NAMES OF FEATURES AND ABBREVIATIONS USED IN THIS BOOK

This list gives the alternative or obsolete names for those used.

Mountains

Mt. Jaya — Mt. Jayakusumu, Mt. Carstensz, Carstensz Toppen, Pk. Sukarno
Ngga Pulu — Ngga Poloe, Pk. Jaya,* Pk. Sukarno
Unnamed peak 500 m west of Ngga Pulu — Sunday Peak, Pk. Jaya,* Pk. Sumantri
Carstensz Pyramid — Carstenz Pyramida (Indonesian spelling; the highest point retains this name)
Midden Ridge — Celah-tengah
Northwall — Noordwand, North Wall
Sudirman Ra. — Nassau Ra., Western Snow Mts.
Merauke Ra. — Snow Mts., Central Ranges; mis-spelt in some atlases as "Maoke Ra"
Mt. Mandala — Mt. Juliana
Mt. Trikora — Mt. Wilhelmina
Mt. Idenburg — Ngga Pilimsit, Gn. Enngea

Pk., Puncak = Peak or Mountain; Gn., Gunung = Mt., Mountain

Fluvial

L. Larson — D. Lyrasetio
L. Discovery — D. Athaboe
L. Dugundugu — D. Wiseku
L. Biru — Blauwemeer
L. Hijau — Groenmeer
D., Danau = L., Lake; Dataran = level area, Plain; Lembah = Valley;
CGE = Carstensz Glaciers Expedition

A list of current and former names used for the language groups living around Mt. Jaya is given in Chapter 11.

* The name Mt. Jaya in this book is not used for any distinct peak but exclusively for the entire masif.

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MT. JAYA: THE AREA AND ITS EXPLORATION

1.1 DESCRIPTION OF THE MT. JAYA AREA

The Merauke Range forms the western half of the great cordillera which runs for 2,000 km along the centre of the island of New Guinea. Except where it is cut by the gorge of the Baliem River, this complex of ranges provides a barrier between the north and south with crests in the divide continuously above 3,000 m, and rising above 4,500 m at several points. Three peaks, Mt. Mandala (Juliana), Mt. Idenburg and Mt. Jaya (Carstensz) are capped by snowfields, and the legacy of far greater ice cover in the past is shown by steep-walled valleys, cirques, splintered crags and long moraine ridges.

The cordillera is asymmetrical, rising abruptly 3,000-4,000 m to the crest of the main divide from the broad lowland swamp plain on the south, and then falling more gradually via series of lower ranges to the great inland basin of the Mamberamo and its tributaries on the north. The southern face is formed by a maze of steep ridges which are cut by deep gorges created by powerful torrents. The dense forest that clings to the slopes is slashed by countless landslide scars and cliffs formed by steeply dipping sedimentary rocks.

The range crest is marked by towering grey cliffs and rolling plateaux of sandstone and limestone. Dun-coloured grasslands dotted with low shrubs form a monotonous cover, broken by patches of low mossy forest or groves of tree ferns. Blind valleys, sink holes and isolated towers of limestone are common. Tall mountain forest covers vast areas on the northern slopes which consist of east-west trending minor ranges and valleys with occasional gaps through which rivers break out to the north.

The warm, humid air that rises from the swampy lowlands brings cloud and daily rain to the mountains. The early mornings may be crisp and clear, but by mid-morning the first wisps of cloud float up and coalesce until a dense cold mist or drizzling low cloud is present. The high areas are uninhabited and in fact not commonly visited by the local people. The population lives mainly in isolated intermontane valleys on the northern slopes, and south of the range there are only a few scattered garden areas for the very small population.

Mt. Jaya lies towards the west of the cordillera at 4^0 05'S, 137^0 10'E, (inset Map 2) near the western end of the Sudirman Range (Nassau Ra) which is the name given to the main divide between the Baliem River gorge on the east and the Paniai Lake region on the west. At 4,884 m, it is the highest mountain in New Guinea, or indeed in the South-East Asian and western Pacific regions.

It is part of a huge block of Miocene limestone astride the range crest, with cliffs over 1,000 m high to the east, south, and north (Fig. 1.1). The block extends only about 5 km north-south but some 30 km towards the west, sloping down gradually to the general level of the range crest. The present ice caps and glaciers, totalling about 7 km^2, are located at the eastern end. The block is a gently folded syncline, buckled in the centre by two sharp, small anticlines. The outer margins of the syncline form the crest of the highest peaks, while one of the anticlines splits the central basin into two west-facing valleys, the Yellow and Meren Valleys. This anticline rises to the east to form the east Carstensz top, while the other anticline forms a dished feature with the northern syncline edge to create a high plateau-like area above 4,400 m, known as the Northwall. A gorge 150 m wide cutting through from the Meren Valley to the northern cliff face is known as New Zealand Pass and provides access to the glaciers and central valleys from the north.

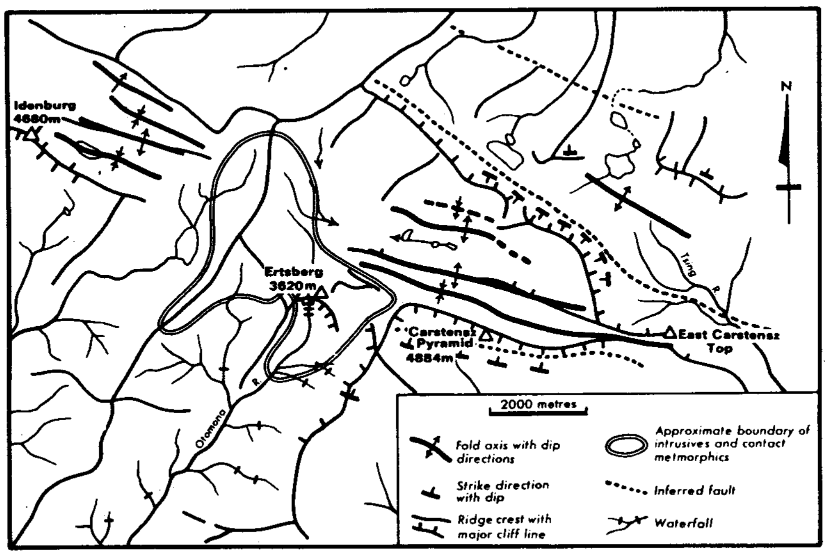

Figure 1.1 Geological sketch map of the Mt. Jaya area (includes information from Dozy (1939) and Dow (1968))

Ice action has cut into the centres of the synclinal Yellow and Meren Valleys and into the slope down to the west to create an opening into the head of the south-facing Aghawagon Valley. This deep gap in the southern cliffs forms an area of grassland, called Carstensz Meadow; it measures 2 km in length and 1 km across and is surrounded by cliffs except for a narrow exit to the south. At the breach in the southern cliffs the valley opens out into a cirque-like hollow nearly 2,000 m deep, with a floor at 2,400 m, a craggy bench at 3,680 m. and the south wall of the mountain block rising to 4,500 m. Also at the outflow of this Carstensz Meadow is the 200 m high Ertsberg, a high-grade copper ore body, probably emplaced with a large granitic intrusion into the limestone which forms the 4,300 m Grasberg, a ridge on the west of the Carstensz Meadow. The granite is shattering into gravel, and a large fan spills from the Grasberg onto the western side of the Carstensz Meadow.

To the west of the Grasberg the pattern of synclinal west-draining valleys continues, intersected by a few deep, south-flowing river courses. About 8 km from the eastern snowfields the southern wall again rises to form the Idenburg Pk. (4,717 m) which retains a small ice-cap glacier. The main snowfields are made up of five separate areas of ice on the horseshoe-like outer margin of Mt. Jaya. They are shown in photos 3.1-3.10 and Map 2 — two on the Northwall west of New Zealand Pass, the two main firn fields feeding the Meren and Carstensz Glaciers, and a small hanging glacier on the southern face of the Carstensz Pyramid.

The glacier snouts reach down into the valleys which they have only recently abandoned. Heaps of crushed and broken rock alternate with clear turquoise pools and ice-smoothed hillocks of brown rock. In the early mornings there is almost complete silence because the meltwater streams are dry. During the day they begin to trickle and then gush, bringing silty light-grey rockflour into the meltwater lakes. There are no continuous streams because the limestone swallows up all surface water, and deep holes are common. Only scattered clumps of grass and a purple-flowered Epilobium have colonised these new moraines, but down in the valley low daisy bushes and creeping shrubs become more common. Away from the moraines a dense tussock grass and low shrubs grow on intensely weathered limestone, with treacherous gaps called grikes and needle-sharp flutings which make safe progress very slow. If the present glaciers do not advance once more the smooth moraine areas will gradually become eroded and vegetated, like those that escaped recent glaciation. The latter areas have been exposed for about 10,000 years, since the retreat of the large glaciers of the last ice age.

Whereas to the south the Carstensz Mountains descend into the dense forest and tangle of foothills, from the foot of the Northwall the rolling Kemabu Plateau extends north for 25 km at altitudes from 3,400 to 3,800 m. Ridges of glacial debris up to 200 m high push out into the plateau for about 8 km and carry a low forest of conifers and prickly Coprosma bushes. The valleys are grassed and dotted with tree ferns. Small tracks left by hunting parties are common, and pairs of the Snow Mountain quail rise from the grass tussocks as one passes. Wide swamps of pineapple grass hummocks and sedges cover soft brown peats.

The Kemabu River, about 1 m deep and 12 m wide, crosses the plateau as a calm stream before descending through a limestone gorge westward to the Kemandoga Valley. The Zengill River and tributaries drain the northern and eastern edges of the plateau into the Tariku (Rouffaer)-Mamberamo system. About two days walk to the north lies Beoga, the centre for the Damal (Uhunduni) population who climb to the high plateau for hunting and trading with their relatives, the Amume-Damal on the southern flanks at Jila, Tsinga, Waa, and Atwanop.

1.2 HISTORY OF EXPLORATION

The first people known to have seen the Carstensz Mountains are the group of hunters who left traces of their fires beneath a glacial erratic 1 km north of the Northwall, more than 5,000 years ago (Chapter 11). However wandering bands of hunter-gatherers may have noted the gleaming ice cap 30,000 years ago from amongst the semi-arid woodlands of the Arafura shelf, then dry land because of lower sea levels. Jan Carstensz, sailing 40 m above the silts covering their drowned campsites, was the first westerner to see the ice. He reported on 16 February, 1623: "at a distance of about 10 miles, by estimation, into the interior we saw a very high mountain range in many places white with snow, which we thought a very singular sight, being so near the line equinoctial" (Wollaston, A.F.R. 1912). His report was disbelieved in Europe — it was after all not very long after the news of snow in the tropical Andes had first arrived, and over 250 years before the first reports on the glaciers of East Africa. It was only after the Dutch assumed control of the western half of New Guinea in 1899 that mapping expeditions in the lowlands obtained approximate positions and height estimates for the peaks of the Merauke Ra. (Snow Mts.). The glacier areas seen by Carstensz were named Carstensz Toppen.

In 1909-1911 the British Ornithological Union Expedition (BOUE) entered the southern swamps with a party of six scientists, 50 Ambonese carriers, 10 Ghurkas, 44 soldiers, and 60 convicts. They were unable to penetrate the coastal swamp forest and left after 18 months, having lost 16 dead and 120 disabled from accidents, beri-beri, and malaria (Rawling 1911, 1913; Ogilvie-Grant 1916; Wollaston, A.F.R. 1912). Van der Bie's expedition of only 88 men was similarly unsuccessful a few miles to the east.

However, a member of BOUE, Dr A.F.R. Wollaston, returned in May 1912 with C. Boden Kloss and a larger party of soldiers and Dyak porters, totalling 224 men. With only three deaths over a six-month period, Wollaston followed Van der Bie's route northward up the Utakwa Valley, the outlet for the Tsing river, and was able to spend three days above 3,000 m. He reached the ice fall to the south of the Carstensz Glacier snowfield

and named it Van der Water Glacier (Wollaston, A.F.R. 1914a, b; Wollaston, M. 1933). He and Kloss made the first scientific plant collections but were unable to assess the extent of the ice. Other open questions concerned the possible existence of higher mountains with snow in the interior, and how the apparently quite isolated mountain populations in the Tsing Valley reached their garden area. These questions were answered by continuing explorations to the north and west of Mt. Jaya which outlined the general nature of the country and showed the peaks from the north (e.g. Roux 1948-50). The existence of substantial populations in isolated valleys to the north, with well established trade routes to the west and south coasts, suggested that the southern mountain people were part of these northern groups.

The next expedition came in 1936 and was led by Dr A. H. Colijn, General Manager of a Dutch oil company operating near Sorong. In dramatic contrast to the massive and cumbersome early ventures it was completely successful in reaching the snowfields. Colijn was assisted by Dr J. J. Dozy, a young petroleum geologist, Lieutenant Wissel, who piloted the amphibious S-38 aircraft used to parachute supplies at strategic points along the proposed route, and 38 Dyak porters from Borneo.

The overland journey started at Aika, the seaplane base on the south coast; 56 days later Colijn, Dozy, Wissel, and 12 porters reached the north wall of the glacier at an elevation of about 4,850 m (Colijn 1937a, b, c; Lugt 1943). Two days earlier the expedition saw a black mass extending upward for tens of metres from the east wall of a hanging valley at the end of a glacial moraine. Dr. Dozy broke off a piece of the black material and found inside it chalcopyrite, an ore of copper. He took a few hand samples and several photographs of this unique mineral deposit which he named Ertsberg ("Ore Mountain") (Dozy 1939).

The positions of the glacier snouts were marked with cairns (Dozy 1938), and oblique air photographs and a small plant collection were obtained. Surveys established approximate heights for the main peaks (for revised figures see Chapter 2). Word lists collected from local people established that the southern mountain groups were indeed Uhunduni speakers (Damal). Lt. Wissel flew over the large inland lakes to the west of Mt. Jaya and discovered the large Ekagi populations in that area.

Missionaries later established posts there and in the Kemandoga Valley, and a government station was set up there (Allied Geographical Report 1943). This was closed down during the second world war, when Japanese patrols operated from Lake Paniai. After the war airstrips and missions were opened in many valleys to the north of Mt. Jaya, and the Dutch administration also extended out from Eneratoli on Lake Paniai.

The central highlands valley of the Baliem discovered by the Archbold Expedition (Brass 1941) was also contacted by missions and the government after the war, and by 1958 several mission airstrips had opened within 100 km of Mt. Jaya to the east (Ilaga), north (Beoga, Hitalipa), and northwest (Bilae). This development renewed interest in the mountains, and climbers came to scale the peaks made known by Colijn's book.

The New Zealand-New Guinea Expedition, 1961, established a route along native tracks from Ilaga, 70 km east of Mt. Jaya, but an airdrop failure prevented the expedition from reaching the ice fields (Temple 1961, 1962). However, the Kemabu plateau was studied and valuable geological and botanical observations were made (Dow 1968, Cooper 1971). A member of this expedition, Phillip Temple, returned twice more (Temple 1963a, b) and guided a mountaineering party under Heinrich Harrer which succeeded in climbing the Carstensz Pyramid and Mt. Idenburg in February 1962 (Harrer 1964). This party placed cairns at the temporary ice fronts and noted the large retreat of the glaciers since Colijn's visit. They also found an ice-free walking route from the north across the Northwall into the Meren Valley through a gap which they named New Zealand Pass.

In 1963 attempts were made by a U.S. glaciologist recently returned from Antarctica to land a light aircraft on the snow of Mt. Jaya. Wind conditions fortunately prevented this, since the snow would have been far too deep and soft for wheeled aircraft (W. Benninghof, University of Michigan, personal communication). Earlier flying operations left the wreckage of two DC3 aircraft at 4,300 m on the north and south sides of Mt. Jaya. The first crashed on Ngga Pulu in 1944 (Temple 1963b); it was a U.S. Air Force cargo plane and was later visited by a U.S. War Graves Commission team. The second aircraft struck the face of the Carstensz Pyramid in 1963 while carrying Indonesian prisoners of war from Merauke to Biak during the Dutch-Indonesian confrontation.

During the hiatus in development which followed the changeover to Indonesian Administration in 1963, only one other expedition visited Mt. Jaya. In 1964 the Cenderawasih (Bird of Paradise) Expedition, an Indonesian military team with Japanese participants, traversed trade routes from Eneratoli to Beoga and crossed the Kemabu Plateau to climb the Northwall (Hamid et al. 1964a, b). Apparently not seeing New Zealand Pass because of cloud, they climbed to the crest of the western ice field, then turned east and descended into the pass before climbing onto the eastern snow field peaks (4,860 m).

After 1968 Indonesian government posts were established at many mission air-strips and government schools were opened. The area to the north of Mt. Jaya falls in the Paniai Kabupaten with headquarters at Nabire. District offices are maintained at Ilaga and Eneratoli. The southern area is in the Fakfak Kabupaten and the nearest district office was moved from Kokonau to Tembagapura in 1973. Permission for climbing parties to enter Irian Jaya has been fairly readily given since 1971. Parties since then include mountaineers from Austria and Germany (Huber 1974a, b), Hong Kong (Baines et al. 1972), the United States, and two visits by members of the Mapala Club of the University of Indonesia. All have walked from Beoga or Ilaga and spent fairly short periods on the mountain.

The renewed scientific study of Mt. Jaya was made possible by a mining development, the Ertsberg Project of Freeport Indonesia Inc.

Forbes K. Wilson, the Company's President has provided the following account of the development of the Ertsberg Project:

The Dozy report came to my attention in the summer of 1959. The geological environment described by Dr Dozy gave me the idea that the Ertsberg could be a unique mineral deposit and possibly much larger than the estimated three to four million ton ore potential. I obtained the approval of my company to organize an expedition to test my theory. In May 1960, Delos Flint (now Freeport's Chief Geologist), Gus Wintraecken, a Dutch engineer, and I started the overland hike from a small native village called Omowka on the south coast of what is now known as Irian Jaya. Seventeen days later, with the help of numerous groups of mountain Papuans, who acted as packers, and several airdrops completed by Dutch marine pilots flying out of Biak, we reached the Ertsberg and established camp. During the next six weeks we accumulated 300 kilos of samples and made sufficient measurements to determine that potential ore extending above ground was in excess of 13 million tons. This clearly proved that the Ertsberg was indeed a unique deposit and probably the largest above-ground outcrop of base metal ore in the world.

It took another seventeen days to move our samples back to the south coast where we were picked up by a single engine amphibious DeHavilland Beaver and were flown to Biak. At that point we were deeply involved in plans for the detailed exploration of the Ertsberg by diamond drilling.

Before these plans could be implemented, however, there was a serious confrontation between the late President Sukarno and the Dutch. The United Nations intervened in this dispute and in 1963 the administration of what had previously been known as Netherlands New Guinea was assigned to Indonesia. The Sukarno government was entirely opposed to any foreign investment in Indonesia so our plans for an immediate exploration had to be abandoned. In 1965 General Suharto formed a new government and shortly thereafter Freeport was invited to come to Jakarta to negotiate some form of agreement with the Indonesian government to develop the Ertsberg copper deposit. In April 1967 Freeport was the first foreign mining company to execute a Contract of Work with the Indonesian government under the new Foreign Investment Law (Anon. 1967a, b).

In the summer of 1967, using small landing craft chartered in Darwin, Australia, we established a beachhead on the south coast of Irian Jaya near Timika where the Japanese had constructed a small landing strip during World War II. Two Bell 203-B helicopters were brought in and assembled on the beach. In October 1967 these units made their first landing in the glacial moraine adjacent to the Ertsberg. A camp was established in November, at which time we brought in three large diamond drills and a crew of fifteen drillers from Canada. By the end of February 1968 we had completed slightly more than 8,000 metres of drill hole and determined that the Ertsberg had an ore potential of 33 million tons averaging about 2.5 per cent copper to a depth of approximately 1,000 feet below the outcrop.

The next two years were devoted to the gathering of data and during this time we went through a long agonizing appraisal before deciding to commit the $120 million estimated to install copper mining facilities.

The decision to go forward was made by Freeport in January 1970 (Anon. 1969a, b) and Bechtel-Pomeroy was retained as the engineering contractor. We began to establish various camps along the proposed access route which took a full two years to complete (Anon. 1971, 1973; Frenière 1971). In October 1972 the first ore was processed through the mill and in December of that year, 35 months after starting construction, the first shipment of copper concentrate was made to Japan. The project was officially opened by President Suharto on March 3, 1973 with Dr J. J. Dozy, the original discoverer present (Anon. 1973). We had a number of startup problems, which involved corrections and modifications to the facilities, but at the beginning of 1974 we were operating at or slightly in excess of the original design capacity. The finished cost of the project will be about US $ 175 million.

The details of the mining operation are given by Adams (1973). The ore-body had already lost about 100 m of height by 1975. The crushed ore is passed down an aerial tramway from 3, 580 m to the millsite at 2, 400 m where a slurry of water and concentrate is prepared. This is fed into a 10 cm pipeline; pumps and gravity carries it 126 km to a kiln drier at Ammamapare, the port site on the south coast. The powdered concentrate is taken to Japan and West Germany for smelting. Supporting this process is Timeka airfield on the coastal plain, 105 km of all weather gravel road connecting a shallow water dock (serviced by barge from Ammamapare) with the millsite via two tunnels, and a town for up to 2, 000 people called Tembagapura (Coppertown). The town is serviced by helicopter and bus.

Further finds of ore have been made and the huge intrusive mass of the Grasberg (probably 1. 5 cubic kilometres) could well turn out to contain low grade porphyry copper ore. At current copper prices the mineral content (including considerable amounts of gold) of the currently known reserves could be in the region of U.S. $ 3, 000 million. The operation, although planned for a life of 30 years, could extend for a considerably longer time, and might eventually lead to other activities such as forestry, hydroelectricity projects or tourism.

1.3 THE CARSTENSZ GLACIERS EXPEDITIONS (CGE), 1971-1973

In 1970 the Ertsberg Project came to the notice of Randell Champion who recognized the opportunity thus created for placing a scientific expedition close to the glaciers of Mt. Jaya. He was able to enlist the support of Forbes Wilson and Freeport Indonesia Inc. for the idea, and with the help of Melbourne University's Meteorology Department proceeded to organise what became known formally as the Australian Universities' Carstensz Glaciers Expedition (CGE), one of the most comprehensive studies ever made of a high equatorial mountain area.

The CGE program was designed to fit into the World Inventory of Permanent Snow and Ice Masses, organised by the International Commission on Snow and Ice (ICSI) for Unesco's International Hydrological Decade (IHD). The results obtained during two field operations and subsequent laboratory investigations are presented in this book. Preliminary reports on the field work (Champion & Radok 1972; Peterson 1973b) and more detailed narratives (Hope & Peterson, in preparation) are available as departmental publications. A synopsis of the CGE follows.

1.3.1 Expedition teams

First CGE, 6 December 1971 — 10 March 1972

Name	Role	Affiliation
C. Randell Champion	leader, surveyor	Meteorology Department, University of Melbourne
John S. Allman	surveyor	Department of Surveying, University of New South Wales
John M. Bennett	meteorologist, glaciologist	School of Earth Sciences, Flinders University of South Australia
Geoffrey Hope	biologist, pollen analyst	Department of Biogeography and Geomorphology, Australian National University
Richard Muggleton	photographer	Preston and Northcote Community Hospital
James A. Peterson	geomorphologist	Department of Geography, Monash University

Second CGE, 1 January — 22 February 1973

James A. Peterson	leader, geomorphologist	Department of Geography, Monash University
Ian Allison	glaciologist, meteorologist	Antarctic Division, Department of Science
Edward G. Anderson	surveyor	Department of Surveying, University of New South Wales
Richard Muggleton	photographer	Preston and Northcote Community Hospital
Sam Mustamou	interpreter, field collaborator	Cenderawasih University, Jayapura
Judy A. Peterson	biologist	State College of Victoria

Uwe Radok, Meteorology Department, University of Melbourne, acted as coordinator for both expeditions.

1.3.2 Narrative of the first CGE

Four expedition members flew from Darwin to Timeka, near the southern coast of Irian Jaya, in December 1971 and with the help of Freeport Indonesia Inc. and Bechtel Pacific gradually moved equipment and stores to the Ertsberg mine, at a height of 3, 580 m, 10 km from the glaciers. After two weeks of reconnaissance by small climbing parties and a helicopter flight for aerial photography the main work got off to a flying start when a Freeport helicopter piloted by D. La Frenière lifted the bulk of the expedition material directly to the base camp near the tongue of the Meren Glacier, at an altitude of 4,250 m, on 20 December 1971. Further supplies were dropped near the camp from the air. The camp was later visited by Freeport officials and by an Indonesian climbing party; it also attracted the attention of neighbouring native tribes, and there were repeated confrontations which were settled with mutual goodwill. Muggleton and Allman joined the main party on 28 December.

Work then got under way on the establishment, by high order triangulation, of a network of topographic survey stations for control of detailed mapping by later photogrammetric and tacheometric analyses. From such a map and related data altitudinal, as well as areal limits, for ice and snow, flora and fauna, landforms and atmospheric processes were to be defined to arrive at a description of Mt. Jaya at least equal to that of any other glacierized tropical area to date. Fortunately the survey for the mining project involved the setting up of a network from the coast to the Ertsberg and was well advanced when the CGE party arrived. John Allman worked with the project survey contractors before supervising the linkage of the CGE survey to the benchmarks around the Ertsberg.

The most intensive scientific work was done on the Meren and Carstensz glaciers and in their surroundings, where the discovery of cairns left by previous expeditions directly indicated a large icefront retreat during the past 35 years. Evidence of earlier glaciations was obtained from glacial deposits at lower altitudes near the Ertsberg and in the Yellow Valley. Following the re-discovery of the New Zealand Pass botanical and geomorphological work was extended to the plateau and lakes north of the icefields during January and February. However, survey work continued to claim a large amount of time from all expedition members.

The final field tasks consisted of re-surveys of stakes on the Meren and Carstensz glaciers, to obtain regime and surface velocity data, and a gravity survey, tied to the by then fairly detailed triangulation, for subsequent computations of ice thickness.

At the conclusion of the work the majority of the team were flown by Freeport back to Australia, but Geoff Hope joined the Indonesian climbers for their five-day trek north to Ilaga, and in this way reconnoitred parts of the approach route later followed by the second CGE.

1.3.3 Narrative of the second CGE

The second expedition began in December 1972 with an airlift of 1,000 kg of stores and equipment from Melbourne to Port Moresby by the Royal Australian Air Force. Ted Anderson arrived there on 26 December to organise the onward transport to Madang where the expedition planned to take off for Irian Jaya on 2 January 1973. At that stage no entry permits for the expeditions had as yet been received; through the tireless effort of many people (especially the Indonesian Ambassador in Canberra, the

Australian Ambassador in Jakarta, and Randell Champion and Geoff Hope of the first CGE) they finally materialised in the closing hours of 31 December and made possible the departure of the main party on 1 January 1973. Shortly afterwards Randell Champion left for Jakarta in pursuit of permits for himself and two members of a Melbourne television station who later recorded the approach route and final stages of the expedition on film.

After ferrying supplies and equipment to Ilaga, via Jayapura, and recruiting porters among the Dani peoples of Ilaga the expedition set out for Mt. Jaya on 11 January. The route led across the Ilu River and up the northern scarp of the Zengillorong Plateau, a climb of over 1,000 m; then across the gorge of the Zengillorong River on to the Kemabu Plateau, where the Mt. Jaya massif came into view. The final march on 17 January took the expedition from Lake Larson (3,976 m) up the Northwall through New Zealand Pass to 4,500 m, and then down to the base camp at 4,250 m. The 7-day trek had covered about 70 km and a net altitude gain of 2,300 m in rain and cold but got the expedition to its planned site with minimal losses and damage to equipment.

The glaciological work was again concentrated on the Meren and Carstensz glaciers and included the coring of 10 m holes. The biological program was confined to the cryo-vegetation on the two glaciers, whilst the survey program served to establish photo-controls, the latest position of the ice front and the locations of the drill holes. The photographic program provided a record of the 1973 ice fronts, while the geomorphological work concentrated on the collection of control samples for radiocarbon dating and on the continued research for soils buried beneath sequences of till deposits.

A notable event of the second expedition was the climbing, on 6 February 1973, of New Guinea's highest mountain, the Carstensz Pyramid by Jim Peterson and Ted Anderson. A survey marker placed on the summit made it possible later to fix its height accurately for the first time as 4,884 m.

The expedition's work was concluded and the base camp abandoned on 18 February. After further geomorphological studies in the mine area the team returned to Australia with Freeport and RAAF planes to start work on the voluminous data obtained.

1.3.4 Synopsis of scientific results

Survey — Both CGE field parties gave top priority to surveying the glacier areas, as a basis for a reliable and accurate map, essential for all other research. A photographic program associated with the survey has provided a basic record against which future changes in ice extent or ecology can be measured (Chapter 2 and Map 2).

Glacial landforms — The great height of Mt. Jaya, the wet climate, and the underground drainage of a limestone terrain combine to create well preserved glacial landforms (moraines, cirques, lakes, etc.). Some of these have been mapped and dated, either relatively by their weathering or vegetation development, or absolutely with radiocarbon methods, to define changes in the former extent of the ice. This in turn provides a much needed picture of past climates in the tropics, and can contribute to the understanding of climatic change (Chapters 3 and 9; Maps 1, 2 and 3).

Meteorology and climate — Observations of meteorological elements near the glaciers have been compared with simultaneous records from the Ertsberg camp and from stations surrounding Mt. Jaya. The smallness of all seasonal variations permits annual estimates to be derived from short-term records, although the main set of observations coincided with a period of abnormal dryness all over New Guinea. Even so the outstanding feature of Mt. Jaya's climate is its wetness; the annual precipitation exceeds 3,000 mm, and the cloudiness is high, with a distinct diurnal variation (Chapter 5).

Glaciology — The glaciers of Mt. Jaya are comparable to the tropical glaciers of East Africa and the equatorial Andes which have been studied more extensively. The prime aim of the CGE was to redress the balance for this sole major ice accumulation in tropical Asia, more than 5,500 km from the nearest temperate glaciers in New Zealand and the Himalayas. Measurements of regime and surface movement, together with topographical details provided by the surveys, has permitted mathematical modelling of the Carstensz glaciers and estimates of mass balance curves corresponding to the current and past extents of the glaciers. These regime changes reflect fluctuations in the climate of the Mt. Jaya region (Chapters 3 and 4, Map 3).

Biology — The flora and fauna of the high mountains of New Guinea are rather like island biota in being isolated from other mountain areas by the lowland jungle. Yet many species show affinities with taxa in the northern and southern temperate regions rather than the tropical lowland. Each mountain has its own distinct communities and interest centres on the Jaya area as the largest and highest of these. The CGE made a preliminary reconnaissance of the vegetation and vertebrate fauna. With the discovery of algal colonies living on the glaciers, the second CGE also investigated the cryobiology of the ice and snow, particularly because the ice ablation rate is markedly affected by such organisms. The degree of influence by man on the flora and fauna of the high mountains is controversial. Observations of usage of the high areas by local hunters and travellers were made to contribute to this discussion (Chapters 6, 7, 8, 10, 11).

Past environments — The survey of the present ecology was designed to help interpret a study of the palaeoecology undertaken by pollen analysis of post-glacial lake sediments. This study complements the glacial history, in elucidating palaeoenvironments and climate as well as showing

the dynamics of the plant communities through time. Archaeological deposits showed that man has also influenced the ecology of the area for several thousand years (Chapters 3, 9, 11).

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2

TOPOGRAPHIC SURVEY AND CARTOGRAPHY

2.1 INTRODUCTION

The surveys, which provide essential support for the various scientific programmes, are of two types:

1. surveys associated with topographic and detailed mapping, and
2. surveys to determine three-dimensional co-ordinates of discrete points, for glaciological and geomorphological measurements.

A network of accurately co-ordinated control stations is an indispensable pre-requisite of both types of survey, and additionally provides a fixed reference frame for any continuing or future comparative studies. This report is concerned largely with survey activities from the time of involvement of the author (mid-1972), and does not provide details of the survey work of the 1971-1972 expedition, directed by C. Randell Champion.

2.2 OUTLINE OF ACTIVITIES

Field work was divided between the two expeditions, CGE 1971-72 and CGE 1972-73, and has been described briefly in the relevant reports (Champion & Radok, 1972; Anderson, in Radok & Champion 1972 and in Peterson 1973). The greatest obstacle to preparation of a basic topographic map of the area was the complete lack of any control survey. Accordingly, the CGE 1971-72 devoted a great deal of its efforts to establishing a primary control network. This work was largely completed with adequate measurements to fix 54 stations. In addition a network of snow accumulation and glaciological stakes, on the Meren and Carstensz glaciers, were surveyed and tacheometric observations for topographic mapping of the majority of the Meren and Yellow valleys were obtained.

During 1972 the control network was adjusted by Dr J. S. Allman at the University of New South Wales, and the remaining data were reduced and plotted by Champion. Also at this time, a set of U.S. Airforce trimetrogon aerial photographs of the area was obtained (see cover photograph, Radok & Champion 1972) and it was decided to complete the topographic mapping by photogrammetric methods. Consequently, photo-con-