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Two Topographic Maps 1:25000 of Simen, Ethiopia

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Summary

Within the context of an extensive research development programme for Simen, Ethiopia, two topographic maps on a scale 1 : 25 000 of the region have been drawn up that will serve for further groundwork and studies. The survey net could be connected to that of the German map, "Hoch-Semyen" 1 : 50 000. The field survey was carried out in May and June 1973 and the photogrammetric analysis was completed in Berne based on the American aerial photographs of the years 1964/65. All the altitudes were obtained from the newest trigonometric calculations of a point in the peak area of Ras Dejen, the highest mountain of Ethiopia (4543 m, US Coast and Geodetic Survey 1961). A vertical contour interval of 20 m was chosen, completed in certain areas by intermediate contour lines with an interval of 10 m. The identification, verification and complementary works were completed between 1974 and 1976 so that the Simen Mountains National Park sheet depicts the situation in 1975 and the Debark sheet that in 1976. Within an area covering 370 km^2 all rock, rivers, forests, buildings and trails were mapped. The geographic names are printed in Amharic and English, the official Amharic-to-English Transliteration System of the

Mapping and Geography Institute of Addis Abeba having been used. The maps show the three typical landscape types of Simen: the lowlands with their hills and terraces richly sculptured by the rivers, the spectacular escarpment disolving itself in many places into picturesque rock bastions, and the mountain ridges forming the large plateaus of the highlands.

Zusammenfassung

Im Rahmen eines umfassenden Entwicklungsprojekts für Semien, Äthiopien, wurden zwei topographische Karten des Gebietes erstellt, die als Basis für weitere unerlässliche Grundlagen- und Planungsarbeiten dienen sollen.
Das Vermessungsnetz konnte an dasjenige der deutschen Karte "Hoch-Semyen" 1 : 50 000 angeschlossen werden. Die Vermessungsarbeiten im Feld wurden im Mai und Juni 1973 ausgeführt. Die photogrammetrische Auswertung erfolgte auf Grund von amerikanischen Luftbildern aus den Jahren 1964/65 in Bern. Alle Höhenangaben wurden von der neusten trigonometrischen Bestimmung eines Punktes in der Gipfelregion des höchsten Berges Äthiopiens, Ras Dejen (4543 m, "US Coast and Geodetic Survey", 1961), abgeleitet. Die Äquidistanz der Höhenlinien beträgt 20 m, stellenweise ergänzt mit 10 m-Zwischenkurven. Die Identifikations-, Verifikations- und Nachführungsarbeiten wurden von 1974 bis 1976 ausgeführt, so dass die Karten den Stand von 1975 (Blatt Simen Mountains National Park), beziehungsweise 1976 (Blatt Debark) wiedergeben. Auf einer Fläche von ca. 370 km^2 wurden alle Felsen, Flüsse, Wälder, Gebäude und Wege kartiert. Die geographischen Namen sind in amharischer und englischer Schreibweise gedruckt, wobei das offizielle "Amharic-to-English Transliteration-System" des "Mapping and Geography Institute, Addis Abeba" angewandt wurde.
Die Karten zeigen die drei typischen Relief- und Landschaftselemente Semiens: die fluvial reich gegliederte Hügellandschaft der "lowlands", den grossartigen und stellenweise in pittoreske Felsbastionen aufgelöste Steilabfall und die plateauartigen Bergrücken und Hochflächen der "highlands".

Résumé

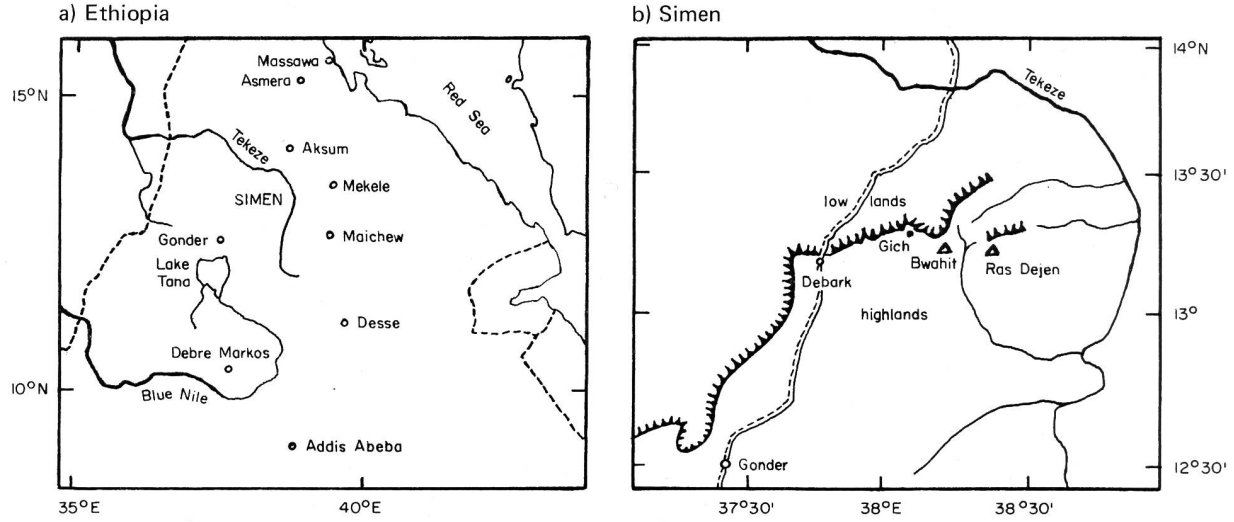
Deux cartes topographiques à l'échelle 1 : 25 000 ont été dressées dans le cadre d'un vaste projet de développement pour "Simen" en Ethiopie. Ces cartes permettront l'élaboration de travaux de base et de planification ultérieurs. Le canevas trigonométrique a pu être rattaché à celui de la carte allemande "Hoch-Semyen" 1 : 50 000. Les travaux de mensuration sur le terrain ont eu lieu en mai et juin 1973. Des prises de vue aériennes américaines des années 1964–1965 ont permis la restitution photogrammétrique qui a été effectuée à Berne. Toutes les altitudes se réfèrent aux points fixes de la carte allemande. Toutefois, grâce à une nouvelle détermination de l'altitude du Ras Dejen par "l'US Coast and Geodetic Survey" en 1961, on a pu adapter les altitudes susmentionnées. Les courbes de niveau ont une équidistance de 20 m et de 10 m dans les régions de plaine ou très accidentées. Les travaux d'identification, de vérification et de mise à jour ont été effectués de 1974 à 1976. Les cartes représentent donc la situation en 1975 pour la feuille "Simen Mountains National Park" et en 1976 pour la feuille "Debark". Sur une surface d'environ 370 km^2 tous les rochers, rivières, forêts, bâtiments, chemins et routes ont été levés. La nomenclature géographique est imprimé en langue sémitique (amharique) et en anglais, en utilisant à cet effet le système officiel "Amharic-to-English-Transliteration-System". On trouve dans les cartes les trois éléments typiques du relief et du paysage du "Simen", à savoir: La campagne vallonnée des "lowlands" riche en cours d'eau – les abîmes majestueux jalonnés de bastions pittoresques de rocher – les sommets des montagnes et les hauts plateaux des "highlands".

1. Introduction and formulation of the problem

1.1. Terminology and situation of Simen

The Amharic word Simen means north; geographically this designates the northern-most region of the Ethiopian highlands bordering the provinces of

Fig. 1: General maps



Eritrea and Tigre. Simen is equally the name of one of the 99 Ethiopian districts (Amharic Awraja). Simen, together with the districts Gayint, Debre Tabor, Libbo, Gonder, Chilga, and Weghera, belongs to the Beghemdir Province, of which Gonder is the capital. With its capital Debark, Simen is divided into the five subdistricts (Amharic Wereda) Beyeda, Jannamora, Tellemt, Dip Bahir and Debark (see STÄHLI 1978).

Geographically Simen is divided into the so-called highlands and lowlands (see fig. 1). The highlands mainly comprise the Simen mountains proper with heights over 3000 m, culminating in Ras Dejen (4543 m) which is Ethiopian's highest peak. With the lowlands we include the territory which in the north continues the highlands up to the Tekeze with altitudes of about 2000 m or less. Highlands and lowlands are clearly separated by an escarpment 1000 to 2000 m high (see fig. 1). The mapped area comprises a strip of land about 40 km long and up to 15 km wide, partly in the highlands and partly in the lowlands (see fig. 6).

The Amharic geographic names used in this study are written without brackets according to the official Amharic-to-English Transliteration-System of the Mapping and Geography Institute of Addis Abeba (see chapter 6). On the other hand all the geographic names which follow another system (e.g. a German one) are in brackets.

1.2. The Simen Mountains National Park

Following the Unesco Mission of 1963 (UNESCO 1963, 1964; GRIMWOOK 1965) interest in protecting the existing wildlife was awakened, although rather late in Ethiopia compared to other East African countries. Subsequently a game preservation bureau and shortly afterwards the Ethiopian Wildlife Conservation Organization were founded. The alarming Unesco report on the situation in the Simen mountains area caused the Emperor Haile Selassie himself to order the preservation of wildlife from human menace. Of special concern was the saving from extinction of the Ethiopian ibex (capra walie Rueppell), one of Ethiopia's emblems. According to RUEPPELL's report (1838) the region had a remarkable stock of ibex, but because of hunting, and above all destruction of the habitant by the natives, the ibex were reduced to less than two hundred individuals in 1963. Only in the rocky inaccessible parts of the imposing escarpment some small groups survived. Together with the even more threatened northern variety of Simen-fox (simenia simensis Rueppell), the walia-ibex was registered in the RED DATA BOOK (1972). In opposition to the native population measures were taken by the Ethiopian Government in collaboration with the World Wildlife Fund to prevent hunting of the walia-ibex and destruction of its habitat. In 1969 a strip of land along the escarpment in Simen was proclaimed the first Ethiopian national park. The first foreign park warden C. W. NICOL (1972) reports the difficulties in this initial phase. It was B. Nievergelt from the Zoological Institute of Zurich University who awakened interest in Switzerland concerning the problems of Simen. After his work on the "Alpensteinbock" (NIEVERGELT 1966) he and his wife made an ecological field study on the subject of the walia-ibex (NIEVERGELT 1968, 1970, 1971, 1972, 1973a, b; VOLLMAR 1969), followed by geobotanic and ecological studies by KLÖTZLI (1975a, b, c, 1977). As an immediate measure to save the threatened wildlife in Simen the World Wildlife Fund decided to put a Swiss park warden at the disposal of the Ethiopian Government. From 1971 to 1973 the position was filled by the Chur zoologist J. MÜLLER (1972a, b, c, 1973) and his wife. In 1973 P. STÄHLI (1973/74, 1975) and his wife were appointed for two years. From 1975 to 1977 H. HURNI (1976/77) was the third Swiss park warden in Simen.

1.3. The foundation "Pro Semien"

The main cause of the extermination of the walia-ibex as well as other wild animals is and remains the destruction of the natural environment by man. NIEVERGELT (1973a: 1) describes it as follows: "During our work in Ethiopia it was soon clear that the ibex was primarily menaced because its natural environment was already destroyed and its last territories, the last natural forest will soon give way to fire and plough. In fact the local peasants depend always on new reserves of land. The reason is not so much the population expansion, as the fact that with the existing agricultural methods the soil is constantly used up and erosion completes the process of devastation. This existing imbalance leads to a constant diminishing of the natural resources" (translated from German).

The foundation and maintenance of a national park in Simen was the first effective step in helping the endangered wildlife. Thus since the park was founded, the registered number of the walia-ibex has increased from 130 (estimation 1968) to over 200 (estimation 1975; see STÄHLI 1975 and NIEVERGELT 1971). Although in the long run the national park alone will not be sufficient for the purpose. In the same period from 1968 to 1975 several hectares of forest were destroyed in the park and dozens of new houses were built (STÄHLI 1975; see further STÄHLI 1978). In order to bring into equilibrium the existing ecological imbalance between natural landscape and cul-

tivated land a general aid programme is needed. On the one hand the national park cannot continue without additional assistance to the population, because all depends on their understanding and good will. On the other hand the concerned population will not be able to survive if their natural resources are destroyed.

The aim set by the foundation "Pro Semien", created in 1974 in Zurich, is the conservation and improvement of life conditions in Simen. Its aid projects are to provide protection for the still existing natural landscape and promote technical help for the population in the surrounding agricultural land. In Simen it can be clearly seen how close the fate of wildlife and its environment is interwoven with that of the population. Based on the above knowledge the complex problem of the aid programme is how to develop the land in the broadest possible terms: "How can one teach to an ever increasing population the conservation of forest and virgin land as well as the protection of animal life, when this population is constantly fighting for its basic food requirements, and its barley fields are advancing higher and higher (3600 m within the park limits and up to 3800 m outside it), where the slopes become steeper. This population, in a few years can destroy irreversibly the rest of the land that took thousands of years to become fertile, as they must compensate for this ravished farmland by expanding ever further into virgin territory. The static idea of conservation leads to success only if it is closely related to the dynamic idea of development. Such a wide integral ecological concept needs a scientific basis: distribution and environment requirements of animals and vegetation, mapping of the land and forests, charting the rainfall and water resources plus an inventory of the houses and roads, representation of expanding fields and pastures etc. Having this basic knowledge, only then will it be possible to improve agriculture and forestry, to educate and train the population and later to develop meaningful tourism" (MESSERLI, STÄHLI, ZURBUCHEN 1975: 27; translated from German).

That is why the aid of the foundation "Pro Semien" besides protecting the natural landscape and assisting technical development of the agriculture, has set as its priority an interdisciplinary research programme and collection of the necessary multiple basic data.

1.4. Scope and aim of the topographic maps 1 : 25 000

An essential part of basic data required for the realisation of the above integral concept is a good topographic map. EVERS (1970) formulated the provocative statement: "To fight hunger we need maps." Surely a topographic map in addition to aerial photographs can be accepted as a valuable tool for further basic research and especially for the subsequent planning of development programmes. From the above goals one can deduce the following points:

1. The reproduction of the topographic map must be on a large scale and as accurate as possible.
2. The net of water resources and roads, forests, number and location of buildings must be registered precisely and mapped in their latest condition.
3. The map must be completed and accessible for further work without delay.
4. The estimated cost must remain within reasonable bounds, proportioned to the totality of the projects.

The present maps are printed in one colour as lay out plans on a scale 1 : 25 000. The mapped area has been divided into two overlapping sheets in order to have a practical format. The first edition of the sheet of the Simen Mountains National Park was published at the end of 1975, only 3 years after the beginning of the project, and was put at the disposal of all interested parties in Ethiopia and Switzerland. With exact topographical mapping of an area, the first essential step towards its development is achieved. Based on these maps further work becomes possible, leading to study of essential problems concerning the vegetation, virgin and cultivated land, erosion and trade, as well as road construction and future tourism.

2. Basic material and preparatory work

2.1. Condition of cartographic mapping in Ethiopia

"Maps with scales larger than 1 : 30 000 are today of prime importance for research, development and planning" (ZURBUCHEN, MESSERLI, INDERMÜHLE 1972: 174; translated from German). According to EVERS (1970: 9) only 0,5 % of Africa is mapped at such scale. In Ethiopia large scale maps are completely absent, with a few exceptions for urban centres (MEKBIB MAMMO 1963: 14). The survey of wider areas necessary for exact mapping was lacking until 1961. Although the French geodesist, D'ABBADIE (1873), during his private expedition between the years 1838 and 1850, had laid out a trigonometric net, starting from Massawa and continuing southwards over Simen, its exactitude was not sufficient for the establishment of precise maps (HILLEBRAND 1967: 118). More accurate surveys were carried

out by the Italians in the former colony of Eritrea. The triangulation made by ISTITUTO GEOGRAFICO MILITARE (1939) during the occupation of the whole Ethiopia did not reach Simen (HILLEBRAND 1954: 86; 1967: 118/119). Single regions were mapped by the Italians on a scale 1 : 50 000, such as the area around Asmera and Massawa, and a strip of land along the eastern main road Asmera–Addis Abeba from Mekele over Desse, Addis Abeba to Nekemte (about 240 km west of Addis Abeba). Furthermore parts of Eritrea and Tigre and a strip near Gonder in the province of Beghemdir were mapped on a scale of 1 : 100 000 (AFRIKA HANDBUCH 1943: 183).

Only the triangulation carried out by the US Coast and Geodetic Survey in the catchment basin of the Blue Nile (ETHIOPIA GEODETIC SURVEY 1961) and the extensive levelling 1957–1965 (CARTOGRAPHY IN ETHIOPIA 1966: 28) as well as the related aerial photographs of most of Ethiopia have provided the necessary basic data for the exact mapping of Ethiopia.

Up to the present the total territory of Ethiopia has not yet been recorded more accurately than by the English map work EAST AFRICA 1 : 500 000. However maps were made long before the American survey and are essentially based on the work of the Italian CARTA DIMOSTRATIVA DELLA COLONIA ERITREA E DELLE REGIONI ADIACENTI 1 : 400 000, as well as on the Italian maps of 1 : 1 000 000 covering the whole of Ethiopia. All the above mentioned maps can only be used for rough orientation, especially for the areas off the main roads.

The long term plan (CARTOGRAPHY IN ETHIOPIA 1966) foresees a cartographic survey of the whole of Ethiopia on scales of 1 : 250 000 and 1 : 50 000. Since 1972 the British Overseas Survey and the Mapping and Geography Institute are working in Addis Abeba on the 1 : 50 000 atlas. As a first step 88 maps of the area bordering Addis Abeba in the south as well as 104 maps around Jimma were planned. At the time of my departure from Ethiopia in the spring of 1975 the proof of the first map sheet was being printed.

2.2. The German map "Hoch-Semyen" 1 : 50 000

The map "Hoch-Semyen" 1 : 50 000 which was realised under the supervision of WERDECKER (1955; 1958; 1968) and was edited in 1967 by the German Research Team represents an excellent example of high mountain cartography. The map is based on terrestrial photogrammetric photographs and on a local survey net undertaken by HILLEBRAND (1954; 1967). The cartographic compilation which was edited in a five-colour print was completed by BRANDSTÄTTER (1967; 1968). The mapped area covers 930 km^2 in the central part of Simen with its highest peaks "Ras Dedschan" (4550 m), "Buahit" (4437 m), "Abba Yared" (4416 m), the "Mayschaha" valley (3000–2500 m), which is deeply incised between these peaks, and the regions of the lowlands (about 2000 m) which border the escarpment in the north (German transliteration of geographic names see chapter 6; altitudes according to the map "Hoch-Semyen" 1 : 50 000, see chapter 2.3.). From the present national park only the mountain range of "Amba Ras" to "Emyet Gogo" figures on the southwest corner of the map. The coordinates and altitudes of the trigonometric points of this area were kindly put at our disposal by HILLEBRAND, which enabled us to connect our survey net to the map "Hoch-Semyen" 1 : 50 000 (see chapter 4.1.).

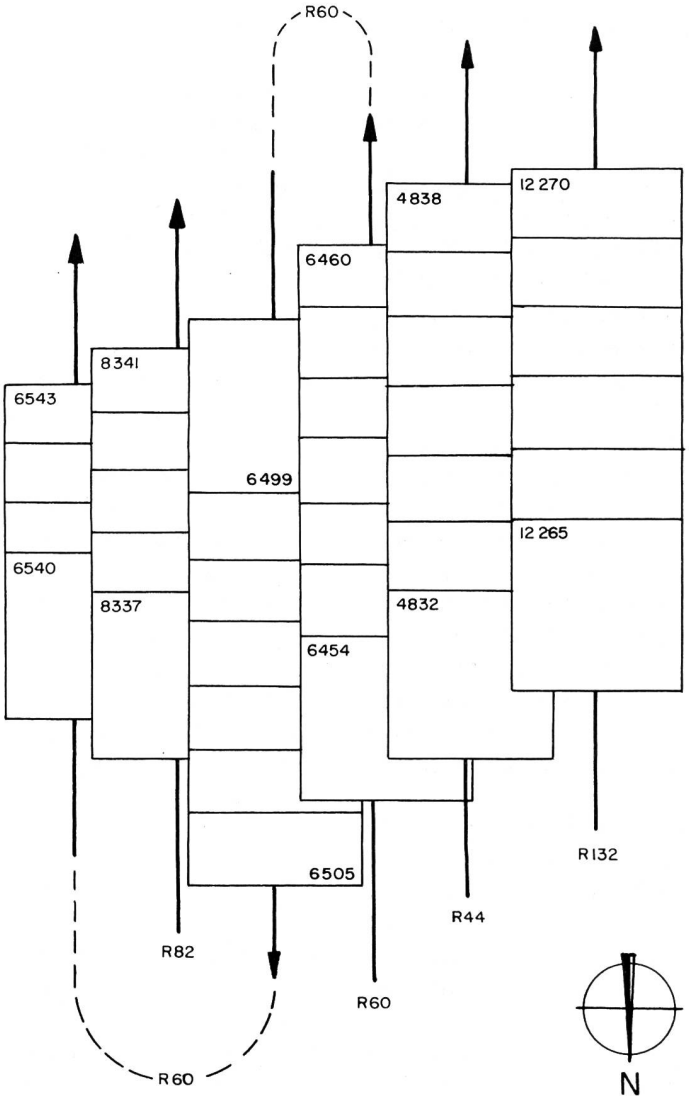
2.3. Recent survey in Simen

The survey made from 1957 to 1961 in Ethiopia by the US Coast and Geodetic Survey (see chapter 2.1.) touches in its northern-most part a point in the Ras Dejen's peak area (ETHIOPIA GEODETIC SURVEY 1961: 2/88). The result of the American survey gave a new height of 4543 m for Ethiopia's highest mountain, Ras Dejen. This is 7 m lower than indicated on the map "Hoch-Semyen" 1 : 50 000. For our maps of the Simen Mountains National Park and Debark, scale 1 : 25 000, we took into consideration the latest altimetric survey (see chapter 3.1.).

2.4. Aerial photographs

Following the survey executed by the US Coast and Geodetic Survey the territory of the central and northern highlands of Ethiopia was flown over and photographed by the US Army Map Service in collaboration with the Addis Abeba Mapping and Geography Institute (MEKBIB MAMMO 1963: 15). Thanks to the co-operation and help of the Swiss Embassy as well as the Ethiopian Wildlife Conservation Organization in Addis Abeba we had at our disposal all the necessary aerial diapositives (23 cm x 23 cm) made by the photolaboratory section of the Mapping and Geography Institute. The scale of the aerial photographs varies from 1 : 35 000 to 1 : 50 000. This is due to the fact that, on the one hand the territory was photographed on four different flights, while on the other hand the topography ranges in altitude through 2000 m, which can be seen in one pair of photographs and also exists between different pairs of photographs. In spite of all these problems the

Fig. 2: Arrangement of air photographs used
(Mapping and Geography Institute, Addis Abeba)



Identification numbers	Flight	Date	Photo-Nr.
VM 1370 PMW AST 4	R 44	17 Jan 64	4832–4838
VM 1370 PMW AST 4	R 60	2 Feb 64	6454–6460
			6499–6505
VM 1370 PMW AF-58-3			6540–6543
VM 1370 PMW AF-58-3	R 82	8 Mar 64	8337–8341
VM 1370 PMW AF-58-3	R 132	6 Jan 65	12265–12270

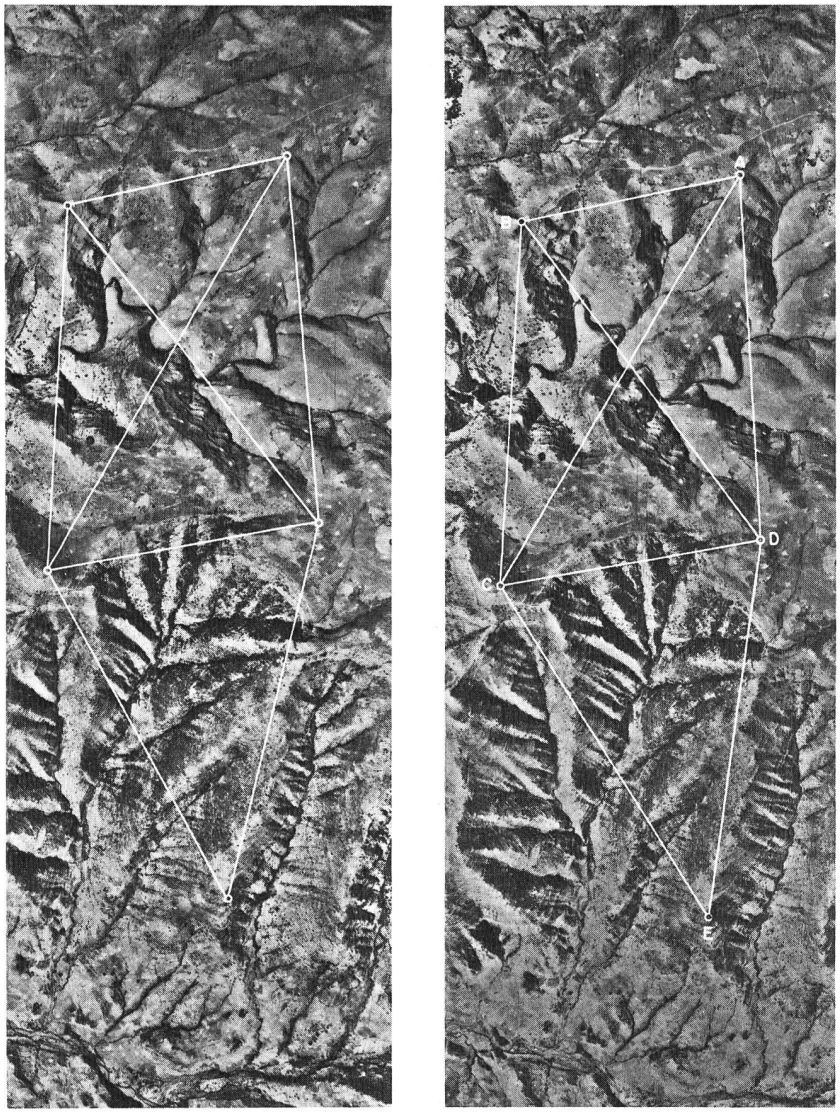


Fig. 3: Provisional triangulation net as fixed by stereoscopic examination

Descriptive example: for the stereoscopic analysis of the pair of photographs a pocket stereoscope is suitable. Note: the line AC clearly penetrates the ground near C and therefore can not serve as a sight in the field. For C a new suitable point has to be found in the proximity. The above detail shows the region of Sawre between Sankaber and Debark.

complete aerial survey of the area allowed us to compose a very precise map (fig. 2). Based on the aerial photographs, the Addis Ababa Mapping and Geography Institute in 1970 roughly sketched a map of the park area on a scale of about 1 : 50 000. This map helped the Wildlife Conservation Organization to record approximately the boundaries of the park already marked on the terrain.

2.5. Establishing the provisory net

A few months before our departure for Simen copies of the American aerial photographs were put at our disposal in Berne. Due to financial considerations a new flight over the area after the marking of the trigonometric points was not feasable. For this reason we had to establish a provisory net based on the existing aerial photographs. The following points had to be taken into consideration:

1. At least four trigonometric points were needed for each pair of photographs.
2. The chosen points had later to be clearly identifiable on the terrain.
3. As the sights had to be realised in the field, the chosen trigonometric points were connected on each pair of photographs with lines equivalent to the sight lines in the field and controlled with the stereoscope (see fig. 3). This method gave a first provisory net with 23 trigonometric points and 7 control points (see the final net, chapter 4.1. and fig. 5). Our field work proved that all the points and sight lines chosen stereoscopically from the aerial photographs could be used for the triangulation net.

3. Survey

3.1. Conjunction to the triangulation net of the map "Hoch-Semyen" 1 : 50 000

The geodetic basic data for the map "Hoch-Semyen" 1 : 50 000

A local triangulation net with a baseline of 1,5 km near Dibil (north of the Bwahit) served as the geodetic basis for the German map. The geographic co-ordinates of a point in the near proximity of this base were established through astronomic observations (HILLEBRAND 1954 and 1968). A conjunction to another survey net would not have been possible in 1954/55 because:

- The survey of D'ABBADIE (1873) was too inexact for a map on a scale of 1 : 50 000.
- The Italian survey reached only up to Adwa/ Mekele and was too distant for a conjunction.
- The survey of the US Coast and Geodetic Survey followed only five years later.

A later comparison between the geographic co-ordinates of the German and American survey showed no significant differences (HILLEBRAND 1968: 123) so that they could be incorporated into our maps.

The new base: Bwahit – Mesareriya

During our first visit at the end of May 1973, the remains of the old stone landmarks which had served as trigonometric points for the German main net could be clearly identified on the Bwahit and Mesareriya. A comparative measurement to the German survey points "Bäla" and "Emyet Gogo" allowed the conjunction of the new trigonometric net to the old one. The trigonometric calculations could be made with this baseline with the help of the coordinates "Buahit" and "Mesarära" set up by HILLEBRAND and WERDECKER. In order to show eventual deflections of the vertical in the greatly extended survey net (see chapter 4.1. and fig. 5), the azimuths of two sides of a triangle in the upper eastern and the western end of the net were determined and checked with the help of the polar star.

The conjunction to the survey net and the baseline for our maps at 1 : 25 000 were established in the following way:

		y Ordinate	x Abscissa	
HILLEBRAND WERDECKER	"Buahit" "Mesarära" A 55	9221 9676	15 657 12 066	[1]
ZURBUCHEN STÄHLI	Bwahit Mesareriya	10 9221.0 10 9676.0	15 657.0 12 066.0	[2]
Baseline: Bwahit – Mesareriya: 3619.7 m				
Map 1 : 50 000 "Hoch-Semyen"		Maps 1 : 25 000 Simen M.N.P. and Debark		
y = 0		y = 100 000		
	corresponds to			
x = 6 000		x = 6 000		

[1] Letters from HILLEBRAND from 12.3.73 and 30.3.73
[2] Transformation by ZURBUCHEN:

Conjunction of the altitude

D'ABBADIE had trigonometrically determined the height of Ras Dejen at 4620 m. For his calculations he used sides of triangles with lengths up to 100 km which gave altimetric errors up to 200 m in the triangles (HILLEBRAND 1954: 88). D'ABBADIE's data, with few exceptions, has been retained in the literature and geographic maps up to this day. In comparison with the latest height of 4543 m trigonometrically determined by the US Coast and Geodetic Survey (1957–61), D'ABBADIE's value of 4620 m seems amazingly accurate considering the means with which he made his calculations more than 125 years ago. The barometric value of 4550 m obtained by WERDECKER and HILLEBRAND in 1954/55 is also extremely accurate, as it proves to be only 7 m higher than the latest American value.

		Height of Ras Dejen	Determined
D'ABBADIE	1838-50	4620 m	trigonometrically
HILLE-BRAND WERDECKER	1954/55	4550 m	barometrically (average value of 4555 m rounded off)
US Coast and Geodetic Survey	1957-61	4543 m*	trigonometrically

Base point of altitudes for the maps 1 : 25 000 Simen Mountains National Park and Debark is Bwahit: 4430 m

The new altitude of Bwahit is therefore 7 m lower than the one indicated on the map "Hoch-Semyen" 1 : 50 000 ("Buahit": 4437 m trigonometrically determined with the altitude of Ras Dejen of 4550 m).

3.2. Field survey

Schedule and organization

The mapped area was surveyed in two stages:
- First the eastern part with the conjunction to the survey net of the map "Hoch-Semyen" was surveyed from 21st of May to 30st of June 1973.
- The western part, from Sankaber to Debark, was surveyed between 14th and 21st of November 1973.

* HILLEBRAND (1968: 123) points out that even the American value could have an inaccuracy of a few meters as Ras Dejen on the edge of the American survey net, was calculated from zenith distances observed from one side only.

The division into two stages was necessary because the rainy season in Simen lasts from May/June to September/October. The survey team consisted of P. Stähli and his wife, one or two armed gamewardens as local guides and interpreters as well as two to four carriers and muleteers. Although the various trigonometric points were not very far apart, the differences in altitude and the inaccessible nature of the terrain forced us to walk for half or even a whole day in order to cover the distance between two surveying points. A Wild theodolite T2 was used as the surveying instrument.

Marking and securing of the stone landmarks

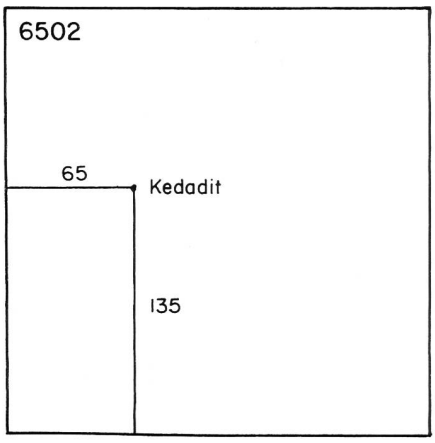
All the trigonometric points chosen in Berne (see chapter 2.5.) could be identified without any difficulty on the ground. The trigonometric points had been marked before the survey with stone landmarks measuring 0,8 to 1,5 m. In most cases a 3 to 4 m high lobelia trunk (Lobelia rhynchopetalum), placed in the center, served as an additional mark for a more accurate sight. As it was probable that in a short time most of the stone landmarks would be destroyed by the natives we made a sketch of the location of each survey point. Furthermore the landmarks were measured with a compass and tape measure from outstanding points in the nearby surroundings (see example in fig. 4). Where possible, the stone landmarks and the outstanding points were photographed together. The complete set of the original land sketches is in the Department of Geography, University of Berne, and can be obtained from the authors. In this way it is possible at any time to make use of the trigonometric points for further surveying and conjunction of new nets.

Difficulties during the survey

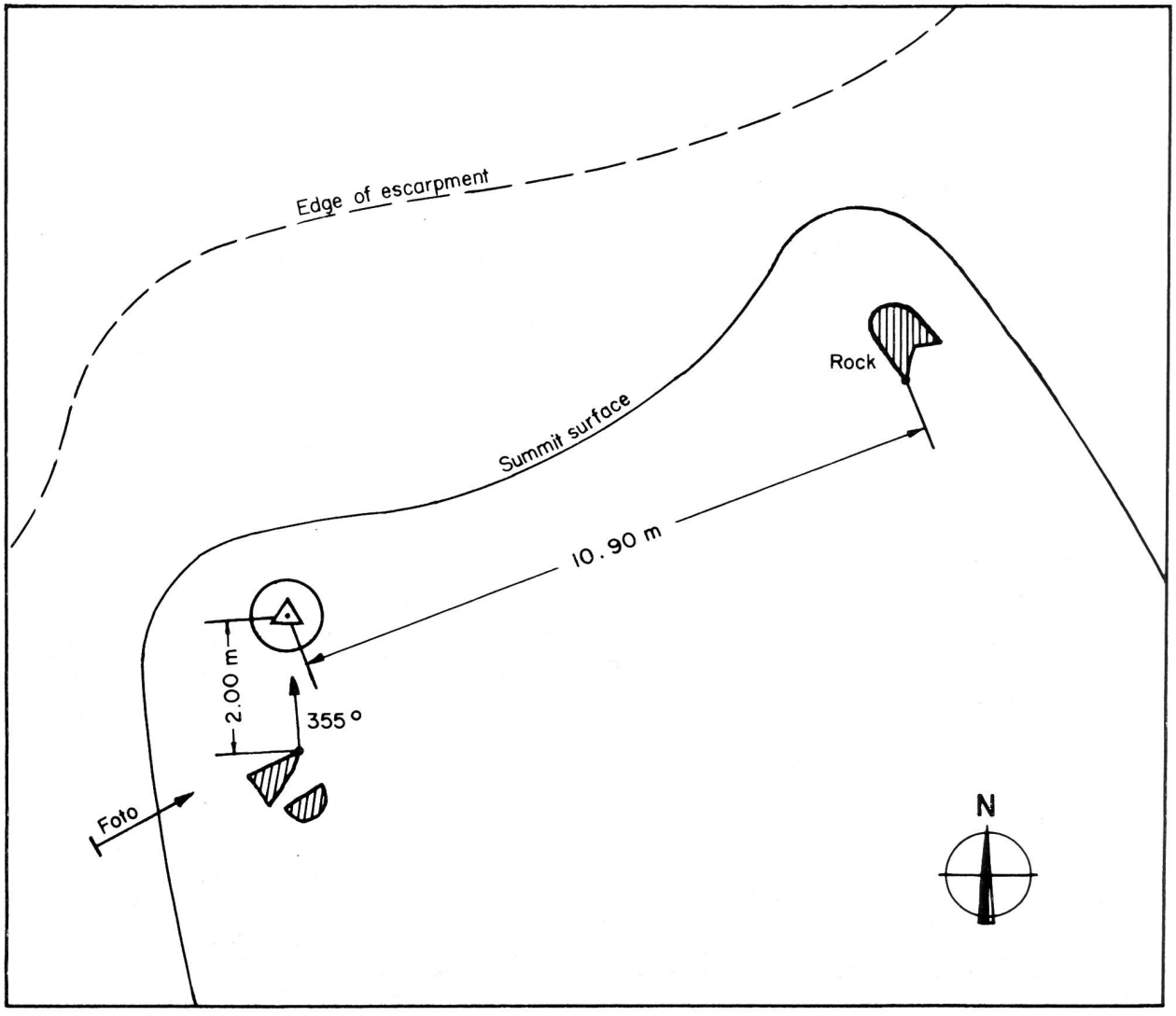
– Climatic conditions

Most of the surveying points are situated over 3000 m above sea level and on the edge of the escarpment. For this reason they are enveloped by fog shortly before, during and some time after the rainy season. A reasonable survey work in High Simen is therefore not possible from mid June until end of October. During the surveying in the eastern part (21.5. to 30.6.1973) we had in May relatively favourable climatic conditions. But in June more than once we could only work in the morning, some days no work was possible because of the fog. In the extreme dry period, January to March/April our vision was hindered by heat haze and dust. As it proved, the ideal time for the surveying in Simen is the period after the rains in November and December, when the sky is cloudless and the view is clear. Thus we advanced rapidly

Fig. 4: Perspective position sketch of a trigonometric point



Trig. point	:	9. Kedadit
Marking	:	Stone landmark with lobelie trunk
Height	:	80 cm
Remarks	:	Highest point of the summit
Erected	:	24.5.1973
Surveyed	:	5.6.1973



with our work in the western section (14.11. to 21.11.1973). Amazing and unexpected was the fact that on heights of over 4000 m the strength of the wind was never so great as to hinder our work.

– Agriculture
Most of the survey points were placed above the limits of cultivation which is 3600 to 3700 m, or on uncultivated land within the boundaries of the national park, so that all the year round they were accessible. For the surveying points in the cultivated area we had to take into consideration the native population and wait for the harvest (end of October to middle of November).

– Mistrust of the native population
NICOL (1972) describes in detail the difficulties he, as park warden, had with the native population during the creation of the national park. Even in 1975 most of the farmers in Simen saw the park solely as a State institution which took away their last land reserves or tried to prevent them to work their own land. It is clear, therefore, that the population distrusted and rejected everything relating to the park. Thus several landmarks were demolished immediately, especially on the land just outside the national park and had to be reerected more than once. It was obvious that the natives were afraid of this new marking, and even of the possibility of enlarging the park premises. Without the help of the local governors and wardens the survey outside the park would never have been possible in the way it has finally been accomplished. Under the circumstances the good relationship which had already been developed by the serious work of the foundation "Pro Semien" proved to be extremely helpful to us as strangers. Especially the work and working methods of NIEVERGELT, KLÖTZLI and MÜLLER made it possible to us to accomplish our task on a solid base of confidence and to be able to resolve difficult situations.

4. Geodetic and photogrammetric analysis and cartographic mapping

4.1. Final net

The survey minutes were sent to Switzerland and the measurements of the angles were controlled by M. Zurbuchen. On this basis and after elimination of uncertain sight lines, 28 new points could be calculated. To the two base points, Bwahit and Mesareriya, 21 points marked with stone landmarks and 7 ground control points (one-side sighted) were added (see net plan, fig. 5 and table 1). The mean error of closure of triangle for all the net lies for situation and altitude within ± 0.5 m and satisfies the requirements for cartographic mapping on a scale of 1 : 25 000. The zero point of the local system of co-ordinates was assumed to be in the southwest, outside the mapped area. With the help of the transformation of Zurbuchen (see chapter 3.1.) the local systems of co-ordinates of the maps of 1 : 25 000 for Debark, Simen Mountains National Park, and the map of 1 : 50 000 "Hoch-Semyen" can easily be connected.

4.2. Photogrammetric analysis and cartographic mapping

The photogrammetric analysis was done with a Wild Stereoautograph A5. With 18 pairs of aerial photographs (see table 2) an area of about 370 km^2 was mapped. In order to determine the form of the terrain accurately, a vertical interval of 20 m was chosen for the contour lines. A smaller vertical interval would have been feasible with the technical possibilities but in this case the map would have been optically overloaded and certain parts, such as the escarpment and the lowlands would have been unclear and unreadable. Yet in the flatter parts intermediate contour lines with an interval of 10 m were introduced in order to permit a clearer appreciation of the terrain. The escarpment and the dissected terrain of the lowlands especially made great demands on the analyst. With the American aerial photographs we had an uninterrupted complete view of the whole area which allowed us to record the topography with high precision. The difficulty in mapping a mountain region like Simen with ground surveying methods only, as for the map "Hoch-Semyen", is described by BRANDSTÄTTER (1967: 127, translated from German) as follows: "Such a varied nature of the ground formation brought to the photogrammetric ground survey, besides some interesting problems, great difficulties as well. The result of the analysis of the photograph measurement is therefore a mosaic of different degrees of precision. It was a great achievement to have obtained the exact mapping of more than two thirds of the area under these hard conditions. Gorges, slope-niches and parts of the elevated plain formed the only gaps in our work."
The many obstructions to visibility on terraces and plateaus which are the source of inaccuracies in terrestrial photogrammetric mapping do not exist with the interpretation of aerial photographs. But with this second method the greatest difficulties arise with the steep slopes. Thus the mapping of the great escarpment was rendered more complicated because various parts were not clearly visible on the aerial photographs due to the shadow cast by the escarpment. Especially for those parts, terres-

Figure 5

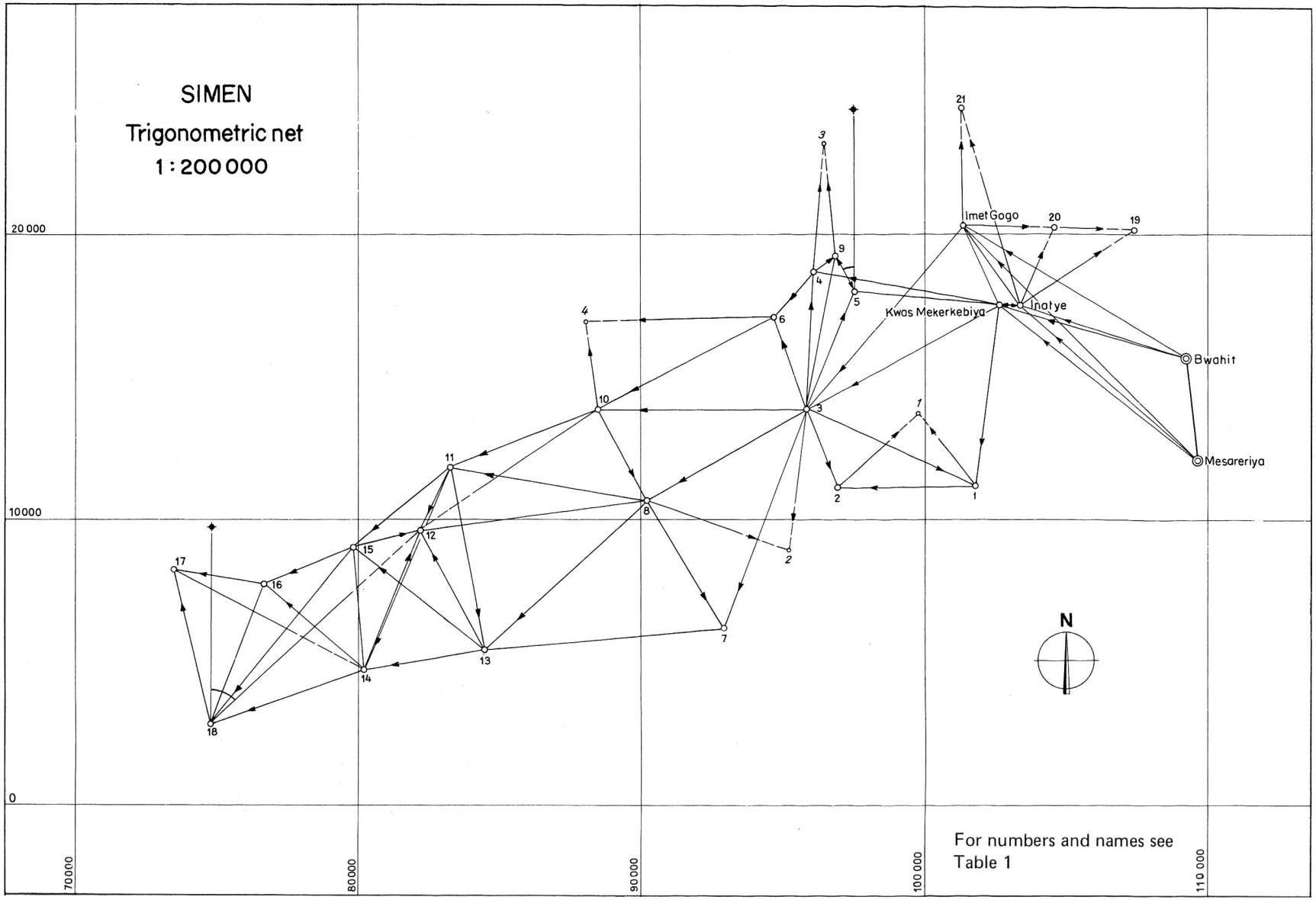

SIMEN
Trigonometric net
1 : 200 000
20 000
10000
0
70000
80000
90000
100 000
110 000
Imet Gogo
Kwas Mekerkebiya
Inatye
Bwahit
Mesareriya
N
For numbers and names see
Table 1

Table 1: List of co-ordinates and heights of the trigonometric points

Names of points	Ordinate Y Meter	Abscissa X Meter	Heights above sea level (in m)	Names of points	Ordinate Y Meter	Abscissa X Meter	Heights above sea level (in m)
1. Conjunction points				Δ 11 Buyit Ras	83240.8	11793.8	3277.7
Δ Bwahit	109221.0	15657.0	4430.0	Δ 12 Milki	82203.1	9629.6	3226.8
Δ Mesareriya	109676.0	12066.0	4353.0	Δ 13 Chilla	84524.2	5407.8	3096.9
				Δ 14 Sawre Terara	80213.2	4731.6	3097.8
2. New trigonometric points				Δ 15 Tillik Meda	79897.3	9023.1	3199.9
Δ Imet Gogo	101359.0	20317.0	3926.0	Δ 16 Ras Amba	76635.2	7784.3	3094.2
Δ Inatye	103410.1	17518.9	4070.0	Δ 17 Kolfo Bella	73541.4	8256.9	2964.4
Δ Kwas Mekerkebiya	102635.8	17517.5	4063.0	Δ 18 Krar Maryam	74847.9	2823.2	2901.4
Δ 1 Schaynu	101789.8	11182.2	3680.4				
Δ 2 Tengelila	96896.3	10160.3	3393.0	3. Ground control points			
Δ 3 Abergina	95825.0	13835.2	3473.1	TP 19 Amiwalka	107371.0	20124.0	3328.0
Δ 4 Gich	96071.1	18743.5	3683.9	TP 20 Truwata	104577.0	20199.0	2924.0
Δ 5 Gich Camp	97469.7	17971.3	3588.1	TP 21 Dirni	101277.0	24415.0	2647.0
Δ 6 Gidir Got	93468.8	17117.1	3427.5				
Δ 7 Gonteda	92891.4	6169.1	3073.6	K 1 Ambaras Mikael	99813.	13692.	3483
Δ 8 Tikur Wuha	90206.0	10676.6	3240.5	K 2 Shuwa Maryam	95206.	8941.	3225
Δ 9 Kedadit	96845.3	19216.2	3759.7	K 3 Serek Amba	96533.	23218.	2918
Δ 10 Sankaber	88421.9	13811.5	3328.1	K 4 China Amba	88129.	16924.	2242

Table 2: Interpreted stereopairs

Camera	Focal length (mm)	Date of photo	Flight line	Paires of plates	Approx. scale
KC-1B 63-149	151.657	17.1.64	R 44	4833–34 4834–35 4835–36	
KC-1B 63-155	151.297	2.2.64	R 60	6454–55 6455–56 6456–57 6457–58 6458–59 6500–01 6501–02 6502–03 6503–04 6540–41 6541–42	~ 1:50 000
		8.3.64	R 82	8337–38 8338–39	
KC-1B 63-152	150.922	6.1.65	R 132	12266–267 12267–268	
				Total 18	

trial surveying was a very valuable complement. With the interpretation of aerial photographs, completed with ground surveying, we think to have covered in an optimal way the topography for the 1 : 25 000 maps.

As the present maps, together with the aerial photographs, have to serve in the first place as basic material for further scientific and development studies, a one-colour print was enough. Therefore the map with the contour lines and site plan could be engraved on the same glass plate. This permitted a reduction of the costs without reducing the value of the maps. Based on this exact topographic material it will easily be possible, if necessary to print multicoloured thematic maps.

5. Verification and complementary works

After a first stereoautographic test interpretation in 1973 it became obvious that general verification and complementary works covering the whole area were absolutely necessary in relation to the ground cover, trails and houses, for the following reasons:

- Changes in the landscape
  The most important reason for the complementary work was the extreme change in the landscape during the previous 10 years. The aerial photographs had been taken in 1964/65 and the maps are dated 1975/76 (see the following article by STÄHLI 1978).
- Trails
  Large cow tracks, unimportant for the communication net, appeared very distinctly on the photographs, while some important local communication routes remained invisible. They had to be added and classified. The trails on the escarpment and in the valleys and forests remained invisible as well, and had to be walked in order to include them on the maps.
- Houses
  The relative smallness of the circular houses (Tukul, diameter of 5–8 m and with a height of about 3 m) as well as their grass roofs hindered a clear identification given the scale of the aerial photographs, especially in areas under 3000 m in the proximity of big trees and in deep valleys. Most confusing were the round threshing places with the mounds of straw which appeared extremely clear on the aerial photographs and were scattered all over the area at the time of the photographing.

These complementary studies took such a large amount of time in the field, that it was impossible to control the whole area to be mapped before the departure of P. Stähli in March 1975. H. Hurni completed the Simen Mountains National Park sheet in May 1975 and the Debark sheet in June 1976. Apart from the exact topographic interpretation of the ground, the maps up dated to 1975 and 1976 respectively include:

- Rocky areas and single bands of rock.
- The water distribution: the inspection on foot of the area during the dry season allowed differentiation between perennial and seasonal streams.
- Forests, bush as well as small groups of trees and single trees.

– Each single house, every church and mosque.
– The major and local trails as well as the most important paths, the trails not practicable for mules and donkeys are marked by an interruption in the lines.

For a future print of the map it will be possible at any given time to report corrections and additions on the original copies.

6. Recording of the geographic names and the mode of writing them

6.1. Different modes of writing

Up to the present the geographic names in Simen have not been clearly recorded in Amharic or any other language. Their reproduction on maps or plan sketches is phonetical. This means that names are written according to the way of pronouncing and writing of the person who made the map or report. As an example we can take the name of the highest mountain of Ethiopia:

Mode of writing	Map
Ras Dascian	Italian pronounciation – On the map 1 : 6 000 000 and the text of the guide CONSOCIAZIONE TURISTICA ITALIANA (1938). – On the sheet MACALLE from the English atlas EAST AFRICA 1 : 500 000
Ras Dajan	French pronounciation – Ethiopie, Carte No. 3, Simen et Zimbila (D'ABBADIE 1873)
Ras Dashan	American pronounciation – On most geographic maps of the last 30 years e.g. 1 : 4 000 000 Michelin Nr. 154, AFRIQUE NORD-EST
Ras Dedschän	German pronounciation – 1 : 50 000 Hoch-Semyen (WERDEKKER 1967)
Ras Dejen	Amharic mode of writing and pronounciation in English transliteration. – On all newer maps and plan sketches of the MAPPING AND GEOGRAPHY INSTITUTE, Addis Abeba. This mode of writing has been used on our maps and reports.

In the same way one could assemble the different modes of writing of other well known names of Simen such as Bwahit, Debark, Lemalimo etc. The large variety of possibilities to write the same Amharic name can clearly be seen in newspapers, reports and on maps. On the "MACALLE" and "GONDAR" sheets of the English 1 : 500 000 EAST AFRICA map, most geographic names are written according to the Italian pronounciation and the spelling is somewhat modified to suit the English pronounciation. The diversity of writing Amharic words is not only due to the language used, as differences exist as well within one and the same language. For instance the transliteration in the two British publications of LESLAU (1973) and ULLENDORFF (1965) greatly differ.

6.2. Recording of the names on the site

During the complementary field work the geographic names of the area were discussed with local, mostly elderly people, and written down in Amharic by literate persons. The way of spelling was then verified and definitively recorded for our maps by the Ethiopian assistant park warden, Ato Berhanu Asfaw. Names of important high mountains, large rivers and larger settlements (these especially related to the name of the church) left little to discuss as they were used by all natives in a large area and pronounced in the same way. Yet many names were known and used only within small local areas. Several times it happened that the same object was designated by different names. Particularly the names along the escarpment vary between natives of the highlands and lowlands. The names chosen for the maps are used by the natives nearest to the area.

6.3. The Amharic-English transliteration

– Amharic language and alphabet

Today in Ethiopia Amharic is the most important language and the official one. Amharic belongs, together with Tigre and Tigrinya in the north, Gurage, Harari, Argobba and Gafat in the south, as well as the old church language Geez, to the Semitic languages which, with Cushitic, form the main part of Ethiopia's languages (LESLAU 1973). The Amharic alphabet consists of 33 basic symbols (consonants), each basic symbol appearing in connection with 7 vowels forming a total of 231 different symbols (syllables). To this are added 20 diphthongs: 4 basic symbols (consonants + w) connected with 5 vowels (see table 3). One of the main difficulties in the transliteration of Amharic into any other language written with the Latin alphabet is that the 7 Amharic vowels have to be replaced with only 5, something which cannot be achieved without the help of phonetic signs. Further difficulties arise for several of the 33 consonants especially in regard to occlusive, fricative, glotal stop, nasal and guttural sounds.

Table 3: The "Amharic-to-English Transliteration System for Geographic Names and Terms"

form	1st	2nd	3rd	4th	5th	6th	7th
	ለ	ሉ	ሊ	ላ	ሌ	ል	ሎ
	le	lu	li	la	le	l(i)	lo
	ሀ	ሁ	ሂ	ሃ	ሄ	ህ	ሆ
	ha	hu	hi	ha	he	h(i)	ho
	ሐ	ሑ	ሒ	ሓ	ሔ	ሕ	ሖ
	ha	hu	hi	ha	he	h(i)	ho
	መ	ሙ	ሚ	ማ	ሜ	ም	ሞ
	me	mu	mi	ma	me	m(i)	mo
	ሠ	ሡ	ሢ	ሣ	ሤ	ሥ	ሦ
	se	su	si	sa	se	s(i)	so
	ረ	ሩ	ሪ	ራ	ሬ	ር	ሮ
	re	ru	ri	ra	re	r(i)	ro
	ሰ	ሱ	ሲ	ሳ	ሴ	ስ	ሶ
	se	su	si	sa	se	s(i)	so
	ሸ	ሹ	ሺ	ሻ	ሼ	ሽ	ሾ
	she	shu	shi	sha	she	sh(i)	sho
	ቀ	ቁ	ቂ	ቃ	ቄ	ቅ	ቆ
	ke	ku	ki	ka	ke	k(i)	ko
	በ	ቡ	ቢ	ባ	ቤ	ብ	ቦ
	be	bu	bi	ba	be	b(i)	bo
	ተ	ቱ	ቲ	ታ	ቴ	ት	ቶ
	te	tu	ti	ta	te	t(i)	to
	ቸ	ቹ	ቺ	ቻ	ቼ	ች	ቾ
	che	chu	chi	cha	che	ch(i)	cho
	ኀ	ኁ	ኂ	ኃ	ኄ	ኅ	ኆ
	ha	hu	hi	ha	he	h(i)	ho
	ነ	ኑ	ኒ	ና	ኔ	ን	ኖ
	ne	nu	ni	na	ne	n(i)	no
	ኘ	ኙ	ኚ	ኛ	ኜ	ኝ	ኞ
	nye	nyu	nyi	nya	nye	ny(i)	nyo
	አ	ኡ	ኢ	ኣ	ኤ	እ	ኦ
	a	u	i	a	e	(i)	o
	ከ	ኩ	ኪ	ካ	ኬ	ክ	ኮ
	ke	ku	ki	ka	ke	k(i)	ko
	ኸ	ኹ	ኺ	ኻ	ኼ	ኽ	ኾ
	he	hu	hi	ha	he	h(i)	ho
	ወ	ዉ	ዊ	ዋ	ዌ	ው	ዎ
	we	wu	wi	wa	we	w(i)	wo

form	1st	2nd	3rd	4th	5th	6th	7th
	ዐ	ዑ	ዒ	ዓ	ዔ	ዕ	ዖ
	a	u	i	a	e	(i)	o
	ዘ	ዙ	ዚ	ዛ	ዜ	ዝ	ዞ
	ze	zu	zi	za	ze	z(i)	zo
	ዠ	ዡ	ዢ	ዣ	ዤ	ዥ	ዦ
	zhe	zhu	zhi	zha	zhe	zh(i)	zho
	የ	ዩ	ዪ	ያ	ዬ	ይ	ዮ
	ye	yu	yi	ya	ye	y(i)	yo
	ደ	ዱ	ዲ	ዳ	ዴ	ድ	ዶ
	de	du	di	da	de	d(i)	do
	ጀ	ጁ	ጂ	ጃ	ጄ	ጅ	ጆ
	je	ju	ji	ja	je	j(i)	jo
	ገ	ጉ	ጊ	ጋ	ጌ	ግ	ጎ
	ge	gu	gi	ga	ge	g(i)	go
	ጠ	ጡ	ጢ	ጣ	ጤ	ጥ	ጦ
	te	tu	ti	ta	te	t(i)	to
	ቸ	ቹ	ቺ	ቻ	ቼ	ች	ቾ
	che	chu	chi	cha	che	ch(i)	cho
	ጰ	ጱ	ጲ	ጳ	ጴ	ጵ	ጶ
	pe	pu	pi	pa	pe	p(i)	po
	ጸ	ጹ	ጺ	ጻ	ጼ	ጽ	ጾ
	tse	tsu	tsi	tsa	tse	ts(i)	tso
	ፀ	ፁ	ፂ	ፃ	ፄ	ፅ	ፆ
	tse	tsu	tsi	tsa	tse	ts(i)	tso
	ፈ	ፉ	ፊ	ፋ	ፌ	ፍ	ፎ
	fe	fu	fi	fa	fe	f(i)	fo
	ፐ	ፑ	ፒ	ፓ	ፔ	ፕ	ፖ
	pe	pu	pi	pa	pe	p(i)	po

	1st	3rd	4th	5th	6th
	ኰ	ኵ	ኳ	ኴ	ኲ
	kwe	kwi	kwa	kwe	kw(i)
	ጐ	ጒ	ጓ	ጔ	ጕ
	hwe	hwi	hwa	hwe	hw(i)
	ጘ	ጙ	ጛ	ጜ	ጝ
	gwe	gwi	gwa	gwe	gw(i)
	ቈ	ቍ	ቋ	ቌ	ቊ
	kwe	kwi	kwa	kwe	kw(i)

The vowel of the 6th form (i) is eliminated in spelling exept when needed in English pronounciation.

LESLAU (1973) selected the following simplified spelling for the seven forms of vowels:

1st form	2nd	3rd	4th	5th	6th	7th
ā	u	i	a	e	ə	o

In connection with one of the 33 basic symbols we have for example:

lā	lu	li	la	le	lə	lo

This simplified Leslau transliteration does not satisfy us for the geographic names on the maps because, on the one hand, it cannot dismiss phonetic signs while, on the other, it is inexact.

– The official Amharic-to-English Transliteration System for Geographic Names and Terms

The difficulties of the transliteration and the resulting confusion in the manner of writing induced the Mapping and Geography Institute in Addis Abeba to develop a uniform system, at least for tis maps, atlases and publications (LEWIS 1959). It actually meant a standardization of the transliteration from Amharic into English: "The system has been devised to transliterate from Ethiopia's official first language (Amharic) to her second official language (English), not from Amharic to an international language or a mixture of languages" (LEWIS 1959: 2).
The standardization was done with the help and advise of Leslau and set a pronounced but necessary simplification. Thus all the geographic names can be written in normal English without any phonetic signs (see table 3). This major simplification is done without doubt at the expense of a more accurate pronounciation. Nevertheless in this case the decision is right, as one who does not know Amharic even with a good transliteration cannot pronounce the names properly and would be even more confused by the phonetic signs. For all those who know Amharic the only right way of writing is the Amharic one. Because of the above mentioned reason (see also chapter 1.4.) the names on the accompanying maps are given in Amharic writing and in the mentioned official English transliteration. Exceptions are the Amharic names of streams which, due to lack of space, are omitted. The transliteration used does not take into consideration the differences in pronounciation and accentuation between the Amharic spoken in Simen and the one in Gonder or Addis Abeba, as according to the Mapping and Geography Institute in Addis Abeba the Amharic and English mode of writing has to be uniform. In reality the dialect of Simen does not differ essentially from the Amharic of the Shewa Province which served as standard for the above mentioned system of transliteration.

6.4. Classification of the geographic names

The names recorded in Simen can be classified into 4 main groups:

Classification	Writing used with examples
a) Mountains, riges, larger rocky sections and hills	Imet Gogo Wuraba Gedel
b) Rivers and streams	*Jinbar Wenz* *Talak W.*
c) Settlements c_1 Hamlets, villages, collective names for larger settlement areas c_2 Churches	Tana Ageb **M e c h e k a** **A b e r g i n a** Giyorgis Medhane Alem
d) Names of fields d_1 Common names of fields d_2 Special names related to persons, special activities or circumstances	*A y n a* *M e d a* Sheh Isman Nigus Aysimush
	Size of characters according to importance

In addition there are indications on the edge of the maps which give information about the nearby and most important places to which the roads and trails lead (settlements, mountains, e.g.: *Mesheha Ras Dejen Beyeda*)

Explanations to:

a) We record only the most important and prominent places and renounce some names of lesser importance, in favour of better reading of the contour lines, especially in the area of the escarpment.

b) Rivers and streams will always be refered to, in Amharic, as Wenz. On the maps, due to lack of space, the abbreviation W. will often be used. Most of the longer rivers change their names. Examples: – Jinbar Wenz in the upper part becomes Indod Wenz in the lower part; – Kaba Wenz, so-called on the way from Sankaber to Gich/Ambaras, will become further down in the valley, near Debir, Wasla Wenz.

c) As the smallest unit, the hamlets have their own names. Several hamlets and villages, mostly bound together by natural frontiers in one area, are grouped under a common name for the whole settlement area. Example:

Hamlet, village	Common name for the settlement area
Kunichbaza Kiflo Tere Mender Werk Azla Jona Awustageb Gebere Mender Daba Semaya Ash Ambaras Shewa	Ambaras (Mikael)

In regions inhabited by Christian orthodox Ethiopians, the area with the common name for hamlets and villages corresponds to the area of the church, dedicated to a particular saint. The local people, when asked about their place of origin (in Amharic Ager, meaning homeland), mostly answer with the common and church name and not with the name of their hamlet or village (in Amharic Mender). So for example: – Ambaras Mikael; – Abergina Giyorgis.

In the regions inhabited by Moslems the hamlets and villages of a settlement area are also grouped under a common name but not that of a mosque. Each settlement counts as a rule, beside a larger mosque, several smaller ones, without particular names. Example:

Hamlet, village	Common name for the settlement area
Sheh Ardman Amioko (1 mosque) Gundiye (3 mosques) Wezahila	Gich

d) The special names of fields grouped in d_2, differ from the usual ones as they designate in the first place, specific local, narrowly defined places related to persons, local history or important, mostly dangerous events. Frequently the name is applied to surroundings beyond the place itself. Examples: – Sheh Abdeloch: burrial place of a well known Moslem sheikh (priest); – Nigus Aysimush: "here the king will not be kissed". With this a place is designated where robbers used to ambush the farmers going to the market place.

The largest portion of the geographic names could clearly be determined with the chosen system. For some particular names we had to estimate their classification as even the natives did not use them clearly and consequentially.

7. The different types of landscape in Simen in the cartographic representation

This chapter with a few changes is borrowed from MESSERLI, STÄHLI, ZURBUCHEN (1975):

The two new topographic maps show the typical landforms and landscape of Simen. We can clearly discern 3 different landscape types: the lowlands with their hills and terraces richly structured by the rivers, the grandiose escarpment disolving itself in many places into picturesque rock bastions and the high plateaus which form, with their forests, pastures and farmland, a widely differentiated landscape of closely interwoven virgin and cultivated land.

The fluvial landscape of the lowlands is characterized by a complex maze of valleys and gorges which have carved out from the stratigraphical richly structured Trap basalt a multitude of plateaus with flat surfaces and sharp crests. Here the high towering table mountains, called by the natives Amba represent a former base of erosion. The complex system of the water courses trends northwards where the numberless rivers and streams flow together to form the Tekeze, after having passed the Sudanese lowlands into the all-unifying fluvial system of the Nile. The gorges are partly impassible, the settlements and farms on the exploitable terraces are to a large extend cut off from the surroundings. In order to reach these farms one needs one to several days walk from the Gonder-Aksum road. Because of this a simple but extremely interesting system with definite trails and market places has developed. Fascinating problems become apparent, which entirely differ from our economical way of thinking and acting, mostly as yet unknown.

The impressive escarpment crosses both maps from west to east with altimetric differences up to 1800 m. Its upper edge climbs from 2800 m above sea level at Lemalimo (north of Debark) to 4200 m on the Bwahit. Without any doubt it is a tectonically characteristic fracture zone which was probably shaped into the actual escarpment during a recent uplift of the extensive Trap formation. Valleys of the highland plateaus which lead abruptly into a gaping void indicate this process. The split off and isolated rock bastions indicate an impressive tectonic fracture. Especially this inaccessible and untrodden mountain landscape of the escarpment became the natural refuge for the fauna and flora. Here the beautiful Ethiopian ibex (capra walie Rueppell) could survive protected from human interference. On the steep slopes and rock ledges the erica forest (erica arborea) was spared from the human destructive and predatory exploitation. The escarpment in the area from Chilkwanit to Chennek forms the heart of the actuel national

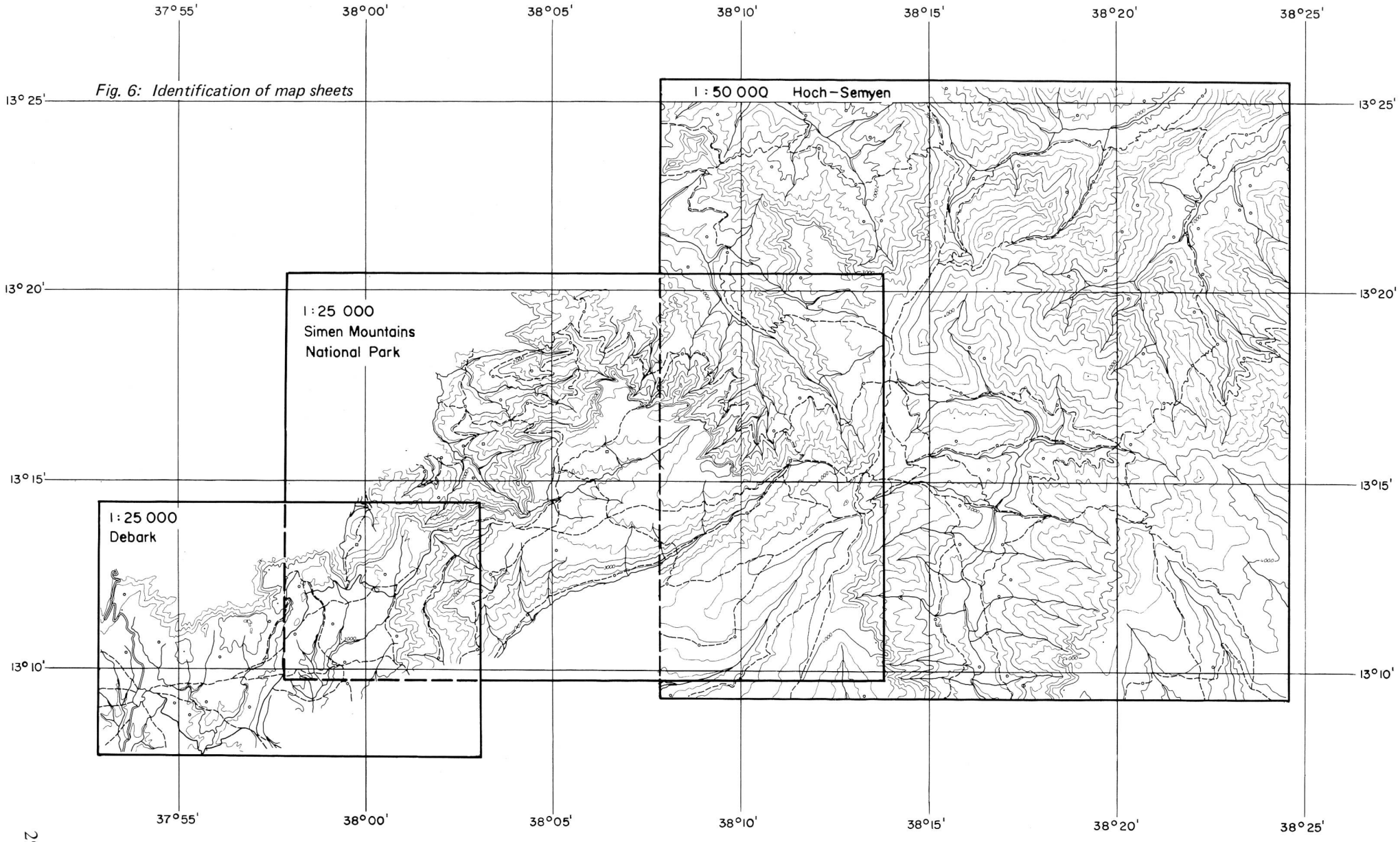


Fig. 6: Identification of map sheets

park. Its protective function has enabled the survival of the natural landscape and its wildlife.

The high plateaus consist of basalt strata of the Trap series over 3000 m thick (GEOLOGICAL MAP 1973 and MOHR 1962), which are to be considered as the remains of gigantic gush of extrusive rock. The rigid slabs of the harder basalt strata decline with 5 1/2 degrees towards south and southeast. Important valleys such as the Jinbar and the Belegez valleys have cut themselves deeply into these high plateaus. Yet the erosion, its chronological process and its interaction with the formation and destruction of the soil is still largely unclarified. Man with his houses and ploughs has penetrated into these high plateaus. The highest houses located in the mapped area are at an altitude of 3700 m (hamlet of Kidane Mado of the settlement Argin), WERDECKER (1968: 38) has mapped and described the highest located houses of Simen in "Atär" south of Ras Dejen at an altitude of 4000 m. The erica forest has survived in some places in the high regions. Its upper limit in the mapped region lies between 3600 m in the Gich area and 3900 m in the Argin area west of the Bwahit. The higher situated mountain steppe is used as pasture. The farmland extends into extremely steep slopes, leading to a reduction of the precious soil and to the possibility of the catastrophic destructive action of erosion (see map of soil erosion, HURNI 1978).

Over the whole of the mapped area undestroyed and destroyed natural and cultivated landscape is to be found, but in many places they overlap in complex interaction. Where should one protect and preserve, where should one develop and change? It is especially the cartographic groundwork which permits us such a differentiated and integral way of thinking and working which should in fact be the characteristic of every development project.

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