods for military mapping. Principally under the energetic leadership and control of Major L. G. Trorey, R.C.E., the 4 Canadian Field Survey Company produced remarkable results, both in connection with mapping preparations for the Normandy invasion, and during subsequent operations on the Continent through north-eastern France, Belgium, Holland and Germany.

Major Trorey built up a most efficient mapping organization, and trained the personnel to a high standard of rapid production methods. The unit had at its disposal a limited amount of Multiplex plotting equipment of which valuable use was made. Major Trorey also designed and had manufactured for unit use various items of photogrammetric apparatus, the most useful of which was, probably, his "anharmonic" rectifier which enabled map detail to be compiled quickly and accurately from the photographic prints.

The company was organized into sections dealing with control, interpretation and marking up the photos, detail compilation, contouring, fair-drawing, final edit, and photography.

To assist in its work a map-photo section was transferred from No. 3 Company.

30 Air Survey Liaison Section R.C.E.

This unit was formed under the control of D.D. Survey First Canadian Army, in June, 1943. Its war establishment and equipment tables were similar to those for R.E. survey units of the same type.

This small but highly technical unit was, throughout its existence, employed on special assignments connected with air survey including the following:—

- (a) The development, production supervision, and operational test of precise air survey cameras (Eagle V, with $3\frac{1}{4}$ -inch lens) embodying original and advanced optical features.
- (b) In co-operation with the National Research Council of Canada, and with the Royal Canadian Air Force, the development of a tri-camera installation in Mosquito aircraft.
(Note—Both the above were carried out under the direct personal instructions of General A. G. L. McNaughton, then G.O.C. in C. First Canadian Army.)
- (c) The determination of submerged beach gradients along the invasion coast of Normandy (Courseulles to St. Vaast la Hogue) by the wave-velocity method. This formed part of the project controlled by D. Survey (S.H.A.E.F.) between January and June, 1944.
- (d) The analysis and test of the wave-velocity method by actual tests on the Normandy coast, in co-operation with H.Q. Combined Operations and the Admiralty, between June and November, 1944.
- (e) The photogrammetric analysis of air-photos for the resection of air stations in connection with the experimental radar control of air-photographic aircraft. This work was done for G.S.G.S., War Office, between October, 1944, and January, 1945.
- (f) An analysis, from the photographs, of the internal and external orientation of tri-camera installations in aircraft, using Eagle V cameras, in co-operation with the Intelligence Division of the Chief Engineer (E.T.O.U.S.A.) and Special Wing 8th U.S. Army Air Force, between February and April, 1945.
- (g) Experimental research in connection with Multiplex plotting equipment and the slotted template, in co-operation with G.S.G.S., War Office, between May and October, 1945.

Training and productive work for operation "Overlord"

During 1943 and early 1944, intensive training was undertaken by all Canadian survey units. G.H.Q. Home Forces, followed by 21 Army Group, conducted large scale training exercises for all arms, in which the survey units took part. Sections of the topographical company carried out training in rapid triangulation, not only as individual exercises, but also in co-operation with the artillery, and the schemes were drawn up largely on the basis of triangulation conditions which were likely to be found in northern France.

Reproduction sections also worked under field conditions in co-operation with the artillery for producing such items as artillery fire plans, diagrams, task and barrage tables, and the overprinting of such information on large scale maps. Exercises were also undertaken which involved co-operation with Air-Photo Interpretation Sections for the production of defence overprints, and much valuable knowledge was gained which was to prove useful during operations following the invasion. Besides all this field-training 3 Field (Reproduction) Survey Company carried out enormous printing programmes in connection with the preparation of 1/25,000 and other large scale map stocks required for the operation.

To No. 4 Field (Air Survey) Company was allotted a share in the preparation from air-photos of 1/25,000 maps of various areas in northern France, including part of the Normandy bridgehead. During the early months of 1944, a revision programme was undertaken to check and bring the 1/25,000 maps covering the actual assault beaches up to date from the latest photos. A series of special large scale maps for the assault crossing of the R. Seine was also prepared. There was, in addition, the usual collection of special productions asked for by the various branches of army headquarters.

Apart from their technical mapping activities, all the units were trained in the waterproofing of vehicles, in the procedure of embarking and disembarking over beaches, and in all essential military subjects to fit them to take their part as fighting soldiers if the need should arise.

The invasion of the Continent

THE MOVE TO FRANCE

When the Canadian divisions first landed in Normandy they were under the command of Second (British) Army until 23rd July, when H.Q. Canadian Army arrived in the bridgehead, ready to assume command of its own troops. The Canadian Army Survey Directorate also started to function overseas. The moves of the survey units to France are referred to below.

No. 2 Company (Topographical). This unit was divided into two flights for the cross-over. The first flight reached Normandy on 9th July, and the second on 30th July.

No. 3 Company (Reproduction). This was also divided into two flights as a safety measure. The first flight went over on 28th July, and the second left the United Kingdom on 31st July, taking four days to get over.

No. 1 (Air Survey) Company. In September, 1944, No. 4 Company was reclassified as No. 1 Company, which title it held for the remainder of the war. Leaving the United Kingdom on 18th August, it took some days to cross and, on arrival, was first installed just outside Caen.

1 Canadian Army Field Survey Depot. The depot section (advanced) landed at Courseulles-sur-Mer on 30th July, convoyed to Fontaine-Henry,

and within two days was functioning as a map depot with stocks sorted and with sub-sections out with corps and divisions.

The main depot arrived overseas on 3rd August, and organized its lay-out of survey stores and bulk map stocks. The latter were obtained from No. 4 Field Survey Depot R.E. (which was the 21 Army Group base map depot) and from 3 Canadian (Reproduction) Survey Company which had begun the printing of 1/25,000 maps required by the fighting troops.

OPERATIONS FROM "D"-DAY TO V.E.-DAY

The First Canadian Army operated throughout on the left, or seaward, flank of the allied forces. The stubborn battles around Caen were followed by the break-out from the bridgehead, the crossing of the Seine, and the quick pursuit through the Pas de Calais into western Belgium and south-western Holland. In connection with all these operations, the survey units contributed their valuable support, especially concerning the production and supply of maps of all sorts without which the army could neither move nor fight.

Then came the vital operations for clearing the Lower Scheldt and the approaches to Antwerp, including the capture of Walcheren Island. There followed the fighting to clear southern and eastern Holland, and the approaches to the Rhine between Nijmegen and Wesel. Finally came the crossing of the Rhine itself and the pursuit into Germany leading up to the enemy surrender.

Some of the principal activities of the units concerned are touched on briefly below:—

2 Canadian Field (Topographical) Survey Company. Survey triangulation control was carried forward from the Normandy bridgehead to the Seine but, at this stage, the advance was so rapid that survey was not required for artillery purposes. It was during the operations round Caen leading up to the break-out that this unit suffered considerable casualties, including the severe wounding of Lieut.-Colonel W. K. McDonald who had by then become A.D. Survey at Army H.Q. and was up forward co-ordinating the survey control work. He had to be evacuated to Canada and was unfit for further service overseas. This was a great loss to the survey organization.

After the break-out the principal survey tasks undertaken included the following:—

- (a) Checking and amplifying the trig control around Boulogne, Cape Gris Nez, Calais and Dunkirk, where enemy pockets still held out.
- (b) Checking the triangulation from Bruges northwards towards Ghent, and from Eindhoven to Turnhout.
- (c) Survey support to the force which captured Walcheren and cleared the Lower Scheldt for opening up the port of Antwerp.
- (d) Survey of a network of microphone stations in connection with the defence of Antwerp against enemy V-weapons.
- (e) Revision of 1/25,000 maps from air-photos. After some special training the unit took over part of the programme being handled by the Air Survey Company.
- (f) Survey support to 2 Survey Regiment R.C.A. during operation "Veritable," which cleared up the area west of the Rhine between the Rivers Maas and Rhine.
- (g) Establishment of trig control in the Nijmegen and Arnhem area.

- (h) Surveys of bridge sites for the Rhine crossings at Emmerich in conjunction with Canadian Army Troops Engineers, and also for sites at Nijmegen, Zutphen, Arnhem and Deventer.
- (i) Survey support to divisions of 2 Corps during the advance into Germany until the final surrender.
- (j) Survey support to 1 Corps in western Holland.

Early in May, when hostilities were over, Company H.Q. moved back from Germany into Holland. On 1st July the unit was disbanded, and the personnel were absorbed into the other two survey units.

1 *Canadian Field (Air Survey) Company*. The history of this unit, from "D"-day onwards to V.E.-day, was a succession of urgent programmes of mapping for one operation or another. Many of these operations never got beyond the planning stage, but the special mapping required had usually reached an advanced state of preparation by the time that the cancellation order was issued. The rapid moves of the allied armies through north-eastern France and Belgium took them across obstacles such as the R. Somme and other potential defence positions with practically no opposition, where it had been anticipated that hotly disputed assault operations would have been necessary.

From Caen the unit moved to Abbeville in mid-September, and on again to Ghent at the end of the month. Here it remained until March when a further move was made to Tilburg in Holland. The stay here was only a short one, a further move being made to Almelo in mid-April, where it was located when the German surrender took place early in May.

A bare summary is given below of the output of this unit, taking into consideration only the principal large scale map series. Practically all the work was done from air-photos, and the amount of skill, energy and hard work expended by day and night, much of it under intense pressure of time, can only be properly appreciated by those who are acquainted with the technical procedure and difficulties involved. The figures given below include work done in the United Kingdom in preparation for operations on the Continent.

Revision	178 sheets
New Mapping	
1/25,000	99 sheets
1/5,000 and 1/4,000	45 sheets
1/10,000	19 sheets
1/12,500	87 sheets
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Total	428 sheets
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3 *Canadian Field (Reproduction) Survey Company*. Within 24 hours of landing on the beaches near Arromanches, the first flight of this unit had two reproduction sections operational, and they started printing 1/25,000 maps. Apart from this more or less stock job one of the first major tasks was to produce "Going" maps, defence overprints, a fire-plan map, and engineer intelligence traces for an operation designed to break the enemy line in the Caen-Falaise area. On 4th August, half-way through the programme, the remainder of the company arrived. It is of interest to note

that the landing of this second flight involved the successful transfer by ship's crane from a Liberty ship to a landing craft of heavy technical printing vehicles weighing up to 20 tons.

There followed a quick series of moves for the unit. From Fontaine-Henry it went to Ouille (near St. Pierre-sur-Dives), then to Brionne and, on 5th September, to Londinières whence another quick move took it to St. Omer. During these moves, demands for map printing were heavy owing to the rapid advance, which meant that the area covered by each map sheet was passed over at great speed. No attempt was made to print complete 1/25,000 cover for the whole area, but only where opposition was met or expected. The efficiency and mobility of the printing equipment was fully tested during this period.

The unit reached Ghent on 25th September, where it was able to house its printing vehicles under a roof for the first time since leaving the United Kingdom. Up till then, the work had been principally the printing of 1/25,000 maps, trying to keep ahead of the advance. Everyone worked at top speed, but it was clear that the establishment, both of personnel and printing equipment, was not sufficient to meet the requirements of the army, and plans were made to obtain reinforcements and to reorganize the unit.

On 10th October, the Company moved to Hoboken, near Antwerp, and the stay here was one of the busiest of the campaign. Maps were reproduced and printed for the crossing of the Leopold Canal, and for operations to clear the Scheldt estuary, including the assault and capture of Walcheren Island.

In mid-November, it moved on to Tilburg in Holland, and here two additional printing lorries were received, bringing the total up to six. The unit was then reorganized so as to consist of headquarters, two reproduction platoons (each of three printing lorries and two helio lorries), and a map-photo platoon.

For operation 'Veritable,' which was to clean up between the Rivers Maas and Rhine, a heavy programme was involved. This included the printing of 22 defence overprints, and a heavy output of 1/25,000 maps.

On 22nd February, one reproduction platoon was attached to 2 Canadian Corps to print fire plans for the fighting in the Reichwald Forest near Cleves. This was the first occasion on which printing equipment of any of the allied formations had crossed into Germany.

A further move from Tilburg to Oss took place in March and, during the last half of the month, a large printing programme was undertaken in preparation for the crossing of the Rhine. The final move, before the capitulation, was to Almelo on 18th April.

1 *Canadian (Army) Field Survey Depot.* The daily routine of a field survey depot is not very visible to the uninitiated, and is not perhaps as spectacular as that of the other types of survey units, but it is of the highest value and importance. The regular and unflinching supply of maps to the fighting troops is entirely dependent on field survey depots operating within the theatre, and the work requires most skilful and energetic handling by all those concerned. The Canadian Field Survey Depot maintained a very high standard of efficiency throughout the whole campaign, and its task was anything but an easy one.

The detailed control of map supply and issues was exercised from the

Survey Directorate, which had to maintain a constant and close contact with the depot, and translate the operational plans into rapid action for ensuring that no movement by any body of troops anywhere should be held up or impeded by a lack of maps.

As the depot was also responsible for holding and supplying expendable survey stores such as printing paper, chemicals, etc., the whole of the printing programmes were dependent on the efficient and timely handling of this side of its business by the depot.

The depot was organized into a main depot and a depot section (advanced), the idea being that the main depot would receive and break down bulk stocks and pass them to the depot section for distribution. Before crossing over to France six 3-ton lorries were loaded with maps and expendable stores which the depot would collect on their arrival overseas.

The depot section, with about 25 tons of maps, landed at Courseulles-sur-Mer on 30th July and by 2nd August it had seven sub-sections out with corps and divisions in the bridgehead. On 3rd August, the main depot arrived.

During August, when there was a rapid increase in the volume of 1/25,000 maps that had to be handled by the depot, it was found that the splitting of the unit into two parts was not giving smooth working. After supplying storemen for the divisional sub-sections, the depot section had not enough man-power left to handle the map orders. Early in September, therefore, the depot section and main depot joined up and opened in one location at St. Omer.

After a period of short supply of 1/50,000 and smaller scale maps during the rapid pursuit of the enemy from the Seine into Belgium, bulk stocks began to come in from the United Kingdom in ever-increasing quantity both by sea and air. The provision of sufficient transport and its maintenance was a constant difficulty, no adequate allowance having been made in war establishments for motor mechanics. Lines of communication were widely dispersed, and the depot was soon delivering maps to places as far apart as Le Havre, Calais and Antwerp.

On 23rd September, the unit moved from St. Omer to Ghent, four 10-ton lorries being borrowed to assist the move. The number of different map series, and the stock of each sheet that had to be held, demanded a large area of covered storage accommodation with good lorry access, and this was not easy to find, especially with the rival claims of other services. It was found by experience that, in order to facilitate quick moves, it was best to make up the maps in flat bundles of 50, and pack them away in clearly marked wood cases, which were easier to move than bales. Only sufficient stocks for immediate issues were kept out of cases. The maintenance of expendable survey stores was rendered difficult, as the 21 Army Group Base Depot was back at Bayeux in Normandy for a considerable time.

On 10th October, the depot moved to Antwerp, and the counting, marking and checking of map stocks was brought up to date, the first opportunity since the landing. Until then the depot staff had been working night as well as day-shifts to keep pace with the inflow and outflow of map stocks and stores.

The air-transport of maps from the United Kingdom was by now well organized. Consignments were accompanied by an officer from the War

Office, and at Brussels airfield he obtained R.A.S.C. lorries and delivered maps direct to the survey depot. The build-up of map stocks for operations in Germany was now taking place with increasing momentum.

During the winter of 1944-45, the large number of sub-sections that had to be maintained with field formations caused a heavy drain on manpower. The establishment provided only sufficient for two corps and five divisions. The need for finding one sub-section for an American division and another for the Polish Armoured Division brought the number up to nine in all.

Antwerp now became the target for attack by V-weapons, and the depot building was badly shaken by blast. It was, in fact, destroyed by a direct hit two days after the unit moved on to Tilburg.

The move to Tilburg took place on 15th November, ideal accommodation being obtained in a textile factory. To move the depot was quite a major operation. Four days were required, and the number of vehicle loads, ranging from 15-cwt. trucks to 3-ton lorries, was over 70.

Map orders for divisions and corps were now being delivered daily, the distances to divisions having been greatly reduced by the move forward to Tilburg.

When the German offensive in the Ardennes was launched in December there was an accompanying threat of a possible German offensive from the north across the Maas to recapture Antwerp. The personnel of the depot took their part in defence measures at Tilburg, and the precaution was taken of moving half the map stocks with a small detachment to Eindhoven. This involved the move of over 2,000,000 maps. It may be of interest to note the map stock situation in the depot at that date:—

<i>No. of Series</i>	<i>No. of different sheets</i>	<i>No. of copies</i>		<i>Total</i>
		<i>Tilburg</i>	<i>Eindhoven</i>	
54	1,212	1,720,000	2,371,000	4,091,000

In accordance with the development of the military situation, including the crossing of the Rhine and the operations northwards through Holland, further moves of the depot took place during March and April.

On 7th March, the main depot opened at Oss (Holland), and the Eindhoven detachment moved to Grave. Canadian divisions were now on the move again, and large map issues were being made daily. Over half a million new maps were taken into stock during one week in March, and the total stock was now over 4,500,000.

The last operational move was from Oss to Almelo, a shift of 120 miles. This involved the transport of about 500 tons of maps and survey stores, and brought the Grave detachment back into the main depot again. Though no doubt justified from the security aspect, the separation of stocks had not been satisfactory. For map storage alone 15,000 square feet of floor space was used in the Almelo factory.

SECTION 2. AUSTRALIA (see Sketch Maps Nos. 3 and 17)

The Australian war effort

To provide an operational background to their survey activities, the following notes give a brief summary of Australia's war effort during the 1939-45 war:—

Europe and the Middle East. The first Australian troops reached Palestine in January, 1940, and by the end of that year, Australian manpower equivalent to one corps was spread between Egypt and Palestine.

18th Australian Brigade, while *en route* from Australia to the Middle East, was diverted to the United Kingdom where it remained during the Battle of Britain.

In December, 1940, 6 Australian Division, consisting of 16th, 17th, and 19th Brigades, moved into the Desert and relieved 4 Indian Division. It then took part in the capture of Bardia, Tobruk and Derna and, on 7th February, 1941, accepted the surrender of Benghazi.

6 Australian Division was then relieved by 9 Australian Division and was sent to Greece in company with 2 New Zealand Division. Following the evacuation from Greece at the end of April, 1941, most of the division went to Crete, which fell at the end of May.

Meanwhile British forces had to retreat in Libya and 9 Australian Division fell back to Tobruk, where it was joined by 18th Australian Brigade from the United Kingdom. After beating off a major attack in April, the Australians in Tobruk were relieved by sea in the late summer of 1941, leaving one battalion which remained in Tobruk until the town was relieved.

7 Australian Division arrived in the Middle East in November, 1940, and was employed in Syria during June and July, 1941, taking part in the crossing of the Damour River line. A brigade group from 6 Australian Division, after its return from Greece, was also employed in Syria. The armistice with the Vichy French in Syria was signed in the Australian lines.

Following the entry of Japan into the war in December, 1941, 6 and 7 Australian Divisions were withdrawn from the Middle East to the Far East in February, 1942. 9 Australian Division, however, remained in the Middle East, and took part in the Eighth Army offensive in October, 1942. It was then withdrawn and sailed for the Far East in February, 1943.

The Far East. 8 Australian Division was sent to Malaya in late 1941. Contact was first made with the Japanese on 14th January, 1942, at Genas, 150 miles north-west of Singapore. When Singapore fell on 15th February, a great part of this division was taken prisoner. One brigade group took part in the fighting in the Dutch East Indies.

In the South West Pacific Area (S.W.P.A.), Australian forces played a major part in the defeat of the Japanese. They came under the supreme command of the American General MacArthur, with General Sir T. Blamey as Commander of the allied land forces. The main fighting, so far as the Australian forces were concerned, took place in New Guinea where the 3rd, 5th, 6th, 7th, 9th and 11th Australian Divisions were employed at various times, leading up to the final landings in Borneo by 7th and 9th Australian Divisions at Balikpapan and Labuan.

Early development of military survey in Australia

In 1907, a survey section of the Royal Australian Engineers was formed for survey duties under the control of the newly formed Australian Intelligence Corps. In 1915, an amendment to the Defence Act enabled a separate Survey Corps to be raised as a unit of the Permanent Military Forces, but its work in Australia was interrupted by the 1914–18 war during which most of the survey personnel volunteered for service overseas. After the war, the Survey Corps was not reformed, its members being transferred back to the old survey section which still existed on paper. This unit then undertook, between the two wars, a considerable programme of mapping, mainly in coastal districts around Brisbane, Sydney and Melbourne.

In 1932 there was a further reorganization, and the Survey Section R.A.E. assumed its previous title of the Australian Survey Corps. Impetus was then given to triangulation and base measurements to provide a proper control for national mapping.

In 1933, the Transverse Mercator Projection and the British Modified Grid system were introduced for Australia as a whole, with 5-degree belts and a standard meridian as origin. This superseded the previous individual state surveys each depending on its own origin, a situation which rendered a proper co-ordination between the individual surveys almost impossible.

Situation at the outbreak of war (1939)

In September, 1939, the military survey of Australia was being carried out by the Australian Survey Corps numbering nine officers and 41 other ranks. Since its inception the corps had produced approximately 70 1-inch maps of excellent standard.

As part of the defence programme in 1938–39, a three-year plan of expansion of the Australian Survey Corps was started by which it was proposed to increase the strength to 15 officers and 82 other ranks. By September, 1939, this plan had been completed for the first year with regard to personnel and equipment, and some of the second-year equipment was on order.

Early in 1940, the situation in the Pacific called for a rapid increase in the rate of production of maps of vital and strategic areas in Australia as under:—

Strategic mapping scheme. This had for its object the production of a series of maps at 4 miles to 1 inch covering:—

- (a) The coastal strip from Townsville to Port Augusta and extending 200 miles inland.
- (b) The coastal strip from Albany to Geraldton extending to 100 miles inland.
- (c) Certain strategic areas around Darwin and in Tasmania.

Emergency 1 inch to 1 mile mapping scheme. This was to provide 1-inch emergency maps of the more vital areas, using civilian surveyors in the employ of the State Lands Departments. This aimed at producing maps for emergency use while field survey units were being trained for the production of the 1-inch standard maps.

Australian Survey Unit in the Middle East

The 2/1 Australian (Corps) Field Survey Company was formed in April, 1940, for service abroad. On arrival in the Middle East during March, 1941, it was immediately warned for service in Greece, but the evacuation from there

caused a cancellation of the move and it was transferred from Egypt to Palestine where it was established at Sarafand. Plane-table mapping was undertaken along the Syria-Trans-Jordan border extending south to Amman.

During the Syrian campaign in June and July, 1941, this unit produced operational maps of the area to supplement those issued by G.H.Q. Middle East. Subsequently it undertook production of a series at 1/25,000 scale in the Lebanon extending over the coastal belt from the Palestine border to Tyre. Moving then to Souk el Gharb in the Lebanon it started on a further series of 1/25,000 mapping around Damascus, and at 1/50,000 scale along the Turkish frontier in the neighbourhood of Azaz and Aleppo.

In February, 1942, following the entry of Japan into the war, the 2/1 Field Survey Company returned to Australia, where it was converted into the 2/1 Australian Army Topographical Survey Company A.I.F. Thereafter it was employed on survey duties in the South West Pacific Area.

Reorganization of the Australian Survey Corps

In September, 1940, the Australian War Cabinet approved of a survey and mapping programme for the Home Forces which embraced:—

- (a) The completion of the balance of the three-year plan for the expansion of the Australian Survey Corps, and the merging of the permanent Survey Corps into a new organization.
- (b) The raising of the following units for field survey and map production:—

Survey Directorate at Army H.Q.
Army H.Q. Survey Company.
Army H.Q. Cartographic Company.
Four Command Field Survey Companies.
One Survey Section for the Darwin Military District.
One Corps Survey Mobile Reproduction Section.

The above units were later converted to:—

Land H.Q. Cartographic Company.
Four Field Survey Companies.
Two Army Topographical Survey Companies.
Three Field Survey Depots.
One Mobile Lithographic Section.

Training

During the early part of the war, recruits into the Survey Corps were reasonably competent, having had some civil training and experience in field survey and drawing, but this supply was eventually exhausted, and in 1942 a Field Survey Training Depot was established in Victoria, where new recruits were given initial training before being posted to field units. This depot was closed down in April, 1944, owing to a deterioration in the man-power position.

Equipment

To start with, the provision of technical equipment presented many difficulties. Theodolites and other technical apparatus were provided mainly from Great Britain. Local manufacture produced a quota of minor optical instruments, and local purchase from the trade helped to ease a difficult situation. The remaining operational equipment was obtained through service channels.

The development of tri-metrogon air survey methods for mapping necessitated the local provision of angulators and sketchmasters, and these were developed from American design.

In addition to field survey equipment the following reproduction equipment was provided:—

- 15 Rotary offset printing presses.
- 7 Process cameras.
- 7 Printing trailers.
- 4 Camera trailers.
- 4 Dark-room trailers.

The provision of Multiplex equipment and stereo-comparagraphs for air-photo plotting remained a difficult problem.

Survey activities in the South West Pacific Area (S.W.P.A.)

SURVEY POLICY

As has already been stated, the Australian Forces operating in S.W.P.A. were under the supreme command of General MacArthur, with mapping and survey policy directed from G.H.Q. S.W.P.A., essentially an American headquarters. General Sir T. Blamey commanded the Allied Land Forces and there was a Survey Directorate at Advanced Land H.Q. maintaining a technical liaison with the Chief Engineer at G.H.Q.

The co-ordination of Australian and American mapping agencies was effective after the initial settling-in period, during which there was inevitably some duplication of effort, conflict of ideas, and other minor "teething" troubles. In general, the Australian Survey Corps undertook the mapping for operations in which Australian formations were engaged. When, however, urgent operational planning necessitated mapping beyond the capacity of either the American or Australian agencies, mutual help was always readily supplied.

Mapping of the Australian mainland was undertaken solely by the Australian Survey Corps, as the U.S. Base Mapping Plant (648 Engineer Topographical Battalion) did not function in S.W.P.A. until late in 1942, by which time New Guinea had become the focus of operation.

Theatre responsibilities for mapping had originally been established in accordance with agreements reached between G.S.G.S. (War Office), and the mapping authorities in Washington, and in Australia. Within the theatre, local survey policy was governed by directives issued from the Chief Engineer's Office at G.H.Q. S.W.P.A. It may be of interest to quote from one such directive, as it gives an indication of the manner in which responsibilities were allocated:—

GENERAL HEADQUARTERS SOUTH WEST PACIFIC AREA

AG 061 (21 Mar 44)E

APO 500

21 March 1944.

Subject: Mapping Responsibilities.

To: Commander, Allied Land Forces.
Commander, Allied Air Forces.
Commander, Allied Naval Forces.

Commanding General, Sixth Army.
Commanding Officer, 648th Engr. Topo. Bn.

1. All previous instructions and directives from this headquarters, in so far as they may pertain to the assignment of mapping responsibilities, are revoked, and the following substituted therefor:—
 - a. Supervision and technical co-ordination of the mapping and charting program of the theater will be exercised by this headquarters. Map and/or chart production of those areas not herein allocated to other headquarters will be executed through the GHQ Base Map Plant, as set forth and described in Technical Memorandum No. 11, Office of the Chief Engineer, GHQ.
 - b. The Commander, Allied Land Forces, is responsible for the production, reproduction and distribution of all maps, produced primarily for the use of ground forces, within continental Australia, Northeast New Guinea south of latitude 5° S, and Papua including the D'Entrecasteaux Group; the islands Arafura Ceram, and Banda Seas south of latitude 0° and east of longitude 125° E, excluding Halmahera and including Portuguese Timor, and revisions and reproductions of the NEI, as already agreed upon as a result of conferences between the Survey Directorate and Commanding Officer, 648th Engr. Topo. Bn. Mapping areas other than as listed herein will be undertaken only on receipt of further directives from GHQ.
 - c. The Commander, Allied Naval Forces, is responsible for the production, reproduction and distribution of all hydrographic charts in the SWPA.
 - d. The Commander, Allied Air Forces, is responsible for the production, reproduction, and distribution of all aeronautical charts, target maps, and other operational maps for the air forces in the SWPA.
 - e. The Commanding General, Sixth Army, will accomplish with the mapping forces under his direct control such portion of the mapping program in the zone of action of the Alamo Forces as may be determined in co-ordination with this headquarters.
2. All mapping agencies within the limits of their capabilities may request assistance from each other. Free interchange of data and direct communication between all mapping agencies are approved and encouraged. This headquarters will, however, be kept informed of any changes in map production brought about by mutual agreement between mapping agencies.
3. All agencies producing the same types of maps will co-ordinate their efforts to avoid duplication of map coverage both as to scale and area.
4. No agencies other than those indicated herein will produce maps in this theater except sketch maps for terrain studies and similar publications. Such sketch maps will not contain a military grid, and will not supersede any maps produced by regular mapping agencies.
5. An officer will be designated by each commander concerned to co-ordinate the mapping program within his command. Semi-monthly reports in both graphic and written form will be submitted by mapping agencies to this headquarters, attention Chief Engineer, and will be interchanged between mapping agencies to show mapping progress during the period of the report and mapping proposed for the future.

6. Except for reproduction or revisions of existing map series, and to minimize the number of different maps produced, new maps and charts will be limited to the following scales:—
 - a. Ground Force maps: Strategic Series—1 inch to 4 miles; 1 inch to 1 mile; 1/25,000 (where Australian Forces are to operate); 1/20,000 (where US Forces are to operate); photo-maps, 1/20,000 or larger, to be wherever possible printed on the reverse side of the equivalent scale battle map.
 - b. Air Force maps: Long-range air navigational charts 1/3,000,000; standard aeronautical series 1/1,000,000, 1/500,000 and 1/250,000; plotting series 1/1,000,000; special navigational map 1/2,315,000; target maps, to such scales as best fit the situation.
 - c. Naval Force charts: such scales as are best adapted to the situation.
 - d. In any case where scales different from those listed are desired, the mapping agency will refer the proposed map to this headquarters for decision. (Note: Construction survey maps made on the spot may be to any desired scale.)
7. A copy of Engineer Technical Memorandum No. 11 summarizing Mapping and Charting activities and procedures is furnished for your information and reference.

For the Commander-in-Chief:

(Sgd.) B. M. FITCH,

Colonel, A.G.D.

Adjutant General.

SURVEY ORGANIZATION IN THE FIELD

Australian survey units were normally army or corps troops but, in the latter stages of the war, a detachment of two officers and 22 other ranks was operating with each division. This detachment consisted of survey and drawing personnel, its primary function being to establish the divisional grid as early as possible, and to revise the maps as required.

There were many changes in the order of battle of Australian survey units consequent on various reorientations of Commands, but a satisfactory situation was eventually reached whereby all the major operational formations had sufficient survey units under command to meet their requirements. By August, 1945, the survey order of battle was as follows:—

Advanced Land H.Q.	Detachment 2/1 (Army) Topographical Survey Company.
	12 Field Survey Depot.
	1 Mobile Lithographic Section.
First Australian Army	6 (Army) Topographical Survey Company.
	Detachment 2 Field Survey Company.
1 Australian Corps	2/1 (Army) Topographical Survey Company (less Detachment).
	5 Field Survey Company (less Detachments).
7 Australian Division	Detachment 5 Field Survey Company.
9 Australian Division	Detachment 5 Field Survey Company.
2 Australian Corps	Detachment 2 Field Survey Company.

Total survey troops overseas: 862 all ranks.

TRIANGULATION AND FIELD SURVEYS

With the exception of Borneo, all territory in which operations took place may be regarded as having been previously unmapped, with no triangulation or other form of basic survey control whatever. After the initial campaign at Moresby, in New Guinea, all operations were of an offensive character. As the jungle terrain did not lend itself to ordinary field survey methods, it was usually impracticable to establish any form of survey control in enemy-held territory. Consequently, the first-edition maps had to be based on control taken from whatever hydrographic charts or administrative maps could be obtained. These were mostly inaccurate, and the adopted control could well be 5 per cent in positional error with a corresponding error in azimuth.

The survey troops with forward formations had the task of establishing a better control in whatever manner best fitted in with local conditions, and a second-, third- or fourth-edition map would be produced in an endeavour to stabilize the grid, and to improve the detail plot from air photographs and ground survey. Triangulation was carried out wherever conditions allowed, but in few instances was this of a standard better than third-order. Triangulation nets were based on a local origin fixed by astronomical determinations for latitude and longitude. Control was then mainly dependent on traverses along jungle tracks.

In Borneo there existed a local triangulation for which the relevant data were partly available. In addition, some reasonably good topographical maps had been produced by the Dutch. This material was used as a basis for new operational maps and, for the first time in the history of Australian operations in S.W.P.A., it was possible to produce maps with a stabilized grid and with detail and contours of adequate accuracy thus obviating, or at any rate reducing, the need for the subsequent production of later editions.

The Australian Survey Corps was not involved in survey work other than for normal topographical mapping requirements, except for the occasional detail survey of some base installation. There was some beach-gradient determination in the theatre, but this was done by the Engineer Intelligence Section at G.H.Q., and the technical work involved was not comparable with that used in the European Theatres.

Surveys for airfield sites were also carried out under G.H.Q. control, firstly from air-photos, and later by the construction unit in the field.

MAPPING IN THE SOUTH WEST PACIFIC AREA

There were no satisfactory maps of the New Guinea area existing before May, 1942, and, although strenuous efforts were made to improve this situation, the early campaigns in the Moresby, Milne Bay, Buna, Wau and Kumiatum areas were much handicapped through lack of reliable maps. In March, 1943, the 2/1 (Army) Topographical Company arrived at Port Moresby. This unit was complete with lithographic printing equipment and, from then on, the production and printing of maps could be undertaken locally. It then became the accepted procedure for urgent operational maps to be produced in New Guinea rather than on the mainland.

For the Lae operations, conditions showed a marked improvement as a result of the time-factor being more favourable, the greater availability of survey units, and the improved standard of air photography. Except for a few isolated cases this improved situation continued, and map production was generally considered effective.

On the mainland, long-range planning maps were produced by the G.H.Q. Cartographic Company located at Bendigo, Victoria. This unit was equipped with nine litho presses, and was able to cope with the many large demands made on it.

In addition to meeting the requirements of the Australian forces, the Survey Corps was called on to produce many maps for their American allies, amongst which those for Mindanao in the Philippines should be mentioned.

The peak of the mapping effort was reached in preparation for the final operations in Borneo. The movement of units and the time-factors were critical, but the standard of efficiency of the survey units involved, together with improved air photography, the existence of some survey control, and the high pressure maintained, resulted in the production of map series which were better than any produced for previous operations in the theatre.

AIR PHOTOGRAPHS

Every endeavour was made to procure air photographs, but until 1943, the supply was not effective. Mapping of the mainland was done by plane-table methods except for a few areas for which photography was available. On the mainland this photography was taken mainly by the R.A.A.F. Survey Flight supplemented by a contract covering 20,000 square miles with a civilian firm (Adastra Airways). The Survey Flight was not, however, equipped with aircraft suitable for operational work against enemy opposition.

In New Guinea and subsequent campaigns in the South West Pacific, the U.S. Air Force supplied the air photography under the direction of the Chief Engineer at G.H.Q. S.W.P.A. This was mainly of trimetrogon type on small and medium scales, supplemented by large scale intelligence photo-coverage. As a result of constant adverse weather conditions and enemy opposition, photography was rarely in the form of block coverage, and consisted usually of the "shoot and run" type with plenty of gaps due to cloud.

This situation improved for the Borneo operations owing to greater availability of photo aircraft, less enemy opposition, and more time available for planning. But the photo-coverage never reached the ideal at any stage of the operations.

The Australian Survey Units did not possess any Multiplex plotting equipment, and compilation depended on simple graphical methods using stereoscopes and parallex bars of local manufacture. Operational mapping photography was carried out mainly with K-17 and K-18 cameras.

A national air-photo library was eventually established by the Australian Survey Corps in Melbourne.

TERRAIN MODELS

These were produced by the Australian Survey Corps for planning purposes. Others were made by the Central Photo Interpretation Unit. Scales varied from 1/1,500 to 1/50,000. The technique usually involved the use of plywood or caneite layering, with water putty for filling in the layer steps, and suitable texturing and delineation. Jungle vegetation was shown by grated sponge rubber. During the last phase of the Borneo campaign the production of some rubber-mat casts was undertaken by survey units, but owing to the difficulty of procuring latex and processing troubles in the tropics, these models were not available in time.



PHOTO-MAPS

This type of map was introduced in 1942 and seems to have been subsequently regarded as an operational requirement. The scale was usually 1/25,000, with *ad hoc* sheet lines and an arbitrary grid. They were used to supplement the normal maps, and their main advantage lay in their capacity for depicting the various categories of jungle vegetation, a topographical feature which was so important in jungle warfare.

MAP DISTRIBUTION

Field survey depots were formed, and they functioned similarly to the British units employed in other theatres. In the operational areas, supply was frequently effected by air, a notable example of which was the movement by air of 30 transport planes loaded with maps which had been produced mainly by the Australian Survey Corps for U.S. forces.

MAP RECORDS

A complete set of records of all maps and material covering the S.W.P.A. was established at the Survey Directorate. This record section controlled the interchange of all material which might be required for the reproduction of maps within the theatre.

ARTILLERY SURVEY IN S.W.P.A. AND CO-OPERATION WITH THE SURVEY CORPS

Survey Batteries were allotted on the basis of one to each division, and consisted each of a battery H.Q., 3 troops and a meteorological section. Artillery survey in S.W.P.A. was influenced by the same basic factors as in other theatres, but an important consideration was the diversity of conditions which had to be encountered. Some of the factors affecting their work were:—

- (a) Topography and vegetation, which varied from bare desert to dense jungle-covered mountains.
- (b) Climate, which affected the health of the troops, their equipment and observations.
- (c) The sparseness of trig data.
- (d) The reliability of the available maps, which varied according to the ground control available.
- (e) The nature of operations—amphibious, airborne, etc.

The primary functions of artillery survey in S.W.P.A. were as elsewhere:—

- (a) The provision of survey information to enable guns, O.P.s, and targets to be correlated on the same grid. This was the main function, and other tasks were subordinated to it in order that data for artillery units might be provided by the time required.
- (b) General survey control in the area of operations if the true grid had not already been established by Survey Corps personnel.
- (c) Surveys for anti-aircraft and coast artillery installations.
- (d) Calibration of equipment.
- (e) Assistance to the Survey Corps for mapping when required.
- (f) The fixation of control for air-photos.
- (g) Supply of meteorological information.

Operations in New Guinea indicated the need for the early establishment of survey control. It was generally found necessary to establish the artillery grid in sympathy with the maps available, this grid being converted to the true grid when the latter had been established by the Survey Corps.

In thick jungle country, survey could only be carried forward by traverse and, as the traverse legs were usually short, extreme accuracy and care were essential, making use of frequent azimuth observations. Triangulation was freely used in open areas such as at Bulolo, Markham and Ramu Valleys, and Rai Coast. This did not always mean an increase in the speed of survey, as considerable time was spent in moving to and from observing stations, and the climatic conditions affected visibility, often only two hours each day being suitable for observations.

Motor transport was rarely available for survey parties in jungle operations, and equipment had to be reduced to a minimum to perform the task in hand.

In S.W.P.A., as elsewhere, an essential need existed for close survey co-operation in the field, particularly in New Guinea. A review of operations in New Guinea indicates that difficulties arose in connection with the work of the Survey Corps and that of artillery survey units as no common origin and orientation were determined at the beginning of each operation. This resulted in two different grids being in use, thus causing confusion when new map editions were published.

Steps were taken to remedy this, and a directive which was issued to formations embodied the following instructions which were framed with a view to smoothing out the major difficulties that had been experienced:—

“Survey personnel should move into an operational area as early as practicable and, where possible, representatives of the Survey Corps should move in prior to or with the first personnel of a Survey Battery. This should ensure:—

“(a) That survey information on the true grid is available for field artillery as soon as it is in the area.

“(b) The provision of early and adequate ground control to facilitate later editions of maps of the area.

“The operational staff should consult the artillery commander before fixing the time at which the new edition of an operational map is taken into use so as to ensure that, whenever practicable, artillery information can be concerted into sympathy before the map is used.”

CARE OF EQUIPMENT

The constant care of survey equipment under tropical conditions was essential. Metal, leather and glass were very susceptible to climatic conditions. After one day's use the metal parts of a theodolite were affected sufficiently by acid from perspiration and jungle vapours to start corrosion and had to be regularly oiled after use. All leather cases and straps were left in the sun to prevent growth of blue mould.

After a period of two or three months, the glass lenses and prisms in instruments tended to develop a fungus growth. Treatment with cotton-wool damped with methylated spirits or alcohol was found effective.

It was found desirable to set all instruments on their tripods and sun-bake them for two hours at least twice a week. When stored in rooms, a constant circulation of dry air had to be maintained. Alternate conditions of hot sun

and high humidity caused warping and cracking of tripod legs. The wood parts were kept well saturated with linseed oil or other preservative and, when not in use, the tripods were stored well off the ground to avoid destruction by termites.

SECTION 3. THE UNION OF SOUTH AFRICA (see Sketch Maps Nos. 3, 5 and 10)

Early considerations

For a few years after the 1914-18 war, the Union Defence Force had a small Military Survey Service. This was, however, disbanded and the Trig-Survey Office, which was the Civil Geodetic and Topographical Service, thereafter maintained a close contact with the Union Defence Force (U.D.F.), and encouraged its professional assistants to take part in the activities of the Active Citizen Force. The Director of Trig-Survey was then appointed Director of Military Survey for the Defence Force, and, early in 1938, he was asked to draw up a survey organization for meeting its military survey needs.

By the South African Defence Act, all citizens were liable to military training in peace-time, and the Active Citizen Force was one of the components of the Union Defence Force, and consisted of officers, senior N.C.O.s and men trained in special duties, as well as citizens undergoing peace-time training. It was organized in units of the various arms.

At that time, it was decided that the Defence Force would base its military survey organization on part-time units of the Active Citizen Force, and have no full-time military unit. The intention was that the Trig-Survey Office would, in the first instance, furnish the nucleus of the first units formed, and that recruiting would be extended to include all surveyors, engineers and draughtsmen who were interested.

Before 1939, it was thought that South African Survey units would, in the event of any future war, serve firstly in Africa, and that their organization and equipment should primarily be designed for African conditions. Although the British establishment tables for survey units (Army and Corps Field Survey Companies), had been studied, it was considered that as they had been designed mainly for European warfare, they would not suit African conditions.

With regard to technical work, the Trig-Survey carried its map production to the fair-drawing stage only. It had no reproduction or printing resources under its own control. All map reproduction and printing were carried out by the Government Printer, with whom a close liaison was maintained. As a result of this arrangement it was decided that a similar system would be adopted for the military organization and, simultaneously with the preparations for a military survey service, the Government Printer was asked to prepare an organization for a Military Printing Service to include both letterpress printing and the lithographic printing of maps. This was arranged in the form of a Mobile Printing Company which included a lithographic section.

The formation of a Military Survey Service

Assumptions. The plan was based on the assumption that the service might have to conduct its work anywhere in Africa, involving the survey of large areas of unmapped territory with bad communications.

Basic principles. These were:—

- (a) An ability to throw off self-contained detachments, which could operate for indefinite periods away from unit headquarters.
- (b) Sufficient transport to make the unit completely mobile.
- (c) Ability to conduct all types of survey, from basic triangulation to the preparation of large scale topographical maps.
- (d) The proper maintenance of all survey records.
- (e) Provision for the supply of air photographs for mapping purposes by a special air force unit.
- (f) Provision for instrument repair within the survey unit.

Original organization. The original scheme provided for:—

- (a) A Field Survey Company for field surveys.
- (b) A G.H.Q. Company for fair-drawing, long-term computation of triangulation and traverses, and the filing and maintenance of survey records.
- (c) A few staff appointments (Survey) at the H.Q. of the Union Defence Force.
- (d) A Survey Photographic Flight with the South African Air Force.

The outbreak of war caused this original plan to be modified. Contact was established with the various branches of the survey profession, and it was known that many ready-trained surveyors, engineers and draughtsmen would be available on mobilization. Training would therefore be limited to military training plus the adaptation of their basic survey knowledge to military purposes.

Mobilization

FORMATION OF A FIELD SURVEY COMPANY S.A.E.C.

The survey service was mobilized on 3rd June, 1940. The previously proposed separate Field Survey Company and G.H.Q. Company were merged into one which was called a Field Survey Company S.A.E.C. It consisted of 33 officers, 242 European O.R.s, 132 non-European O.R.s, and 115 vehicles with a major in command.

The organization of the unit was as under:—

Company H.Q., which included:—

- A geodetic officer and 5 computers.
- A map-production officer and 31 draughtsmen.
- 3 instrument repairers.

Trig Group, for all types of field surveys:—

- Group H.Q.
- 5 Trig Sections each of 4 officers and 16 O.R.s.

Mapping Group, for the compilation of line maps from air photographs:—

- Group H.Q.
- 5 Mapping Sections each of 1 officer and 15 O.R.s.

MAP REPRODUCTION AND PRINTING

At no time during the war was there any establishment provision for map printing to be included as an integral part of the South African Survey Service.

As has been previously stated, the peace-time procedure in the Union was that the Government Printer undertook this work for the Trig-Survey Department.

On mobilization, the Government Printer mobilized a printing unit for both letterpress and lithographic work, and the intention was that the printing of maps would be done by this unit as in peace-time without the survey service having any direct control or responsibility for it.

In East Africa, however, as soon as a Survey Directorate had been set up to control and co-ordinate all the survey resources that were available for that campaign, it was found desirable, as was the practice in all other theatres, to place map production and printing under the direct control of the survey service. The lithographic section of the Mobile Printing Unit was therefore attached to the South African Survey Company for technical work, and this arrangement continued throughout the war.

FORMATION OF A SURVEY DEPOT

This was formed so as to ensure that the Field Survey Company could be maintained. Its functions were to give technical training to recruits, to carry out military surveys and mapping in the Union, and to provide a reserve. The Depot, which was a Major's command, consisted of 21 officers, 190 O.R.s, and 99 vehicles.

Operations in East Africa

The move to Nairobi. On 14th July, 1940, the 1 Field Survey Company S.A.E.C. (less the mapping group which joined the unit in December) left the Union for East Africa by rail (1,400 miles) and by road (1,500 miles) arriving in Nairobi on 3rd August.

The rapid mobilization and equipping of this unit was made possible only by the following factors:—

- (a) The loyal action of the surveyors, engineers and draughtsmen who had promised to join the Survey Company when it was mobilized, and who maintained interest before mobilization by attending meetings and lectures.
- (b) The fact that all the technical personnel had been technically trained in civil life.
- (c) The support of the Trig-Survey Office, which transferred a high proportion of its technical equipment to the unit.
- (d) The provision of a block appropriation of £10,000 to cover the acquisition of technical equipment not available from military or Trig-Survey stores, with authority delegated to officers of the unit to acquire the equipment by signing government order forms.

Amendment of unit establishment. In February, 1941, the establishment of the unit was altered. It was now called the South African Survey Company, and consisted of 35 officers, 209 European O.R.s, 241 non-European O.R.s and 142 vehicles, and became a Lieut.-Colonel's command. The new organization was:—

Company H.Q. including:—

Geodetic officer and 6 computers.

3 instrument repairers.

2 Drawing Sections (each of 1 officer and 15 O.R.s).

Two Field Groups, each consisting of:—

Group H.Q. (Captain in command).

3 Field Sections (each of 3 officers and 13 O.R.s).

Photo-topographic Group:—

Group H.Q. (Captain in command).

3 Sections (each of 1 officer and 16 O.R.s).

Activities during the East African Campaign. These are described in Chapter VI dealing with the East African operations. The Survey Company remained in East Africa from August, 1940, until the summer of 1941 when it proceeded to the Middle East. The H.Q. of the unit remained in Nairobi all this time where compilation from air-photos, the fair-drawing of maps, long-term computing of triangulation, and instrument repairs were carried out. The survey operations in the field were conducted by five field sections, two map depots, a divisional survey section, and a brigade survey section. The last two were not allowed for in the establishment, but were found to be very useful in certain types of operations. In bush and other difficult country these sections navigated the formations to which they were attached and assisted them in various survey matters.

The field sections were engaged on triangulation and small scale mapping in northern Kenya, their most difficult task probably being the triangulation of the Sugoca Valley area.

The vast areas involved, and the speed of the advance, precluded systematic mapping from air-photos so, in order to provide some sort of large scale map in time for day-to-day operations, uncontrolled strip maps were prepared from air-photos, covering the main communications.

Operations in the Middle East (see also Chapter V)

The move from East Africa to Egypt. The South African Survey Company received orders during April, 1941, to move to the Middle East. There was some delay, and the move did not actually take place till some weeks later, when the unit went round by sea. The H.Q. of the unit was established at Maadi, near Cairo.

Early activities in the Middle East. Air-photo compilation and fair-drawing were done at Company H.Q., and the field sections carried out valuable surveys, the most notable of which were, perhaps, the 1/50,000 mapping of the El Alamein area, which was to prove of such value later on, and the completion of the triangulation link between the Egyptian, Palestine, and Trans-Jordan triangulations. During this period of 1941-42 several divisional survey detachments operated in the desert.

Organization

The Japanese successes in the Far East made it necessary to make provision for the defence of the Union. At that time, the largest scale map completely covering the Union was on the 1/500,000 scale, which was not large enough for use as a tactical map. It was decided, therefore, to increase the survey strength in the Union, so as to improve the mapping situation, and major changes were made in the organization of the South African Survey Service.

It was found that the policy of combining training and production in one

unit was not sound. The Survey Depot, as it originally existed, was therefore disbanded, and in its place there were formed a Survey Depot (Training), and a Survey Depot (Technical). The former provided an establishment for giving all types of technical and military training to officers and O.R.s. The latter was a unit, consisting largely of female personnel, whose main functions were:—

- (a) The production of maps from air-photos.
- (b) The compilation and fair-drawing of maps of all sorts.
- (c) The production of photographic prints, enlargements and air-photo mosaics.

The South African Survey Company was found to be somewhat cumbersome. This led to the formation of the Type "A" and Type "B" Companies. The former was designed to work as a G.H.Q. unit, and the latter as an army unit. Their composition is given briefly below:—

Type "B" (Army Survey Company.)

Company H.Q.

Map Production Group.

Group H.Q.

Two Sections (each of 1 officer and 12 draughtsmen).

Checking and Records Group.

2 officers and 6 O.R.s.

Two Survey Groups (each having a Group H.Q., and 3 survey sections).

Type "A" (G.H.Q.) Survey Company.

This was double the size of a Type "B" Company, being of a more static nature, and having 4 Survey Groups, a Map Production Group of 4 Sections, and a Checking and Records Group.

It will be noted that both units included a Checking and Records Group. Experience had shown the need for a centralized section to control and check all the work produced by the unit. American topographical units had the same sort of thing, and called them "Operations Sections." The Checking and Records Group was responsible for co-ordinating all technical work between the various branches of the unit, and arranging for the flow of work evenly and smoothly, for checking the work, and for maintaining all the technical records. In the original South African Company such a group had been found essential, but as there was no provision for it on establishment, it had been formed by robbing personnel from other sections.

Reference has been made to the use of divisional and brigade survey sections during the East African operations. In 1942, provision was made in the establishment of the Survey Company for a number of divisional survey detachments, thus enabling one or more of them to be furnished without upsetting the normal strength of the parent unit. Each detachment consisted of three officers and nine other ranks with four vehicles, and was allotted to a division only when operations warranted such action. When not so allotted the detachments operated with the parent company.

Throughout the war, the South African Survey Service supplied staff officers for the various formations with which its units were operating. As the division was the highest South African formation in the field, there was no call for the provision of a Survey Directorate. There was always, however, a South

African administrative headquarters in the field at G.H.Q. level. Although this H.Q. had administrative powers only, with no operational control, provision was made on its establishment for four survey staff officers, and these appointments were filled as and when circumstances required. The officers were attached to formations where they were needed. For example, at one period they were more or less permanently attached to such widely separated formations as G.H.Q., Middle East, A.F.H.Q. at Algiers, and H.Q., Allied Armies in Italy.

Conversion to 46 Survey Company S.A.E.C., and assignment to Eighth Army

In the summer of 1942, the South African Survey Company was converted to the 46 Survey Company S.A.E.C. (a Type "B" Company), made fully mobile, and assigned to Eighth Army for operations in Egypt and Libya. Surplus personnel after this conversion were returned to the Union.

46 Survey Company was in survey support of Eighth Army from El Alamein to Tunis, together with 517 Field Survey Company R.E. which operated as a reserve company during most of this period. The achievements of 46 Survey Company, both technical and otherwise, were outstanding. The successful production and use of block-plots, first used at the battle of El Alamein as an aid to counter-battery shoots and the destruction of enemy targets by artillery concentrations, was perhaps the technical high-light. Map supply and distribution to fast-moving and widely separated formations was a difficult and never-ending task and, in addition, there was the day-to-day preparation of battle maps and the printing of map stocks in the field on the mobile printing equipment attached to the unit.

On the conclusion of the North African campaign in May, 1943, 46 Survey Company returned to Maadi for rest and refit in preparation for its next task.

Operations in Italy

ASSIGNMENT OF 46 SURVEY COMPANY TO FIFTH U.S. ARMY IN ITALY

In August, 1943, 46 Survey Company was assigned to Fifth U.S. Army and proceeded to Tripoli pending the move over to Italy. On 8th October, it landed at Salerno.

Group A was responsible for triangulation work covering the army front throughout the whole of the campaign in Italy. Mapping preparations for the landing at Anzio were carried out, and all the other many and various tasks that fall to the lot of any survey unit working in support of an army in the field.

After completing 19 months' unbroken service with Fifth Army, during which time it was twice awarded the army plaque for excellence in discipline, performance and merit, 46 Survey Company was released from this assignment on 16th May, 1945, on the conclusion of the war in Europe.

49 SURVEY COMPANY S.A.E.C.

This unit was formed in South Africa in October, 1943, arrived at Maadi Camp in December, and reached Taranto on 25th January, 1944. Shortly afterwards it came under command of Fifth U.S. Army.

In March, 1944, it was transferred to Eighth Army, and divisional survey detachments were supplied to 6 (British) Armoured Division, 6 (S.A.) Armoured

Division, and 1 Canadian Division, remaining with them till June when it became clear that the nature of the operations did not justify the continued use of these detachments.

49 Survey Company carried out trig work over Eighth Army front until 8th April, 1945, and a detachment was furnished to 3 South African Air Force Wing, remaining with it until the close of hostilities, being engaged on special computations connected with radar.

For the crossing of the R. Po, one section was assigned to the Task Force engaged on this operation. It began its special training in February and did the survey work for the bridging of the river and the final assault and follow-up.

General comments

The following general comments and criticisms are based on opinions and statements of officers who were closely connected with the work of the South African Survey units in the field. They are recorded, for what they are worth, as a matter of general interest, and for future reference and discussion:—

- (a) *Type "B" Company.* The war proved this type of unit to be a success. In all phases of warfare encountered from El Alamein to the Alps it fulfilled practically all the requirements for survey work of an army in the field, though it has been suggested that it might be improved by the addition of a third drawing section in the Map Production Group.
- (b) *Type "A" Company.* This was intended to be used at army group or G.H.Q. level, but it was too cumbersome. It has been suggested that it would be preferable to deploy two Type "B" Companies rather than one Type "A."
- (c) *Technical training considerations.* Experience showed that plane-tableing formed the soundest basic training for survey personnel. This should be an obvious fact to anyone who has had the responsibility of seeing or controlling the work of topographical surveyors under field conditions. The South African Survey Service recognized its importance from the start.

In the Type "B" Company the Field Group personnel (surveyors, topographical) were capable of carrying out triangulation, topographical surveys, and the production of line maps from air-photos. The personnel of the Map Production Group (draughtsmen, topographical) were qualified in all types of fair-drawing for reproduction.

It was considered that the efficiency of the Type "B" Company as a whole would be improved if all surveyors and draughtsmen were qualified in the compilation of line maps and the revision of maps from air-photos.

AIR PHOTOGRAPHS

It has frequently been suggested that, from the survey point of view, it is desirable to have an air force unit specializing in survey photography. In East Africa there was a South African Air Force Survey Flight which was virtually under the control of the Survey Directorate, and it certainly made a major contribution to the successful survey support which was given during that campaign.

The personnel of the Survey Flight moved to the Middle East when the South African Survey Company arrived there, and they were formed into

No. 60 Squadron S.A.A.F. Although the chain of command between Survey and the Squadron was not so direct in the Middle East as it had been in East Africa, nevertheless 60 Squadron did act in very close support of Survey and, during the El Alamein-Tunis period, 46 Survey Company sited its camps as near as possible to 60 Squadron.

The value to Eighth Army of the block-plots and maps which were produced from air-photos may be judged from the fact that the first Mosquito aircraft supplied to the Desert Air Force were, at the personal request of General Montgomery, used by 60 Squadron.

The demand for photo-mosaics and gridded photographs was a large and growing one. Experience indicated that Type "B" Survey Companies ought to be trained and equipped to deal with this requirement. It was suggested also that the equipment should include a portable enlarging and rectifying camera, fitted in a dark-room truck.

SECTION 4. SOUTHERN RHODESIA (*see* Sketch Maps Nos. 5, 7 and 8)

Formation

In February, 1939, the Chief Staff Officer, Southern Rhodesia Forces, initiated discussions with the Surveyor General (Major L. M. McBean) regarding the formation of a Field Survey Unit in Southern Rhodesia. The War Office had drawn up a suggested establishment for a Field Survey Company (African Colonial Forces) based on West African conditions, and in July, 1939, proposed that three such companies be formed, *viz.*:—

One from Nigeria and the Gold Coast.

One from Kenya, Uganda and Tanganyika Territory.

One from Northern and Southern Rhodesia.

All the above to be combined into a Survey Battalion on mobilization.

In view of the wide variation of conditions prevailing between East Africa, West Africa and Rhodesia, the Surveyor General was of the opinion that it would be a mistake to base the organization of all three units on the West African pattern, and suggested that the establishment of their respective units should conform to local conditions and resources.

Meanwhile the East African Command, with War Office approval, had taken action to produce its own establishment for a Field Survey Company, the first sections of which were mobilized by 3rd September, 1939. The formation and activities of the East and West African Survey Companies are referred to in Sections 5 and 6 of this Chapter. Thus, for service in the East African Theatre, three distinct types of survey units were formed, the establishment of each being drawn up to fit the personnel available, a course which seemed to be inevitable owing to the limited resources of trained survey personnel.

On 27th October the Southern Rhodesian Government, in response to an enquiry from the G.O.C., East Africa Force, agreed to provide a survey unit on the understanding that supplementary African personnel would be provided in East Africa. The original war establishment of the survey unit provided for 5 officers, 14 British warrant officers and N.C.O.s, 16 coloured M.T. drivers

and vehicles, and 67 African other ranks. The organization was such as to provide a headquarter section for administration, computing and drawing, and a field section of eight sub-sections for trig, topographical and phototopographical work.

The personnel consisted of land surveyors and topographers, and men from the geological, mining, engineering and architectural professions. There were practically no map printing personnel available, as it was considered essential to keep the existing base map reproduction plant operating in Salisbury.

Of the original N.C.O.s 66 per cent were eventually commissioned and, by the end of the war, the Southern Rhodesian contribution of military survey personnel had grown to a total of 20 officers and 45 British warrant officers, serjeants and corporals.

The unit was mobilized on 2nd March, 1940, and proceeded to a training camp at Salisbury under its commander, Major (later Colonel) J. E. S. Bradford. Nearly all the personnel had undergone recent military training in the Southern Rhodesia Territorial Forces, and ten intensive days were spent on drill, morse signalling and Swahili lectures. On 12th March, the unit left Salisbury for Broken Hill *en route* for Nairobi.

A Reserve Survey Section was organized in Salisbury during May, 1940, under the Surveyor General. Its main functions were, firstly to train and supply reinforcements to the Field Survey Company, and secondly to provide topographical maps required in the Colony for defence purposes. The Government Lithographic Press, though not mobilized, carried out printing and publication duties for map making throughout the war. In January, 1941, a military Survey Directorate was formed for Southern Rhodesia with Major McBean as Director of Military Survey.

Later on, in April, 1943, by agreement with the Union of South Africa, survey trainees from Southern Rhodesia, selected from suitable serving soldiers by the Director of Survey, were sent to the Survey Training Depot S.A.E.C. at Ladysmith to complete their military survey courses. They were then drafted to the East African Command to obtain final field experience before being drafted to the South East Asia Command as reinforcements to 155 (E.A. and S.R.) Field Survey Company about which details will be given later.

The campaign in Abyssinia (see Sketch Map No. 5)

ARRIVAL AND EARLY WORK IN EAST AFRICA

On 12th March, 1940, Major Bradford flew to Dar-es-Salaam *en route* for Nairobi. The Field Survey Company, moving by road after a rail journey to Broken Hill, completed the trip of 1,650 miles in 13 days. The unit was brought up to strength by the addition of African personnel from the East African Engineers, and moved, on 3rd April, to Ngomene in the Garissa area to carry out field surveys along the Tana River, which was regarded as the forward defended locality for British East Africa. There was an immediate requirement for the mapping of some 39,000 square miles in the northern frontier district of Kenya along the Abyssinian and Somaliland frontiers where no reliable topographical mapping existed.

Unfortunately there were no air photographic resources in the Command at that time, and the policy laid down by the General Staff was that methodical surveys at 1/100,000 scale should be undertaken by ordinary ground survey

methods. This continued until May when it was clear that Italy's entry into the war was imminent. By this time it was obvious to the officers commanding both the Southern Rhodesian and East African Survey Companies that the 1/100,000 mapping project would cover only a relatively small area in the time available before hostilities were likely to break out. They therefore recommended to the General Staff a change of policy whereby as large an area as possible should be surveyed by rapid reconnaissance methods so as to produce maps of the potential operational area at 1/500,000 scale as soon as possible. This was approved, and a new programme was started at once. In some localities which were difficult of access sketch topography was carried out from aircraft with successful results.

On 9th June, just before Italy's declaration of war, the reconnaissance parties were recalled and unit headquarters moved into the 1st East African Brigade area. The field sections were then employed on large scale mapping of selected defence areas, and the production of route reports from railhead at Thika to the advanced post at Garissa, 250 miles to the east.

RECONNAISSANCE INTO ITALIAN SOMALILAND (JUNE, 1940)

In preparation for forthcoming moves eastwards into Italian territory there was a need to fix the positions of salient points such as water-holes, and to establish ground control for air photography which would be undertaken by the recently arrived 60 (Photo) Squadron S.A.A.F. along the probable lines of advance. While doing this it was desired to prepare a route report. A survey section of the Southern Rhodesian Survey Company, with escort, left Garissa on 26th June, crossed the frontier and penetrated 23 miles inside enemy territory. Observations were taken *en route*, and in a little over 24 hours they had completed their mission, obtaining much information and data which were eventually used for the production of maps used by 12 (A.) Division when it advanced into Somaliland in the following February.

FORMATION OF SURVEY DIRECTORATE AND EAST AFRICAN SURVEY GROUP

In July, 1940, during a visit by D. Survey, Middle East, it was decided to form a Survey Directorate for the East African Force. It was decided also that 1st Survey Company (East African Engineers), the Southern Rhodesian Survey Company, and the West African Survey Company should be amalgamated to form an East African Survey Group with Lieut.-Colonel Bradford as its commander.

The Survey Group was organized into a H.Q. Group, a Map Production Group, and a Field Group. The personnel of the existing units were split up and used to the best advantage for making up sections in the new group, according to their qualifications and trades. The group had no authorized establishment of its own. Each unit retained on paper its own war establishment and, in spite of this somewhat unorthodox arrangement, the group functioned most efficiently for over two years of useful hard work.

Southern Rhodesian personnel were spread throughout the whole group but in particular No. 1 Field Section (photo-topo) was composed mostly of Rhodesians by virtue of their having been trained in such work in peace-time, and they were also represented strongly in the field sections employed on topographical duties. The photo-topographical section was withdrawn from

the field to Survey Group H.Q. in September, 1940, where, for seven months, it worked at high pressure preparing maps for the advance into enemy territory.

As the campaign in Abyssinia developed, it became necessary to alter the composition of the original field sections. Four of them were transformed into divisional and brigade survey sections to operate with formations in the field and to look after their immediate survey and mapping needs. No. 1 Field Section however, retained its original identity and functions.

MAPPING WORK BY NO. 1 (PHOTO-TOPO) FIELD SECTION

The advance of the East African Force into enemy country was, in general, along routes hitherto practically unmapped. On some occasions there was a complete absence of ground control, which affected the production of maps from air-photos in that it was impossible to show either an accurate true north or scale. These defects were partly overcome by the divisional and brigade sections, who were able to make the necessary observations in the field and impose a grid on the maps.

Movement was so rapid that the air photography was often only just able to keep ahead of the advancing troops, and the time available for the compilation and printing of the maps at Survey Group H.Q. was very limited. No. 1 Field Section was working for an average of 15 hours a day for weeks on end. During some emergency periods long non-stop sessions were necessary, with several of over 40 hours, including one peak stretch of 55 hours. Similar rush-periods were worked by other sections such as printing.

TRIG AND TOPOGRAPHY BY FIELD SECTIONS

The strategy up to August, 1940, had been of a defensive nature centred on such areas as Marsabit, Wajir, Isiolo, Garissa and Bura. During this phase Nos. 2 and 3 Field Sections, which included Rhodesian personnel, were employed on large scale mapping of defence areas. This included plane-table surveys, astronomical observations and triangulation for ground control, and rapid route reconnaissance traverses by prismatic compass. Shortage of water, and the need for keeping a constant look-out against attack by bands of enemy irregulars, hampered the work.

In August, the strategy became offensive in character, and preparations were put in hand for an advance eastwards towards Kismayu with a feint to the north. Between August and December, 1940, Nos. 2 and 3 Sections were engaged on trig and topographical survey in the northern frontier district of Kenya.

FORMATION OF DIVISIONAL AND BRIGADE SURVEY SECTIONS

In December, 1940, it was decided that survey sections should be attached to divisions and brigades during offensive operations. They operated with 11 and 12 (African) Divisions and with several of the independent brigades, and were present in all the major actions. On the fall of Addis Ababa in April, 1941, when the remaining 30,000 Italians retreated to Gondar, one survey section was assigned to the force which invested and finally overcame them there. The positions of enemy gun batteries were fixed by intersections from co-ordinated O.P.s and assistance was given to the artillery in other ways. The remaining sections were withdrawn and were employed in Addis Ababa investigating captured maps and equipment, and arranging for their evacuation to Nairobi.

OTHER WORK DURING 1941

Part of the remaining field sections was employed on the rapid establishment of mapping control in the areas of Abyssinia and Somaliland which were accessible under escort, but which, owing to the unruly tribes, would become inaccessible later when British troops withdrew.

Triangulation was carried out in the Lake Rudolf area and westwards along the south and east borders of the Sudan towards the White Nile. Training areas in Kenya also had to be mapped.

Defence preparations against a possible Japanese offensive

With the entry of Japan into the war in December, 1941, it was necessary to take defence measures against possible Japanese action. This involved the allied occupation of Madagascar and French Somaliland. Rhodesian survey personnel were actively engaged on mapping and other survey work in connection with these preparations.

No large scale maps existed for important coastal areas such as Malindi, Mombasa, Tanga, Dar-es-Salaam, and Lindi. Sections were deployed over wide areas to fix ground control for photography, and to survey coast defence batteries. At the end of July, 1942, following the initial landings in Madagascar, the field sections were withdrawn from their work in the coastal area to operate in Madagascar, in connection with the second allied landings and final conquest of the island.

At Survey Group H.Q. mapping work went on at high pressure through the whole of 1942-43. From July to November, 1942, there was an intensive mapping programme for Madagascar. At that time the East African Survey Directorate was responsible for a vast area embracing Eritrea, Abyssinia, the eastern part of the Sudan, French, British and Italian Somaliland, Aden, Kenya, Uganda, Tanganyika, Zanzibar, Madagascar, Indian Ocean Islands, Nyasaland, Northern Rhodesia, and the northern part of Portuguese East Africa.

The Madagascar operations

In March, 1942, Survey Group H.Q. were asked to produce under great secrecy a few copies of a large scale map of Diego Suarez from air-photos. On 4th May a force which had sailed direct from the United Kingdom landed at Courier Bay and captured Diego Suarez. This force was provided with maps prepared by the War Office. There was no survey representation for the initial operations and the R.E. Survey Section went in with the second flight some days after the first landing. In response to an urgent call from the force, a survey officer flew over from East Africa two days before the arrival of the survey section from the United Kingdom.

During the next few months, a strong survey section, including many Rhodesian officers and N.C.O.s, was based on Diego Suarez for fixing ground control, and for carrying out large scale coast defence surveys. Later on this section furnished personnel for attachment to the brigades which took part in the second landings at Majunga and Tamatave in September, and the final operations leading up to the capitulation in November. The last of the Rhodesian personnel left Madagascar in October, 1943, after completing a great amount of field survey in the island. Lack of air-photographs was a constant source of delay, as it had been in the coastal area of East Africa.

Reorganization of the survey organization in East Africa

By June, 1943, it was clear that very soon much of the survey resources in the East African Command could be transferred elsewhere. In response to an enquiry from the War Office, the Government of Southern Rhodesia agreed that their survey personnel should be employed wherever most required, and promised to provide reinforcements for the field sections.

Several alternative methods of utilizing them were considered, and finally it was proposed that a combined East African and Southern Rhodesian Field Survey Company should be formed for service outside Africa, with a Base Survey Company to be left behind for service with the East African Command. This proposal was agreed and adopted. On 20th October, 1943, the East African Survey Group was disbanded and the following came into being:—

155 (E.A. and S.R.) Field Survey Company for service overseas.

157 (E.A. and S.R.) Base Survey Company for service in East Africa.

The former, consisting of 19 officers, 2 warrant officers, 54 British N.C.O.s, 326 African ranks and 104 African non-combatants, was commanded by Lieut.-Colonel A. J. Seex (E.A. Engineers) and was organized as Headquarters, 3 topographical sections, 1 drawing section, and 1 reproduction section. Practically all the Southern Rhodesian personnel were posted to this unit.

For the last two years of the war, 157 Base Survey Company was kept very busy meeting extensive demands for mapping and survey which inevitably arose in such a large Command as that in East Africa. The work included not only the provision of maps for training, the preparation of large scale maps of specified areas such as the Island of Socotra and parts of Madagascar and Abyssinia, but also a special mapping programme for S.E.A.C., which included Army/Air maps of Java and Sumatra and navigational plotting charts.

With S.E.A.C.

155 Field Survey Company reached Colombo on 14th February, 1944, and Bombay a few days later. The first task in which Rhodesian personnel took part in the new Command was in connection with the combined hydrographic, topographic and engineering survey of the Cocos, or Keeling Islands, situated about midway between Colombo and Australia. This survey was part of a strategic plan for the development of the islands as an air-base in anticipation of future operations to recapture Malaya. A topographical party from 155 Field Survey Company was there for nearly three months.

Meanwhile the main unit moved on from Bombay to Fourteenth Army H.Q. which was then at Comilla in Eastern Bengal, and by mid-April one field section, including six Rhodesians, was operating with 33 Corps which was then fighting the battle for Kohima. The work of the section consisted largely of survey for, and in conjunction with, the Royal Artillery, and after two months in the Kohima area it was withdrawn to Comilla as soon as the road from Kohima to Imphal had been opened up.

In mid-April, another field section, including six Rhodesians, joined 15 Corps on the Arakan front and was engaged in extending the triangulation and the production of large scale maps from air-photos. When the monsoon broke in mid-May this section was withdrawn to Comilla.

H.Q. 155 Field Survey Company, with all sections other than the two temporarily detached to 15 and 33 Corps, remained at Comilla from April till mid-October, engaged on the production of maps for Fourteenth Army. There

were some delays in map printing owing to the non-arrival of certain equipment from the United Kingdom.

By June, 1944, it was apparent that some radical changes in the organization of the unit were necessary. Experience with Fourteenth Army and a consideration of future trends showed that 155 Company was too large for efficient employment as a single unit, and that a certain amount of splitting up and reduction in numbers would produce the flexibility that was necessary for utilizing the personnel to the best advantage.

On 18th September, therefore, 155 Company was converted into four smaller units, which effected a saving of about 200 African ranks. The new units were:—

155 (E.A. and S.R.) Field Survey Company consisting of H.Q., 1 trig, 1 topographical, and 1 air survey section.

17 Air Survey Section.

67 (Indian) Reproduction Section.

158 (E.A.) Map Supply Section.

Under the new arrangement, East African Command became responsible only for the maintenance of the first and last of the above, India assuming responsibility for the other two units. Practically all the Rhodesian personnel were posted to the new 155 Company and, with Major J. L. Reid in command, it moved to 15 Corps on the Arakan front on 19th October, 1944. Rhodesians now formed 86 per cent of the British personnel.

155 Company reached Cox's Bazar, where H.Q. 15 Corps was located, on the eve of the advance down the Arakan coast. The field sections were sent out to fix positions in the forward areas including Bawli Bazar, Maungdaw, Foul Foint, and Mayu River.

The remainder of the unit was employed at Cox's Bazar from November, 1944, till March, 1945, on air survey, block-plots, and the preparation of beach landing maps. The field sections accompanied the advancing troops of 15 Corps down the coast, carrying out triangulation on Akyab Island, at Myebon, on Ramree Island and on other islands in the vicinity, remaining with 15 Corps from February till April, 1945.

One field section was held in readiness to accompany the 15 Corps Task Force for the capture of Rangoon, but the assignment was cancelled at the last moment when the decision was reached to withdraw 155 Company from Burma to Bangalore for refit and training pending the projected invasion of Malaya. In July, however, shortly before the Japanese surrender, H.Q. Allied Land Forces decided to disband the unit and, leaving Bangalore on 7th October, it disembarked at Mombasa on the 25th.

During the period when 155 Field Survey Company was in S.E.A.C., Colonel J. E. S. Bradford held the appointment of D.D. Survey at H.Q. A.L.F.S.E.A. and later at H.Q. S.A.C.S.E.A., and had under his control the Survey Production Centre where so much of the mapping for the theatre was carried out. Major P. H. O'Brien, another Rhodesian, was D.A.D. Survey with the Survey Directorate at H.Q. Fourteenth Army. Several other Rhodesians held survey staff appointments or were in charge of technical survey activities, principally in connection with air survey mapping, both in India and with A.L.F.S.E.A.

With a limited number of experienced surveyors and map production personnel, which were not really sufficient for the formation of a properly balanced

unit, Southern Rhodesia had thus provided a most valuable contribution to allied survey resources in two major operational theatres.

SECTION 5. EAST AFRICA (*see* Sketch Map No. 5)

Kenya, Tanganyika, and Uganda

In March, 1939, a scheme was prepared for the formation of a field survey unit consisting of trained surveyors of the Survey Division of the Department of Lands and Mines in Tanganyika Territory. When war became imminent in the late summer the officer members of the unit, who had joined the King's African Rifles, Reserve of Officers, were in a position to take the field with little delay.

The Field Survey Unit, K.A.R., was mobilized on 1st September, 1939, and was located at Dar-es-Salaam. Early appointments included Major H. P. Rose in command, one Captain and Adjutant, five other officers, and three serjeants. 12 African ranks were enlisted at Survey H.Q. in Dar-es-Salaam, and 31 African ranks were enlisted from the K.A.R. In addition four European and some Asiatic civilians were posted to the Map Production Section at Headquarters. The unit was at first organized into a H.Q. Section, No. 1 Field Section and a Map Production Section. No. 1 Field Section was equipped with technical stores drawn from the Survey Division, and the Map Production Section began work on redrawing and publishing the Italian series of 1/M maps.

On 26th September, No. 1 Field Section left for Nairobi, where it immediately started on field surveys, including plane-table traverses on the lines of communication. One party went to the Isiolo-Archer's Post road, another to the Isiolo-Wajir road. The remainder began a series of astronomical observations to establish control for road traverses and for local trig schemes. Early in October, the adjutant reported to East African Force H.Q. at Nairobi to act as a liaison officer, and to undertake the formation of No. 2 Field Section, the European personnel for which was drawn from the Survey Departments of Kenya and Uganda. African ranks were recruited from the K.A.R. and, after some weeks of training, the section left for the North Frontier District. There they carried out plane-table road traverses, and a plane-table survey at 1/50,000 scale of an area round Wajir.

The formation of No. 3 Field Section was under consideration, the plan being to use Southern Rhodesian personnel, when it was learnt that Southern Rhodesia was forming its own survey unit, so the raising of the third section was temporarily postponed.

At the end of October, the designation of the unit was altered to 1st Field Survey Company, East African Engineers (E.A.E.), and it was assigned to Force Headquarters for operational control. The two field sections continued to carry out surveys in the forward areas, No. 1 being at Isiolo, and No. 2 at Garissa, and the Map Production Section at Dar-es-Salaam was busy with the reproduction of the Italian 1/M maps and of other maps as required by Force H.Q.

A large scale survey of Moyale was undertaken, combined with a topographical survey of the surrounding area of this frontier post. As war had not yet broken out with Italy, the work was conducted under conditions of secrecy.

No. 3 Field Section was formed in February and at the end of May all the field sections were concentrated at Isiolo in readiness for a rapid mapping reconnaissance of the whole of the North Frontier District so as to produce a 1/500,000 map of the potential operational area. Hitherto the policy had been to map methodically at the scale of 1/100,000, and it was clear that, on this basis, only small areas would have been completed by the time required. It was owing to the representations of the officers commanding the East African and Southern Rhodesian Survey Companies that this change of mapping policy was put into operation.

In July, the East African Survey Group was formed by grouping together the East African, Southern Rhodesian, and West African Survey Companies, the latter having now arrived in Kenya. The personnel of the three units were used to the best advantage to form trig, topographical, photo-topographical, drawing, and printing sections and, from now on, the independent operations of the 1st Field Survey Company E.A.E. came to an end. On incorporation into the Survey Group the unit retained on paper its separate war establishment although the personnel was split up, and it was redesignated 55 Survey Company E.A.E.

References to further activities of the East African survey personnel will be found in Section 4 of this chapter and also in Chapters VI (Italian East Africa) and VIII (South East Asia).

SECTION 6. WEST AFRICA (*see* Sketch Maps Nos. 5, 7 and 8)

Formation of Survey Company and activities in East Africa

When Nigeria and the Gold Coast sent military contingents to East Africa in the summer of 1940, they were accompanied by two survey contingents, one from each of the two Colonies. The European personnel were drawn from the civil survey organizations, and the trained survey draughtsmen and lithographers were recruited from the West African native staffs of the respective survey departments. These two contingents were formed into one West African Survey Unit, part of the Royal West African Frontier Force, the personnel belonging to the Nigerian and Gold Coast Regiments. The unit was under the command of Major E. W. Nesham (Nigeria).

The Nigerian contingent took with it some map reproduction plant including camera, hand litho-press and ancillary equipment. This proved to be of great value in East Africa during a critical period when map production facilities were very limited pending the arrival of equipment from elsewhere.

In August, 1940, the unit became part of the newly formed East African Survey Group together with the survey units from East Africa and Southern Rhodesia, and was redesignated 56 (W.A.) Survey Company. References to the activities of the unit as part of the Survey Group will be found in Section 4 of this Chapter and also in Chapter VI (Italian East Africa). It returned to West Africa in August, 1941, on the conclusion of operations in Abyssinia.

Formation of divisional survey sections for operations in S.E.A.C.

The West African Survey Unit was employed in West Africa during 1942-43 as a training unit. During that time divisional survey sections were formed for

duty with 81 and 82 (W.A.) Divisions who were to take part in the operations in S.E.A.C. These sections were composed of personnel drawn from the Survey Company plus a number of new recruits trained by that unit. The unit was eventually disbanded in 1945, all trained personnel being sent to India.

The Burma Campaign

10 (W.A.) *Divisional Survey Section*. When 81 Division first arrived in India in 1943, there were three brigade survey sections, attached respectively to 3rd, 5th and 6th (W.A.) Brigades. The sections with 5th and 6th Brigades were in the Kaladan Valley on the left flank of the Arakan front in Burma. They took part in a 200-mile outflanking march, and were employed mainly on surveys for the artillery, and on mapping a new 150-mile jeep road which was constructed by the division as a supply route. In July, 1944, the section with 5th Brigade was detached to H.Q. Fourteenth Army for 1/25,000 map production covering part of the Kaladan Valley.

3rd (W.A.) Brigade, with its survey section, was detached from 81 Division and joined one of the brigades of Wingate's 'Chindits' operating in northern Burma. This section was employed on the production of sketch maps of air-strips and camps, but otherwise did little survey work.

In August, 1944, the three brigade survey sections were amalgamated to form No. 10 (W.A.) *Divisional Survey Section* with 81 Division just behind the main Arakan front. Between September, 1944, and January, 1945, it produced a number of new 1/25,000 sheets of the Kaladan Valley for use by 81 Division on another outflanking march in that area.

In February, 1945, 81 Division was withdrawn from Burma to India to train for the invasion of Malaya. The survey section was to have been employed mainly on air-photo mapping for the operation, but in May, 1945, it was decided to withdraw the division from the Command, and its move back to West Africa was completed by early 1946.

11 (W.A.) *Divisional Survey Section*. This section operated with 82 (W.A.) Division on the left flank of the Arakan front in Burma. One of its field sections accompanied the advanced troops, the remainder being employed on 1/25,000 mapping.

In May, 1945, the section was withdrawn from the division and took over the Akyab map depot until it was closed in September, 1945. It then rejoined 82 Division at Taungup and moved with it to Rangoon in December. During the early part of 1946 it was working on the production of a new 1-inch sheet of part of the Shan States from air-photos, and in April of that year it returned to West Africa.

For further references see Chapter VIII (South-East Asia).