Bulletin of Glacier Research 5 (1987) 1–10

Glaciological studies in Asiatic Highland region during 1985-1986.

Okitsugu Watanabe[1] and Keiji Higuchi[2]

1 National Institute of Polar Research, Tokyo 173 Japan

2 Water Research Institute, Nagoya University, Nagoya 464 Japan

(Received February 2, 1987)

Abstract

Glacio-hydrological, glacio-meteorological and glaciological observations in the central Nepal Himalayas and the West Kunlun Mountains were carried out during 1985-86 as a part of a project to study the glaciology of the Asiatic highland region. This project was composed of a Glaciological Expedition of Nepal, Langtang Himal 1985 -86 in cooperation with Nepalese scientists, and of the first Sino-Japan Scientific Joint Expedition to the Kunlun Mountains 1985. This report summarizes the activities and observation undertaken by the two expeditions.

1. Introduction

Since 1973, glaciological and meteorological observations relevant to the climate and existence of glaciers in the Nepal Himalayas were carried out under a continuing scientific program known as the "Glaciological Expedition of Nepal", in co-operation with Nepalase scientists.

The aim of this research has been to establish the present condition of Nepal Himalaya, glaciers and their variation during the past centuries and millennia in order to understand the response of glaciers to a changing climate.

Previous results obtained through these programs were published under the title of "Glaciers and Climates of Nepal Himalayas - Reports of the Glaciological Expedition of Nepal, Parts I, II, III and IV, (1976, 77, 78 and 80)", special issue of Seppyo (Journal of the Japanese Society of Snow and Ice). During 1981 -1982, preliminaly studies on glacio-hydrologic condition of the Langtang Himal region were started in connection with studies on glacier distribution, their condition and variation and were successfully concluded. In this project, full-depth coring in the Yala Glacier was completed. Results of this project were reported under the title "Glacier Studies in Langtang Valley in 1981-82", as the publication No. 2 of Data center for Glacier Research, Japanese Society of Snow and Ice.

As seen in various papers contained in these reports, distribution, recent condition, and variation of glaciers in the Nepal Himalayas were studied from an interdiciplinary point of view combining glaciology, meteorology, geomorphology, and hydrology.

The Nepal Himalayas are situated on the margin of the huge Asiatic highland, mainly consisting of the Plateau of Tibet including several ranges more than 4000 meters in altitude, such as the range of Karakorum, Kailas (Trans Himalaya), Nyenchen Tanglha, Tanglha, and Kunlun mountains. In general the climate is dry to the north and more humid to the south due to the summer monsoon influence. Reflecting this difference of climates, regional characteristics in glacial phenomena such as distribution and scale characteristics and dynamics and mass balance processes of glacier are found. According to the information derived from recent remote sensing studies by means of satellite, year-to-year variations of winter snow cover have been considered to have an effect on the climate of the northern phemisphere through air-surface interaction.

From the viewpoint mentioned above, an in-

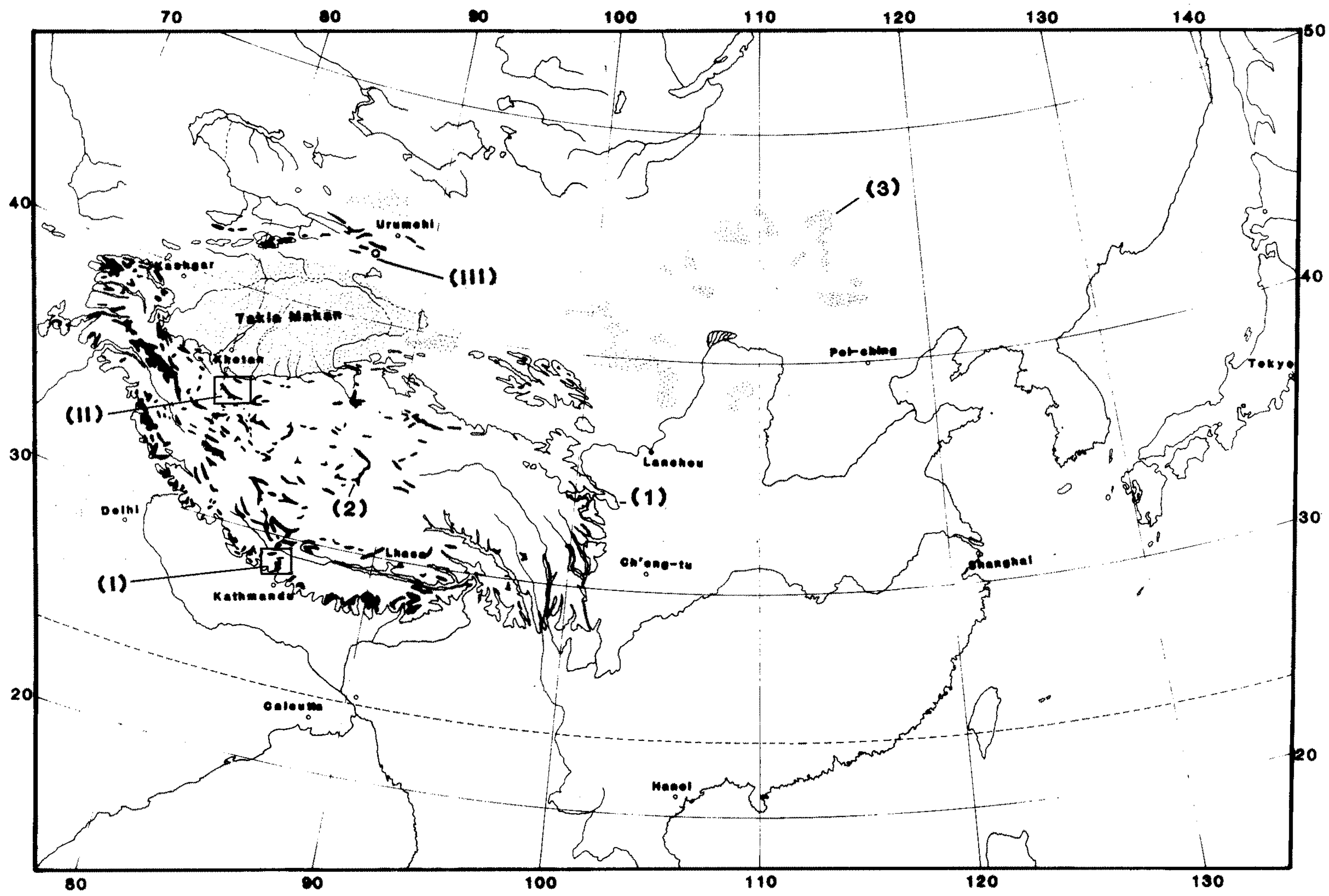


Fig. 1. Geographical map of the Asiatic highland region and the researched area
(I) central Nepal Himalaya, Langtang Himal
(II) West Kunlun Mountains, China
(III) Tien shan glaciological station.
Geographical remarks (1) 4000 m contour line, (2) Mountain Ranges above altitude of 5000 m and (3) Desert region.

creased effort toward comparative studies of glaciers in the Asiatic highland was planned in cooperation with Nepalese and Chinese researchers.

The aim of this project is to collect detailed glaciological, climatic, and hydrological data and simultaneously to study the various glaciological and meteorological process relating to the cryosperic environment of the Asiatic highland.

This project was proposed as a five-year plan during 1985-1989. For the begining stage, the central part of the Nepal Himalayas (Langtang Himal region) and the western Kunlun Mountains range were chosen as the primary research area. A geographic map of this area including the system of high mountain ranges, rivers and the distribution of deserts is shown in Fig. 1.

Given the lack of permanent data from the study region, our task for the first year was to establish long-term meteorological and hydrological observing station in the Langtang Himal. The station were set up to cover a full hydrologic cycle beginning in the early stage of the 1985 summer monsoon, which is of special importance to the glacierized regions of the Nepal Himalayas.

For understanding the climatic sequence in this Asiatic highland region, the data obtained in the Langtang Himal station will be examined together with data observed in the Tien Shan Mountains, colleted by the Lanzhow Institute of Glaciology and Geocryology, and the daily upper atmospheric meteorological data of the northern hemisphere provided by the international weather network.

Based on the open door policy of the Chinese government, the first Sino-Japan Joint Scientific Expedition to the western Kunlun Mountains was carried out in the summer of 1985. This was a preliminary effort in preparation for the main project to be launched in the summer of 1987. Preliminaly reports on glacial and geocryological phenomena in this almost entirely unknown area are also reported in this volume.

2. Scheme of the observations in the Langtang Himal, central Nepal Himalayas and the western Kunlun Mountains, during 1985-1986.

2. 1. Langtang Himal

The research work in this region started in the early phase of 1985 monsoon season and continued to the beginning of July, 1986. The full-year observations in both meteorology and hydrology were completed.

The Base House for routine observation and field investigation was set up at Kyangchen (3920 m a. s. l.). The observations made in this region can be divided into three categories : glacio-hydrologic observation, glacio-meteorologic observation, and glaciological investigation. The map of glacier distribution and observation stations in the Langtang Himal are shown in Fig. 2.

2. 1. 1. Glacio-hydrologic observations

Following the preliminaly observations carried out during 1981-82, more detailed and precise observations for a full hydrologic year were made, and a complete hydrograph was obtained. The main aim of our glacio-hydrologic studies is to clarify the role of liquid and solid precipitation in glacier and snow cover melting and in the water balance of this area. Liquid and solid precipitation, and melting processes on the glacier surface, occur simultaneously in the same season.

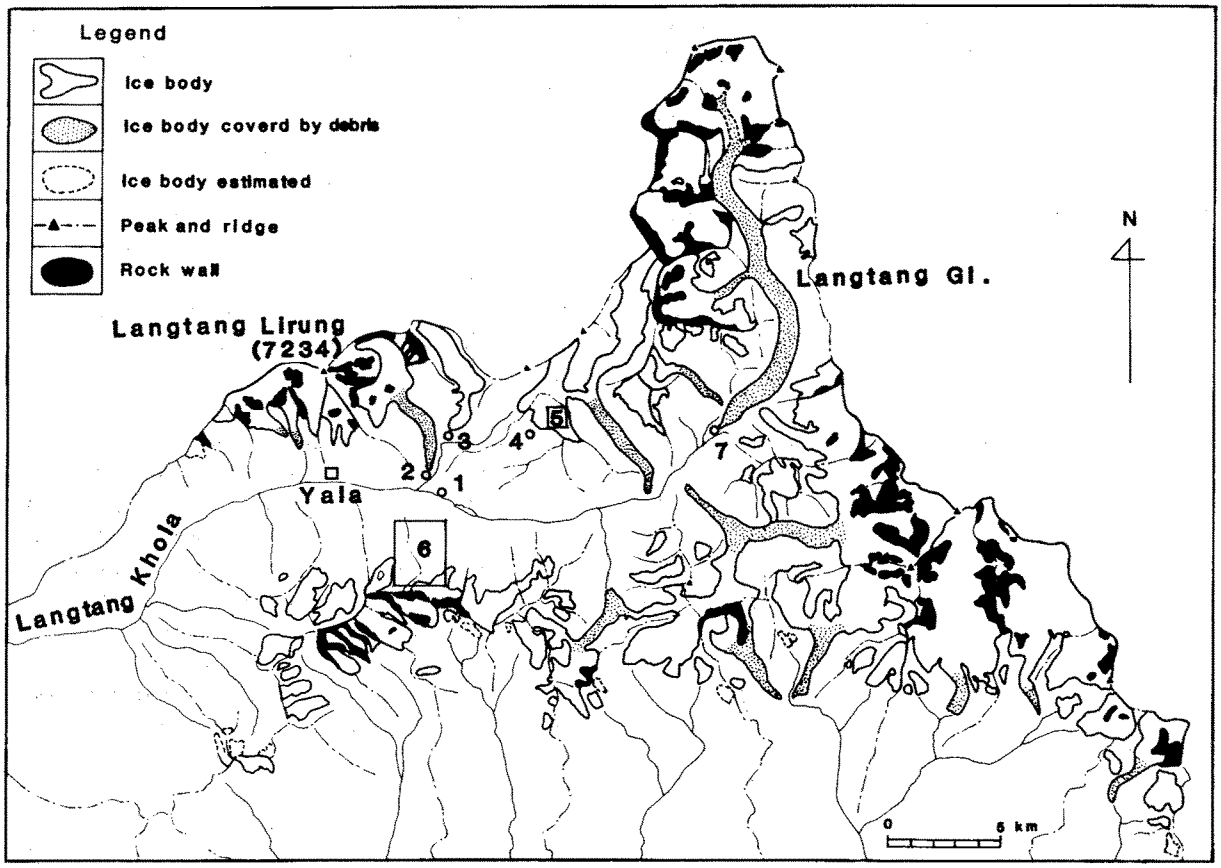
2. 1. 2. Glacio-meteorological observation

Adding to the meteorological deta throughout a year related to the glacio-hydrological process and weather of this region, the cryospheric characteristics of Himalayas were studied. The precipitation process related to cumulus convection along the slopes of the Himalayas during the summer monsoon, the seasonal variation of snow line as a vertical reflection of the areal change of the cryosphere in Himalayas, and the heat balance study on snow covered and snow-free surface were carried out.

2. 1. 3. Glaciological investigation in the Yala Glacier

During 1981-82 project, the first attempt to drill into the basement of glacier from the surface have been made, and full-depth ice core was retrieved. Following this success, the detailed studies were made, to interpret the dirt layer stratigraphy for determination annual layers. For the same purposed, several shallow cores were taken in both the areas of accumulation and ablation.

Glacio-biological studies on the glacier and in the surrounding area were also carried out during the 1985 monsoon season.



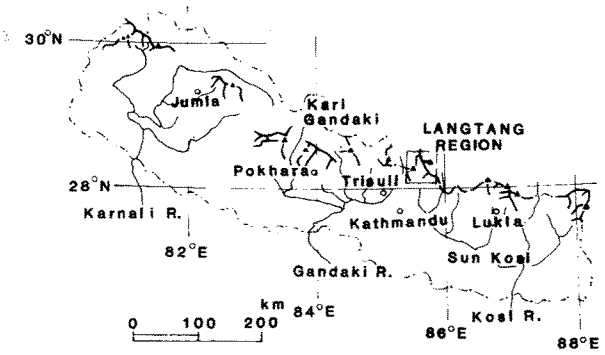


Fig. 2. Glacier distribution in the Langtang Himal and the sites of observations (1) Kyangchen base station, (2) Langtang Lirung Gl. station, (3) Khyimjung Gl. station, (4) Yala Gl. station, (5) Investigated area of Yala Gl., (6) Kangja La climatic observation area and (7) Langshisa observation site

2. 2. *Preliminaly research in the western Kunlun Mountains*

Little information on this mountain region was available so finding an access route to the glacier area and a suitable site for glaciological research were the most important purposes of this expedition in the summer of 1985. The route of the expedition and the area of reconnaissance are shown in Fig. 3.

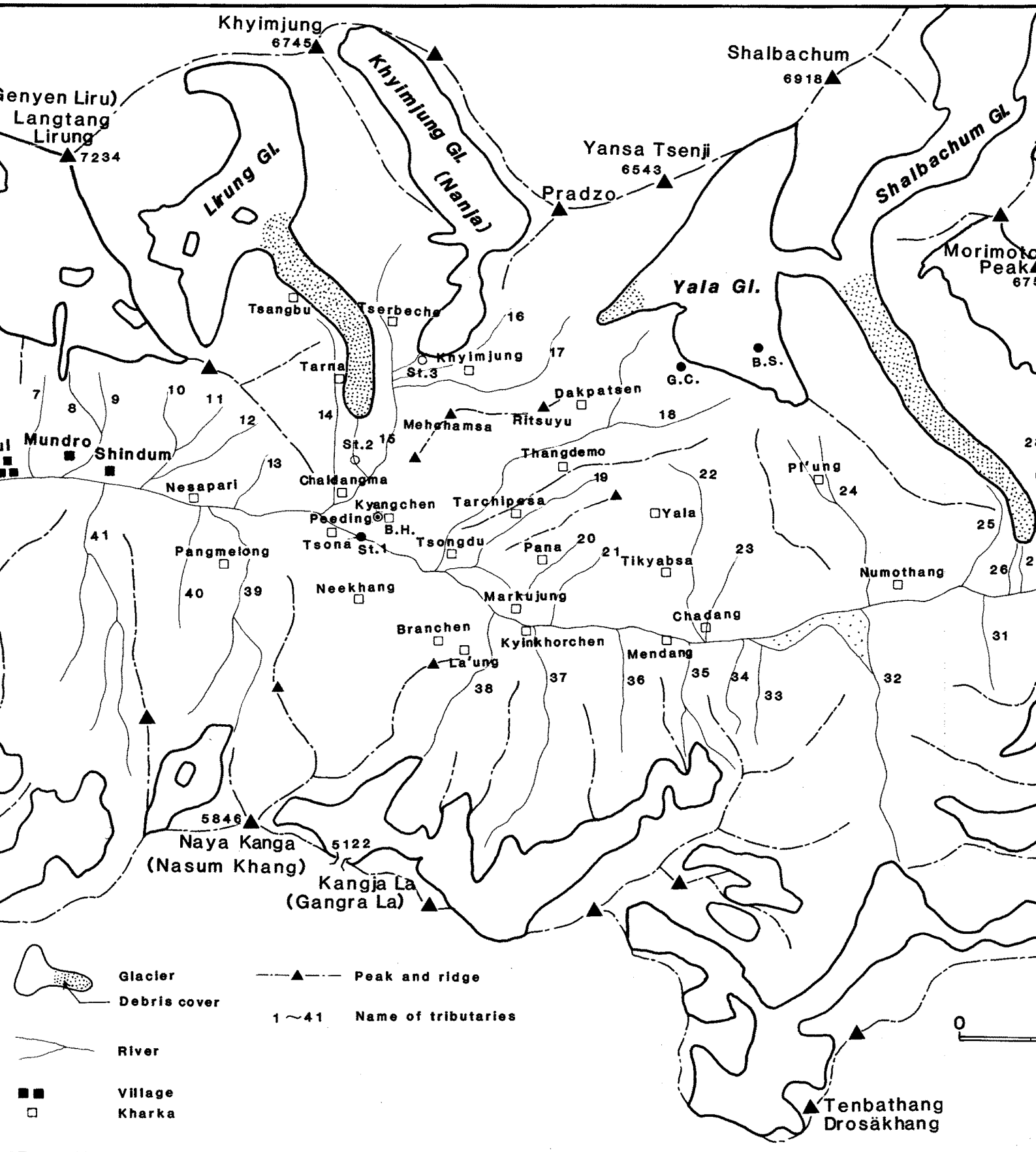
In this area, the following works were accomplished :

(a) Geographical reconnaissance including finding a access route and suitable research area for the coming 1987 project.
(b) Testing of shallow coring on a flat-top type glacier selected.
(c) Meteorological observations and preliminary observations on glaciological phenomena and sampling of falling snow, glacier ice, river water, and loess sediment.

2. 3. *Items of observation*

A description of the observation sites in the Langtang Himal region is given in Table 1. These locations are shown in Fig. 2. The term of each observations are shown in Table 2.

The detailed items of the Langtang Himal project carried out during 1985-86 are listed according to


Khyimjung
6745
Khyimjung Gl. (Nanja)
Shalbachum
6918
Shalbachum Gl.
Yansa Tsenji
6543
Pradzo
Lirung Gl.
Langtang Lirung
7234
Yala Gl.
Tsangbu
Tserbecha
Khyimjung
St.3
Tarna
B.S.
G.C.
Dakpatsen
Ritsuyu
Mehrhamsa
Mundro
Shindum
St.2
Thangdemo
Nesapari
Chaidangma
Kyangchen
Tarchipasa
Yala
Peeding
B.H.
Tsona
St.1
Tsongdu
Pana
Tikyabsa
Numothang
Pangmelong
Neekhang
Markujung
Chadang
Branchen
Kyinkhorchen
Mendang
La'ung
5846
Naya Kanga
(Nasum Khang)
5122
Kangja La
(Gangra La)
Tenbathang
Drosäkhang
Glacier
Debris cover
River
Village
Kharka
Peak and ridge
1～41 Name of tributaries
0

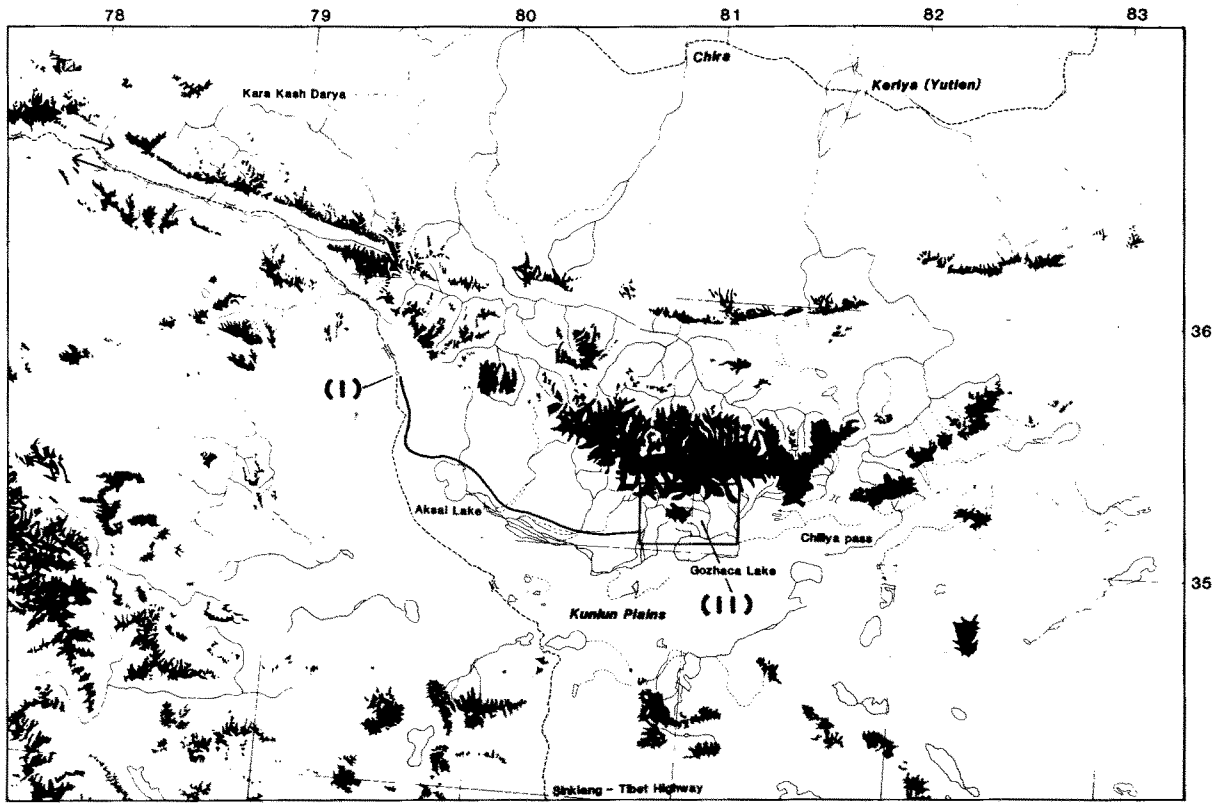


Fig. 3. Glacier distribution in the West Kunlun Mountains and route of the expedition (I) the access route and (II) the area of reconnaisance.

three categories ; .

2. 3. 1. Glacio-hydrological observations

(a) water level observation throughout one year at the St. 1-3 (from June 1985 to May 1986).

(b) measurements of the relation between water level and discharge, at regular intervals (one or two times per month).

(c) water sampling for measurement of suspended material and heavy metals in running water, at regular intervals (one or two times per month).

2. 3. 2. Glacio-meteorogical observations

(a) meteorological observations throughout one year at Kyangchen (B. H.) Langtang Village, and Glacier Camp (from June 1985 to May 1986).

(b) heat balance observations on the Yala glacier during and after the monsoon season of 1985.

(c) observation of altitude change of the snow line and radiative characteristics of the Langtang Himal region.

(d) observations on clouds, such as motion of cumlus convection, vertical and areal distribution of precipitation, and observations of rain drop and snow crystals.

2. 3. 3. Glaciological observation on the Yala Glacier

(a) observations of the mass balance of the glacier and accumulation-ablation process by means of shallow drilling.

(b) observations on snow cover metamorphism during the winter and spring of 1985-86.

(c) biological studies on the glacier and in the surrounding area.

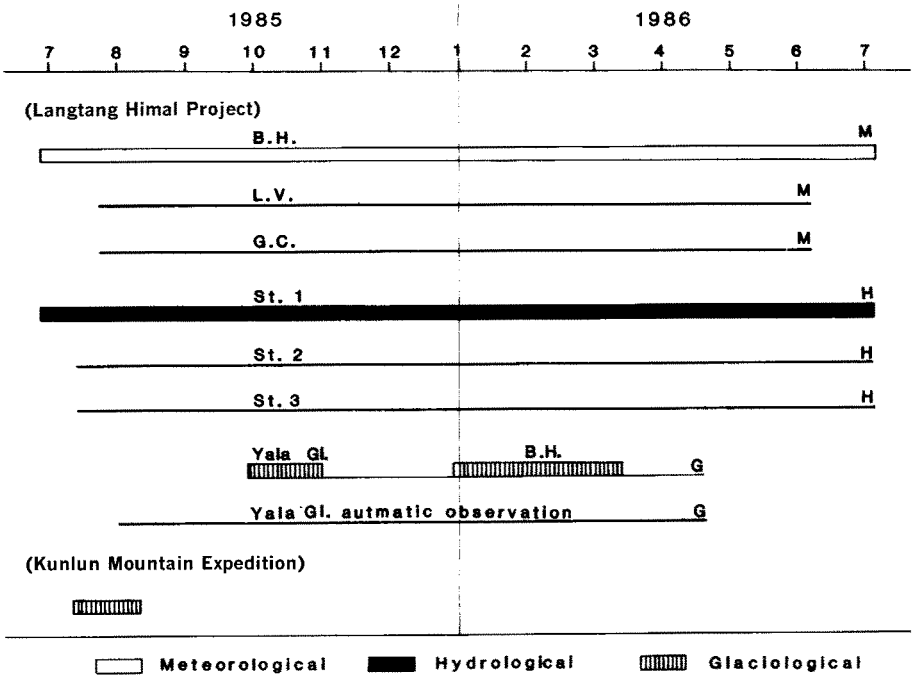
As a part of the results obtained in 1985-86, records of air temperature, liquid and solid precipitation, and water discharge at Kyangchen are shown in Fig. 4. This is the first data set of this kind obtained for a whole year in the Langtang Himal region. Detailed descriptions and analyses on these data are presented by Fukushima *et al.* (1987) and Takahashi *et al.* 1987 in this volume.

Table 1. Description of the observation sites in the Langtang Himal

Name of Site	Abbreviation	altitude (m)	observation
Base House (Kyangchen)	B.H.	3920	M(M,A), G(M)
Glacier Camp (Yala Glacier)	G.C.	5090	M(A)
Langtang Village (Yul)	L.V.	3500	M(A)
Hydrological Station 1	St. 1	3840	for Langtang Khola Watershed H(A)
Station 2	St. 2	4000	for Lirung Khola Watershed H(A)
Station 3	St. 3	4200	for Kimshun G1. Water shed H(A)
Kyijungphu	K.J.	4200	temporal observation site for M(A), H(A)

M: Meteorological, H: Hydrological
G: Glaciological, (M): manual (A): automatic.

Table 2. Term of the observations in Langtang Himal



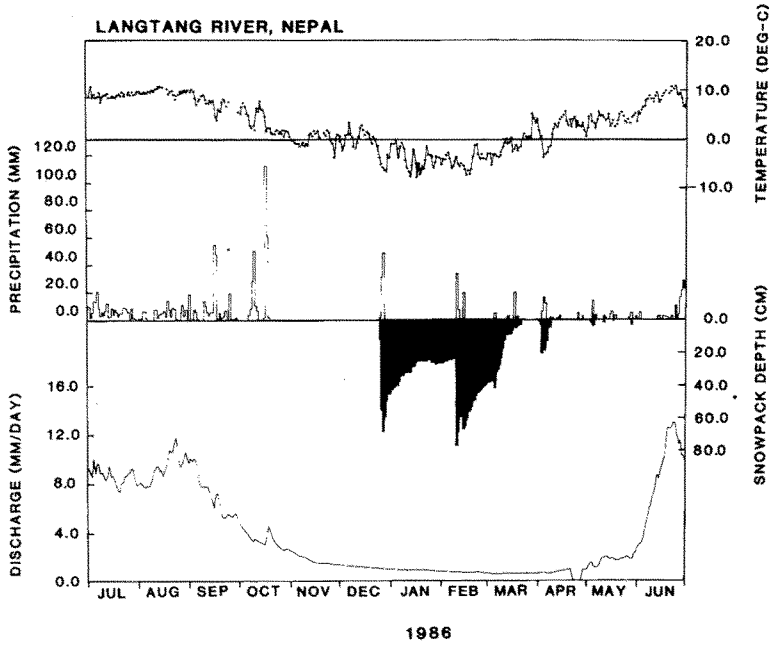


Fig. 4. Hydrological and meteorological data of 1986 in Kangchen, Langtang Himal.

A topographic names including seasonal pasture places (Karka) in Langtang Valley collected by A. Sadakane is shown in Fig. 5.

3. Members

The members of the project on the Glaciological Studies in Asiatic highland region during 1985-86 were composed of two teams working in different areas. One was the Glaciological Expedition of Nepal Himalayas, Langtang Himal Project (GEN-LP 1985-86), and the first Sino-Japan Joint Scientific Expedition to the Kunlun Mountain 1985 (Sino-Japan Joint Kunlun Expedition 1985).

Dr. Keiji Higuchi (Chief Investigator, Glaciology)
Professor, Water Research Institute, Nagoya University, Nagoya.

I. GEN-LP 1985-86
(Japanese members)

Dr. Okitsugu Watanabe (Field party leader, Glaciology)
Professor ; National Institute of Polar Research, Tokyo.

Dr. Yasoichi Endo (Glaciology)
Research Associate ; Institute of Low Temperature Science, Hokkaido University, Sapporo.

Dr. Yoshihiro Fukushima (Hydrology)
Research Associate ; Faculty of Agriculture, Kyoto University, Kyoto.

Dr. Katsutoshi Tsusima (Glaciology)
Associate Professor ; Faculty of Science, Toyama University, Toyama.

Dr. Shuhei Takahashi (Meteorology)
Professor ; Kitami Institute of Technology, Kitami.

Dr. Masakazu Suzuki (Hydrology)
Research Associate ; Faculty of Agriculture, Kyoto University, Kyoto.

Mr. Tetsuo Ohata (Meteorology)
Research Associate ; Water Research Institute, Nagoya University, Nagoya.

Mr. Hiroshi Kubota (Hydrology)
Chief Scientist, Karter Art Landscape Co. Ltd., Tokyo.

Dr. Shiro Koshima (Biology)
Fellowship for Japanese Junior Scientist ; Faculty of Science, Kyoto University, Kyoto.

Dr. Takeshi Ota (Hydrology)
Research Associate ; Faculty of Agriculture, Iwate University, Morioka.

Mr. Hajime Iidea (Glaciology)
Post graduate student ; Water Research Institute, Nagoya University, Nagoya.

Dr. Hideki Motoyama (Hydrology)
Post graduate student ; Institute of Low Temperature Science, Hokkaido University, Sapporo.
Ms. Yuki Morinaga (Climatology)
Post Graduate Student ; Institute of Geoscience, University of Tsukuba, Tsukuba.
Mr. Katsumoto Seko (Meteorology)
Post graduate student ; Water Research Institute, Nagoya University, Nagoya.
Mr. Katsuhisa Kawashima (Glaciology)
Post graduate student ; Institute of Low Temperature Science, Hokkaido University, Sapporo.
Ms. Ayako Sadakame (Tibetologist)
Lecturer ; Institute of Asian Studies, Asian University, Tokyo.
(Nepalese member)
Mr. Om Ratna Bajracharya, (Hydrology)
Junior Scientist ; Department of Irrigation, Hydrology and Meteorology, Ministry of Water Resources, Government of Nepal, Kathmandu.
Mr. Naveen Ratna Tuladhar (Meteorology)
Lecturer ; Department of Meteorology, Tri-Chandra campus, Tribhuvan University, Kathmandu.

II. Sino-Japan Joint Kunlun Expedition 1985.
(Chinese scientific members)
Mr. Zheng Benxing (Leader, Glacial geomorhology)
Professor ; Lanzhow Institute of Glaciology and Geocryology (LIGG), Lanzhow, PRC.
Mr. Li Shude (Cryopedology)
Associate Professor ; LIGG.
Mr. Zhang zhengshuan (Glaciology)
Researcher ; LIGG.
Mr. Zhang Wenjing (Glaciology)
Researcher ; LIGG.
(Japanese members)
Dr. Okitsugu Watanabe (Glaciology)
Dr. Masayoshi Nakawo (Glaciology)
Associate Researcher ; Faculty of Engineering, Hokkaido University, Sapporo.

Acknowledgments

We would like to express our thanks to Dr. S. P. Adhikary, Dr. Kiran Shankar and Mr. N. N. Vaidya, Nepalese counterpart officers of this project, (Department of Irrigation, Hydrology and Meteorology, the Ministry of Water Resources, His Majesty's Government of Nepal).

We are indebted to Prof. S. R. Chalise (ICIMOD, Tribhuvan Univ.), T. Mochida (the Embassy of Japan, Kathmandu) and his staff, Mr. D. D. Mulmi and Dr. B. P. Upadhyay (Tribhuvan University). Our particular thanks are due to the staff of the Hydrological section for their cooperation in the field observation of the Langtang Himal. We are very much obliged to the people of Langtang village and the Sherpa people who helped this project in Nepal.

For the Sino-Japan joint scientific expedition to the Kunlun Mountains, we would like to express our sincere thanks to Prof. Xie Zichu, Director of Lanzhou Institute of Glaciology and Geocryology, Academia Sinica for the special consideration given to the organization of this expedition. Our particular thanks are due to the Chinese logistic members of this expedition.

The expenses of this project, the research work and publication were supported by a grant-in-aid for Science Research from the Ministry of Education, Science and Culture, Japanese Government.

List of the publications relevant to the project
Glaciers and Climates of Nepal Himalayas, Report of the Glaciological Expedition of Nepal, Part I, special issues of Vol. 38 of "Seppyo" (Journal of the Japanese Society of Snow and Ice), ed. K. Higuchi, 1976.
Same title as above ; Part II, special issues of Vol. 39 of Seppyo, ed. K. Higuchi, 1977.
Same title as above ; Part III, special issues of Vol. 40 of Seppyo, ed. K. Higuchi, 1978.
Same title as above ; Part IV, special issues of Vol. 41 of Seppyo, ed. K. Higuchi, 1980.
Glacial Studies in Langtang Valley, Report of the Glacier Boring Project 1981-82 in the Nepal Himalaya, Publication No. 2, Data Center for Glacier Research, Japanese Society of Snow and Ice, ed. K. Higuchi, 1984.

References

Fukushima, Y., Kawashima, K., Suzuki, M., Ohta, T., Motoyama, H., Kubota, H., Yamada, T. and Bajracharya, O. M. (1987) : Runoff characteristics in three glacier-covered water sheds of Langtang Valley, Nepal Himalayas. Bulletin of Glacier Research, **5**, 11-20.
Takahashi, S., Motoyama, H., Kawashima, K., Morinaga, Y., Seko, K., Iida, H., Kubota, H. and Tradahr, N. R. (1987) : Meteorological features in Langtang Valley, Nepal Himalayas, 1985-1986. Bulletin of Glacier Research, **5**, 35-40.

Yala Glacier and Langtang Valley, in the
Nepal Himalayas

Kangja La. from the Yala Glacier

Kunlun peak (7167m) the highest mountain
in the West Kunlun Mountains

Chongce Flat - top Glacier from B. C. 2
in the West Kunlun Mountains.