

CHAPTER VIII  
SOUTH EAST ASIA

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SECTION 1. A BRIEF HISTORY OF THE BURMA CAMPAIGN

**Strategical considerations**

Burma forms a barrier of rivers, hills and malarial jungle between India and southern China, Thailand, and Malaya. To supply China with essential war requirements the Burma Road had been constructed from Rangoon through Mandalay and Lashio to Chungking. There was also an air-supply route from Calcutta to Chungking *via* Myitkyina.

When the Japanese swept westwards early in 1942 they naturally included Burma as one of their principal objectives, not only to protect their gains in the Pacific and Malaya but to cut off China from her supply sources in the west, and to act as a springboard for an invasion of India.

The Burma campaign defeated these plans, and China was never completely isolated. In face of stupendous difficulties a new road was constructed by American engineers through north-eastern Burma to join up with the original Burma Road, and a new air-supply line was opened up across the now famous "Hump" to Chungking. Allied forces, after the initial retirement from Burma, fought back from India, and transformed the attempted invasion by the Japanese into a chaotic and costly retreat ending with the enemy surrender in August, 1945, and the reoccupation of Singapore.

The following brief summary gives the principal events of the campaign which will serve as an operational background to the survey story.

**The retreat from Burma (December, 1941–May, 1942)**

On 8th December, 1941, following the Japanese attack on Pearl Harbour, Britain and the United States declared war against Japan. On the same day Japanese forces landed in Thailand and north-eastern Malaya, and a week later crossed the Burmese frontier and captured Victoria Point. In January they struck west from Thailand and advanced on Moulmein. 17 Indian Division retreated across the Sittang River, and Rangoon was evacuated early in March.

As a result of negotiations with Marshal Chiang Kai-Shek, Chinese divisions were made available for operations in Burma, and General Stilwell (U.S. Army)

was appointed Chief of Staff to the Marshal to act as liaison officer between the British and Chinese commands. On 14th March, he reached Lashio, about 120 miles north-east of Mandalay on the Burma Road, in command of the Chinese forces in Burma.

The British retreat continued to Mandalay, which was evacuated at the end of April and, from there northwards to the Indian frontier, the British troops and those under General Stilwell had to traverse nearly 300 miles of mountain and jungle with no roads or other communications. Crossing the R. Chindwin at Kalewa, General Alexander's gallant troops—their spirit still unbroken despite severe casualties and continuous retreat—then passed into India late in May, 1942, and were incorporated into the 4 Indian Corps based on Imphal. General Stilwell crossed the Chindwin higher up and passed into India *via* Homalin.

The Japanese entered Myitkyina on 7th May, and on the west flank in Arakan they struck from the Irrawaddy towards the Indian frontier through Taungup and Akyab. All Burma was now in enemy occupation except for a few strips of territory in the north.

#### **The build-up period (May–December, 1942)**

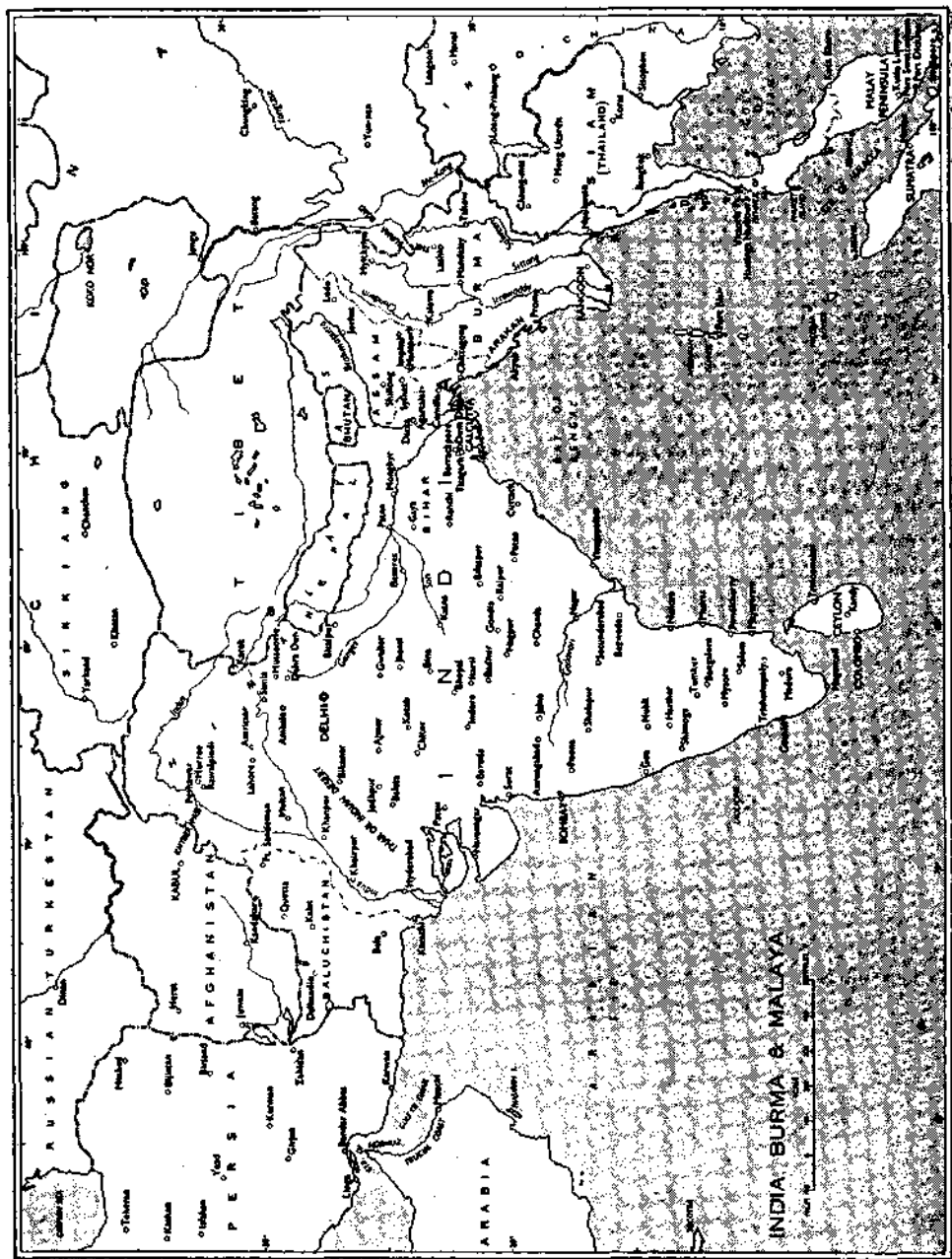
With the monsoon starting in May, and the need for the enemy to establish his supply lines, this was a more or less static period. The allied forces built up and trained their formations, and took post along the frontier. During this period much road construction was carried out both in Assam and in the forward areas, the road from Dimapur (Manipur Road) to Imphal receiving special attention, and also its extensions beyond Imphal towards Tiddim and Tamu respectively. Further to the north clearance work was started for the first stage of the new road running south from Ledo, which was to provide an alternative land route to China. Airfield sites were prepared in Assam.

General Stilwell resumed the training of Chinese divisions in India, reinforcements being flown in from China across the "Hump" by the newly established air-ferry service which, in December, 1942, became the India-China Wing of the U.S. Army Air Force Transport Command. General Stilwell's main objective, with his American and Chinese troops, and in conjunction with new Chinese armies which were being trained in Yun Nan by U.S. officers, was to reopen the land route to China by reoccupying northern Burma and building a new road from Ledo across the mountains to link up with the old Burma Road beyond Myitkyina and Bhamo.

The operational front along the India-Burma frontier fell, topographically, into three main areas:—

- (a) The Northern Front, which was based on Ledo at the terminus of the Bengal-Assam railway. This eventually comprised the operational area of the Northern Combat Area Command (N.C.A.C.) and extended into Burma from Ledo over the mountains and across the upper Chindwin into the Hukawng Valley, and on towards the northern section of the Rangoon-Myitkyina railway. It included such places as Myitkyina itself, Mogaung and Indaw, with Bhamo and Lashio still further to the south-east. This front was the scene of General Stilwell's operations in north-east Burma, and for those of Wingate's "Chindits." The new road from Ledo to link up with the old Burma Road was built through this area.

SKETCH MAP 7



- (b) The Central (Manipur) Front, which was based on Dimapur (Manipur Road), a station on the Bengal-Assam railway. This included such places as Kohima, Imphal, Ukhrul, Tamu, Kalewa, Kalembo and Tiddim, all of which were made famous during the heavy fighting by Fourteenth Army during 1944.
- (c) The Southern (Arakan) Front, based on Chittagong and Comilla. This comprised a coastal strip of creeks, mangrove swamps, rivers and jungle-covered hills, and included such places as Cox's Bazar, Maungdaw, Buthidaung Donbaik and the Kaladan and Mayu River valleys. Further south down the coast towards Rangoon were Akyab Island, Ruywa, Ramree Island and Taungup.

These three sections of the total front stood along the mountain wall dividing India from Burma. While Fourteenth Army dealt with the main enemy forces on the central and southern fronts, General Stilwell struck back in northern Burma, with the Chindits harrying the Japanese communications, and the Ledo Road was gradually extended south-eastwards towards Myitkyina.

#### **The first Arakan campaign**

It is now necessary to return to the latter part of 1942. During the monsoon period the coastal road from Chittagong towards Maungdaw was developed, and air-strips were built. In mid-December a British offensive was launched by 14 Indian Division with the object of capturing Akyab. This was unsuccessful, and by the middle of May, 1943, the force was back behind Maungdaw and on the defensive to prevent the enemy from pressing through to India *via* Chittagong.

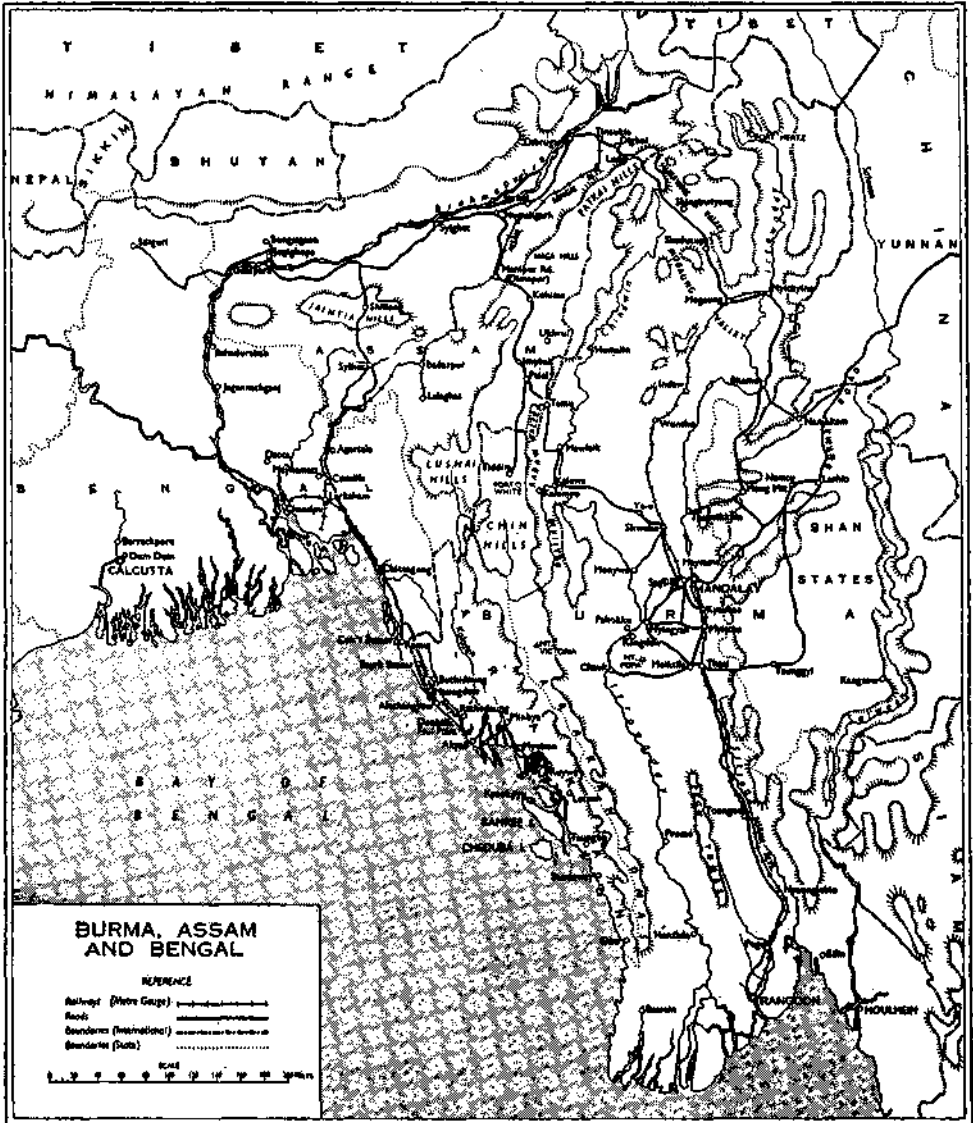
#### **Wingate's first expedition**

In July, 1942, an Indian brigade had been placed under General Wingate for special training in long-range jungle penetration duties, and in February, 1943, this force left Imphal for Burma. The main object of this operation was to determine whether a large force could operate on air supply alone. The task given to the force was to cut the railway between Mandalay and Myitkyina, then to cross the Irrawaddy and cut the line between Mandalay and Lashio, thus hampering the Japanese supply communications in north-eastern Burma, and harrying the rear of the enemy forces operating against General Stilwell's troops on the northern front. The first railway was cut successfully and much interference was caused to the enemy communications generally, but the difficulties of air supply at that time and the heavy sickness-rate necessitated the abandonment of the second main objective. The force, split up into several dispersed groups, made its way back to India, and the expedition was over by June, 1943.

#### **The formation of South-East Asia Command (S.E.A.C.)**

In the latter part of 1943 a new Allied Command for South East Asia was set up with Admiral Lord Louis Mountbatten as Supreme Commander. General Stilwell was appointed Deputy Supreme Commander, and he combined this function with those of Chief of Staff to Marshal Chiang Kai-Shek, Commanding General of U.S. forces in the China-Burma-India theatre, and Commander of the American and Chinese troops of the Northern Combat Area Command on the northern front.

SKETCH MAP 8



Drawn by Ordnance Survey, 1951

Vigorous action was taken to build up allied air strength, with special emphasis on air supply, which it was intended should form the principal means of supplying all requirements to the allied forces when they should eventually operate through Burma. It was also made clear by the Supreme Commander that operations would be conducted in all weathers despite the monsoon. Arrangements were made for the development of the Bengal-Assam railway by U.S. Railway Engineers during the winter of 1943-44, and for the building of roads from railheads to the front.

At the Quebec Conference in August, 1943, a considerable quota of landing craft and other shipping to facilitate amphibious operations down the coast had been allotted to S.E.A.C., but these were later cancelled at the Tehran Conference and allocated back to the European theatre. This altered plans, as it ruled out the possibility of conducting large scale sea-borne assaults along the Arakan coast during 1944, and made it necessary to plan for a re-entry into Burma from the north, across the mountain barrier.

#### **The second Arakan campaign (January-April, 1944)**

Fourteenth Army decided to push south on the Arakan front so as to clear the Mayu peninsula and secure the mouth of the Naaf River for aiding sea supply. This operation was to be undertaken by 15 Indian Corps, consisting of 5 and 7 Indian Divisions with 81 West African Division out on the flank in the Kaladan valley. The attack was launched on 19th January, 1943. Maungdaw was taken and progress made, but early in February the Japanese counter-attacked in the coastal sector and by means of by-passing tactics, 5 and 7 Divisions were isolated. 26 and 36 Indian Divisions from reserve restored the situation, and by the end of February the enemy's counter-stroke had been defeated. This success was made possible owing to the great assistance given by air supply.

In March, when the enemy's main assault was delivered in Manipur, both 5 and 7 Divisions were switched across to the central front, and 36 Division was later moved back into Army reserve, but 25 Indian Division had arrived, and a line was established to maintain the allied gains during the malarial season of 1944.

#### **Wingate's second expedition**

A new long-range penetration force was built up by General Wingate, and it was planned that this should be flown in to landing areas which had been selected by him during his first expedition. The areas were in that part of the northern front around Mogaung, Indaw and Bhamo. The object was to strike against the rail, road and river systems on which the enemy depended for his communications, and to harry the rear of the Japanese force fighting against General Stilwell's troops as they moved south. Four Chindit brigades were flown in, and a fifth marched in over the Naga Hills from Ledo. Supply was entirely by air, heavy fighting was experienced, and considerable damage was inflicted on the enemy rear installations.

#### **Operations on the northern front**

General Stilwell started his march back into Burma at the end of 1943. The new Ledo Road and pipe-line followed his advance over the mountain range to Shingbwiang, crossing the upper reaches of the Chindwin, the Hukawng

and Mogaung valleys, and thence eventually towards Bhamo and beyond to link up with the old Burma Road. By mid-March the Mogaung valley was reached, just at the time when the Japanese launched their offensive across the R. Chindwin further to the south towards Assam and the Bengal-Assam railway. This move threatened the Japanese lines of communication. General Stilwell was operating under the tactical command of Fourteenth Army and was instructed to drive ahead, being aided by Wingate's Chindits in rear of the enemy facing him, and with a U.S. Commando Force known as "Merrill's Marauders" out on his northern flank. By May, 1944, he had captured Myitkyina with its valuable airfield at the terminus of the Rangoon-Myitkyina railway. He was supplied throughout by air, an advantage which the enemy did not enjoy, and by this operation the Japanese were cleared from the area lying between the allied forces and China.

#### **The Japanese offensive on the central front (March, 1944)**

While General Stilwell was advancing into Burma further to the north, the enemy built up his forces in the centre. The enemy offensive on the Arakan front was in the nature of a diversion, and he selected for his main assault the Manipur area on the central front. It seems clear that his objectives were:—

- To seize the advanced allied base at Imphal, and to capture Kohima and Ukhurul.
- To cut the Bengal-Assam railway and thus disrupt the allied lines of communication.
- To overrun the Assam airfields, and so hinder the air traffic across the "Hump" to China.

The Japanese plan was evidently based on the hope of a quick success to enable them to make use of our supply dumps, as they had no properly organized air supply, and their land supply communications were slow, strained and difficult.

In the middle of March, 1944, three crack Japanese divisions attacked across the R. Chindwin. The Fourteenth Army Commander had decided to withdraw his troops holding the frontier and to fight in the Imphal Plain. 17 Indian Division therefore withdrew from Tiddim, and 20 Indian Division from Tamu, joining 23 Division in Imphal. They were considerably harried all the way back by the advancing enemy.

At this time 5 and 7 Indian Divisions were switched over from Arakan largely by air, and 33 Indian Corps and 2 (British) Division were ordered to move in from India, the primary objective being to reopen the road from Dimapur to Kohima, to prevent the enemy from penetrating into the Assam valleys, and to link up Kohima with 4 Corps at Imphal.

After a siege of 15 days Kohima was relieved by troops of 33 Corps, and by mid-May the whole Kohima ridge was cleared. The assault on Imphal was repulsed with heavy casualties to the enemy, and by the end of May the whole of Imphal Plain was practically clear of Japanese troops. The crisis on the central front was now over. The monsoon had started at the end of April, and by the middle of July the enemy base at Ukhurul had been captured.

#### **Pursuit to the south**

11 Army Group, under General Giffard's command, had been formed when S.E.A.C. was set up in November, 1943. When General Leese was

appointed C-in-C. Allied Land Forces (A.L.F.S.E.A.) on 11th November, 1944, the name "Army Group" was dropped. 15 Corps, which had formed part of Fourteenth Army, now came directly under the command of H.Q. A.L.F.S.E.A., and Northern Combat Area Command also came under General Leese's command. The intention was to capture Mandalay, while N.C.A.C., by taking Lashio, would protect and secure the line of the new road route to China.

The Fourteenth Army plan was to drive the enemy across the R. Chindwin into the plain north of Mandalay and force him to battle there. 11 East African Division harried the Japanese back to Tamu, while 5 Indian Division chased the remnants of 33 Division through Tiddim, and by 19th August the last remaining Japanese were thrown out of India.

Early in December troops of General Slim's army, consisting of 4 and 33 Corps, crossed the Chindwin at Kalewa where, two and a half years before, he had commanded the British rearguard in retreat from Burma to India.

Meanwhile a second allied force was converging towards the selected battle ground from the north. This was the N.C.A.C. which General Stilwell had led to Myitkyina before returning to the United States in October, 1944. It included five Chinese divisions, "Mars" Force (which replaced Merrill's Marauders) consisting of U.S. and Chinese troops, and 36 (British) Division which had been sent to reinforce N.C.A.C. 36 Division relieved the Chindits in the Mogaung area and began to move down the railway from Mogaung in August, while the Chinese Sixth Army moved on a parallel axis. On 16th December 36 Division made contact with 19 Indian Division of Fourteenth Army, thus linking the forces of the northern and central fronts. In addition, a Chinese Expeditionary Force, which had been trained in China by American officers, appeared from Yun Nan after seven months' fighting, having crossed the Salween River.

The road from India to China was reopened on 27th January, 1945. The jungle country now lay behind Fourteenth Army, and movement conditions became easier. Both corps advanced on Shwebo and Monywa. General Slim's intention was that the enemy force should be destroyed around Mandalay, and Rangoon captured before the monsoon broke in May.

The advance through Burma was dependent on air supply. It was not feasible to build and stockpile airfields across the R. Chindwin, and anywhere south of Mandalay was outside the radius of action of the northern airfields. It was necessary, therefore, to develop operations down the Arakan coast so as to establish airfields in that area. From there the Mandalay-Rangoon road and rail system could be supplied by air and stockpiled by sea. It was, in fact, the only means of effecting air supply south of Mandalay.

15 Corps had been pushing down the Mayu peninsula since the main battle had shifted from Arakan to the central front in March, 1944. The plan was that 15 Corps should capture Akyab and Ramree by sea-borne landings so as to secure airfields from which Fourteenth Army could be supplied by air during its advance through central Burma.

Certain outside factors now affected the situation. A new Japanese offensive in China caused certain valuable air-supply squadrons and some Chinese divisions to be diverted from Burma back to China. Also the German winter offensive in the Ardennes sector of the European theatre upset plans which had been made to send further divisions from Europe to Burma. At the end of February, Marshal Chiang Kai-Shek halted the southward advance of his



Chinese divisions in eastern Burma, and all these factors combined to slow up the allied offensive.

The enemy, moreover, succeeded in withdrawing over the Irrawaddy and concentrated his forces south of the river, thus upsetting the plan to bring him to battle north of Mandalay and destroy his forces there. General Slim then planned the final moves of his victorious campaign which, as a result of clever strategy, and magnificent achievements on the part of Fourteenth Army, brought about the complete defeat of the Japanese armies in Burma. The intention was that 4 Corps should cross the Irrawaddy in the Pakkoku area about 100 miles south of Mandalay and, by a quick mechanized dash across to Meiktila behind the enemy lines, disrupt his defence and cause chaos in the enemy rear areas. Meanwhile 33 Corps was to cross the river just above and below Mandalay.

7 Division crossed the Irrawaddy near Pakkoku by assault on 14th February and the concerted attack began on the 19th. On the following day 17 Division passed through 7 Division's bridgehead and pushed on rapidly to capture Meiktila with its airfield.

In the meantime 19, 20 and 2 Divisions had each forced crossings higher up the Irrawaddy, and Mandalay was captured on 21st March. The concentration of 5 and 17 Divisions with a tank brigade in the Japanese rear at Meiktila, while they were still trying to drive back the three divisional bridgeheads further north, gave the depleted Japanese divisions very little hope of survival. After a few weeks' fighting around Meiktila, Mandalay and Pakkoku, in which the Japanese suffered heavily, Fourteenth Army regrouped with 4 Corps (two divisions and a tank brigade) moving rapidly down the railway from Meiktila towards Rangoon, while 33 Corps moved down the Irrawaddy. At this stage the only doubt was whether 4 Corps, whose needs had first priority, would reach Rangoon before the monsoon should make the supply position impossible. They reached Pegu, 50 miles from Rangoon, on 29th April, but were held up there for two days by the Rangoon garrison and heavy rain. They were clear of opposition and ten miles south of Pegu, when 26 Division landed from the sea on 2nd May.

These last stages of the campaign presented a very difficult situation for the Survey Service. The course of the operations has therefore been given in some detail.

### **The third Arakan campaign**

It is now relevant to consider the operations that had been conducted along the coastal front in Arakan, which played an important part in the final stages of the operations leading up to the capture of Rangoon. The topography of Arakan is such that the hills sweep down towards the sea, leaving only a narrow strip of land along the coast suitable for operational movement. By Christmas Day, 1944, 15 Corps (two Indian and two West African Divisions) had reached Foul Point, and on 3rd January 25 Division was ferried across to Akyab Island, which had been evacuated. This provided a vital airfield and there followed swiftly a commando and infantry landing on the Myebon Peninsula, 35 miles east-south-east of Akyab. In view of the rapid advance of Fourteenth Army and the approaching monsoon in May speed was essential, and a succession of amphibious operations made steady progress down the coast. 26 Indian Division landed on Ramree Island by sea-borne assault, thus enabling a further airfield to be developed. Then followed landings by other formations at

Kangow (22nd January), where some of the bitterest fighting in the whole campaign was experienced, at Ruywa (17th February), and at Letpan (19th March).

At this stage two divisions of 15 Corps were sent back to India in preparation for operation "Zipper," the planned invasion of Malaya. For the sea-borne assault on Rangoon by 26 (Indian) Division, Gurkha paratroops were dropped to neutralize the coastal batteries at the mouth of the estuary. The main landing force was transferred to landing craft from their transports, sailed up the estuary, found Rangoon evacuated, and occupied it on 2nd May. Contact was then made with Fourteenth Army, which was approaching from the north.

### **The closing stages**

15 Corps and divisions withdrawn from the main force were sent back to India where, with other troops, they were regrouped to form a new Fourteenth Army for the invasion of Malaya.

Divisions from 4 Corps and 33 Corps in Burma then formed a new Twelfth Army whose task it was to capture Moulmein and trap and destroy the remaining Japanese in Burma. After inflicting further heavy casualties Twelfth Army forced the Japanese across the R. Sittang.

Operation "Zipper" was planned for 9th September. It provided for a landing in the Port Swettenham area, 200 miles to the north of Singapore, by seven divisions and an armoured brigade; a parachute brigade was to be dropped on Singapore and a commando brigade landed on the island from the sea.

Before that date, however, the Japanese had realized their defeat as a result of the allied offensives in the Pacific and in Burma, and the dropping of the atom bombs on Hiroshima and Nagasaki on the 5th and 9th August precipitated their surrender, which took place a few days later.

## **SECTION 2. SURVEY ORGANIZATION**

The build-up of a Military Survey organization in India for operations in South East Asia, and its subsequent control and activities, were attended by many difficulties and complications. It may be well, therefore, to consider shortly the facts and policies that governed the various stages of development, the principal sources from which the organization sprang, and certain factors which emerged during the process which had a considerable effect on the problem.

### **The Survey of India**

Peace-time survey activities in India were controlled by the Survey of India, a highly efficient organization which operated under the Department of Education, Health and Lands. The Surveyor General, holding the rank of Brigadier, and his principal officers were, as a rule, officers of the Royal Engineers who held specialist survey qualifications. In most cases these officers joined the Survey of India as junior officers, and stayed with it for the remainder of their active career. Apart from them, the majority of the remaining personnel were of Indian nationality, and their standard of proficiency and training as surveyors and map makers was very high.

In some respects, therefore, it will be seen that there were points of resemblance between the Survey of India and the Ordnance Survey of Great Britain. With regard, however, to fundamental policy affecting military survey

relations with the General Staff, and the formation of a military survey organization to operate with the Army on active service, there were distinct differences between British and Indian policies.

In Great Britain there was, before the war, a Geographical Section of the General Staff, which formed one of the sections of the Directorate of Military Operations and Intelligence at the War Office. This section was officered principally by R.E. officers holding specialist survey qualifications, and it was responsible for advising the General Staff on all matters concerning military survey and mapping, and for implementing the resulting survey and mapping policy laid down by the General Staff, including the preparation of maps and other survey data for war and the technical aspects affecting the formation of survey units and their training. During the course of the war this section was greatly enlarged, and eventually assumed the status of a War Office Directorate known as the Directorate of Military Survey. (See Chapter I, Section 1.)

The Director General of the Ordnance Survey in Great Britain did not owe any responsibility to the War Office on military survey matters. He was responsible only for the control and administration of his department which, though owing allegiance to the Ministry of Agriculture, devoted its energies, during the war period, to military map production in accordance with the mapping programmes laid down by the Director of Military Survey at the War Office. (See Chapter I, Section 2.)

In India, however, there was, in peace-time, no proper survey representation at G.H.Q., and nothing comparable with the Geographical Section at the War Office.

To clarify subsequent developments, it may be well to summarize the pre-war organization of the Survey of India, as it bears an important relation to the course of events. As in the case of the Ordnance Survey of Great Britain, the Survey of India was responsible for the execution of triangulation and topographical field surveys, the preparation of maps, and their printing and publication on various scales. Map publication was mainly concentrated at Calcutta, and a geodetic branch, which was responsible for scientific and other special work, and some of the topographical survey, drawing and map publication branches were at Dehra Dun. For topographical surveys in the field the Survey of India was organized in "Circles" as under:—

- (a) The Eastern Circle, based on Shillong (Assam).
- (b) Independent topographical parties working in Burma and southern India.
- (c) The Frontier Circle (topographical and military) which worked in north-western India, in liaison with Northern Command and Western District. It had its H.Q. at Simla, and maintained a liaison with G.H.Q. It was primarily responsible for mapping and survey in connection with any operations which might take place on the North West Frontier. Each of the above was under the control of a Director.

From the military aspect, the Survey of India's original responsibilities were:—

- (a) To provide such maps of India, Burma, Afghanistan and Iran as might be required by the defence services.
- (b) In the event of war, to provide two field survey companies and two survey H.Q.s for service on the North West Frontier, and a Survey Depot (administrative).
- (c) To carry out annually a small amount of training in military survey.

When war broke out in Europe in 1939, and later in the Middle East in 1940, there was, in effect, no military survey organization in India, other than the liaison between the Director of the Frontier Circle and G.H.Q., which was concerned primarily with possible operations on the North West Frontier. There was nothing in the nature of a Survey Directorate or Geographical Section General Staff at G.H.Q., and no survey units in actual being.

The ensuing transition from peace activities to those required for a maximum war effort naturally took place slowly. A good deal of help was gained from the experiences of the R.E. Survey organization in the Middle East during the early stages of operations in that theatre. Military survey training which took place in India late in 1939 and early in 1940 helped to crystallize ideas, as did also the Survey Conferences which were held in Cairo during the summer of 1940 and in Delhi early in 1941, the latter being attended by survey representatives of India, Middle East, and the Far East. These conferences were especially valuable for settling policy questions regarding responsibility for the mapping of potential operational areas in South East Asia.

From an early stage in the war the civil activities of the Survey of India were subordinated to war needs though, during the early war period, certain civil functions continued with a strict control of priorities. Some of these were considered essential to the administration of the country and, at a time when there were large fluctuations in demands for war maps, it was undesirable that personnel should remain idle during lulls in the war-work. Later on, when military operations had started in earnest, the demand for war mapping was so great that practically all civil activities were suspended.

The pre-war and subsequent operational responsibilities and activities of the Survey of India for mapping and map production are described in Section 3. It may be noted here, however, that the map reproduction and printing resources, though adequate according to peace-time standards, had no opportunities of local expansion. There was no source from which competent Indian lithographic tradesmen could be recruited in any numbers. This was unlike the United Kingdom, where there was a large number of civilian printing firms which formed a valuable pool of map reproduction power, either for carrying out the actual map printing on a contract basis or for the provision of skilled personnel for mobilization into survey units. The existing printing equipment in India, moreover, was not of the most modern design, and was not entirely suitable for rapid mass-production output.

#### Formation of a Military Survey organization

By the middle of 1941, the pre-war commitments for the supply of two field survey companies and two survey H.Q.s for service on the North West Frontier had been extended to provide:—

7 H.Q.s	}	For service anywhere.
6 Field Survey Companies		
3 Park Sections		
2 Map Supply Sections		
1 Survey Depot		
		To remain in India.

These commitments were extended further during subsequent months, but by July, 1941, one Survey H.Q. and one Field Survey Company had been

formed and had gone overseas to Iraq. Two more of each had been formed and were awaiting orders to proceed to the same destination. One Survey H.Q., a Map Supply Section and a Park Section were on the stocks, with further units to follow shortly after. After their formation the Survey of India retained responsibility for their maintenance with regard to personnel.

The necessity for a strong base drawing and map production organization, additional to the military field organization, soon became very clear. The number of sufficiently skilled lithographic technicians in India being very limited, it was necessary to reinforce them by the importation, through army sources, of technical tradesmen who had been mobilized into British survey units from the printing trade. A special military establishment was formed to hold this personnel, who were attached to the Survey of India.

A military Survey Depot, combined with a Survey Training Centre, was formed for the administration of survey units as they were formed, and to undertake the training of surveyors for the survey units.

A Central Map Depot (military) was established in Delhi, with smaller map depots serving the eastern, southern and north-western armies. Arrangements for map distribution are described in Section 6. A survey stores organization was also created.

### **Air photography**

This subject will be dealt with more fully in Section 4, but one important item of organization in connection with it should be recorded here. During the latter part of 1942, the Indian Government chartered the photographic resources, including three aircraft, of the Indian Air Survey and Transport Ltd. It was realized that air photography would play a large part during any campaign in connection with programmes of new mapping and revision. The charter was operated under the orders of the Surveyor General, who placed aircraft and photographic resources at the disposal of the Director of Survey as necessary.

Colonel D. R. Crone, a Superintendent of the Survey of India, who had specialized in air survey technique, was appointed Air Survey Officer, Survey of India, to co-ordinate all air survey work and training, both civil and military, and to operate the Indian Air Survey and Transport Charter on behalf of the Surveyor General.

The above notes give a short background picture of the survey situation in India during the early war period, with special reference to the Survey of India, and the action taken towards the formation of a military survey organization. The mixture of civil and military responsibilities and loyalties will be noted, and the effect of this on the course of events on the military operational side will be seen in succeeding paragraphs.

### **First campaign in Burma (1941-42)**

Towards the end of 1941, when Japanese forces were threatening Burma, a small military survey organization was raised in Burma consisting of:—

- An A.D. Survey with an Indian Field Survey H.Q.
- One Indian Field Survey Company on a special establishment.
- One Map Supply Section.

There was also, in Maymyo, the residue of a Burma (Civil) Survey party and a reproduction unit with camera and flat-bed printing press. The rapid Japanese advance into Burma put a stop to the work of revision and triangulation and the newly raised military units were employed on map distribution and emergency printing. In April, 1942, they had to evacuate Maymyo and, by devious routes, and in dispersed groups, they found their way back to India, having lost their equipment and many of their numbers.

A.D. Survey (Burma) was able to move the more important of the Burma survey records as far as Myitkina but, during the final stages of the retreat, could get them no further. They were buried in the grounds of the Forest Officer's bungalow, the officer being a Burmese who elected to stay on. After the recapture of Myitkina in May, 1944, H.Q. A.L.F.S.E.A. made every effort to recover the records, but they had evidently been found and removed by the Japanese. It is understood that they were recovered in Singapore after the Japanese surrender.

#### Survey organization (Spring, 1942)

In the spring of 1942, the war in Burma was obviously going badly, and the defence of India became a paramount issue. The Eastern and Southern Commands in India were converted to field armies known as the Eastern and Southern Armies respectively, and Survey representation with these formations was provided by the creation of one Survey Directorate headed by a Deputy Director (Colonel G. Bomford) consisting of three British officers and approximately 50 other ranks. The D.D. Survey had as his mandate:—

- (a) The control of mapping and survey work for both armies.
- (b) To act as deputy to the Director of Survey (Military Circle) in connection with surveys in Assam, and for liaison with China.
- (c) To exercise control over survey units in Burma. This latter item did not, however, materialize owing to the evacuation of troops from that country.

At this time, then, the military Survey Service for India consisted of:—

The Director of Survey (Colonel E. A. Glennie) with the Military Circle. He had no military staff, and continued to exercise his civil survey functions with the Survey of India.

Three Indian Field Survey Companies and associated Survey H.Q.s which had been in Iraq since 1941 and were still there.

The relics of the Survey H.Q. and Field Survey Company which had returned from Burma, disorganized and without equipment.

A Survey Depot for map storage.

The Survey Directorate for the Eastern and Southern Armies referred to above.

Thus there were no effective survey troops actually in India at this critical time and the available map stocks of probable operational areas were dangerously low. The only available resources consisted of the civil survey department with its printing equipment at Dehra Dun and Calcutta, and a reserve of surveyors and draughtsmen with which to form further military survey units.

During May, 1942, the War Office sent out to India an officer (Major M. O. Collins, R.E.) who had had considerable experience with the Geographical Section at the War Office in connection with the mobilization and equipping of survey units for the B.E.F. in France, and with the preparation of map stocks for operations in Europe. Having reported for duty to the Surveyor General, he was posted to the Military Circle as A.D. Survey.

In July, the Survey H.Q. and Field Survey Company from Burma were re-formed and brought up to strength and, after administrative and military training, were engaged on productive mapping work. Anti-aircraft sites, coast defence batteries and airfield sites required urgent survey work which was undertaken first by civil parties and then by military units.

#### **Formation of Geographical Section, General Staff**

In August, 1942, a Geographical Section, General Staff, was formed at G.H.Q. (I.). This was, in effect, a Survey Directorate and was headed by Colonel E. A. Glennie of the Survey of India as its Director. This officer, however, continued to be paid by the civil department, and also continued to carry out his duties in connection with the Military Circle, which rendered him responsible still to the Surveyor General. His staff was strengthened by the addition of an A.D. Survey, and two more officers who were sent out by the War Office. A small printing section was added for dealing with R.A.F. target maps and miscellaneous jobs.

#### **Increase of map printing resources**

It was realized that no further local expansion in printing output was possible so in response to India's request for more printing units the War Office organized the technical nuclei of a number of reproduction sections. Each of these units, when augmented by its Indian component, consisted of two British officers, 36 British O.R.s and 48 Indian O.R.s. They were equipped with the same type of rotary printing machines as were being supplied to standard British field survey companies. One of these mobile sections, with demy Crabtree machines mounted in lorries, was posted to the Eastern Army in September, 1942.

#### **Survey control for Eastern and Southern Armies (January, 1943)**

In January, 1943, the combined survey control of the Eastern and Southern Armies was separated, a D.D. Survey being appointed for each. The year just starting was to include the unsuccessful offensive in Arakan during the first half of the year, the 1943 Wingate expedition, and an inconclusive offensive-defensive in the Kabaw valley and the Chin Hills. During this period the Survey Service received reinforcements and was built up into an effective organization. In February a Corps Survey Directorate with one Field Survey Company (less detachments left behind at Army H.Q.) was allotted to 4 Corps which was operating in the Imphal area.

#### **Base map production**

One of the more important organizational items during the year was the build-up of a base map-production establishment near Calcutta. This, in due course, comprised the following:—

Headquarters and A.D. Survey.

Nos. 63 and 66 Indian Reproduction Groups.

Drawing Section. (Detached from 6 (Indian) Field Survey Company.)

No. 2 (Indian) Field Survey Company (from Iraq).

No. 22 Survey Park Section.

Difficulties were encountered owing to defective power plant, and were not overcome satisfactorily until the arrival of the Lister generators from the United Kingdom.

### Air Survey

The technical aspects of air survey work are dealt with in Section 4. It had been appreciated early in 1942 that, without considerable air survey potential, future progress in map production for operations in South East Asia would be severely handicapped, even if not rendered impossible. By agreement with the War Office and Middle East, the Indian Field Survey Companies which had been in Iraq and Persia were transferred back to India, and were concentrated at Bangalore where they underwent military training and courses in jungle and air survey. One Indian Air Survey Company was formed early in 1943, with a second following later in the year.

### Formation of S.E.A.C.

As stated in Section 1, in November an important change in higher command and control took place, by the formation of South East Asia Command (S.E.A.C.) which was responsible operationally direct to the Chiefs of Staff. The British and Indian formations operating under this Command formed the 11 Army Group, and the Eastern Army was renamed the Fourteenth Army.

Plans were worked out for the survey organization in S.E.A.C. under the new Command arrangements. Hitherto, as will be clear from this narrative, the control of all survey policy and activities had been exercised from India, where the principal military survey organizations and directorates under the control of D. Survey, India Command, were:—

G.S.G.S. at G.H.Q. (I.) (Colonel E. A. Glennie).

Survey Directorate, Eastern (Fourteenth) Army (Colonel G. Bomford).

Survey Directorate, Southern Army (Colonel J. B. P. Angwin).

Air Survey Directorate (Colonel D. R. Crone).

The main functions of these directorates were as follows:—

G.S.G.S. carried out the technical and administrative functions of a Survey Directorate at G.H.Q., kept up a map library of the areas of survey responsibility allotted by the War Office to India, and issued drawing and printing orders to the Survey of India.

The Eastern (Fourteenth) Army was engaged in operations on the Burma front. About the time of the formation of S.E.A.C., H.Q. Eastern Army moved to Comilla and became H.Q. Fourteenth Army. This army was well provided with survey, reproduction and map supply units.

The function of the Survey Directorate (Southern Army) was to train survey units, some of which had recently returned from Persia-Iraq, and to provide for the survey needs of the Southern Army, which was then the main training centre in India.



The Air Survey Directorate controlled two Indian Air Survey Companies, and two Map Reproduction Sections. It was located at Dehra Dun, and its units were spread out between Dehra Dun, Mussourie and Risalpur. Close control by the Directorate was therefore difficult. The D.D. Survey (Air), in addition to his military survey duties, had certain civil responsibilities to the Surveyor General of India.

The new proposals envisaged the creation of a completely independent survey organization for S.E.A.C. G.H.Q. Survey (I.) would then only control survey units in India which did not belong to S.E.A.C., the flow of reinforcements and stores, and the farming out of mapping programmes to the Survey of India as required by S.E.A.C. Survey co-ordination between S.E.A.C. and India was not a simple matter, more especially with regard to the planning and preparation of maps covering future operational areas. It was considered by Survey (S.E.A.C.) that, as their own H.Q. staff would be directly responsible to the Chiefs of Staff concerning the preparation of future operational plans, and might, under certain conditions, not even inform G.H.Q. (I.) of what those plans were, it would not be correct, or even possible, for D. Survey (I.) to retain responsibility for controlling the policy, planning and mapping programmes for S.E.A.C. operations. As a result of a conference in London, however, between the Director of Survey, War Office (Brigadier M. Hotine) and D. Survey (I.), it was decided that the latter should continue to retain responsibility. One of the principal arguments put forward by the War Office in support of this decision was that the technical independence of S.E.A.C. would possibly result in Indian mapping resources not being fully utilized. It was, however, well understood that S.E.A.C. should and would handle urgent and highly secret production with their own resources, and that these latter might have to be strengthened for the purpose. In coming to this decision the War Office possibly had in mind a relationship such as that which was subsequently to exist between them and S.H.A.E.F., whereby the latter was responsible for large scale map production and supply, and the former, subject to the operational requirements of S.H.A.E.F., retained general responsibility for production and supply of the medium and smaller scales. It should be remembered, however, that the War Office was always fully in the operational picture with regard to current and future operations in north-western Europe, whereas G.H.Q. (I.) was not in this position with regard to the activities of S.E.A.C.

The decision having been made, those concerned took action to regularize their procedure accordingly. As the Supreme Commander did not wish to have a large executive staff it was proposed that, with regard to Survey, there would be only a small policy directorate at his Headquarters, the remainder of the directorate to function at 11 Army Group H.Q. The proposals were approved, and the D. Survey (Brigadier G. F. Heaney) assumed duty at H.Q. S.A.C.S.E.A., his D.D. Survey (Colonel J. E. S. Bradford) being at H.Q. 11 Army Group. By March, D. Survey came to the conclusion that it was difficult for him to exercise proper control over the Survey Service in S.E.A.C. from the Supreme Commander's Headquarters. It was agreed, therefore, that he would operate at H.Q. 11 Army Group where he could exercise executive functions, and that an A.D. Survey (Lieutenant-Colonel M. O. Collins), transferred from that H.Q., would represent him at H.Q. S.A.C.S.E.A. with the following mission:—

To act as survey representative at H.Q. S.A.C.S.E.A.

To keep D. Survey 11 Army Group informed of all trends and aspects of forward planning.

In conjunction with the Joint Planning Staff to draw up survey appreciations and plans for each proposed operation, bearing in mind the technical survey policy laid down by D. Survey.

During these negotiations certain happenings occurred which are of interest to record:—

- (a) In view of the proposed move of S.E.A.C. headquarters to Ceylon designs were prepared for the erection of a factory building in Kandy to house a map reproduction plant, and the work was undertaken on a high priority basis.
- (b) By agreement with the Hydrographic Officer of the Eastern Fleet, a Hydrographic Section R.E. was raised for the production of charts and chart maps. The section was under command of a lieutenant-commander R.N.V.R., and the personnel were R.N.V.R. or Royal Marines except for lithographic tradesmen, who were Royal Engineers. The section first operated in the Survey of India's offices at Dehra Dun, but later moved to Kandy where it could work in close co-operation with Main H.Q. A.L.F.S.E.A., and later the Survey Production Centre.
- (c) In November, 1943, H.Q. Fourteenth Army moved to Comilla in eastern Bengal. Good accommodation was obtained at Maynamati, about five miles from Comilla, for the Survey Directorate and those units which would be working at Army H.Q. level. It was decided, therefore, to bring forward the units concerned from Calcutta and install them for work at this new site. Though Maynamati was very suitable for the working units, it seems probable that the directorate would have been better located alongside Army H.Q. at Comilla, where close and constant liaison with the General Staff would have been easier.
- (d) With the reopening of the Arakan offensive in January, 1944, a Survey Directorate was raised for 15 Corps. Two West African Brigade Survey Sections had joined the Army in advance of 81 (W.A.) Division in October, 1943, and were allotted to 15 Corps.
- (e) 155 (E.A. & S.R.) Survey Company had been expected in December, 1943, but was delayed and did not arrive until April. This was a large unit with 20 officers, 55 warrant officers and British non-commissioned officers, and approximately 450 Africans, but only a very small proportion of the latter were survey technicians. The unit was designed for a field role, not a static one. It contained three trig/topo sections, one drawing and one reproduction section.

In January, 1944, the Fourteenth Army Survey organization was as under:—

*At Army H.Q.*

Survey Directorate (Colonel G. Bomford as D.D. Survey).

No. 2 (Ind.) Field Survey Company (less air surveyors and detachment with 15 Corps).

Nos. 53 and 54 Drawing Sections.

Nos. 61 and 63 (Ind.) Reproduction Groups.

No. 22 Survey Park Section (at Dum Dum).

Combined Air Survey Section.

No. 36 Map Supply Section (less Detachment with 15 Corps).

No. 34 Map Supply Section (at Barrackpore).

*With 4 Corps*

Survey Directorate.

No. 6 (Ind.) Field Survey Company (less air surveyors).

No. 33 Map Supply Section.

Photo-zinco Section.

*With 15 Corps*

Survey Directorate.

Detachments of No. 2 (Ind.) Field Survey Company.

Nos. 3 and 4 West African Brigade Survey Sections.

Detachment of No. 36 Map Supply Section.

Photo-zinco Section.

The survey set-up at Army H.Q. was so organized that further moves could take place in two echelons.

#### **Survey co-ordination difficulties between S.E.A.C. and India**

To facilitate the control and conduct of operations, the greater part of H.Q. 11 Army Group moved to Barrackpore towards the end of 1944 and was known as Advanced H.Q. Allied Land Forces (A.L.F.S.E.A.). A small portion of H.Q. 11 Army Group went to Kandy, to a location near H.Q. S.A.C.S.E.A., and was known as Main H.Q. A.L.F.S.E.A. This separation between D. Survey (India) and D. Survey (A.L.F.S.E.A.), and the split in the latter's own headquarters made it very difficult to ensure that the senior survey officers all had the same operational picture in mind. It was by no means always easy for them to get a clear overall picture of the planning which was going on simultaneously at Delhi, Kandy and Calcutta. This difficulty was aggravated by the fact that only a few officers at G.H.Q. India were fully briefed so far as future S.E.A.C. operations were concerned, and D. Survey (India) was not one of these.

#### **Survey organization and activities during 1944**

The year 1944 covered the Japanese counter-offensive on the central front in Manipur, the siege and relief of Kohima and Imphal, the subsequent advance to the R. Chindwin, and preparations for the reoccupation of Burma.

In July, 1944, when it was clear that S.E.A.C. would be carrying out extensive campaigns during the latter half of that year and in 1945, it was agreed that in view of the probable large mapping commitments, all the survey units in the Southern Army should come under 11 Army Group control and be concentrated at Harihar, and that the D.D. Survey (Colonel J. B. P. Angwin) from Southern Army should, with a small directorate staff, take charge of their work. This was, in effect, the beginning of the Survey Production Centre which was further developed later. The units concerned at that stage were:—

Two Air Survey Companies.

Three Field Survey Companies.

One Base Map Production Section.

Three mobile Reproduction Sections.

Some ancillary units.

As future plans became clearer, a list of requirements for further reinforcements in survey units, personnel and equipment, including provision for an expansion of the Kandy map reproduction plant, was sent to the War Office. The situation in Europe at that time did not, however, allow extensive reinforcements to be supplied immediately and the War Office accepted the data supplied as a basis for planning a future supply when available.

The decision to create an advanced H.Q. of 11 Army Group at Calcutta with main H.Q. at Kandy necessitated an alteration in the dispositions of the Survey Directorate whereby D. Survey went forward to advanced H.Q. and D.D. Survey remained with main H.Q. Meanwhile the A.D. Survey who had been all this time at H.Q. S.A.C.S.E.A. remained there as the survey representative.

In September a D.D. Survey (Colonel Angwin) and an A.D. Survey were briefed for duty with the force scheduled to undertake operation "Dracula," a sea and airborne attack on Rangoon by some seven divisions. This operation was, however, cancelled in October and once more opinions appear to have varied amongst the senior survey officers as to the probability of future large scale operations. Opportunity was taken at this stage to send back to the United Kingdom the D.D. Survey who became redundant from the "Dracula" force, in order to study some of the survey lessons to be learnt from operation "Overlord" (the invasion of Normandy).

Reverting now to the survey situation in Fourteenth Army, the arrival of 155 (East African and Southern Rhodesian) Company brought a valuable accession of strength in survey resources to the army. It was apparent, however, that the unit was too large for use with any one corps under Indian conditions, and also that the proportion of non-technicians was too high. The company was therefore reorganized into the following units:—

One small Company (No. 155).

Two small Reproduction Sections, Nos. 67 and 68 (Type C), each with one printing press. Actually No. 68 was not raised until March, 1945, owing to the repatriation of a number of British O.R.s.

One independent Air Survey Section (No. 17).

One small Map Supply Section.

To simplify administration, the smaller units were provided with Indian O.R.s. instead of African and the surplus African personnel were absorbed into a Map Supply unit in Calcutta.

In July, 1944, the Survey Directorate with 4 Corps was transferred to 33 Corps when the latter took over Imphal and, at the end of November, Army H.Q. moved from Comilla to Imphal. The Survey Directorate moved with it, including all the units which had been employed on map production duties at Maynamati. All useful map stocks were moved forward, and Imphal then became the Army's main production centre and map supply base.

In November, 15 Corps was transferred from Fourteenth Army and came under the direct command of H.Q. A.L.F.S.E.A. With it went the A.D. Survey and his small directorate, the new 155 (E.A. & S.R.) Company and other units. Between December, 1944, and May, 1945, 15 Corps undertook a series of amphibious operations down the Arakan coast to assist Fourteenth Army by containing or destroying two Japanese divisions and by securing air bases. The Survey Directorate and units operating with 15 Corps had a busy time producing and supplying the necessary maps and carrying out surveys.

### **Survey organizational changes (S.E.A.C. and India. January, 1945)**

In January, 1945, the Director of Military Survey (War Office) visited India in order to study at first hand the organizational and control problems that had been the cause of much misunderstanding and confusion during recent months. As a result of his visit several important changes were approved:—

- (a) For mapping and survey purposes S.E.A.C. would become operationally independent of India and would be answerable direct to the War Office on technical mapping matters.
- (b) S.E.A.C. would make bids on India for mapping work which it was convenient or necessary to farm out away from S.E.A.C. resources.
- (c) S.E.A.C. would bid on India for survey units and personnel when such could be made available.
- (d) All the survey units which had been concentrated in India at Harihar were to be moved to Ceylon where, with the Kandy units, they would form a Survey Production Centre under a D.D. Survey (Colonel J. E. S. Bradford).
- (e) The survey staff at H.Q. S.A.C.S.E.A. was to be slightly increased and, under a D.D. Survey (Colonel M. O. Collins) instead of an A.D. Survey, would take over all survey staff functions for that headquarters and for main H.Q. A.L.F.S.E.A. It would also deal with all air photographic and inter-service matters.
- (f) The entire Survey Service in S.E.A.C. was to be under the technical control of the D. Survey (Brigadier G. F. Heaney), even though the latter was at the time located at Advanced H.Q. A.L.F.S.E.A. In view of the great dispersion of the whole organization, a considerable measure of autonomy and direct dealing was granted to deputy directors on lines laid down in detailed instructions.
- (g) War Office agreed to the demand for reinforcements, which would be supplied as soon as available.

This recognition of, and clearing up of, the difficulties of control, together with the simplification of the S.E.A.C. survey organization, went a long way towards making the whole structure run smoothly, and eliminated the tendency towards a clash of loyalties and interests which had prevailed hitherto.

The period between December, 1944, and May, 1945, covered the advance into Burma, the destruction of three Japanese Armies, and the capture of Mandalay and Rangoon. Fourteenth Army H.Q. moved successively from Imphal to Indaingyi (January), to Monywa (February), to Meiktila (April) and to Rangoon (May). The move of the army map production and supply centre from Imphal to Myingyan took place in stages so arranged that not more than two printing presses were out of action at any one time.

After December, 1944, A.D.s Survey were withdrawn from 4 and 33 Corps and were replaced by captains with small field survey and map distribution detachments.

At the end of July, 1945, Advanced H.Q. A.L.F.S.E.A. moved to Kandy. This involved a slight readjustment of survey duties between H.Q. S.A.C.S.E.A. and H.Q. A.L.F.S.E.A. whereby the former took over all map production programmes, and the latter all distribution. This continued until the conclusion of hostilities in August.

### United States Forces

The organization of the American Forces which were operating in this theatre was somewhat complicated. This is well illustrated by the following list of appointments which General Stilwell (U.S. Army) was filling at one period:—

- (a) Chief of Staff to Marshal Chiang Kai-Shek.
- (b) Deputy Supreme Commander of the Allied Forces under Admiral Mountbatten.
- (c) Commanding General of U.S. Forces in the China-Burma-India (C.B.I.) Theatre, for which he was responsible to General Marshall in Washington.
- (d) Commander of the Northern Combat Area Command. This was equivalent to a Corps Command in northern Burma consisting of four Chinese divisions, one British division and one U.S. brigade.

To cover the mapping requirements of the American Forces, a Survey Liaison Office was set up which dealt with their demands either from their own sources or by calling on British map stocks. This led to a satisfactory and efficient co-operation on survey matters between the British and American staffs. A U.S. Engineer Topographic Battalion was early available in India, with a Combat Mapping Squadron and a Multiplex Platoon (for air-photo work) following soon after. There was frequent and economical interchange of production work between British and American organizations according to what mapping potential was available. When the Northern Combat Area Command came under the direct control of H.Q. S.A.C.S.E.A., an American engineer officer joined the survey staff of that H.Q. to act as a link with the Survey Liaison Office. Later, when the staff was increased, he took over the duties of A.D. Survey.

### Survey unit organization

The problem of unit organization was different under Indian conditions from that which applied in, say, Europe or North Africa. This was owing partly to a serious local shortage of lithographic tradesmen, with a negligible reserve of technical civilian personnel. The topographical conditions in Burma, with its jungles and trying climate, produced further factors which had to be taken into consideration. The following notes refer to some of the principal types of survey units which were employed:—

*Field Survey Company (Indian).* Out of a total of about 300, barely 50 were skilled technical tradesmen, a large number of sepoys being used in non-skilled trades such as chainmen. Map reproduction was taken away from these units owing to the shortage of Indian printers when separate reproduction groups were employed, and it was common practice to detach sections from these units to meet varying technical requirements.

*Reproduction groups and sections.* These consisted of a mixture of British reproduction tradesmen and Indian administrative personnel. As explained previously, they were formed by the War Office owing to the lack of Indian tradesmen, and sent out to India for completion with Indian personnel.

Some of the sections were equipped with mobile lorry-borne equipment, and some were static, involving the erection of the machines, and other plant, on some form of strong, solid flooring.

*Air Survey Companies.* Each of these units carried on establishment nearly 100 technical tradesmen trained in the compilation of maps from air photographs. They were more or less static, and could therefore dispense with a number of administrative personnel.

*Air (Survey) Liaison Sections.* These had been designed and raised in the United Kingdom to work in close liaison with R.A.F. Photographic Squadrons in connection with air survey programmes for mapping and for beach gradient determination. They did very valuable service in South East Asia, in the same way as they had proved their worth in Europe and in the Mediterranean theatres.

*Survey Production Centre.* This was formed in March, 1945, its major functions being briefly as under:—

- (a) To serve as a headquarter organization for controlling the brigaded mapping and reproduction units. It was capable of large intensive output.
- (b) To serve as the holding authority for all map records and compilation material, trig records and air photographs within the Command.
- (c) To serve as a link, on all matters concerning map records and production, between the Survey Service in S.E.A.C. and agencies outside the Command.
- (d) For the production of "Top Secret" and long-term planning map requirements for the Command.
- (e) For research in survey and map production methods.
- (f) For the bulk distribution of its output.

The following units were under its control:—

- Two Indian Air Survey Companies.
- Three Indian Field Survey Companies.
- Two Indian Drawing Sections.
- One Map Production Company R.E.
- One Map Reproduction Section R.E.
- Three Map Reproduction Groups (Type B).
- One Park Section.
- One Map Supply Company.

The potential of the above was reckoned to be about 90 new or revised sheets from air survey each month, and about 100 straight reproductions from existing kodelines (average run, 10,000 in four colours), in addition to normal miscellaneous requirements. This organization functioned smoothly under the control of Colonel J. E. S. Bradford during the latter part of the Burma campaign during which period preparations were in hand for the invasion of Malaya. It helped to simplify the work of the Survey Directorate at H.Q. A.L.F.S.E.A. and, with air transport as auxiliary to sea and rail, no difficulty was experienced in bulk map distribution to the various map depots.

*No. 110 Map Production Company R.E.* This was one of the units (see above) which was raised for the specific purpose of providing a large base map reproduction unit for service with the Survey Production Centre. It

was somewhat similar to 512 Field Survey Company R.E. in Middle East, but had no field sections. In essentials it consisted of nine officers, approximately 130 printing tradesmen R.E., 36 draughtsmen (topo) R.E. and necessary administrative personnel both British and Indian. The unit was designed and equipped to operate nine rotary machines for 24 hours a day, with a total monthly output of about 7,000,000 colour impressions. The machines, which were of sizes according to availability and not selection, included five single-colour (demy), one two-colour (quad crown), one two-colour (double-demy), and two small Harris machines for miscellaneous jobs. Being near the Equator, some of the standard sheets based on the graticule were of large size, and it was not always possible to print two up at one time on the double-demy machines. The set-up of the plant enabled "Top Secret" work to be undertaken with the utmost security.

*West African Survey Sections in Burma.* In January, 1943, when it had been decided to form two West African Divisions (81 and 82), arrangements were made for the raising and equipping of six brigade survey sections so that each brigade should have its own survey section. This conformed to a procedure which had been more or less routine during the Abyssinian campaign whereby each survey section was under the control of the formation commander.

By the end of April, Nos. 3, 4 and 5 Survey Sections were concentrated in Nigeria as independent units under the command of 81 (W.A.) Division and were ready to move to India.

No. 6 Survey Section started forming in January, 1943, and was soon employed on survey work in the Gold Coast. Nos. 7 and 8 Survey Sections were formed at Accra in July, 1943, and were assigned to 82 (W.A.) Division.

The original organization, as stated above, was one survey section to each brigade of the two West African divisions operating on the Arakan front in Burma. It was found, however, that the brigades were not operating independently, and the sections were therefore amalgamated to form two divisional survey sections. Each of these consisted of two officers and 30 African other ranks. These latter included four surveyors, two draughtsmen and 15 pioneers (Survey) with the necessary cooks, batmen and drivers to make the unit completely self-supporting. It was equipped for carrying out ground and air surveys, and had sufficient transport to make it semi-mobile. There were no facilities for map printing. During operations the equipment was head-loaded.

When 81 Division arrived in India in 1943 the survey organization was still on a brigade section basis.

5 and 6 Brigades were operating in the Kaladan Valley on the left flank of the main Arakan front and the survey sections accompanied them on a 200-mile outflanking march. During this 1943-44 campaign they were employed mainly on ground survey for the artillery and in mapping a new 150-mile jeep road which was constructed as a divisional supply road.

In July, 1944, the section with 5 Brigade was detached to Fourteenth Army H.Q. for 1/25,000 mapping of part of the Kaladan Valley.

3 (W.A.) Brigade was detached from 81 Division and formed one of the brigades of General Wingate's special force (Chindits). The survey section



with this brigade did little, if any, real survey work but was employed on the production of sketch maps of airstrips and camps.

In August, 1944, the three survey sections were amalgamated to form 10 (W.A.) Divisional Survey Section which was located at Rear Divisional H.Q. just behind the main Arakan front.

During the 1944-45 campaign 81 Division again carried out an out-flanking operation in the Arakan area, and the Divisional Survey Section produced a new series of 1/25,000 sheets of the Kaladan Valley. Between September, 1944, and January, 1945, this section produced ten such sheets from air photos and the printing was arranged by A.D. Survey 15 Corps. 81 Division was moving very quickly, and it was a constant struggle to maintain production so as to publish the sheets ahead of the forward troops.

In February, 1945, 81 Division was withdrawn from Arakan and moved to India to prepare for the Malayan invasion, and the Divisional Survey Section was scheduled for employment under Corps H.Q. on air-photo mapping for the forthcoming operations. In May, however, it was decided to withdraw the division from S.E.A.C. and send it back to West Africa, this move being completed early in 1946.

82 (W.A.) Division operated on the main Arakan front on the left flank amongst the foothills of the Arakan Yomas. During early 1945 the Divisional Survey Section produced eight 1/25,000 sheets and also had a field section with the advanced troops.

In May, 1945, the section was withdrawn from the division and staffed the Akyab Map Depot until September, when it closed down. The section then rejoined 82 Division at Taungap and moved with it to Rangoon.

During the early part of 1946 it worked, under A.D. Survey Burma, on the production of a new 1-inch sheet of part of the Shan States. In April, 1946, it returned to West Africa.

### **General Notes and Comments**

There is scope for much opinion and argument on the question of unit organization. Survey tasks in S.E.A.C. were extremely variable both in nature and magnitude, depending on terrain, climate, and other operational conditions. It would be difficult, if not impossible, to devise a war establishment for any type of survey unit which would be suitable in all theatres, under all conditions and circumstances. Flexibility is a great asset. It is evident that some form of temporary local modification should be possible by some easier means than by constant amendments to war establishments. As a general rule, there is no doubt that the constant splitting of a unit into its component parts, and the placing of detachments under other people's control, is not sound from the point of view of the unit's morale and general efficiency. This occurred frequently, however, in S.E.A.C. and no doubt the varying conditions and requirements rendered it necessary so that the available resources could best be fitted to the tasks as they arose.

The fact that the military survey service was created almost entirely from the civil department of the Survey of India meant that difficulties arose because, though a man was technically competent he might fall short by military standards for promotion to V.C.O. or N.C.O. Thus promotion during the war produced a new set of standards unknown in the civil department. The attempt to ensure equality of treatment both for civil and military promotion proved

very complex and troublesome. It would have been better had dual civil and military posts and responsibilities been avoided.

It will be remembered that, although during the early B.E.F. operations in France and Belgium in 1939-40 there was survey representation with corps, the general policy thereafter was that Survey would be organized no lower than on an army basis. In S.E.A.C., however, conditions were rather exceptional, and some corps (e.g., 4 Corps at Imphal, and 15 Corps in Arakan) found themselves operating more or less independently. Under such conditions it was usually found necessary to allocate to each corps an A.D. Survey with an assistant (captain) and a small Survey Directorate; a Field Survey Company for air survey, drawing and field-work; a small reproduction unit; and a map supply unit. At other times, however, corps only had a minimum of survey representation, such as a captain at corps H.Q., with a very small drawing and record office, a small map distribution and map depot staff, and a detachment of a Field Survey Company, for such field-work as might be required.

Survey organization at army level was found to be largely dependent on the length and nature of the communications between army and army group. In S.E.A.C. it was found desirable and necessary for armies to handle all their own 1/25,000 map production and revision, and to do a great deal of whatever revision was required for the ½-inch and 1-inch maps. Unfortunately, the total resources in S.E.A.C. with regard to map production and revision units, did not admit of allowing Fourteenth Army to have enough of them to make its position in this respect completely secure during the advance to Rangoon. D. Survey (A.L.F.S.E.A.) had to keep a certain amount in reserve for other operations which were being planned, though many of these were, in fact, never launched.

Survey control channels necessarily vary in detail as between one theatre or command and another. In S.E.A.C. the following was taken as the general set-up:—

- (a) In accordance with accepted British policy Survey was recognized as being responsible to, and under the operational control of, the General Staff, and not coming under the Chief Engineer. It was not affiliated to any particular branch of the staff, and the Director (or D.D.) of Survey worked under the orders and direction of the C.G.S. (Chief, General Staff) or B.G.S. (Brigadier, General Staff,) making all necessary contacts with the operations, intelligence, and planning branches.
- (b) Within the army group (or army) the survey control organization at H.Q. level was as under:—

*A Director (or D.D.) of Survey* with directorate staff for exercising the following functions:—

Advice to the C.G.S. (or B.G.S.) on all map and survey matters.  
Control of its own production, distribution, and air-liaison units.  
Liaison with, and technical direction of, Survey Directorates at subordinate H.Q.s.

*Army Group (or Army) Survey Troops* such as:—

- (i) The Survey Production Centre, which operated under its own D.D. (or A.D.) Survey and a small staff. If the Production Centre was far away, a small group of units was assembled alongside army group or army H.Q. for drawing, printing, etc.

- (ii) Map distribution units, and Survey Park Sections (for stores). Stores sometimes passed through the map distribution organization; sometimes they were handled separately.
- (iii) Air Survey Liaison units, under the direct control of D. (or D.D.) Survey.
- (iv) Possibly some Field Survey units.

As was found in all theatres, but perhaps more so in S.E.A.C. owing to the long distances, the survey organization was complicated by the splitting of operational headquarters into advanced and main, and their wide separation. Thus there was at one time a survey directorate at H.Q. A.L.F.S.E.A. in Calcutta without local survey troops, a production centre in southern India (later in Ceylon), and a D.D. Survey at H.Q. S.A.C.S.E.A. in Ceylon. This was inconvenient but was enforced by unavoidable circumstances.

### SECTION 3. MAPS AND MAP PRODUCTION

The arrangements for the preparation and production of maps for operations in South East Asia were considerably dependent on, and affected by, the survey organization which was in force in India before the war, the developments in that organization which took place during the war years, and the formation of the independent military Command S.E.A.C.

To enable the reader to get a perspective picture of mapping activities it will perhaps be well to begin with a short description of the pre-war organization and military mapping responsibilities of the Survey of India, and to trace its mapping activities during the war. There will then follow a short summary of the mapping work undertaken by the military Survey Service under the control of S.E.A.C.

#### PART I

##### THE SURVEY OF INDIA

Before the war, the Survey of India was responsible for providing such maps as the defence services might need of India, Burma, Afghanistan and Iran. In accordance with this policy, the Survey of India continued its routine programme during the field season of 1938-39 and the summer of 1939 of providing topographical maps of the above areas. As the new (post-1905) surveys of India and Burma were nearing completion, research was being devoted to the problem of revision and maintenance of the map series, and the rapid production of maps for war purposes, with special emphasis on the compilation of maps from air photographs.

The greater part of the pre-war map reproduction work was done at Calcutta, where 70 per cent of the total machine power was located. There was, in addition, a small reproduction office at Dehra Dun, with smaller offices at Risalpur and Murree. The latter dealt mainly with emergency requirements of the defence service on the North West Frontier. A small reproduction plant was also maintained at Simla to meet General Staff needs. There was no map reproduction in Burma.

The lithographic printing machines operated by the Survey of India before the war consisted of six rotary and eleven flat-bed machines. The pre-war maps were mostly printed in about six colours, and the number of copies printed of any individual sheet was usually only about 500, and seldom exceeded 1,000. It will thus be realized that at the beginning of the war the stock position, from an operational standpoint, was not a healthy one. To act as a basis for comparison with figures of production during the war period, it may be of interest to note that the number of maps printed during the 12 months from April, 1939 to the end of March, 1940, amounted to only 824,000.

The spread of hostilities in the Middle East and the possibility of war with Japan rendered communications between the United Kingdom and the East uncertain and precarious. British forces in the Middle East were, during 1940, becoming increasingly involved in the Mediterranean area. At that stage India was undertaking operational responsibilities in Iraq and, following the Survey Conference held in Cairo in the spring of 1940, and by arrangement with the War Office, India took over full responsibility for the preparation of maps of Iraq, Trans-Caucasia, a strip of the U.S.S.R. from the Caspian Sea eastwards, and a large part of Thailand, Indo-China and Yun-Nan, in addition to her previous responsibility for maps of India, Burma, Afghanistan and Iran. India also undertook to supply assistance or, if necessary, full responsibility for the printing of maps of a considerable part of North Africa, the Balkans and Turkey on the one side, and Malaya, the remainder of Indo-China and Thailand on the other, should the map production potential in Cairo and Kuala Lumpur (Malaya) be seriously reduced or destroyed by enemy action.

With increased demands being placed on Indian map printing resources the use of several colours on the maps was stopped, and during the early part of 1941 printing was limited to black and brown only, except where additional colours were essential for clarity. Later in the year, however, as a result of operational experience and criticisms from the troops, this policy was revised as the two-colour maps were found to be difficult to read. Whenever time was available thereafter a wider range of colours was adopted. The size of editions rose to an average of about 5,000 a sheet and, during the four months from April to July, 1941, over 1,300,000 maps were printed.

With changing operational conditions, certain alterations in mapping responsibility were made during the latter part of 1941.

*Iraq.* Middle East took over the responsibility for all mapping work in Iraq and Iran as far east as Long. 54° E.

*Malaya and the Far East.* The entry of the United States into the war, the loss of the Malayan and Netherlands East Indies Survey Departments, and the Japanese offensive westwards towards India, placed further responsibility on India, who now took over the preparation and maintenance of maps of Siam and Indo-China and, so far as forces based on India were concerned, of China and a portion of Malaya. Mapping material was exchanged between India and other authorities concerned, so that India could, if required, produce maps of the Dutch East Indies and the remainder of Malaya.

*Ceylon.* The Ceylon Survey Department produced its own maps, but India held reproduction material from which maps of Ceylon could be produced if necessary.

Within the limited capacity of the Security Press, the Survey Departments of Provincial Governments, and civil firms, attempts were made to farm out printing so as to increase production. It was first of all necessary to make duplicate printing plates, and there were delays due to the fact that the civil firms and other provincial agencies were unaccustomed to the type of work involved. The great distances between the Survey of India offices and these agencies added further difficulties, and the procedure was therefore slow in expanding.

Estimates of probable future requirements showed that the Survey of India would have to increase its drawing and reproduction resources. Arrangements were therefore made with the War Office for British technical personnel to be sent out to India, who would be held on a special military establishment attached to the Survey of India. Further printing presses were also ordered, both from the United Kingdom and from India itself.

It was also arranged that, when the modern lorry-borne demy printing equipment was available for the field units, the larger (double-demy) trailer-borne machines would be withdrawn from the forward units and used, either in the base organization in India, or to establish advanced base printing plants. With the Japanese threat from the East, and the desirability of building up a large central establishment, the bulk of the machines were concentrated at Dehra Dun instead of at Calcutta.

During the period from August, 1941, to the end of July, 1942, the Survey of India was principally engaged on the production of maps of Burma and eastern India, but their work also included maps of Iraq, Iran, Afghanistan, north-western India, China, Indo-China, Thailand, Malaya and Ceylon. A large amount of drawing was involved in respect of foreign maps, and in the gridding of the maps of India and Burma.

The output for this period of 12 months from August, 1941, to July, 1942, was:—

Number of individual maps	4,320
Number of copies printed	6,906,000
(not including those produced by the Indian Survey units in Iraq.)	

Mapping activities for the war effort during the period from August, 1942 to July, 1943, were intensified, emphasis being placed on air survey training and production. The chartering by the Indian Government of the Indian Air Survey and Transport Ltd. helped towards the acquisition of air photographs, and Colonel D. R. Crone was appointed Air Survey officer (Survey of India) to co-ordinate all air survey work and training, both civil and military, and to operate the Air Survey and Transport charter on behalf of the Surveyor General.

A photographic programme was begun in October, 1942, and between then and the end of July, 1943, over 22,000 square miles of country were photographed in various areas, from Bengal to Persia, and from Trichonopoly to the Khyber Pass, the greater part of which was for military mapping purposes. The R.A.F. and the U.S.A.A.F. also provided many photographs which were used by the Survey of India for mapping purposes.

During August, two sets of slotted template apparatus were obtained from the Fairchild Corporation and put into production and, by July, 1943, about 8,000 square miles of country had been compiled from air photographs with this apparatus.

By now, most of the maps were being printed in at least four colours, and the bulk of the production resources had been moved to Dehra Dun. The Army/Air style was adopted for the 1/M maps, and a new 1/500,000 series, primarily for air use, was introduced.

The base printing establishment at Dehra Dun issued an average of about 425,000 maps a week during the year. Its output potential for dealing with peak periods had risen to about 2,000,000 a week steady output with the prospect of a rise to 3,000,000 when all the new plant had been installed.

Production during the 12 months from August, 1942, to July, 1943, was:—

Individual maps published	3,441
Copies printed	20,575,000

In order to distinguish those maps specially prepared for war requirements from the standard Survey of India series, the designation "Hind" was applied to the former. The 1/M and 1/500,000 were samples of the "Hind" series.

During this period maps were provided for Chinese divisions operating in Burma. They were the Burma  $\frac{1}{2}$ -inch and  $\frac{1}{4}$ -inch maps overprinted with Chinese characters. The preparation of the overprints was organized by a Chinese officer, who recruited Chinese locally in Calcutta. Between November, 1942, and April, 1943, a total of over 250,000 such maps were overprinted, the work being done by the Bihar and Assam Government Presses.

Generally speaking, the Survey of India was, from August, 1943, till July, 1944, responsible in its capacity as a base organization for undertaking map production and printing work as demanded by the Director of Survey (India), who acted as liaison between the military forces and the Survey of India for such requirements. At this time India was responsible for producing maps of Persia (East of Long. 60° E.), Afghanistan, India, Burma, Siam, Indo-China, western and southern China, Malaya and Sumatra. The general policy was that the military survey service carried out the short-term programmes and that the Survey of India dealt with the long-term requirements.

Though not yet completely equipped, the new production establishment at Dehra Dun was now running to big capacity. The output for the 12 months from August, 1943, to July, 1944, is shown below, with the percentage increase compared with 1939-40:—

		<i>Output compared with 1939-40</i>
Individual maps published	2,281	140 per cent
Copies printed	11,787,000	1,400 per cent

These figures show a falling off compared with 1942-43. This was owing partly to the fact that maps were being printed in a greater number of colours, partly to the stabilization of the operational front, and also to the time taken to accumulate mapping material from forward areas.

A large quantity of mass production drawing was undertaken in the various drawing offices of the Survey of India. The amount completed for the production of new maps from new surveys was small, as there were few new surveys other than from air photographs, for which the drawing was principally done in the military units. Most of the drawing work was in connection with the redrawing of existing maps, mainly of Burma and overseas, for which so much new information had become available that the correction of the existing

printing plates was unsatisfactory. There was also the initiation of new map series on previously unpublished scales, and the preparation of separate colour drawings for published maps for which separate colours had not hitherto existed.

During the final period from August, 1944, to July, 1945, map drawing and printing by the Survey of India continued at high pressure. The machine position, by 1945, was as under:—

2-colour quad-demy	2
1-colour quad-demy	5
2-colour double-demy	6
1-colour double-demy	6
2-colour demy	2
Hand-feed double-demy	8
Flat-bed	4

The output for the 12 months was:—

Individual maps published	2,483
Copies printed	22,075,000
Impressions (all colours)	108,222,000

Before the war there was no central survey stores organization in India, each Circle being responsible for obtaining its own stores through various authorized channels. This method broke down under war conditions, and it was necessary to form a central organization.

The "Stores Office (Surveys)" opened in Calcutta in August, 1940, but it was a local arrangement for the Calcutta offices only. In April, 1941, it moved to Delhi, and a few months later to Dehra Dun, its role being still relatively local, and its activities confined to a small percentage of the total quantity of stores required by an organization such as the Survey of India.

Between 1942 and 1945, there was a rapid growth of the Stores Office. Eventually it served about 120 civil and military Indian, British and U.S. units in the theatre. In addition to the Survey of India, all R.E. and I.E. survey units, including map reproduction elements, obtained all their survey technical stores, instruments, machines, chemicals, etc., from the Stores Office (Surveys). In 1941 some 240 items only were under supply. By 1945 this figure had risen to some 10,000 items, and the Office was handling approximately 7,600 tons of stores a year.

The range of the stores was very wide, and included 17 different types of modern lithographic printing machines, the smallest of which would print a sheet 13 in. × 8 in., and the largest 48½ in. × 36½ in. Ancillary equipment and a multitude of spare parts were carried in order to maintain the machines in operation.

Indian manufacture was encouraged to take up production of the many survey stores, chemicals, inks, etc., required, and about 25 per cent of those held were of Indian make. Over 2,500 tons of Indian-made paper, prepared from bamboo pulp, were used annually by military and civil survey units in the theatre.

In 1941, the Stores Office had occupied a mere two bungalows. By 1945, the floor area occupied had increased to 68,000 square feet. There were two branch offices, one at Calcutta and the other at Bombay. The latter dealt with

the thousands of tons of stores which were being shipped for Survey annually from the United Kingdom, South Africa, and the United States.

## PART 2

### H.Q. SUPREME ALLIED COMMAND AND H.Q. 11 ARMY GROUP (LATER A.L.F.S.E.A.)

Part 1 of this section gives a brief summary of the principal map production activities of the Survey of India in connection with the operations in South East Asia. In Part 3 which follows will be found a description of the work carried out by the Survey Directorate and units of Fourteenth Army. In between these two there was the survey organization at H.Q. 11 Army Group (later known as A.L.F.S.E.A.), and at H.Q. S.A.C.S.E.A. Part 4 will cover the mapping activities with 15 Corps during the final Arakan campaign.

### Mapping responsibilities and resources

The organizational development of the military survey service in South East Asia, and its relations with the Director of Survey (India), both before and after the formation of S.E.A.C. have been dealt with in Section 2. It will, however, be necessary to mention some of the main factors concerning organization during this account of mapping work.

Before the formation of S.E.A.C., India had been allotted an area of mapping responsibility by the War Office which included all likely operational areas within the theatre. On the formation of S.E.A.C., India still retained the same mapping responsibilities for the whole area, but decentralized some of the work to D. Survey 11 Army Group.

To make the organizational picture clear it must not be forgotten that the Director of Survey in the field found it advisable, for various reasons, to have his main survey directorate at H.Q. 11 Army Group, with a small directorate for forward planning, etc., at H.Q. S.A.C.S.E.A.

Early in March, 1944, D. Survey (India) transferred to D. Survey 11 Army Group the technical control of the survey directorate Fourteenth Army, and later in the month transferred control of the following units:—

Indian Air Survey Directorate.

Nos. 5 and 7 Indian Air Survey Companies.

No. 71 Base Map Reproduction Section.

No. 11 Indian Air Survey Liaison Section.

Nos. 32 and 35 Map Supply Sections.

No. 51 Drawing Section.

In addition, two-thirds of the combined survey strengths of Nos. 1, 3 and 4 Indian Field Survey Companies, which were in Southern Army, together with such of their reproduction strength as was required, were put at the disposal of D. Survey 11 Army Group. This formed the basis of his map production resources.

The air survey directorate was one of the items transferred as stated above. The air survey units, which had been widely dispersed, were concentrated at Harihar in southern India together with No. 71 Base Map Reproduction Section. To facilitate the control of these units, D.D. Survey (Southern Army) with his survey directorate was placed under the technical control of 11 Army



Group, and assumed responsibility for all the survey work which was being carried out for S.E.A.C. by the units of Southern Army.

### Basic map series

The basic map series for the operational area of S.E.A.C. were, in March, 1944, as follows:—

India and Burma	1 inch to 1 mile (or $\frac{1}{2}$ inch where no 1 inch existed).
Malaya	1 inch to 1 mile.
Sumatra	1/50,000, or 1/100,000 or as planned by Washington.
Thailand (Siam)	1/100,000.
Indo-China	1/100,000.
Ceylon	1 inch to 1 mile.
Andaman Islands	2 inches to 1 mile.
Nicobar Islands	} 1 inch to 1 mile.
Cocos Islands	

Responsibility for the provision of new or revised editions of these basic maps, or maps on a larger scale, was delegated to D. Survey 11 Army Group (later A.L.F.S.E.A.).

The production of any maps on a scale smaller than the above was reserved by D. Survey (India) except in case of operational urgency.

### Survey Production Centre (A.L.F.S.E.A.)

Until early in 1945, D. Survey (India) was the departmental channel of communication between D. Survey, 11 Army Group and the Director of Military Survey at the War Office, the War Department at Washington, and the Survey of India. Within the limits imposed by this chain of control D. Survey 11 Army Group had been allotted responsibility for survey planning within the operational theatre, and for initiating demands for new maps and series other than those for which production had been reserved by D. Survey (India).

In January, 1945, however, as a result of the difficulties which were experienced, it was decided to recast the working relations as between S.E.A.C. and the India Command. As a result S.E.A.C. took over responsibility from India for all military survey and mapping of their operational area, on scales of 1/M and larger, India retaining responsibility for all work other than the above within geographical limits which would be allotted from time to time by the War Office. Although thereby becoming master of its own house with regard to survey and mapping, S.E.A.C. still, of course, remained dependent to a certain extent on India for the bulk printing of certain map stocks which it could not undertake with its own resources, and for this purpose D. Survey (India) remained as the link between S.E.A.C. and the Survey of India. S.E.A.C. now assumed the task of initiating the production of maps and survey data, and it became essential to set up an adequate and efficient map production installation to deal with base mapping and other matters. The Survey Production Centre (S.P.C.) came into being in March, 1945, by forming new units and by concentrating in Kandy some existing units which hitherto had been engaged on

air survey, drawing and map reproduction in India. It was placed under the command of a D.D. Survey (Colonel J. E. S. Bradford) who was assisted by one A.D. Survey for dealing with operational matters, two D.A.D.s Survey (one for map production and one for air survey), and a number of junior staff officers. For further details about this unit see Section 2.

To understand better the status and work of the S.P.C. it is well to consider the respective functions of the Survey Directorate (A.L.F.S.E.A.), the Survey Division (S.A.C.S.E.A.) and the S.P.C. itself. Briefly, so far as mapping and production were concerned, they were as follows:—

(a) *Survey Directorate H.Q. A.L.F.S.E.A.*

- (i) Notifying H.Q. S.A.C.S.E.A. of stock requirements of survey publications, and details of their distribution, breakdown, and short-term requirements.
- (ii) Meeting the requirements of H.Q. A.L.F.S.E.A. and Ceylon Command for miscellaneous maps, and for placing orders for these on S.P.C.
- (iii) Scrutiny of demands for air photographs and map production, and passing approved demands to H.Q. S.A.C.S.E.A.

(b) *Survey Division H.Q. S.A.C.S.E.A.*

- (i) Production plans and programmes for all maps other than the miscellaneous requirements of H.Q. A.L.F.S.E.A.
- (ii) Placing all work orders on the Survey Production Centre.
- (iii) Procurement of all air photographs.
- (iv) Staff requirements of maps for H.Q. S.A.C.S.E.A.

(c) *Survey Production Centre.*

- (i) Control of all map production for S.E.A.C. not allocated to lower formations.
- (ii) Production orders on United Kingdom, India, and other agencies as directed by H.Q. S.A.C.S.E.A.
- (iii) Research into map production methods.
- (iv) Preparation of technical instructions and cartographic specifications.
- (v) Distribution to main map depots.
- (vi) Holding authority for all map records and material, trig records and air photos within the Command.

D. Survey (A.L.F.S.E.A.) laid down as policy that his prior approval was necessary before action was taken on the following:—

Programmes of map production and air photography.

Allocation of priorities for work in the S.P.C.

Specifications for standard map series.

Rejection of demands from forward formations for air survey map production, air photography, or bromide prints.

Space does not allow, nor would there be any object in giving, a detailed record of all the many mapping tasks undertaken by the S.P.C. and the other productive agencies which worked under the control of A.L.F.S.E.A. and S.A.C.S.E.A.

Extensive programmes of new 1/25,000 mapping from air photographs of parts of Burma, Malaya, Siam and other areas were carried out. The air

revision of the 1-inch maps of Burma was another of the major tasks. In connection with this work large areas were photographed by British and U.S. Air Forces, in spite of the fact that, over most of Burma, survey photography was impossible during the monsoon and preceding haze (April to October).

Photography had to be undertaken between November and March for operations which would take place the following November–March. The Air Survey Liaison Sections played a prominent part in this work, briefing the pilots for their technical tasks, and recording all the sorties as they were undertaken. They also carried out extensive programmes in connection with the determination of beach gradients, the preparation of collation maps showing beach intelligence information, surveys of airfield and bridging sites, and many other tasks of operational importance. Considerable assistance in connection with this work was given by U.S. Engineer Topographic units with their multiplex plotting equipment.

The preparation of large scale town plans was an important feature of the work of the S.P.C. and, under the future planning control of H.Q. S.A.C.S.E.A., the preparation of maps of all sorts for the proposed final assault operations in Malaya formed a mapping task of great magnitude.

With the Japanese surrender, the intensive operational mapping programmes had to be switched over, at a moment's notice, to the task of providing maps for the forces which were despatched to occupy the surrendered territories over widely dispersed areas.

### PART 3

#### FOURTEENTH ARMY

##### Mapping during 1942

At the start of operations in Burma, the whole of that country and eastern and southern India had been surveyed on the 1-inch scale except for a belt covering the Chin and Naga Hills, where the  $\frac{1}{2}$ -inch scale had been adopted. There were also some compiled maps on  $\frac{1}{4}$ -inch and  $\frac{1}{2}$ -inch scales. All these maps had been published before the war, and were mostly well printed in six or seven colours, but in some areas the survey was an old one and the maps were out of date.

The map stock situation was unsatisfactory. The normal printing order for map sheets in peace-time had numbered only 500 of each edition. Additional stocks were printed of certain areas in southern Burma and the Shan States during 1940–41 and were stored in Rangoon, but by March, 1942, that area had been overrun by the Japanese and the stocks were lost.

In March, 1942, when the Burma campaign was going badly, and India was threatened, the newly created D.D. Survey (Eastern and Southern Armies) had the responsibility of providing maps for the defence of India. As time was so pressing it seemed unwise to embark immediately on a reprint of all the 1-inch sheets, so a reprint of the  $\frac{1}{4}$ -inch sheets was taken up as first priority, to be followed by the  $\frac{1}{2}$ -inch, or by the 1-inch where the  $\frac{1}{2}$ -inch was non-existent or inadequate. On completion of these, the 1-inch sheets were to be printed. The programme comprised 3,000–4,000 copies each of 142  $\frac{1}{4}$ -inch, 320  $\frac{1}{2}$ -inch, and 200 1-inch sheets. In addition to this, demands had also to be met until about the end of April for the army in Burma. As seven-colour printing was out of the question, the style adopted for this reprint programme was a black outline with brown contours, and one additional colour in a few special cases

(e.g., purple grid or green for forest). The task was completed by the Survey of India by the end of September.

In view of their limited printing resources at the time, the Survey of India tried to farm out some of the work to the Provincial Government presses. The Bombay Press at Poona offered to print 70 sheets a month but shortage of paper, and other adverse circumstances prevented a satisfactory use of these facilities. Under a threat of Japanese invasion the Madras Government Press was evacuated, and it was not available again until the vital need had passed. The Bihar and Assam Governments also offered their presses, but they could not be used for the printing of standard sheets, and no photographic plant was available.

With the onset of the 1942 monsoon, the arrival of reinforcements from Europe, and other factors, the immediate threat of a Japanese invasion of India receded, and the reprint of 1-inch maps of India was cancelled. A reprint of maps covering Burma and the Assam frontier was substituted, and the programme included:—

14,500 copies each of 96  $\frac{1}{4}$ -inch sheets.

14,500 copies each of 304  $\frac{1}{2}$ -inch sheets.

10,000 copies each of 800 1-inch sheets.

The printing was started by the Survey of India in August, 1942, and completed early in 1943. Two colours only, black and brown, were used.

In September, 1942, No. 6 Reproduction Group was posted to the Eastern Army. It was equipped with two Crabtree demy presses mounted in special Foden lorries, two photo-mechanical vehicles, and five 22-kw. Lister generators on trailers. There should have been camera and process lorries, but they never arrived, so Hunter-Penrose portable cameras and a portable dark room were used instead. The units carried a grainer, guillotine and arc lamps for the camera.

#### **Map production for the 1943 operations**

The operations for which maps were required during 1943 included:—

- (a) The unsuccessful offensive in Arakan during the first half of the year.
- (b) The Wingate expedition.
- (c) Operations in the Kabaw Valley and the Chin Hills around Tiddim and Fort White.

The maps of Burma available in January, 1943, comprised:—

- (a) The pre-war 1-inch series ( $\frac{1}{2}$ -inch only in certain areas) which had been reprinted in black and brown. The maps were of indifferent quality in the dense jungle-covered hill areas.
- (b) A 3 inches to 1 mile air survey map of Akyab Island. This was revised and a new edition was published, for which a trace showing enemy defences was added to weekly so as to be able to produce up-to-date copies just before the assault.

Early in 1943 there were only a very small number of surveyors trained in air survey methods, so it was not possible to embark on a large 1/25,000 mapping

programme. A number of photo mosaics were therefore produced as a substitute. They were considered to be a valuable addition to the 1-inch map in the absence of large scale maps, but their quality was poor.

To supply the Wingate expedition  $\frac{1}{2}$ -inch maps were flown to the force from its base at Aggartala airfield. As it seemed likely that, on its return journey, the brigade would pass through difficult country to the north of the Uyu River, where the  $\frac{1}{2}$ -inch map was known to be inaccurate, a special 1-inch map was hurriedly prepared for use when crossing the watershed.

The need for the formation of a small map production organization to serve the immediate needs of Eastern Army became apparent early in 1943. This must not be confused with the base production establishments set up by the Survey of India and by A.L.F.S.E.A. Calcutta was selected as the location and the following units were available in January:—

- No. 9 Indian Survey H.Q. (with A.D. Survey).
- No. 6 (Indian) Reproduction Group (later renumbered No. 66).
- B Photo-zinco Section.
- No. 53 Drawing Section.
- Detachment from No 6 (Indian) Field Survey Company.

During June and July it was reinforced by the arrival of:—

- No. 22 Survey Park Section.
- No. 2 (Indian) Field Survey Company (from Iraq).
- No. 63 (Indian) Reproduction Group.

Production during 1943 mainly consisted of:—

- (a) New editions of  $\frac{1}{2}$ -inch and  $\frac{1}{4}$ -inch maps covering Arakan, Manipur, and the Chin and Naga Hills, incorporating new roads, and introducing more than the two colours of the 1942 reprint.
- (b) 1/25,000 maps, compiled by the air survey section.
- (c) New editions in colour of 1-inch maps of Arakan and the Kabaw Valley, incorporating air revision.
- (d) Target maps for the R.A.F.
- (e) Defence overprints and administrative lay-outs.
- (f) Block-plots and large scale airfield surveys.
- (g) A little half-tone work.

The standard 1-inch,  $\frac{1}{2}$ -inch and  $\frac{1}{4}$ -inch sheets were reproduced by various methods. In some cases the original drawings were brought up to date, in others the negatives were corrected. Each sheet was treated on its merits according to the quality of the material and the amount of correction needed.

As an improvement to the basic black-brown printing extra colours were added as follows:—

- (a) A pale red ribbon was overprinted on the existing black roads. This was not very satisfactory, but colour separation at that period was too laborious. Later, when sheets were redrawn from air survey, a separate road plate was prepared.
- (b) A pale blue filling was printed over sea areas, tanks, and double-line rivers.

- (c) Cultivated and other open areas were overprinted in yellow. This was satisfactory in northern Burma and Arakan where the country was either jungle-covered hill or open cultivation. In the drier parts of central Burma yellow was reserved for cultivation, forest being shown by black tree symbols or a green tint, and other land being left white with symbols for scrub or grass.

Throughout 1943 and most of 1944 there was a great shortage of surveyors in the Eastern Army who had been trained for air survey work. When mapping work started for the Arakan operations in December, 1942, only six were available, this number rising to about 15 in the middle of 1943. They came from various units and were combined to form a headquarter air survey section, reinforced by personnel from the Indian Air Survey and Transport Ltd.

During the early months of 1943, the work of the air survey section included:—

- (a) Photo-mosaics of Arakan, and 1/25,000 maps of the Chindwin Valley, which appeared likely to be a potential battle area.
- (b) Survey of 1-inch sheet around Tamu, and the revision of several other 1-inch sheets in the Chindwin area.
- (c) Original 1-inch survey and revision in Arakan.
- (d) An extensive programme of 1/25,000 maps in Arakan.
- (e) Photo-mosaics of rear areas for training purposes.

With a great scarcity of recognizable trig points, the 1/25,000 air surveys were based on a large number of detail points on the 1-inch map which had presumably been fixed with adequate accuracy by plane-tables. Attempts were made to obtain a near fit with a number of such points rather than a perfect fit with a few only. On average, maps so controlled were found to be correct with regard to detail position to within about 100 yards.

During 1943, few facilities existed for the provision of survey photographs. Fortunately, a large area of Burma had been photographed before the war by the Indian Air Survey and Transport Ltd. for the Burma Oil Company and, by good luck, these photographs covered areas in Arakan and the Chindwin Valley where map revision was most required. Where such photos did not exist use was made, in those early months, of low obliques taken for reconnaissance purposes.

The Indian Air Survey and Transport Company was located at Dum Dum and was of great assistance to the Eastern Army early in 1943 when survey photography by the R.A.F. was practically non-existent. Members of its staff worked with the air survey section, indexing photos and making mosaics, and they photographed also 8,000 square miles for the possible revision of 1-inch maps of Bengal before the company was taken over by the Survey of India under a charter.

Photo-mosaics were prepared on a scale of about 1/15,000, and were produced as half-tone litho prints. Before reproduction, the bromide mosaics were treated as follows:—

- (a) A grid was added by comparison of detail with the 1-inch gridded map.
- (b) Contours were drawn in black.
- (c) Roads, tracks, streams, river banks and buildings were touched up in black or white as appropriate where the contrast was insufficient.
- (d) Names were added.

Photography of the bromide mosaics for half-tone reproduction was usually done through a 133-line screen, and most of those produced in 1943 were printed by the Survey of India.

In view of the inaccuracy of the 1-inch maps in those parts of Burma concerned, the 4-inch to 1 mile photo-mosaics were appreciated in spite of their defects, and the battles of Donbaik and Rathedaung were largely fought with their guidance. The points in their favour were stated to be:—

- (a) They required less work from air-trained surveyors than 1/25,000 maps.
- (b) The photos inspired confidence in the user, who was unable to report that the map was wrong if and when he misidentified his position.
- (c) In some types of country the mosaic gave a good picture of the vegetation.

There were, however, the following serious defects in the photo-mosaics:—

- (a) Unless the original bromides were of good quality and evenly matched, and the reproduction processes free from fault, the result was usually an unintelligible smudge.
- (b) In jungle-covered hills nothing showed except what the draughtsman had drawn on the bromide mosaic, and this would have been clearer on the normal white background of a map.
- (c) The grid was distorted though not necessarily inaccurate.
- (d) For clear reproduction the scale had to be about 1/15,000, which was rather large from the point of view of distribution of the printed copies.

In actual fact, these mosaics were little used after 1943, which bears out similar experience in other theatres, where much work was put into the preparation of photo-maps, and little if any use was made of them.

Considerable use was made of block-plots. These had been used originally in the Middle East, where they were found so successful in desert country at the battle of El Alamein. The main essential was a set of overlapping photographs, each having its principal point, and those of adjacent photos, marked on it. Accompanying the photos was a gridded map, or plain piece of gridded paper, on which the principal points were plotted. Using a piece of transparent talc or kodatrace, any target which could be recognized on two overlapping photos could be cut in on the plot-sheet or gridded map, and its position fixed on the radial line principle. It was of special use in areas where there was little map detail.

Block-plots were first prepared in India in May, 1943, for the defence of Maungdaw, and in 1944-45 they were used extensively, a divisional commander considering himself ill-equipped if he had to fight without them. They were usually based on 1-inch map detail for control.

#### **Map preparation for the 1944 Arakan operations**

The Eastern Army was now known as Fourteenth Army. The failure to take Akyab in 1943 entailed extensive preparations for a 1944 offensive. Maps were required to meet the following requirements:—

Four Divisions were scheduled for the land operations, and it was estimated that they would require a total of 12,000 copies of all 1-inch maps covering the probable fighting area, and about 6,000 copies of 1/25,000 maps where they existed or could be produced.

Two Divisions were to effect sea-borne landings, for which the estimated requirements were 20,000 copies of the relevant 1-inch maps and about 10,000 of the 1/25,000. As things turned out, these projected sea-borne landings did not take place.

It having been decided not to use photo-mosaics, a series of 1/25,000 maps was put in hand extending from Bawli Bazaar (north of Maungdaw) to Akyab, comprising 22 sheets. This area was later considerably extended to the north, east, and south-east.

Before reprint, the 1-inch maps were revised from the air survey material used for the preparation of the 1/25,000 maps. In the Kaladan Valley, where only ½-inch maps existed, enlargements were made up to the 1-inch scale. No extra detail was added, but the larger scale was preferred in the field as it allowed room for manuscript notes and additions.

### **The 1944 operations (February to November)**

When the Japanese opened their offensive at the end of March across the hills to Kohima, and surrounded Imphal, more than three divisions were transferred into Assam and Manipur. Heavy fighting in these areas, and the threat to areas further back for which the existing stocks were small, put a big strain on printing resources. Luckily the area was one which was covered by ½-inch maps. A reprint of 1-inch maps could not have been done in the short time available. As it was, 25 ½-inch sheets with a total of 340,000 maps were printed during April.

For the relief of Imphal, and the subsequent advance to the Kabaw Valley, a large demand arose for 1/25,000 maps and block-plots over a wide area. Nearly 60 1/25,000 sheets were surveyed between April and July. Some of this work was done under the control of A.D. Survey 4 Corps in Imphal, and the remainder by army survey units at Comilla.

As successors to the first Wingate expedition, 3 (Indian) Division, consisting of six brigades, was operating in northern Burma, together with an American Chinese force under General Stilwell, this latter forming what was known as the Northern Combat Area Command (N.C.A.C.). At the time under consideration, these formations were under the tactical command of Fourteenth Army.

Four brigades of 3 (Indian) Division were operating behind the enemy lines, and the supply of maps to the division was not an easy matter. To a certain extent their map demands were met by 11 Army Group. At a late stage in the operation they asked for 300,000 waterproofed maps which, in order to save weight, had to be trimmed to a specified size. They were mostly supplied from the Titagarh and Ranchi depots and, after being sent to Delhi for trimming and varnishing, were flown to the division's air base at Sylhet.

N.C.A.C. had its own map supply organization based on Chabwa.

In November, 1944, when Eastern Army became Fourteenth Army under General Slim, its H.Q. moved to Comilla, and D.D. Survey set up his own Survey Directorate there. Most of the remaining survey units were brought forward from Calcutta, and an army base map production organization was established at Comilla. Its main task was the preparation of air revised or modernized 1-inch and ½-inch maps of Burma north of Lat. 21° in contemplation of a return to that area. For current operations there were demands for 1/25,000 maps and reprints of the smaller scales. Shortage of air surveyors and



photos unfortunately prevented all the maps from being air revised. The following is a summary of the more important tasks accomplished during 1944 at Comilla:—

Completely resurveyed from air photos:—25 1-inch and  $\frac{1}{2}$ -inch sheets in northern Burma.

Extensively revised, including redrawing of the whole sheet:—25 1-inch sheets.

Revised for serious changes and errors only:—49 1-inch sheets.

Modernized:—95 1-inch, and 53  $\frac{1}{2}$ -inch sheets. This modernization consisted of recasting the old double-size sheets to the normal single-sheet size, drawing communications in modern symbols, and printing about 16,000 to 20,000 copies of each in four or five colours.

Considerable extensions were made to the Arakan 1/25,000 series during the year to the north of Maungdaw, and south-eastwards towards Myebon. A number of sheets were surveyed near the Chindwin Valley round Kalemyo and Mawlaik, and work was begun on a series of 1/25,000 maps extending from Kalewa to Ye-U and beyond.

It has already been noted that, during 1942-43, there were no proper facilities for the provision of vertical survey photos in Burma. Early in 1944, however, some Mosquito aircraft, based on Dum Dum, were fitted with K-17 air cameras (9 × 9 picture with 6-inch and 12-inch lenses) and an air survey liaison section was located at the H.Q. of the photo reconnaissance unit.

In anticipation of bad photographic weather between April and November an intensive programme of 1/50,000 photography was undertaken, covering most of northern Burma between Myitkyina and Rangoon. To attain this, demands for current operational photography were kept at a minimum. The 1/50,000 photographs, when clear, were found to be excellent for 1-inch map revision. Though far from being a satisfactory substitute for larger scale photography for 1/25,000 mapping and block-plots, it was better than nothing and in many cases, where there was little detail in hilly country other than streams and contours, the 1/50,000 photos were enlarged for mapping purposes to the 1/25,000 scale.

Block-plots were provided for the 4 Corps battles round Imphal, and for the advance of 33 Corps from Kohima southwards. Only three sets of prints could be obtained from Dum Dum, so they were re-photographed at Army H.Q. and further prints taken off which, though of second-rate quality, were satisfactory. Although plans were drawn up for duplicate negatives to be supplied to Army and Corps H.Q.s, they did not materialize, and Dum Dum remained the source of all original prints.

Slotted template equipment was obtained in June, 1944. This enabled a mechanical method to be adopted for the radial line control of photographs instead of the graphical method (Arundel) which is so dependent on the individual skill of the draughtsman. It was used for controlling many thousands of square miles of photo-cover, but it was found unsatisfactory in the following respects:—

There was an absence of reliable trig data, and it was found difficult to adapt the mechanical process for the control of photos by unreliable points of map detail.

The cardboard templates softened in the damp climate, thus preventing the pins from sliding properly in the cut grooves.

At the end of November, 1944, when Army H.Q. moved from Comilla to Imphal, Survey H.Q. also moved there with its units, and Imphal replaced Comilla as the main map production centre for Fourteenth Army.

5 (Indian) Division and 11 (E.A.) Division advanced south during the monsoon and captured Kalemyo. Moving through the Chin Hills 5 Division used the old  $\frac{1}{2}$ -inch maps, and in addition the whole length of the road along which they moved was covered by 1/25,000 or 2-inch maps. From Tamu to within 25 miles of Kalemyo 11 (E.A.) Division had no 1/25,000 maps but used recently revised 1-inch maps.

#### The final phase (December, 1944 to May, 1945)

This included the advance into Burma, the destruction of three Japanese armies, and the capture of Mandalay and Rangoon.

During this period the main tasks of the Survey Service included:—

- (a) Compiling and printing new 1/25,000 maps.
- (b) 1-inch revision, and reprinting 1-inch map stocks.
- (c) Map distribution.
- (d) Preparation of block-plots for battle use.
- (e) Ground surveys, levelling, etc., for airfields in forward areas.

The army map production centre moved from Comilla to Imphal during the winter. With the further advances of Army H.Q. it was found necessary to move it once more and, in April, 1945, it was transferred from Imphal to Myingyan. The survey directorate accompanied Army H.Q. successively from Imphal to Indaingyi, Monywa, Meiktila, and Rangoon, and took with it one reproduction section and one air survey section.

The 1945 operations were well covered by 1/25,000 maps which were produced as under:—

- (a) *By survey units of Fourteenth Army.* A series extending, with a few breaks, from Manipur Road in Assam to Nyaunglebin (85 miles north-east of Rangoon) and Prome, where it joined the Hind 601 series.
- (b) *By Survey Production Centre for A.L.F.S.E.A.* The Hind 601 series consisting of 188 sheets which had been prepared for a possible landing in the Rangoon area.
- (c) *By Southern Army.* 12 sheets of an area near Pakkoku-Chauk.
- (d) *By U.S. Topo Battalion at Dehra Dun.* 14 sheets covering the railway south of Wuntho.

Many of the early sheets were compiled from 1/50,000 photos enlarged up to 1/25,000, but, to the south of the Irrawaddy, and to a certain extent to the north of it also, 1/25,000 photos were available in time. Apart from a break of eight miles at Imphal, another of 15 miles north of Myingyan, and a stretch along the Tiddim road, the 1/25,000 sheets prepared between April, 1944, and April, 1945, extended from Manipur Road to Rangoon, and in May this series was extended to Moulmein and beyond as far as the Siamese frontier.

Those produced by survey units of Fourteenth Army were made under high pressure, and only just kept ahead of the advancing troops. D.D. Survey considered that, with limited resources only, it was better to work on sheets closely ahead of the advance so as to avoid, as far as possible, using his mapping

strength on sheets which might never be used. In the case of Hind 601 Series of 188 sheets, which had been planned and produced by H.Q. A.L.F.S.E.A. to cover an amphibious assault and the subsequent join-up with Fourteenth Army advancing by land from the north, the Army passed through the area against slight opposition, and if this series had been planned on the spot closer to the date of the operation, the actual lines of advance would have been covered by 60 sheets only. On the other hand, by the time that it was apparent that 1/25,000 maps in the form of a road strip would be all that was required, it is doubtful whether there would have been time to initiate and complete a 1/25,000 programme covering the roads to Rangoon. On balance it is probably wiser and safer to plan well in advance, even at the cost of covering an unnecessarily wide area. This will, of course, always depend on available resources and local conditions of time and space, and no rigid rule can be followed.

To deal with late changes of plan, help was sought from H.Q. A.L.F.S.E.A., and sheets were produced by them and the U.S. Topo Battalion. There were difficulties, however, in laying on urgent work at short notice from such a distance.

Before the advance started early in 1945, the 1-inch maps of Burma north of Lat. 21° had been put into fairly good order, though some 25 sheets still remained to be finished off. A total of from 16,000 to 20,000 copies of each sheet were printed, with rather more for those sheets which had to be supplied to the N.C.A.C. To the south of Lat. 21° H.Q. A.L.F.S.E.A. had revised and printed the 1-inch maps, and sufficient stocks were generally available. There were some critical occasions, such as the unexpectedly rapid advance to Pak-koku and Meiktila where 1-inch maps were not available to cover a full 15 miles ahead of the advance.

Until 1/25,000 photographs began to come in during 1945, block-plots could not be produced. They were not available for the operations resulting in the capture of Kalemyo and Kalewa, and the advance to Ye-U and Shwebo soon got ahead of the block-plots which were being prepared from the newly obtained photos. They were, however, available for the Irrawaddy River crossings, and for all the fighting around Mandalay and Meiktila, and for most of the advance to the south.

American enthusiasm regarding the Photo Reconnaissance Force resulted in a reintroduction of photo-maps south of Mandalay. As an insurance against the possibility of not being able to prepare 1/25,000 maps they had some value but, in actual fact, they were little used.

There was some difficulty in connection with the photo-map grid, which could not be made to agree with the grid on the 1-inch and 1/25,000 maps. An arbitrary 1-inch square mesh was therefore overprinted.

There is no doubt that, for certain purposes, especially where target identification was concerned, the supply of air photos to the troops and to the R.A.F. was desirable. To facilitate the passing of reports and messages some kind of reference grid was essential. It was a matter of argument whether this should be an arbitrary one such as a 1-inch mesh, or the theatre grid transferred to the photo. Discrepancies between grid references measured from the photos and the maps of the same area were dangerous. In S.E.A.C. it was found better and quicker as a general rule to use an arbitrary mesh.

Under jungle conditions, where enemy defences were not visible from the air, little use was made of defence overprints.

During the advance, ground survey could do nothing to improve the existing maps of the battle area, and no such work was undertaken for that purpose.

Each corps had with it a small survey detachment for carrying out the surveys of airfields, and for possible co-operation with the artillery. They were almost continuously employed on the survey of light aircraft and Dakota landing strips at scales of 6 or 8 inches to the mile.

#### Matters of general interest

The table below summarizes the principal mapping work carried out in Fourteenth (Eastern) Army between December, 1942, and April, 1945:—

(a) 1/25,000 sheets surveyed from air photos	377
(b) 1-inch or $\frac{1}{2}$ -inch sheets surveyed or revised from air photos in whole or part	132
(c) Standard sheets printed on scales of 1/25,000, 1-inch, $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch	1,007
(d) Other maps printed	1,255
(e) Number of copies printed	11,509,000
(f) Number of colour impressions	46,803,000

Of the 1,007 standard maps printed, 509 were surveyed or revised from air photos. The balance of 498 sheets were either modernized without air revision or reprinted without correction.

The 1,255 other maps included R.A.F. target maps, photo-maps, town plans, large scale maps of airfields and installations, and overprints showing dispositions, communications, forest boundaries, malaria belts, etc. Plans and diagrams of a non-topographical nature are not included in the totals shown above.

In addition to the 11,509,000 copies printed with Fourteenth Army, about 2,500,000 copies of maps of Burma on 1-inch and 1/25,000 scale were received from India between February and May, 1945, and about 1,000,000 of the black and brown reprints produced by India in 1942-43 were, at one time and another, sent forward from Calcutta. The total number of printed copies produced in, or received by Fourteenth Army was thus about 15,000,000, excluding the 1/M and 1/500,000 maps prepared in India and sent forward principally for R.A.F. use.

At a rough estimate, between 7 and 10 million maps were actually issued to the troops. The remainder were either superseded by new issues or remained unused in map depots at the end of May, 1945.

Experience during operations in South East Asia indicated the necessity for the 1/M and  $\frac{1}{4}$ -inch (or 1/250,000) maps, and the desirability of the 1/500,000 and 1/25,000 scales.

There was considerable controversy, however, about the  $\frac{1}{2}$ -inch and 1-inch scale maps. The two opposing schools of thought said respectively:—

- First produce a  $\frac{1}{2}$ -inch map as the most readable overall general map. Replace by a  $\frac{1}{4}$ -inch and 1-inch and discontinue the  $\frac{1}{2}$ -inch. Then add 1/25,000 for specific battle areas.
- Give us a 1-inch (or 1/50,000) map and we can make do. If you have any resources left over, give us a 1/25,000 map where you can.

The answer to this controversy cannot be given as a general statement. The position must be judged independently for each campaign in the light

of the conditions prevailing. It is obvious that there are many factors which must be taken into consideration such as:—

The nature of the terrain and the probable character and speed of the operations.

The state of the mapping material already available.

The survey resources and time available for the work.

It seems to be common sense that, if operations are likely to take place anywhere over a wide area, certainty of map coverage on the smaller scale all over the battle area is better than patchy cover over limited areas on the larger, though possibly more suitable, scale. This is especially so when the Survey Service can produce 1/25,000 maps wherever serious fighting will take place.

In the thick jungle country of Burma it seems that the following two fairly firm conclusions were drawn:—

- (a) The  $\frac{1}{2}$ -inch scale was too small as a tactical map on which to fight a battle.
- (b) Where there was going to be a fight, the provision of a 1/25,000 map was very desirable if at all possible. If not possible, then a 1-inch map was the next best thing.

Fortunately in Burma there were 1-inch maps covering practically the entire area outside the Chin-Naga Hills, and 1/25,000 maps could be, and were, produced wherever required. In addition, the somewhat inferior  $\frac{1}{2}$ -inch map was available as an insurance against failure to print or distribute the larger scale maps. As in other theatres, D.D. Survey adopted the policy of insuring against the unexpected, and arranged his mapping policy accordingly.

The size of printing orders depended very largely on the scale of issue adopted for the theatre. This was approximately as shown below:—

$\frac{1}{2}$ -inch	1,500 for each Division (often not drawn in full).
1-inch	1,500 for each Division.
1/25,000	1,000 for each Division.

Independent brigades had about one-third of the above, and corps troops generally a little less. Divisions sometimes asked for 2,000 or 2,500. Demands for replacement of wastage were small owing to the speed of movement. It was considered that intensive operations in one limited area involving all units of a division continuously would probably have necessitated a new issue every two or three months.

Much waste occurred through divisions drawing maps of areas in which they were likely to operate according to their original orders, but to which they did not go owing to a change of plan. This was, of course, inevitable and could not be avoided.

The general rule when framing printing orders was to print such a number that, if an additional 4,000 were printed, it would be an even chance that they would never be wanted. This was based on the assumption that it involved about as much work to put the job on the machine a second time as it did to print another 4,000 in the first place. Another basis of computation was to multiply 1,500 (divisional issue for the 1-inch map) by the number of divisions which were at all likely to enter the area, then double it for spares and

wastage. In the case of the 1/25,000 scale, two-thirds of the number arrived at above was taken. In the ordinary way 4,000 was regarded as a minimum print order, and 20,000 was rarely exceeded.

The controversial subject of sheet lines arose in practically every campaign during the war and S.E.A.C. was no exception. The standard  $\frac{1}{4}$ -inch,  $\frac{1}{2}$ -inch, and 1-inch maps of Burma were on graticule sheet lines, *i.e.*, bounded by meridians and parallels and therefore not rectangular in shape. For a demy-size press this gave a limit in size of  $1^\circ$ ,  $\frac{1}{2}^\circ$ , and  $\frac{1}{4}^\circ$  respectively for the scales mentioned above.

For the 1/25,000 maps there were two possibilities:—

(a) *A graticule lay-out*, measuring 5 min.  $\times$   $7\frac{1}{2}$  min. This had the following advantages:—

- (i) A tidy lay-out.
- (ii) It afforded the possibility of a systematic nomenclature based on either the Indian or International systems. This, of course, had great advantages in regard to indexing, recording and storing.
- (iii) It led to simplification if the 1/25,000 sheets were to be compiled later into a 1-inch series. In Burma, however, the 1-inch series existed first.

(b) *A grid lay-out*, which had as advantages:—

- (i) It allowed a maximum size of sheet to be chosen which would fill the paper better than any graticule lay-out could do.
- (ii) Sheets could be staggered to fit the coast line and main communications, thus involving a minimum number of sheets.

In the case of the 1/25,000 maps produced by Fourteenth Army, a grid lay-out was adopted. The irregular lay-out enforced a type of nomenclature such as "Monya 5," where sheets were grouped into blocks of sheets, and named after a well-known and uniquely named town or other feature in the area.

Shortage of paper and the difficulties of transport made it essential to cut to a minimum the wastage of paper. One way of doing this was to ensure that the actual map detail should cover the maximum percentage of the paper area. Marginal information was cut to a minimum, and consisted principally of the sheet name, scale, and road-classification symbols. In order to reduce the tonnage which would be transported by air the Wingate Expedition insisted that their maps should be trimmed to the bare edge of the map detail, leaving only the sheet number.

#### PART 4

#### 15 CORPS

#### Final campaign in Arakan (December, 1944–May, 1945)

In December, 1944, 15 Corps was transferred from Fourteenth Army and placed under the direct command of H.Q. A.L.F.S.E.A. for operations in Arakan. Its task was to assist Fourteenth Army in the latter's advance through the centre of Burma by destroying or containing Japanese forces in the coastal area and by securing air bases on the Arakan coast from which Fourteenth Army could be supported and maintained. The operations, which originally

had a limited objective, were enlarged in scope as a result of their success, and finally took 15 Corps to Rangoon in May, 1945.

To understand the mapping problem it is well to summarize the five phases in which the operations were conducted:—

- 1st Phase.* December, 1944–January, 1945. The clearance of the Mayu Peninsula and the securing of Foul Point and Akyab by 25 Division, with 82 (W.A.) Division as east flank guard.  
The clearance of the Kaladan Valley by 81 (W.A.) Division, which was then relieved by 82 (W.A.) Division.
- 2nd Phase.* January–February. 82 Division advanced south from Kaladan, and 3 Commando Brigade and 25 Division landed at Myebon to cut the enemy line of withdrawal southwards at Kangdaw.  
The capture of Ramree and Cheduba Islands was achieved by 26 Division in an amphibious assault mounted from Chittagong.
- 3rd Phase.* February–March. 82 Division moved south, and 25 Division landed at Ruywa to carry out a pincer movement against the Japanese 54 Division.
- 4th Phase.* March–April. Operations in the Taungup Pass area, to prevent the withdrawal of the Japanese 55 Division. One brigade of 26 Division landed at Letpan from Ramree and moved on Taungup. 22 (E.A.) Brigade from Ruywa moved south in support; 82 (W.A.) Division followed later and occupied Taungup.
- 5th Phase.* May. 82 (W.A.) Division occupied Sandoway and Gwa. 26 Division captured Rangoon by amphibious assault.

The Corps Survey Directorate had under command 155 (E.A. and S.R.) Field Survey Company and 34 Map Supply Section. Each of the two West African Divisions had a Divisional Survey Section (No. 10 with 81 Division, and No. 11 with 82 Division). No reproduction unit was available at the beginning of the period. By degrees No. 68 (Ind.) Reproduction Section was formed at Cox's Bazar, and by February was in production.

Fourteenth Army had completed a considerable amount of 1/25,000 mapping in the Arakan area before December, 1944, so 15 Corps was well placed with regard to maps for the first phase of its final campaign. There was also a block of 1/25,000 mapping in the Taungup area which had been produced in India.

For all the amphibious assaults there were demands for collation maps with defence and beach information overprints or, in their absence, for 1/25,000 maps. Owing to the rapid advance, these map demands were beyond the capacity of 15 Corps Survey with its own resources. Much of the work was therefore done by A.L.F.S.E.A. survey units in Ceylon or at Bangalore, the maps being sent forward by air. Until 68 Reproduction Section was created and fully working, printing work was sent either to Fourteenth Army presses at Comilla, until they moved to Imphal, or to Advanced H.Q. A.L.F.S.E.A. at Calcutta.

Collation maps were prepared for the Akyab and Rangoon landings. The planners were located at Cox's Bazar, and it would have been desirable to have set up a complete team capable of publishing these collation maps locally, but this was not possible. The intelligence information was therefore prepared at Main H.Q. A.L.F.S.E.A. in Ceylon, where the printing also was carried out.

The following is a short summary of the mapping work completed for the final Arakan operations:—

By Fourteenth Army	1-inch new sheets	4
	1-inch revised sheets	11
	1/25,000 new sheets	59
By 155 Field Survey Company	1/25,000 new sheets	36
	1/25,000 revised sheets	1
By 10 and 11 (W.A.) Divisional Sections	1/25,000 new sheets	17
By A.L.F.S.E.A. units:—		
Arakan area	1/25,000 new sheets	97
	1-inch new sheets	2
	1-inch revised sheets	48
	Collation maps	5
	Beach maps	4
Rangoon area	1/25,000 new sheets	43
	1-inch revised sheets	37
	Collation maps	13

During 1944, block-plots were extensively used. 23 were produced for the final Arakan operations, 15 of them by Fourteenth Army and eight by 155 Company. As a rule, ten sets of photographs were provided with each block-plot, all of which were base-lined by hand. Sets of base-lined photos were also provided for the Hind 601 maps on 1/25,000 scale, the sheets of which had the principal points of the photos plotted on them.

## SECTION 4. AIR PHOTOGRAPHY FOR MAPPING AND REVISION

### Introduction

The development of air survey photography in the South East Asia campaign followed the familiar pattern experienced elsewhere. At the beginning there was an almost complete absence of any resources whatever for the work. Then came a period of makeshift, using various types of aircraft, cameras and other equipment which, though unsuitable for the work, had to be used, these being all that were available. Finally, towards the end of the campaign, the provision of suitable aircraft and cameras enabled the survey photographic programmes to be planned and carried out on a proper basis.

The urgent need for survey photography was plain to see, not only for the production of new maps, especially on a large scale where they did not already exist, but also for the revision of already published maps which were out of date. The eventual provision of the necessary resources was the result of continuous and urgent representation by the Survey Service backed by the Headquarters of the Command.

### Weather

The incidence of the annual south-west monsoon meant that little or no photography was possible from April to October each year. Over most of the area, the flying season extended from November to March. The period between April and October afforded opportunity for planning, and for the



build-up of photographic resources which would operate during the following six months.

To allow time for the production of maps of a large area from the photographs, it was necessary that the area of probable operations should be photographed during the preceding fine weather. Survey planning had, therefore, to take account of this fact.

#### **Survey photography before April, 1943**

During this early period there were no aircraft or cameras available to the R.A.F. which could produce photographs suitable for simple, straightforward methods of map making. The Survey of India then took over the resources of the Indian Air Survey and Transport Ltd. on a charter basis. As they were equipped with Moth aircraft they were not suitable for photographic missions in operational areas. The company had, however, carried out some vertical photography in Burma before 1942, and this cover was extensive and very useful for mapping purposes. Under the charter arrangements they undertook some new photography in Bengal as an insurance against a further Japanese advance, and also in other parts of India where it was required for various purposes.

Maps of the Andaman Islands were available for a limited area only around Port Blair. The R.A.F. accepted the commitment of covering the islands, and used B.25 aircraft fitted with old-pattern cameras which were normally used for intelligence photography.

The resulting photographs, which did not conform to proper survey specification, added many complications, extra effort, and time to the subsequent operations of map production, but it did enable a series of maps at 2 inches to 1 mile to be published during 1943 covering most of the islands.

For operations in Arakan the Eastern Army was able to obtain from the R.A.F. photographs of a similar intelligence type covering parts of the Arakan area which, combined with the photo cover which had been obtained from the I.A.S. and T. Company, enabled some maps on 1/25,000 scale to be produced.

Units of the U.S. Army Air Force, using K-17, 6-inch Fairchild cameras, took a block of photos in northern Burma which, though of poor quality, enabled some map revision to be carried out in an area through which the Ledo Road was to be constructed.

#### **Equipment considerations during the period April–November, 1943**

The development of operations, and a consideration of future mapping requirements, made it perfectly clear that, unless modern-type aircraft and cameras of suitable design were made available in sufficient numbers by November, 1943, the survey programme would be very seriously prejudiced.

The U.S. Army Air Force was asked to provide a mapping squadron, and No. 24 Combat Mapping Squadron was allotted to the China–Burma Theatre. This arrived in May, 1944, and was equipped with B.24 aircraft and Fairchild cameras. These B.24s were, however, very vulnerable to enemy fighters, and could not operate in areas where enemy air opposition was expected.

The R.A.F. made several applications to the Air Ministry for the supply of K-17, 6-inch Fairchild cameras, which were of suitable type for survey photography, but were told that none were available. The Survey Service therefore took up the case with the Director of Military Survey at the War Office, with

the result that the latter was able to obtain the release of six K-17s and some K-8, 24-inch cameras for the Far East.

With regard to aircraft, six Mosquitoes had arrived, or were on their way out to the theatre by November, 1943.

#### **Period from November, 1943 to May, 1944**

During this period S.E.A.C. and 11 Army Group were both formed, and the control of all air survey photography was taken over from India by 11 Army Group until the formation of the Survey Division at H.Q. S.A.C.S.E.A. in February, 1944. After that date S.A.C.S.E.A. assumed control of forward planning. The period will be considered below in two phases, the first extending from November, 1943, to February, 1944, and the second from February to May, 1944.

*1st Phase.*—In October, 1943, a request had been submitted by India to the Chiefs of Staff for the provision of a Survey Flight. The Air Ministry reply was to the effect that as all reinforcing aircraft (Mosquito XVI) were fitted to take survey cameras, and the crews were trained for survey as well as for intelligence photography, a special Survey Flight was not considered necessary.

In December it was arranged that all demands for photography, including those for Survey, should go through a photographic reconnaissance (P.R.) priorities committee. As it was considered that in largely unknown areas, small scale photographic cover was often the prerequisite for defining further tasks, and that such cover fulfilled a Survey requirement, it was agreed that all demands for intelligence photography should be notified to Survey and, if they involved such tasks as the reconnaissance of an important topographical feature such as a road, the photography would be planned by Survey. This had the effect of reducing the number of sorties, and provided a more comprehensive picture. It was also arranged that aircraft should operate survey cameras when engaged on intelligence missions. Thus, on the weekly intelligence sorties to Bangkok for large scale photography of the port, the aircraft was routed each time on a new course and, by exposing a survey camera on the journey, the basic cover was considerably extended to everyone's advantage.

In January, 1944, when survey photography of the southern areas was under consideration, D.D. Survey submitted that the Cocos Islands would provide the most suitable base from which photographic aircraft could operate for covering those areas. As will be seen later, an airfield was subsequently constructed there.

Planning for future operations in areas which were at that time inaccessible for air photography resulted in a request being sent to the Chiefs of Staff for the allocation of long-range aircraft. The Air Ministry replied that they were hoping to obtain a limited number of American aircraft of suitable type, of which production was beginning, and recommended an investigation into the possible use of carrier-borne photo-reconnaissance aircraft.

*2nd Phase.*—During this period 11 Army Group took action to intensify air photographic demands and their execution, and 147,000 square miles were covered in Burma during the flying season.

The Survey Division at S.A.C.S.E.A., in execution of its responsibilities for future planning, took action regarding the following important items:—

- (a) Expansion of the existing P.R. Force and facilities for the provision of survey photographs.
- (b) The provision of extra-long-range aircraft.
- (c) The employment of the Fleet Air Arm.
- (d) The development of new techniques.

The Air Ministry agreed to increase the number of Mosquitoes in the P.R. Force, and to provide a further squadron as soon as operations against Germany should terminate. The resulting numbers would provide sufficient aircraft to meet all requirements within their operational range but, even if Burma should be recaptured during the dry season in 1944–45, there would still be large areas which could not be reached till 1945–46 unless special means were taken. A ground survey was carried out in the Cocos Islands to ascertain the possibilities of constructing an airfield there.

With the lack of long-range aircraft the employment of the Fleet Air Arm, based on aircraft carriers, offered possibilities of development. In February, the C.-in-C. Eastern Fleet was invited to make an urgent investigation into the methods by which a photographic reconnaissance of Sumatra could be obtained. Two Mosquitoes were sent to Ceylon for trials, but it was found impracticable to use them off carriers. Difficulty was found in modifying Corsair aircraft for the work and, when it was understood from a U.S. liaison officer that the Americans were using specially designed Corsairs for photographic work, the Chiefs of Staff were requested to allocate six such aircraft. They supported the request, but it was then ascertained that the U.S. Navy was using Hellcats, not Corsairs. Six of them were available, and the Admiralty accepted the offer and arranged for them to be formed into a new unit which would be raised and trained in the United Kingdom.

Owing to the paucity of ground control, it was realized that air survey in areas outside Burma would become increasingly difficult. There was an urgent need for some means of controlling air surveys without having access to the ground. It was known that experiments had been conducted in the United Kingdom regarding the use of radar for determining the position of an aircraft on a survey flight at a given instant. The Chiefs of Staff were asked to press for further research in this important subject, and the first radar-controlled unit (Mosquitoes) was ready to proceed from the United Kingdom to the Far East when the atom bombs were dropped on Japan. (For further details see Chapter XIV, Section 6.)

#### **Period from May to November, 1944**

Weather conditions during the period grounded the Mosquitoes of 684 Squadron R.A.F. No. 11 (Ind.) Air Survey Liaison Section, which worked with them, took the opportunity of tidying up its work of the preceding six months, and getting ready for the next season's photographic programme.

The principal development of this period was the raising and training of the Fleet Air Arm (F.A.A.) Squadron. It was found that Hellcats could be adapted to take a K-17, 6-inch and one other camera, whereas a Corsair could only take an F-24 camera. Work on Corsairs was therefore abandoned. The

six Hellcats promised by the U.S. Navy were despatched to the United Kingdom at the end of July.

In accordance with the existing policy of survey liaison with the R.A.F., No. 12 (Ind.) Air Survey Liaison Section was formed in July, and worked with the Fleet Air Arm during their period of training with the converted Hellcats. The first operational photography was undertaken at the end of August and covered some of the islands lying to the west of Sumatra. The work was planned by Survey, and 2,200 square miles were covered by photography. This operation formed a very successful debut to the photographic work of the Fleet Air Arm.

During September, 1,300 square miles were covered by vertical photography in Sumatra and in October, in spite of bad weather, 660 square miles of cover over the Nicobar Islands were photographed.

In October, No. 880 Squadron of six Hellcats, which had been raised in the United Kingdom, arrived in the theatre, and this brought to an end the period of dependence on locally adapted aircraft. The latter had, however, produced over 4,000 square miles of vertical cover, and had provided experience of fleet-operated photographic reconnaissance which was to prove of such great value in subsequent stages of the campaign.

During this period, a certain number of Liberators and two Mosquitoes, based on Ceylon, operated over northern Sumatra. They were equipped with Fairchild cameras, and the briefing for the work was given by No. 12 (Ind.) Air Survey Liaison Section. By this means over 4,000 square miles of vertical cover was obtained.

#### **Period from November, 1944, to June, 1945**

From November to the end of February A.L.F.S.E.A. controlled the survey photographic activities of the R.A.F. operating from Bengal. The work of the Fleet Air Arm, was, however, more of an inter-service nature, and the Survey Division (S.A.C.S.E.A.) retained a watching brief over their work and also that of 12 (Ind.) Air Survey Liaison Section, though the latter nominally remained under A.L.F.S.E.A.

There was, however, a radical change in the functions of the various survey staffs in March, 1945, and from then onwards the Survey Division (S.A.C.S.E.A.) took over complete control of all air survey photography.

The work of the period under review will therefore be considered in two phases, as represented by the above conditions.

##### *(a) From 1st November, 1944, to 28th February, 1945.*

In November there was an urgent need for basic cover in the Hastings Harbour-Victoria Point area. This work could only be undertaken by Mosquitoes but, owing to technical troubles, only six out of the 18 Mosquitoes available were fit for operations.

During November and December they were concentrated on the first priority task in the Victoria Point area which involved over 50,000 miles of flying. In order to help out the Mosquitoes, XX Bomber Command (U.S.A.A.F.), who were not then under S.A.C.S.E.A. control, agreed to take part in the work and, during their training flights, completed the task, thus releasing the Mosquitoes for urgent work elsewhere.

By December, owing to the falling off of enemy air opposition, it was possible to employ a greater amount of photographic resources of all kinds. These consisted of:—

- R.A.F. One squadron of Mosquitoes.
- U.S.A.A.F. One combat mapping squadron (B.24s).  
Two photo-reconnaissance squadrons (P.38s).

The above were deployed according to the range and suitability of the tasks.

Survey demands for photographs were of two kinds:—

- Small scale (1/60,000) for areas as yet unmapped.
- Medium scale (1/30,000) for more limited areas where 1/25,000 maps were required.

During this period of four months the area photographed by ground-based aircraft was as under:—

	<i>Small scale</i> (Square miles)	<i>Medium scale</i> (Square miles)
R.A.F.	74,133	51,650
U.S.A.A.F.	81,650	10,640

During February, 1945, there was a unification of command of all U.S.A.A.F. and R.A.F. P.R. Forces in the theatre under a central P.R. Force H.Q. This was under the control of the Director of Intelligence at H.Q. S.A.C.S.E.A., and the allocation of work was made by a P.R. Board consisting of representatives of each service, with the Director of Intelligence as chairman. All survey demands were submitted to the Board by the Survey Division (S.A.C.S.E.A.). The Board was also responsible for co-ordinating the work of the Fleet Air Arm and other agencies.

(b) *From 1st March, 1945, to August, 1945.*

During this period all matters relating to photography for survey purposes were under the control of the Survey Division (S.A.C.S.E.A.). This simplification of staff control and the build-up of resources which had taken place during the preceding periods made this final phase the most successful photographic period of the campaign.

During May the new Mosquitoes (Type XXXIV) began to arrive, and a detachment was based on the Cocos Islands, where an airfield had been constructed. Even though the normal photographic season had shut down in April owing to the monsoon, activities could be continued beyond that date by using the Fleet Air Arm and the Cocos detachment. Coverage was obtained of South Malaya, South Sumatra and Java.

The U.S.A.A.F. undertook tri-metrogon photography of an area of 170,000 square miles in northern Thailand (Siam) which facilitated the production of navigational sketch maps. These were used both for actual flying and for plotting the vertical cover of the area which was planned for the next season's work.

The allocation of XX Bomber Command to S.E.A.C. also allowed small scale vertical cover to be obtained of Singapore, the Penang area,

and some of the Port Dickson–Port Swettenham area, which was well outside the range of the Mosquitoes.

From March to August, 1945, the area covered with vertical photography by the R.A.F. and U.S.A.A.F. was:—

	<i>Small scale (Square miles)</i>	<i>Medium scale (Square miles)</i>
R.A.F.	145,890	28,850
U.S.A.A.F.	44,360	72,740

The Eastern Fleet was successful in obtaining cover of the following vital areas, special Fleet sorties being planned for each operation:—

*Operation “Stacey” in March.* This took place in the Phuket and Kra Isthmus area, which was outside the range of Mosquitoes XVI. Vertical coverage over 30,000 square miles was obtained, and a detachment of No. 12 (Ind.) Air Survey Liaison Section assisted in the planning, and accompanied the Fleet for briefing and controlling the photography.

*Operation “Sunfish” in April.* The object of this was to obtain small scale cover and beach photography of the “Zipper” assault area. The Fleet was concentrated to the west of Sumatra, and the aircraft flew across Sumatra to Malaya. They obtained 5,500 square miles of much-needed vertical cover along the coast of Malaya.

*Operation “Balsam” in June.* As the force scheduled to take part in the “Zipper” assault operation had no large scale photo cover of the assault area for 1/25,000 map production, fleet operation “Balsam” was staged. The fleet entered the Malacca Straits and 2,900 square miles of 1/30,000 photo cover was obtained. Approximately 100 miles of beach were photographed between Port Swettenham and Singapore. To cover the beaches two of the Hellcats were equipped with split F-52 cameras with 20-inch lenses.

#### Summary of photographic cover

The total area covered by photography for survey purposes on all scales by the Allied Air Forces is summarized below:—

Fleet Air Arm	46,100 sq. miles
R.A.F.	290,523 sq. miles
U.S.A.A.F.	209,390 sq. miles
Total	<hr/> 546,013 sq. miles <hr/>

This total area is equivalent roughly to that of the whole of pre-war France, Belgium, Holland, Germany, Italy, Switzerland, Austria, and half of Czecho-Slovakia. Taking into consideration the number of aircraft available in the theatre, the delays experienced in building up resources, and the bad weather conditions during many months of the year, this was a remarkable achievement.

## SECTION 5. TRIANGULATION AND FIELD SURVEYS

### Introduction

The need for ground surveys of various sorts arose during the Burma campaign as in other theatres. The thick, jungle-covered terrain considerably restricted the use of triangulation methods, and in most parts of the battle zone very little triangulation was carried out. There were demands for surveys of airfield sites, base installations, roads, anti-aircraft and coast defence batteries, and so forth. There was also a need for topographical surveys in connection with the preparation of new maps and the revision of existing ones.

Provision was made, as in other theatres, for co-operation between R.A. and R.E. surveyors in connection with the establishment of control for artillery shooting, but here again a combination of factors, chiefly connected with the difficult type of terrain, resulted in very limited need or demand for such co-operation.

### Surveys of airfields, triangulation, etc.

In March, 1942, urgent demands arose for the survey of airfields and base installations in Assam. The first and most urgent job was a location survey for the base at Ledo, which was to be the railhead and stores depot for the new China Road. There was also the base at Manipur Road. Both the above continued intermittently for about two years, more and more survey work being required as they developed.

Surveys for new airfields were undertaken at several sites in Assam. All this work was attended with many difficulties such as thick jungle, rainy weather, leeches, breakdown of transportation, and other adverse factors which affected progress. A number of new roads were surveyed for inclusion in revised editions of 1-inch,  $\frac{1}{2}$ -inch, and  $\frac{1}{4}$ -inch maps.

During 1943, 6 (Ind.) Field Survey Company with 4 Corps in Manipur carried out many medium and large scale surveys of important localities, notably 2 inches to 1 mile surveys of strips two to four miles wide along the Palel-Tamu and Imphal-Tiddim roads. These proved to be very useful later during the fighting of 1943. Some triangulation was observed round the Imphal Plain and between Imphal and Tamu which, in the absence of any existing 1-inch surveys, proved most useful as control for 1/25,000 mapping and block-plots. Other ground surveys were carried out for administrative purposes.

Surveys of airfields in Bengal and Assam continued during 1943, the largest being a 16-inch survey of the big airfields at Chittagong, Comilla, Dacca and Aggartala, a 12-inch survey of the Manipur Road Base, and much work around Ledo.

In Arakan, during the fighting in early 1944, a section of 155 (E.A. and S.R.) Field Survey Company observed a triangulation south of the Maungdaw-Buthidaung road and a 4 inches to 1 mile survey of the Maungdaw Port area was completed.

In the spring of 1944, surveys were carried out under A.D. Survey, 4 Corps in the Kohima-Imphal area for the preparation of operational maps required by the corps.

In December, 1944, 15 Corps began its final campaign in Arakan which ended in the capture of Rangoon. Trig and topographical surveys were carried out by two sections of 155 Field Survey Company. At the close of the

dry season in May, 1944, triangulation had been completed in the forward area with some intersected points further south and, with the advance of 15 Corps down the coast, the trig section was called upon to provide points for R.A. Surveyors. At any stage of the advance trig control, which was "tied in" to the Burma coast series, could have been supplied either in the Mayu Valley or along the coast. Fixes were provided for the R.A. before the assault on Akyab. After the landing at Myebon and the clearance of the enemy from the Minbya area, the section re-established its trig control there and also among the islands to the south and east of Akyab as far as the southern end of Ramree Island. No points were fixed on the mainland south of Myebon. In addition to the triangulation, surveys of some anti-aircraft sites were completed.

The topographical section of 155 Field Survey Company did some levelling for airfield sites, and also carried out ground surveys for some large scale town plans such as that of Akyab.

Meanwhile, during the final advance through Burma leading up to the capture of Mandalay and Rangoon, each corps with Fourteenth Army was provided with a survey detachment of one officer, a computer, and a few surveyors for the survey of airfields, and for possible co-operation with R.A. surveyors if so required. These small parties were found to be very useful, and were almost continuously employed on survey work at 6-inch or 8-inch scale for light aircraft and Dakota strips.

#### **Co-operation between R.A. and R.E. surveyors**

During the advance on Maungdaw early in 1944, R.A. surveyors were being employed for the first time and they carried out a certain amount of triangulation based on two primary stations which were available. Two R.E. surveyors worked in association with them at this period but the topographical and other conditions were such that R.A./R.E. survey co-operation of the orthodox kind, such as was practised in other theatres, did not appear to be profitable.

In the Manipur area during the early part of 1944, a section of 155 Field Survey Company was attached to 33 Corps during April and May to assist R.A. survey along the road from Manipur to Imphal, but they had little opportunity of doing any useful work and, as a result, it was decided to withdraw R.E. survey resources from this type of employment unless specifically asked for. During the final advance through Burma, small survey detachments accompanied each corps as stated above, but there was no call for assistance from R.A. surveyors. In Arakan on the other hand, at the specific request of 15 Corps there was a certain amount of co-operative survey work between R.A. and R.E. surveyors during the final campaign along the coastal belt.

#### **Divisional and brigade survey sections**

In poorly mapped country, such as in East Africa during the advance from Kenya into Abyssinia, the attachment of survey sections to brigade columns had proved of real value. They were able to guide the columns by locating position and direction by astronomical and other methods when no proper maps were available and, in anticipation of a battle, they were able on the spot to provide valuable sketch maps from air photos, plane-table sketches, and hasty triangulation.

In Burma, however, the position was different. The country was by no



means unmapped, and the preparation of hasty sketch maps in the field from ground survey or air photos could obviously have no advantage over maps properly prepared in the rear.

The only examples of the use of brigade and divisional survey sections in South East Asia were those of the two West African divisions in Arakan. The sections were a relic of the East African campaign where they had been so successful that, when these divisions proceeded to Burma, their commanders would not do without them. Their employment in Burma was against the considered judgment of the Director of Military Survey (War Office) who was categorically opposed to their use in that theatre. In the event it was not long before the divisional commanders themselves recommended that these sections should be abolished. The man-power released was then used for mapping work in the rear, where the demand for such work was very great.

## SECTION 6. MAP SUPPLY AND DISTRIBUTION

### Introduction

The operations in South East Asia, beginning with the first retirement from Burma early in 1942 and ending with the Japanese surrender in August, 1945, presented many problems in map distribution. Though many of these were common to all theatres, some of them were probably peculiar to the conditions under which the operations against the Japanese were conducted.

As has been stated elsewhere, all military survey activities in India were controlled directly by the Survey of India until about March, 1942, when a Director of Survey was appointed to G.H.Q. India, and a D.D. Survey, with a small directorate, was assigned for duty with the Eastern and Southern Armies.

At that period, when the British force was withdrawing from Burma into India, and there seemed to be a possibility of the Japanese invading India itself, the map stock situation was bad. The normal peace-time printing of any one sheet of India or Burma was about 500 only. Additional stocks of Burma and the Shan States had been printed and sent to Rangoon in 1940-41, but these were lost during the retreat. The Survey of India then undertook the printing of stocks of maps of northern Burma to try and keep pace with the withdrawal, and these were flown in, and were either used, destroyed or abandoned.

It is fair comment to state that in India, as elsewhere generally, the important task of map distribution had received little thought before the war, and all the machinery for carrying it out had to be built up as operations developed. Fortunately, there was available by 1942 a considerable amount of valuable experience on the subject of map distribution which had been gained in other operational theatres.

### Early formation of map depots in India

Map depots for operational purposes were set up as under:—

At Ranchi. This was the main depot for the Eastern Army with a holding capacity of 4,000,000 maps.

At Barrackpore. A small depot with a capacity of 500,000 maps. This served 15 Corps whose H.Q. was located there.

At Bangalore. Capacity 1,500,000 maps.

At Poona. A small depot.

As maps were printed by the Survey of India they were sent by rail to Ranchi or Bangalore where they were stored, or issued to divisions and the R.A.F. Distribution to formations was by rail, or by the formations' own vehicles, or by liaison officers from Army to headquarters of corps or divisions.

### **Operations in Burma during 1943**

The Eastern Army, which was fighting the Burma battle, was directly controlled at first from G.H.Q. (India); so also was the Southern Army, whose primary role was the defence of southern India. Maps, printed by the Survey of India, were issued by G.S.G.S. (I.) to the Armies, either from the Central Map Depot at Delhi, or direct from the printing plants.

The policy governing map distribution in the theatre was that Survey was responsible for the supply of maps down to the headquarters of formations next below that which carried a survey representative, that is to say, normally to divisions and independent brigades. For the holding of maps at divisional H.Q.s and for distribution within a division, one 3-ton lorry with one survey record keeper and one sepoy storeman were introduced into the war establishment of divisional H.Q., and these worked under the G-3 (I.) of the division.

The 1943 operations of the Eastern Army included the unsuccessful Arakan offensive, the Wingate expedition, and the fighting in the Kabaw valley and the Chin Hills. Then in November S.E.A.C. was formed, and, at the same time the Eastern Army changed its name to Fourteenth Army and its headquarters moved from Calcutta to Comilla. New map depots were opened at Imphal to hold stocks of the Manipur and Chindwin areas, and at Chittagong to hold a reserve for Arakan and to act as a local issue depot.

No. 36 Map Supply Section (M.S.S.) joined Fourteenth Army in November and opened the Comilla depot, to which all stocks of Assam, Arakan and Northern and Central Burma were brought forward.

### **Development of the map supply organization during 1944**

In March, 1944, the Survey Directorate at H.Q. 11 Army Group was established, and the Director of Survey became responsible for all survey matters affecting that formation, a responsibility hitherto held by G.S.G.S. (I.). He was also responsible to the Supreme Commander for all survey matters in the command, and a survey liaison office was set up at H.Q. S.A.C.S.E.A. During March Nos. 32 M.S.S. (Delhi) and 35 M.S.S. (Comilla) were transferred from G.S.G.S. (I.) to S.E.A.C.

In June, a new map depot unit, No. 40 Map Supply Company, was raised in order that the main S.E.A.C. depot could be moved from Delhi to Madras, and to supply a detachment to operate a depot at Kandy. This latter was intended to supply the needs of the East Indies Fleet, the headquarters at Kandy, and the Army and Air Force units in Ceylon.

The Madras depot (No. 92) became the main S.E.A.C. depot for all maps other than those of Burma. No. 91 Depot in Calcutta, which was staffed by the East African Map Supply Company, came under the direct control of 11 Army Group, and was the main S.E.A.C. depot for maps of Burma.

Comilla (35 M.S.S.) was now the main Fourteenth Army map depot, with Chittagong feeding 15 Corps, and Imphal feeding 4 Corps. To reduce the risk of the total loss of all stocks the Imphal depot had a subsidiary depot at Patel.

The Assam lines of communication were fed by a small depot at Jorhat and, for the operations leading up to the relief of Imphal, map depots were temporarily opened at Manipur Road and at 33 Corps Headquarters.

Distribution from the Calcutta depot to Comilla, and from Comilla forward was normally by passenger train in lots of about 40 sacks (50,000 maps) conducted by a sepoy courier. During the siege of Imphal use was made of air transport.

Rail transport along the Assam lines of communication, even with couriers, was always unreliable. To make things safer, the couriers were given letters to all the intermediate movement control officers, who were asked to forward all couriers without delay, and not to separate them from their maps.

At the end of November, 1944, when Fourteenth Army H.Q. moved from Comilla to Imphal, large map stocks were transferred from Comilla to Imphal, which then became the Army's main supply base.

### **Reconquest of Burma, 1945**

Between December, 1944, and May, 1945, the operations developed rapidly, becoming more mobile, and increasing the difficulties of distribution. This period covered the advance into Burma, with the capture of Mandalay and Rangoon. Fourteenth Army advanced from Kalewa down the centre of Burma; and 15 Corps carried out a series of amphibious operations along the coast to assist the advance of Fourteenth Army, and entered Rangoon in May. For this purpose 15 Corps was placed under the direct command of H.Q. A.L.F.S.E.A., the title 11 Army Group having been dropped.

Although U.S. troops of the N.C.A.C. came under the command of H.Q. A.L.F.S.E.A., it was arranged, at the Americans' request, that their map supply would remain the responsibility of the U.S. survey liaison officer for the China-India-Burma Theatre, whose H.Q. was at Delhi. This seems to have been an arrangement attended by many disadvantages, though admittedly N.C.A.C. and Fourteenth Army each had its own lines of communication, one leading back to Delhi and the other to Calcutta. During the period of rapid advances, which were co-ordinated by H.Q. A.L.F.S.E.A., it seems clear that the Survey Directorate at H.Q. A.L.F.S.E.A. was early aware of the C.-in-C.'s future intentions, whereas the U.S. liaison officer in Delhi was unlikely to be in a position to plan his map distribution with that early knowledge which was so essential. The situation was affected by the fact that total stocks of maps were insufficient to allow both Fourteenth Army and N.C.A.C. to draw full supplies covering all their possible areas of operations. Issues had to be controlled and co-ordinated in order to make available stocks go round.

At the beginning of this period the A.L.F.S.E.A. map distribution organization was untried under battle conditions. Some of the distribution staff were inexperienced in their tasks, and the main depots were not in smooth working order. All this had to be put right in a short time, and the reorganization of working methods was carried out concurrently with supply to the forward areas, the setting up of the Madras depot, and the "cleaning up" of the Calcutta depot. No major breakdown occurred, but the strain on all concerned was a heavy one. The special arrangements for Fourteenth Army and 15 Corps are described below:—

*Fourteenth Army.* All the maps likely to be required for its advance into Burma were concentrated at Imphal. Until mid-April distribution

was effected by air direct to divisions, and sometimes to brigades, through the Rear Airfield Maintenance Organization (R.A.M.O.) at Imphal. The liaison survey captains at Corps H.Q.s kept the divisions informed of what maps were available, and divisions signalled their requirements direct to the Imphal depot, and to the R.A.M.O. responsible. Maps were then flown to them, generally the following day with their mail, ammunition, rations, etc. As the Army advanced, divisions began to depend more on R.A.M.O.s in Chittagong and Akyab. Supply from Imphal would eventually have been impossible but, until 20th April, when the Myingyan map depot opened, all divisions were getting supplies of some kind by air from Imphal, and there was no difficulty in sending maps with them. For the opening of the Myingyan depot, half of the Imphal stocks were moved, early in April, by road to Kalewa, and thence by river to Myingyan, the remaining stocks being moved after the safe arrival of the first half. Supply forward from Myingyan was by road transport *via* corps H.Q.s. For the Fourteenth Army advance to Rangoon a special reserve depot, holding 1,000 copies of each map, was opened at Meiktila, under 4 Corps' control, in case supply from Imphal should break down before the Myingyan depot opened. For this move, and other similar large stock transfers, special full-load Dakota aircraft were used.

Fourteenth Army was averaging the equivalent of six divisions in the line at this time, and map consumption during this 450 mile advance from Kalewa to Rangoon, was about 120,000 maps a division for each month. Put in terms of weight, between December, 1944 and April, 1945, the tonnage of maps carried to divisions and corps troops in Fourteenth Army amounted to 88 tons by air and 32 by road.

15 Corps. During this period 15 Corps was conducting a series of amphibious operations down the coast under the direct command of H.Q. A.L.F.S.E.A. in support of the Fourteenth Army advance. In December, 15 Corps was controlling map depots at Chittagong, Cox's Bazar and Maungdaw, using 34 M.S.S. and personnel from 155 (E.A.) Survey Company. Most of the printing was being done by rear formations and sent forward by air from Ceylon, Bangalore, Madras, and Calcutta. In arranging the supply of maps by air-drops to 81 and 82 (W.A.) Divisions in the Kaladan Valley, and in mounting the amphibious assaults on Akyab, Myebon, Ramree, Cheduba Island, Ruywa, Letpan and Rangoon, 15 Corps experienced and overcame a variety of map distribution problems.

The depot at Maungdaw, which had been opened in December, was closed after the initial stages of the advance had been completed because it was found easier to supply divisions by air from Cox's Bazar. This latter, manned by a detachment of 34 M.S.S., reopened at Akyab in February, 1945. The two West African divisions (81 and 82) in the Kaladan Valley were supplied by air from Chittagong.

26 Division was mapped up in readiness for an amphibious assault on Akyab but the operation in that area went so well that the assault was changed to a "ferry trip" by units of 25 Division, while 26 Division immediately prepared for the assault on Ramree. This necessitated a quick switch of map stocks over long distances.

For the Ramree assault the maps were distributed within the concentration area at Chittagong two days before embarkation. They were coded and put into bundles of 50 at Cox's Bazar Depot, and taken by survey

transport to 26 Divisional H.Q. at Chittagong, where a survey officer supervised the distribution. To deal with any last-minute arrangements that might be necessary, he remained there until the convoy had sailed. The maps were distributed to unit commanders on shore but, to preserve security, the breaking of seals and final distribution on board ship was not effected until after the convoy had actually sailed.

The Rangoon assault entailed very widely scattered arrangements under high security conditions. The mounting ports were:—

- (a) Kyaukpyu, for the main force, where a detachment of 34 M.S.S. from Akyab carried out the distribution. As the ships were widely dispersed in the anchorage, and the units were to be split up among many ships, the maps were distributed to units on shore within a sealed perimeter, before embarkation.
- (b) Akyab, for the R.A.F. and airborne troops.
- (c) Chittagong and Calcutta, for the follow-up troops. The advanced Survey Directorate A.L.F.S.E.A. was responsible, under 15 Corps orders, for the mapping up at Calcutta, and 15 Corps at the other ports. A small depot detachment was sent with the headquarters of the assault force in order to open up a beach-head depot to supply maps for the initial exploitation.

All the maps for Fourteenth Army and 15 Corps printed by base units and rear organizations passed through 91 Depot at Calcutta. Between three and four million maps a month were handled by the depot, a peak of 5,000,000 being recorded in April. Originally staffed by 158 (E.A.) M.S.S., it was reinforced in January by a detachment of 40 Map Supply Company from Madras. After the fall of Rangoon, the East African M.S.S. went to Ceylon to operate 92 Map Depot, the detachment of 40 Map Supply Company returned to Madras, and 91 Depot was then operated by 35 M.S.S. which moved from Comilla.

### Final Phase

The map supply and distribution situation during the final stages of the campaign is described briefly below:—

Immediately before the Japanese surrender in August, 1945, Twelfth Army (recently formed) was operating in Burma, and Fourteenth Army was mounting operation "Zipper" for the invasion of Malaya. Map distribution activities were at their peak of activity. The map supply units comprised the following:—

40 Map Supply Company (A.L.F.S.E.A.)	Madras.
31 Map Supply Section (A.L.F.S.E.A.)	Calcutta.
35 Map Supply Section (A.L.F.S.E.A.)	Comilla.
33 Map Supply Section (Twelfth Army)	Burma.
36 Map Supply Section (Twelfth Army)	Burma.
34 Map Supply Section (Fourteenth Army)	"Zipper."
37 Map Supply Section (Fourteenth Army)	"Zipper."

In addition, the following special units were formed for map supply duties:—

A detachment of the Survey Production Centre at Kandy for running a map depot at that place.

Port depots at Cochin, Bombay, Madras, Vizagpatam, Calcutta, and Chittagong.

The main A.L.F.S.E.A. depots were No. 90 at Madras, and No. 91 at Calcutta. From these two the Army and Port depots were supplied, except in the case of very urgent deliveries which were made direct from the Survey Production Centre at Kandy, or from the main Indian printing plants under G.S.G.S. (I) through their Central Map Depot at Delhi.

With the capture of Rangoon, the increasing interest in Malaya and the Netherlands East Indies, and the move of A.L.F.S.E.A. to Ceylon from Calcutta, 91 Depot gradually diminished in importance. It was intended, however, that air maps for H.Q. R.A.F. Burma, and maps of Burma for the ground forces, would have remained there, all other series being concentrated at 90 Depot in Madras.

At Comilla were the remains of the depot left there by Fourteenth Army when it moved to Imphal. It performed three main functions:—

- (a) It was an interim depository for all map stocks and survey stores returned from scattered points in northern Burma, until 91 Depot (Calcutta) could accept them.
- (b) It was the map depot for the L. of C.
- (c) It provided a detachment and supervised the working of the port depot at Chittagong.

92 Depot at Kandy supplied H.Q. S.A.C.S.E.A., East Indies Fleet, H.Q. A.L.F.S.E.A. and Ceylon Army Command.

For operation "Zipper," the coding of maps was done by 40 Map Supply Company at Madras, work being started in mid-June and continuing till 5th August without a break, working two 12-hour shifts, and averaging over 100,000 maps coded each day.

The port depots were opened in July and placed under the direct technical control of D.D. Survey Fourteenth Army. Their task was to break down the bulk coded stocks received from the main depots or printing units into ship or unit consignments for the launching of operation "Zipper." Their task was completed in September.