New Research on High Asia, Tibet and the Himalayas

The International Symposium on Tibet and High Asia on Oct. 8–11, 1985 in Göttingen

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In the Institute of Geography of the University of Göttingen on Oct. 8–11, 1985, the International Symposium on Tibet and High Asia took place under the auspices of the president at which 54 scientists from 12 countries participated – Canada, Japan, China, Korea, England, Switzerland, Austria, Poland, France, Australia, India and Germany. The author of this report, M. Kuhle, was the organizer. The occasion of the symposium was the 2nd Sino/German Joint Expedition to S Tibet and the N slope of Mt. Everest in 1984. The results of the expedition conducted by Wang Wenying (Institute of Glaciology and Cryopedology, Academia Sinica, Lanzhou, People's Republic of China) and M. Kuhle (Göttingen, FR Germany) were presented by a group of specialists and interested scientists and were discussed in the framework of other research on High Asia.

Following the welcoming addresses, the report on the route, logistics and research of the undertaking from Aug. 12 to Nov. 20, 1984, was presented by the German expedition director. Geomorphological, glaciological, paleoclimatological, climageographical and vegetation studies were carried out from 1800 m elev. to over 8000 m elev. The 1984 expedition is a part of the expeditionary research on High Asia carried out by Göttingen since 1973 and should be extended and intensified into regions not yet studied.

The first point of emphasis at the symposium was recent and Pleistocene glaciation (session directed by J. Hövermann, Göttingen). Wang Wenying (Lanzhou, China) reported on the glaciers in SW Tibet and the recent and subrecent changes. Debris-covered glacier tongues are very stabile, whereas changes in balance over years to a few decades are expressed by shifts in the extension of ice pyramids. The N glacier of Everest, the central Rongbu glacier, has shown a tendency of retreating from 1920–1980, whereas the zones of ice pyramids of other glaciers have advanced 13 to 75 m since 1974–1979.

M. Kuhle presented measurements of the movements of the Rongbuk glacier taken with a new method. With an active infrared measuring instrument exact measurements down to 0.5 mm were obtained. The measurements allowed an exact differentiation of moving and static ice. With this same method solifluction movements of 4–8 cm/yr were measured on the valley slopes (inclined 33°–45°) at 5300 m elev. In addition, the values of 2.5–4 m/yr for ablation were registered in firn and glacier ice at the snowline level (5800 m).

W. Kick (Regensburg, FR Germany) (session chaired by P. Höllermann, Bonn) presented studies on the Sachen glacier on Nanga Parbat in a comparison with pictures and maps of the debris-covered tongues. He deduced only small changes in the Sachen glacier for the periods following 1856 and the turn of the century, whereas substantial reductions in thickness of most other Nanga Parbat glaciers are known for the past 130 years. Methods of dating and causes for the differing glacier behavior were also discussed.

Zheng Benxing (Lanzhou, China) reported (in a session directed by K. Heine, Regensburg) on historical to Pleistocene glacier margins from the S and N slopes of the Xixabangma massif. Since absolute datings on paleosoils and limnic sediments are still lacking, a quadripartite glacial and interglacial phase model was proposed. During the discussion the idea was expressed that the moraines here could represent a much younger and shorter time span, i.e., since the last ice age and during late-glacial times.

Y. Ono (Tsukuba, Japan) showed a late-glacial to historical moraine sequence from the Langtang Valley (Nepal Himalayas), in which he was able to date neoglacial glaciation levels of 3000–4000 BP using C14 analyses. He designated 1815 as an historical high point of glaciation. The lowest moraines were found at 2500 m elev. In the discussion these moraines were thought to have been developed at altitudes too high for the high glacial times.

N. E. Odell (Cambridge, England) reported (in a session directed by H. Hagedorn, Würzburg) on the classic Mt. Everest expedition of 1924 on which he participated as geologist and mountain climber. The material he presented for comparison with the observations of the Sino/German joint expedition 60 years later was of great documentary value.

M. Kuhle calculated a snowline depression of 1200 m using erratics, moraines, glacial striations, outwash aprons, alluvial plains and varved clay in the 1984 expedition region. Together with the snowline depressions of 1100 m to 1500 m from the areas studied on expeditions since 1976, this means that the snowline exceeded below the average plateau level on a NS profile through Tibet.

Hence, this indicates that High Tibet was covered with 2–2.4 mill. km^2 of inland ice. In addition to the Tsaidam depression only the Tsangpo valley and adjacent basins remained free of ice. Detailed measurements of global radiation between 5000 and 6650 m elev. evidence that 3 to 4 times the amount of radiation is encountered at high elevations in subtropical latitudes compared with the latitudes around 60°. Radiation measurements show that snow reflects a maximum of 95 % of the radiation, whereas glacial debris and moraine material only reflect ca. 20 %. Thus, during the Pleistocene the area of High Tibet which now acts as a heating surface most probably changed to a cooling surface with regard to the atmosphere. This surface must have had a heat loss which would be four times that of a glacier surface of equal size at 60° latitude. A new concept for understanding the development of the ice age is given by an 'auto-cycle' hypothesis; the location of the Tibetan plateau surface within the scope of an early-Ice Age snowline depression started a self-boosting process which actually triggered the Ice Age.

The reduction in temperature of 3°–4°C explained by changes in the earth's orbit initiated sudden glaciation over large areas of Tibet. The resulting increase in albedo led to an autointensification and to the final change from a heating to a cooling surface through the formation of an inland ice in Tibet. This then had an additional influence on the formation of inland ice in the north.

Hereby, the theory that a low-latitude plateau of large size extending above the snowline is introducted as the trigger for the cooling of the planet.

The discussion of findings and of this theory concentrated on the question of the age of maximum glaciation in Tibet. K. Heine suggested that such a cooling mechanism would be 30,000 to 40,000 years old.

H. Heuberger (Salzburg, Austria) (session chaired by M. Kuhle) proposed, based on moraines, that valley glaciation extended down to at least 2500–2450 m elev. on the S slope of the Mt. Everest group, from which a Pleistocene snowline depression of ca. 1200 m can be calculated compared with recent glaciers. He also maintains that the ice margins could have reached down even further. The discussion yielded that the 1984 field work confirmed the findings of snowline depressions which were worked out in 1976 and 1977 in the Dhaulagiri and Annapurna Himalayas.

J. Hövermann (Göttingen) proposed a classification of Tibetian lakes based on field studies in NE Tibet and posed the question of whether they could be related to glacial erosion. Such a relationship is supported by the concentration of lakes in areas of former glaciation centers with particularly intensive and long-lasting glacial

excavation. Overdeepened basins in bedrock, the obtuse contour lines and finger-shaped, elongated lake forms and loess deposited in lake basins were interpreted as only being able to have a glacial origin. Chinese datings of 10,000 to 20,000 BP on the lake sediments in question evidence the young age of these lakes corresponding with this view. In the discussion it became clear that alternative explanations of these forms are lacking.

(Session director – R. Raynal, Strasbourg, France) J. Röthlisberger (Aarau, Switzerland) presented radium-carbon datings of postglacial glacier sites from Karakorum and the Himalayas. As shown in the discussion, datings of this type always have a certain amount of latitude in their interpretation. The value of this contribution lies in the collection of data in the mountains of High Asia which are very difficult to reach and have been previously hardly studied, and in the start of a comparative ice age chronology for this region.

M. Fort (Paris, France) reported on the development of terrace landscape in the Pokhara basin combined with studies of earlier authors (1970s) on glaciofluvial outwash plains on the S slopes of the Himalayas (Annapurna group). Through the apparent inconsistencies in datings it became clear that recent debris flows and mudflows from higher glaciogenic deposits did reach the deeper valley floors of diamictite in the Himalayan foothills. This example demonstrates that very young sediments of another kind can be intercalated with the late-glacial, well-sorted terrace deposits.

The session on rapid dry and wet mass movements (directed by H. Blume, Tübingen) was began by Xu Taoming (Lanzhou, China) with a contribution on recent debris flows in the catchment area of the Bo Chu (Sun Kosi) in the W Rolwaling group. The previous presentation on the Annapurna S slope was clearly confirmed with respect to rapid alluvial displacement of subrecent moraine material from the zone of the recent glacier termini down to the level of the valley floors below 1800 m elev.. The recent large-scale debris flow in August 1981 took over 100 human lives and attained a maximal flow of about 16,000 m^3/sec. The impounded morainal lake of the Zhang-zangbo glacier broke loose, and the subrecent moraines deposited in the upper part of the Phoda Kosi valley were picked up and transported with the water. The accelerating bottle-neck effect of ravines and gorges allowed the mudflows to even shoot decameters out of the main valley. In the discussion the possible causes of morainal lake breaks like glacier collapse or the breakout of water collected in large intraglacier caverns were considered.

Li Jian (Chengdu, China) emphasized the significant relief energy of the Tibetan plateau and its surrounding mountain systems as important risk factors of the numerous natural disasters of High Asia. Debris flows and mudflows are the primary dangers, followed by flooding, landslides and rapid glacier advance (surges). In the discussion it was pointed out that one major condition for mass movements is the glacial deposition of moraines and the existing *in situ* weathered material.

H. Kienholz (Bern, Switzerland) demonstrated the risks of erosion and slope instability in the Lower Himalayas (the Kathmandu-Kakani region) between 1100 and 2400 m elev. and compared them with those in the Khumbu Himalayas between 2200 and 6000 m elev. The special mappings showed the greater instabilities in the more heavily populated hill country. The cause is the deep regolith. In the higher regions of the Khumbu Himalayas there is contrarily a lower regeneration potential.

In the session on solifluidal processes and forms (directed by H. Heuberger, Salzburg) G. Furrer (Zürich, Switzerland) talked about solifluidal land forms in the Braldo and Biafo valleys in Karakorum and presented a hypsometrical classification of the subnival level. Permafrost was confirmed at 4500 m elev. with N exposure and at 5100 m elev. with S exposure. The finds of macro-patterned ground at 36°N, as also encountered in the Arctic (Spitzbergen), are of principle significance. This supported the idea that subtropical and, in this case, even semiarid regions are in no way exempt from an intensive periglacial formation.

In the discussion numerous examples of macro-patterned ground in High Asia were cited in confirmation – in part, even associated with pingo and frost-crack systems.

J. P. Chattopadhyay (Darjeeling, Sikkim) presented observations from the much more humid Sikkim Himalaya of the Kangchenjunga region. In his opinion, the solifluidal-periglacial inventory of small-scale forms are surprisingly sparsely developed. Insofar as the disadvantage of the relief (strong linear erosion and steep slopes) can be disregarded, it appears, as realized in the discussion, that in the Himalaya system there is a periglacial intensification of formation from E to W.

On the history of Quaternary landscape (in a session led by J. Hagedorn, Göttingen) St. A. Harris (Calgary, Canada) reported on the reconstruction of a large subrecent lake in the W foreland of the Zagros system. The spread of this limnic formation 8000 years ago was proven using evaporites. The necessary period of humidity during late-glacial times could be climatically related to the substantiated subrecent mountains glaciations in Iran.

A 3-dimensional structure pattern of geomorphological levels was given by R. Raynal (Strasbourg, France) from the central and E Elburz Mtns. Both the E-W and meridional change in forms superimposed by local climatic effects led to asymmetries, anomalies and shifts in the semiarid hypsometrical pattern. The climate-genetic and orographical relationship to the marginal Tibetan mountains became clear. The question of the demarcation of the corresponding regions of summer precipitation and mountain groups of higher humidity was then raised.

The session on weathering and climate (directed by J. Borchert, Hamburg) began with observations and measurements from the 1984 expedition by M. Kuhle. The data were collected with J. P. Jacobsen (Göttingen) using instruments made available by various companies. The irradiation value of 1100–1300 W/m^2 which lie near the solar constant and were recorded between 5000 m and 6650 m elev. were of substantial importance. The measured differences in albedo of between 10 %–25 % on dark alluvia and alpine meadows and up to 95 % in the firn areas had great energetic consequences for the atmosphere during the high Ice Age glacier cover. The systematic soil-temperature measurements, which are important for periglacial processes, evidence a 4–5-month freeze-thaw period per year in the near-surface detrital layers at 5200 m elev. An absolute 0°C boundary at 7200 m elev. was set using telemetric surface temperature measurements (1800 values) taken between 4000 and 8848 m elev. on the mountain slopes. The boundary was calculated using regression and correlation analyses. An upper glaciation boundary observed at this altitude is related to year-round temperatures which are too low for a rapid snow-ice metamorphism. The dry, very cold snow of this pergelic level is blown like sand from the steep slopes. The exceptions are the stable leeward slopes whose uninterrupted snow accumulation enables the slowly progressing pressure metamorphism and molecular diffusion.

Z. Szarejko (Bielsko-Biala, Poland) gave a comparative report on surface ablation and heat transfer in near-ground air layers at measuring stations in the Mittelgebirge (Riesengebirge, Karkonozse) and in the Hindukush (Kohi Baba massif).

(Session directed by St. A. Harris, Calgary) K. Hormann (Kiel) presented computer maps of the precipitation distribution in the W central Himalayas (Dhaulagiri and Annapurna regions). They were produced with a multiple regression model with 21 topographical variables. Based on statistical interpretation and extrapolation, averages of 8000 mm/y and more were postulated for the S slope of the area studied which greatly exceed those from the measuring stations of max. 6000 mm/y for several places. Considering the lack

of measuring stations, the method used proves to be of importance for future climate-oriented research in high mountains and High Tibet.

A. Kessler (Freiburg, FR Germany) reported on the South American altiplano for comparison with Tibetan conditions. This is also a high-elevation, energy-conversion surface in a climate at low latitudes, though in the S hemisphere. The problem of the periodicity of the fluctuation in the surface level of Lake Titicaca and of the water quantity at the time of the late-glacial Cauca lake were discussed.

The session on vegetation (led by H. Freitag, Kassel, FR Germany) began with a lecture by Huang Rongfu (Xining, China) on the flora of the S slopes of Mt. Everest and Xixabangma with the results of the 1984 expedition. Of the 5913 vascular plant species which have been identified in Tibet, Huang Rongfu encountered 1636 of them in the area studied. There the most significant families are the Compositae and Rosaceae. 41.7% is made up of the arctic-alpine and temperate flora alone. Only 2.7% are endemics which is explained by the geologically young age of the high mountain area.

G. Miehe (Göttingen) presented further results of the 1984 expedition with emphasis on the relationship of vegetation to morphodynamics and anthropogenic degradation along four profiles. Regarding the climatic history there is an interesting change from uninterrupted alpine mat cover (Cyperaceae with *Kobresia*) to discontinuous mat cover during the last century. Wind and solifluction hinder the regeneration of turf so that fields of frozen ground form. The upper boundaries of vegetation climb about 400 m from the windward slopes of the Mt. Everest region to its leeward side N of the main summit. Caryophyllaceae *Arenaria bryophilla* extends up over 6000 m elev.

J. Poelt (Graz, Austria) dealt with the distribution and locality conditions of crustose lichens in the high Himalayas. The genus *Lecidea* as the highest lichen occurrence, was found up to 7100–7200 m elev. on the S face of Makalu by a Jugoslavian mountain climbing expedition. In the author's opinion (Kuhle) these finds must be regarded as particularly important because they show that crustose lichens reach their upper boundary in the zone of the upper boundary of glaciation. This confirms the relationships with the absolute 0°C boundary which appears to have been reached here because the vital moisture is lacking.

D. Schmidt-Vogt (Merzhausen, FR Germany) described the inventory of the high forests in Jugal-Himal (central Himalayas). The inventory analysis enabled the study of the anthropogenic influence and the understanding and prognosis of its tendencies.

C. Kleinert (Hagen, FR Germany) delivered the last contribution on settlements and cultural-geographic levels in the W Nepal Himalayas. A look at the living conditions of the people in the Himalayas is obligatory at the conclusion of a conference on physical geography. Rural culture here is influenced by the natural environment in an extreme way. This is seen for example in the types of housing, as in the transition from gable roofs on the monsoonal windward side of the Himalayas to the flat roofs on the leeward side of the main summit.

The organizers intentionally did not turn down any of the submitted contributions for the sake of freedom in scientific research, as far as the relevant regional thematic of a High Asia and Tibet symposium allowed. This margin of freedom enabled the presentation of a diversity of new results and interpretations, possibilities of comparison and stimulation for future research in this still little known region. Above all, the possible key role of paleoclimatology came into view for future research, particularly with respect to the development of the ice age in the highest mountain areas of the earth. This was one of the main concerns of the organizers.

The program offered the possibility for international scientific contact and personal and professional encounters. The symposium participants accepted an invitation from the mayor of Göttingen in the old city hall and then gathered for a reception at the Institute of Geography. The film 'The 1984 Mt. Everest Geography Expedition. Geomorphological, Climatological and Glaciological Research in Southern Tibet' (M. Kuhle, author) was then shown. The film was produced in cooperation with the Institute for Scientific Films (IWF Göttingen).

The publication of the symposium papers and the results of the 2nd Sino-German Joint Expedition to S Tibet and the N flank of Mt. Everest 1984 is planned in two volumes of the *Göttinger Geographische Abhandlungen*.

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