ANCIENT PAPER OF NEPAL

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Results of ethno-technological field work on its manufacture, uses and history – with technical analyses of bast, paper and manuscripts

JESPER TRIER

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Thor A. Bak
Dekan

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Preface

A great number of libraries and museums all over the world possess Asian manuscripts, block-printed books and other written or printed items, on paper, palm leaves, parchment, metal tablets etc. Their texts and scripts have, to a large extent, been studied and published, but the actual writing materials have only rarely been closely examined, and hitherto no systematic investigations of this subject covering a specific area in Asia have been undertaken.

The present work deals with the history, manufacture and uses of writing materials – mainly paper – in the Himalayan kingdom of Nepal, and is based on three journeys in Nepal and intervening studies. The primary aim of the research has been to make it possible to date and place manuscripts in all those instances where the text or script does not yield sufficient information on provenance. Such investigations are all the more important as manuscripts from Asia do not generally state their origin. Well-known examples are the big collections from Chinese Turkestan (among others the famous Tun-huang collections) which are by far our most important sources on the early history of Central Asia. Systematic technical investigations of the writing materials, predominantly paper, will substantially help to establish the origin of these heterogeneous collections of manuscripts. Such data also bring to light all sorts of information relating to cultural history, such as the development and diffusion of various handicrafts – even the relations between ethnic groups and their migrations.

Only when detailed paper-historical information from greater parts of Asia has been gathered and worked up, will technical investigations of writing materials be a must for librarians and others concerned with such items. It is my hope that the present book may encourage others in research of this kind.

In the first place I wish to express my sincere gratitude to rigsbibliotekar Palle Birkelund, cand. jur. Estrid Bjerregård and konservator Ove Nordstrand, *Det kgl. Bibliotek*, for their encouragement and support for my research. I also wish to thank *Videnskabsfonden* for granting to *Det kgl. Bibliotek* a substantial part of the means to carry out the investigations as well as *Dansk Ekspeditionsfond* and *De Forenede Papirfabrikker* A/S, for supporting my stay in Nepal.

A special debt of gratitude I owe to dr. phil. Erik Haarh for his many-sided theoretical and practical advice and to my father for reading the proofs.

Many institutions and private persons have kindly placed their knowledge, collections or laboratories at my disposal. In Copenhagen especially: museumsinspektør Werner Jacobsen, *Nationalmuseet;* professor dr. phil. Johannes Nicolaisen, *Institut for Etnologi og Antropologi;* Mr. Tarep Tulku Ngawang Losang Tashi Rabtan; civilingeniør Erik Flindt Kruse and the staff at the central laboratory of *De Forenede Papirfabrikker;* professor dr. phil. Tyge Böcher and cand. mag. Hans Tybjerg, *Institut for Planteanatomi og Cytologi;* lektor Bertel Hansen, *Botanisk Museum*; dr. med. Claus Brun, *Kommunehospitalet.* In Aarhus: professor Halfdan Siiger, *Institut for Religionshistorie,* and museumsinspektør Poul Kjærum, *Forhistorisk Museum, Moesgård.* Finally dr. Marianne Harders-Steinhäuser, *Institut für Cellulosechemie mit Holzforschungsstelle der Technischen Hochschule Darmstadt,* and A. W. MacDonald, *Musée de l'Homme,* Paris.

Last but not least I which to thank my Nepalese friends, who have been of great help in different ways by sending samples and information on paper-making. They are Mr. Purna Harsha Bajracharya, Chief Research Officer, *Department of Archaeology* in Kathmandu; Sherpa Urgen, Kalimpong, my travelling companion for three months, and Sherpa Lobsang Tenzing and his family, Kathmandu. Particular thanks are due to Mr. G. B. Shah, Kathmandu, who besides having collected plants etc. has taken the trouble to answer endless questionnaires.

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Introduction

The art of making paper has been of the greatest importance to every culture possessing a script. Only with this material has the effective spread of knowledge to great numbers of people become possible, since no other material has proved so cheap and so suitable for both writing and printing. The study of the migration and use of paper is therefore of considerable interest for the history of civilisation.

Paper-making developed in China about two thousand years ago, and attained a high degree of perfection only a few centuries later. It was, however, a long time before the outside world learned to produce paper, presumably because the Chinese endeavoured to keep their valuable knowledge secret. Paper-making did not reach Japan until the beginning of the 7th century, and the eastern parts of the Arabian empire (Samarkand) until the middle of the 8th century, while in Europe it arrived at late as the 11th century.

The spread of paper-making westwards through Chinese Turkestan along the "Silk Road" has been fairly thoroughly investigated. But its migration south and southwest towards Further India, Tibet and the Himalayan states remains but little explored. Yet because of the isolation of these regions until recently, some primitive methods of production have survived that presumably differ only sligthly from the oldest Chinese ones, and may therefore throw light upon the origins of the craft in China. Moreover, the isolation has caused a number of interesting and ancient uses of paper to be preserved in Further India, Tibet and the Himalayan states.

The object of the investigations

1) The technique of manufacture. The main purpose of my travels in Nepal was to trace and to study in detail the age-old techniques of paper-making before they disappeared entirely. As a result of the Chinese occupation of Tibet in 1959 the paper-makers in Himalaya have lost their most important customers, and in Tibet production has practically stopped. Even in the most isolated valleys of Nepal, Bhutan and Northern India, machine-made paper is superseding handmade.

2) Research on the history of paper. Before the 7th century the Tibetans were probably already importing paper from China, and according to the Imperial Annals (cf. for example Pelliot, 1961, p. 6) the Tibetan king Srong-btsan-sgam-po asked the Chinese shortly before A. D. 650 to send paper-makers in order to teach the Tibetans how to produce their own paper. It appears from manuscript finds and various texts that only two hundred years later paper-making in Tibet was quite common. But very little is known to this day about how the art spread in Tibet and Himalaya. However, by subjecting the fairly numerous manuscripts and printed books from the area to a series of systematic investigations, it is possible to trace when and whence the various districts learned the craft, and how the techniques of paper production and book-craft have developed.

3) Determining the origins of books. Manuscripts and printed books provide us with our most important source of knowledge about the past of the Himalayan states, indeed of all Central Asia, largely because archaeological, ethnographical and linguistic investigations have been restricted by the inaccessibility of the area. Old books from Asia, however, are mostly without indications of either date or provenance. In such cases it is necessary to investigate text, script, place of purchase etc. in order to determine age and origin; yet even on the basis of such criteria doubts will still as a rule persist. For example, the text may be old and widely diffused or exist only as a fragment, or both script and colophon may have been copied from an older model. It is then necessary to examine the miniatures, the pagination, the framing of the text, the shape of the book, as well as the materials used, not only for the leaves but also for ink, colours, binding etc.

Most of the books preserved from the Himalayan states and Tibet are of paper. Even within this comparatively limited area raw materials, the method of production and the subsequent treatment of the paper show great variation with reference to time and place. Therefore a series of special paper analyses can decide—at any rate approximately—the origin of books and other objects of paper from the area, provided that the investigations mentioned under items 1 and 2 above have already been undertaken.

4) Cultural and historical information. Knowledge of the production and use of paper in Tibet and the Himalayan states may also throw new light on the little known cultures that grew up between the cultural centres of India and China. At the beginning of our era a highly developed society already appears to have existed in the Kathmandu Valley in Nepal, thanks to the ideal climate and the valley's position on one of the most important caravan routes between India and Central Asia. Furthermore, several small states came into existence at an early date in Southern Tibet and were united into one large state in the 7th century. This was the beginning of the unique Tibetan culture, which in the course of time spread widely in Central Asia. Bhutan and Ladakh should also be mentioned in this context: both old states with a predominantly Tibetan culture.

It should be emphasised that in Tibet, the Himalayan states and India there has been a close connection between the spread of paper-making and the migrations of those people who make paper; for this reason research into the history of paper may indirectly yield information about racial migrations, and at the same time reveal long-forgotten cultural contacts. The art of making paper is only one among many skills that reached Tibet and the Himalayan states from China. Architecture or metalwork, for example, could also be subjects of studies similar to those of the present work.

The present work

After the opening of the frontiers of Nepal to Westerners in the 1950's, it became possible to study the manufacture and use of paper in an important part of the Himalayan range, and for this purpose I stayed in Nepal for six months in 1964 and two months in 1970. The present work deals exclusively with the production, use and history of paper in Nepal. During the studies it emerged, however, that the development of paper in Nepal, as well as in the rest of Himalaya, can only be satisfactorily explained if the broad outline of that in India and Tibet is known. The results of my investigations concerning these broader aspects of the subject are included in this work only insofar as they pertain to Nepal.

From the very start it has been my aim not only to treat the topic from a narrowly technical point of view, but also to relate the results obtained to the geography, peoples and history of Himalaya, realising that otherwise much would remain unexplained or be liable to misinterpretation.

Material

1) Literary sources concerning:

a) The flora, peoples, communications and history of Himalaya.
b) Paper-making: the plants used, methods of manufacture, sale etc.
c) The uses of paper, primarily for manuscripts (including mss. from India and Tibet).
d) The anatomy of paper fibres and methods of paper analysis, especially microscopical analyses of paper fibres.

The literature dealing with paper-making in the Himalayan states and Tibet is extremely sparse. It is limited to short articles, and brief notes in books and articles on other topics. Brian H. Hodgson's four-page article published in 1832 still represents some of the best that has been written about the process of manufacture and the paper-makers. Also worth mentioning are the articles of W. F. Tschudin in the magazine "*Textil-Rundschau*" (see references

p. 249), which deal particularly with the plant fibres used.

The literature on the use of paper is more ample, but the sources are very scattered. However, manuscripts from Nepal have been thoroughly dealt with in Cecil Bendall's excellent book of 1883 "*Catalogue of Buddhist Sanskrit Manuscripts*".

Technical investigations of Central Asiatic paper are still rare, but attention must be drawn to the works of Julius Wiesner and Marianne Harders-Steinhäuser. They concentrate particularly on microscopical analyses of paper fibres, a technique which till now has yielded most information concerning the origin and production of unknown paper.

2) Investigations in Nepal:

a) Personal records, photographs and drawings of paper-making, as well as notes concerning the use of paper in Nepal.
b) Information about Himalayan paper-making from colleagues and acquaintances in Nepal and Europe.

3) Items for detailed technical analysis, such as plant materials, unused paper and paper in its various uses – particularly manuscripts:

a) Collected personally in Nepal or sent from there or from India.
b) In European collections.

The chapters are arranged so that they may be read independently if desired. Chapters I, IV and VI have general summaries, and V has summaries on mss. (pp. 136, 140 and 144).

Chapter I contains a brief summary of the physiography, peoples, history and communications of Nepal. Besides forming a background for the more specialised information given in the following chapters, this chapter deals especially with the question of when, through which peoples, and in which way the art of making paper entered Nepal.

Chapter II gives a survey of the various species of plants used, with respect mainly to place of growth, special characteristics and local names.

Chapter III enumerates in chronological order the descriptions to be found in the literature on Nepalese paper-making: the methods, where and by whom paper is produced, how it is traded etc.

In chapter IV my own observations from East and West Nepal and the Kathmandu Valley are described, together with material placed at my disposal by Nepalese and European friends. Special emphasis is laid upon the commonest and most widespread method of production, not least because this is most probably the oldest still in existence and not much different from the first Chinese method.

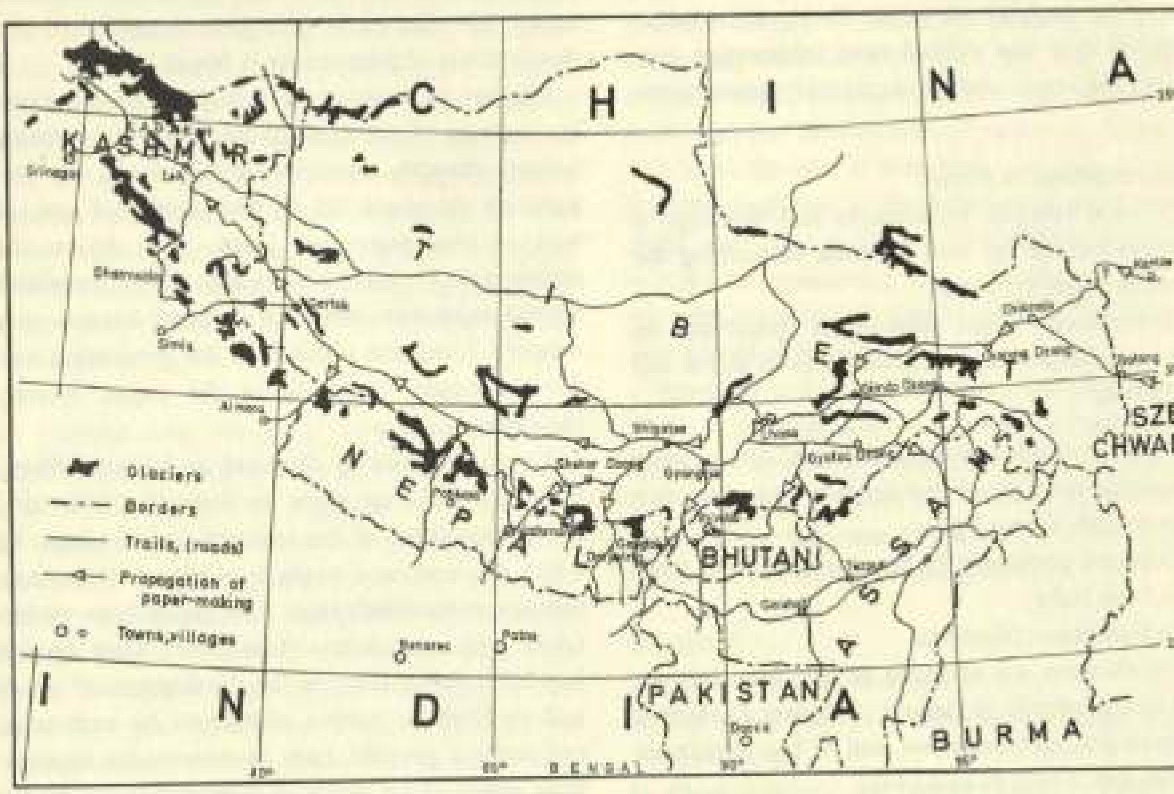
Chapter V enumerates the uses of paper. Particular importance is attached to manuscripts. Text, script, format and make-up are mentioned too, hence this chapter in fact gives a survey of the development of manuscripts in Nepal.

Chapter VI contains the technical analysis. Firstly, analyses of the macroscopic properties (shape, colour, strength, character of fibres and the imprint on the paper left by the mould) of new as well as used paper are given. Then follow the microscopical analyses of paper fibres, to which special importance has been attached, because they supply information about both the production and the subsequent treatment of the paper, thereby indicating its origin.

Finally a series of chemical analyses of fibres, pulp and paper are given, to determine, inter alia, the composition of the colours and coatings by which the untreated paper is rendered fit for use, measurements which have only rarely been undertaken with manuscripts from Asia. They furnish important information on the development of paper and on book production techniques for each area, and make it possible, also, to discover the approximate origin of the paper of manuscripts etc. Moreover, they can disclose additions, forgeries or enable fragments to be correctly determined. Hence the chemical analyses may be ranked with microscopical analyses—hitherto the most important aid in the research on Oriental paper.

The manuscripts dealt with in the text, tables, photographs and microphotographs are arranged in chronological order. As far as possible, the manuscripts and the other applications of paper investigated have been analysed by all the methods described in chapter VI.

Apart from transcriptions of common Asian names I have normally employed the transcriptions used by my sources not least to permit a later recognition of the original words.


C H I N A
KASHMIR
T I B E T
N E P A L
BHUTAN
A S S A
SZE-
CHWAN
I N D I A
PAKISTAN
BURMA
Srinagar
Leh
Simla
Almora
Shigatse
Gyangtse
Benares
Patna
Dacca
Glaciers
Borders
Trails, (roads)
Propagation of
paper-making
Towns, villages

CHAPTER I

Nepal and its People
The Introduction of Paper

Nepal borders to the west and south on India, to the east on India and Sikkim (a Maharaja principality under Indian suzerainty) and to the north on Tibet (China). It is almost rectangular, about 800 km. long and 180 km. wide. The size of the population is not exactly known, but may be estimated at c. 11 million in 1970.

Only a few countries in the world contain such great contrasts as Nepal. In the lowlands of the south there are dense, tropical jungles with a Hindu population deriving mainly from India, while in the bleak, lofty mountains of the north the population is mongoloid and Lamaist. However, the many transitional forms between these two extremes of nature and population make up the main part of Nepal.

A. Geographical Zones

The great difference in height between the Indian lowlands and the Tibetan highlands, and the elongated form of the Himalayas, divide Nepal into a series of long zones running southeast–northwest, each with its particular character (see map at back of book). These may be grouped into 3 main zones which differ widely in climate, vegetation, population and culture.

1. The Lowlands

Terai represents the continuation of the Indian lowlands into Nepal up to an altitude of about 300 m. where the foothills of the Himalayas begin. 28 % of the population of Nepal lives in Terai.

Churia (in India called the *Siwaliks*) comprises the southernmost parts of the Himalayan massif. From an altitude of about 600 m. the terrain rises steeply, and in several places breaks into one or several long, narrow crests running parallel to the southern border and with hilltops up to 1500 m. The crests are separated by valleys of various widths, the so-called *"duns"*. Some of the duns broaden into rather large enclosed areas; they are called *Inner Terai* and are situated at an altitude of about 300 to 600 m. Churia and the Inner Terai are thinly populated; only 6 % of the inhabitants of Nepal live here.

2. The Middle Range

This zone is the area between the lower Terai and Churia and the Great Himalayas. The southernmost part of the Middle Range is *Mahabharat Lekh*, a fairly well-defined mountain range which cuts through almost the entire length of Nepal with peaks of up to 3000 m. With its steep slopes to the south and its smoother gradient to the north this mountain range, together with the unhealthy Terai, makes a formidable natural barrier, which only few armies have been able to force. This obstacle has, moreover, been of paramount importance in the development of a specific Nepalese culture.

The Middle Range is between 60 and 100 km. broad. It lies mainly at an altitude of 600 to 2000 m. and is characterised by rounded mountain chains, often following irregular courses (plate 27). Yet there are also peaks up to 3500 m. high and deep river valleys below 600 m. Almost 60 % of the population lives in the Middle Range, which contains the only two large valley systems of Nepal, the valleys of Kathmandu and Pokhara.

3. The Highlands

The *Great Himalayas* form an irregular, but on the whole southeast–northeast running system, almost parallel to the southern border of Nepal and Mahabharat Lekh. It is easily recognisable by its numerous jagged and snow-clad peaks (plates 20, 21, 38 etc.) which are 5000–9000 m. high.

Big rivers running north–south break through the mountain range in immensely deep gorges. For example, in West Nepal the Kali Gandaki river has eroded a gorge down to 1500–2500 m. between the two 8000 m. peaks, Annapurna and Dhaulagiri, which are only 37 km. apart. Through such gorges age-old caravan roads connect Nepal and India with Central Asia. They are very narrow here and not without their dangers.

Within and to the north of the Great Himalayas, in the area adjoining the northern border of the country, we meet with a series of elevated valley systems, the so-called *Inner Himalaya*. To the east they are of moderate size, whereas to the west they form large isolated and thinly populated areas at an altitude of 2500–5000 m.

Further north the border mountains of the Tibetan plateau form most of the frontier between Nepal and Tibet. On the average they are a great deal lower than the peaks of the Great Himalayas, but constitute the main watershed between the Ganges in India and the Tsangpo river in Tibet. A number of passes lead into Tibet. These passes are nearly all very high and exposed to icy storms most of the year, so the few lower and more convenient passes have played a decisive part in the intercourse between Nepal, India and Central Asia.

B. Natural Vegetation

The vegetation of Nepal is one of the richest and most varied in the world, mainly because altitude, rainfall and radiation are so diverse. Moreover, Himalaya constitutes a corridor for the diffusion of temperate plants and trees from East and West Asia, bordered by tropical India to the south and the cold, dry climate of Central Asia to the north. According to Sasuke Nakao, cf. KIHARA, 1955, p. 76, most species of plants and trees are supposed to have spread from West China, the older region, to Himalaya, the younger region which has been rising ever since the Cretaceous period.

Four zones of vegetation may be distinguished. In Terai and the lower parts of Churia the vegetation may be described as *tropical, moist and evergreen*. Particularly valuable are the *sāl* forests (*Shorea robusta*) which, however, have been almost eradicated in many places. In Churia the undergrowth consists of *sabai* grass, which is sold to India for paper-making.

The next zone is *subtropical and moist*. It comprises parts of Churia, Inner Terai, Mahabharat Lekh and the southern part of the Middle Range. Pine is predominant in the wide range from c. 1000 to 2000 m. Underwood is sparse or totally absent. On Mahabharat Lekh the forest consists chiefly of various species of conifer, oak, rhododendron, poplar, walnut, alder and magnolia.

The vegetation changes and becomes *temperate and moist* in the higher parts of the Middle Range and near the border of the highlands at about 2000 m. Up to 3000–3500 m., besides different hardy evergreen trees such as rhododendron and bamboo, there are many kinds of oak, maple, larch, kail (*Pinus excelsa*), spruce (*Picea morinda*), fir (*Abies pindrow*) and birch (*Betula utilis*). This zone is characterised by the variety of its species, a dense jungle-like undergrowth, and also by splendid and gigantic trees even at altitudes above 3000 m. The attitude of about 3500 m. in the east and 3000 m. in the west, where the rainfall is far less, represents the upper limit of shrubs of the Thymelaeaceae family, from the inner bark of which paper is made in Nepal (the 3000 m. contour is indicated in the map at the end of the book). North of this contour i.e. at higher altitudes, paper is seldom made in Nepal. Up to the tree limit at 3500–4300 m. the woods consist mainly of pine, birch, various species of rhododendron and juniper shrubs.

The fourth vegetation zone is *alpine* and stretches from 3500–4300 m. to 4500–5500 m. The only trees growing here are small stunted ones, or low bushes of rhododendron and juniper, and they can only be found in particularly well sheltered places. At this altitude extensive areas are covered by a grass-like vegetation well suited for the grazing of yak and sheep. However, the rainfall in Northwestern Nepal is in many places so slight that mountain valleys are reduced to deserts (plate 26). Above c. 4000 m. permanent habitation is quite exceptional, but it can occur, as in the Dolpo district in the northernmost part of Nepal.

Altogether about one-third of Nepal is covered by forest, but the rapidly increasing population and the resulting felling and burning of trees to provide more farm land represent a serious threat to the forests of the country. Excessive felling of trees has furthermore resulted in a fatal erosion which has impoverished the soil and caused flooding. To meet these dangers the government has introduced very severe restrictions concerning wood cutting, as a result of which the paper-makers in many places have been forced to cease their work.

C. People

In Nepal no palaeolithic finds of stone tools or the like have yet been discovered, but researches in this field are still in their infancy. In other words, we do not know whether Nepal was already inhabited many thousands of years ago. Through the ages Nepal has been peopled from India by Dravidians, Mundas etc., people with both negroid and caucasoid features, and then by the Indo-Europeans. A number of mongoloid tribes came from Tibet, and in East Nepal even people with Indo-Chinese features are found. A series of transitional forms have thus arisen, but the enormous differences of altitude and the very difficult conditions of transport have contributed to the preservation of a colourful variety of ethnic groups.

1. Ethnic Groups

In Nepal we find at least a score of groups which, with regard to physiognomy, language, and spiritual and material culture as well as location, differ so greatly that they are thought of as different peoples. Every Nepalese is not only well aware of his position in these groups, but normally also knows his subgroup, whether it be clan or caste. Even to Westerners the differences between many of the groups are often quite obvious. At the same time, however, it must be stressed that there are diffuse transitions; appearance and dress are not such reliable indications as they may at first appear.

The most important ethnic groups arranged in 4 main groups are:

I. Indian, Kumaon.
II. Brahman, Chetri, Thakur.
III. Newar, Sunwar, Rai, Limbu, Tharu, Tamang, Magar, Gurung.
IV. Bhotia, Sherpa, Thakali.

Furthermore, there are small low-caste occupational groups dispersed over most of the country, consisting of tailors, musicians, blacksmiths, potters, sweepers, shoemakers etc., who look much like Indians. Moreover there are small groups of short people of dark complexion, but with marked mongoloid features (plate 31), who speak Tibeto-Burman dialects. Until recently they were hunters and gatherers, who lived in foliage dens or caves or under overhanging rocks. They are often spoken of as the last remnants of the aborigines of Himalaya (cf. e. g. HODGSON, 1874, part II, pp. 45–54). To-day they have settled as farmers like the neighbouring peoples.

Finally there are a number of mixed groups, each consisting of intermarried couples from two of the groups, and their descendants. In the lower Hindu areas such alliances are very rare, whereas they are quite common in the Lamaist highlands (e. g. Tamang—Sherpa).

2. Dispersion

Ethnic groups of mixed, yet predominantly Indian appearance and origin, main group I, occur in Terai and along the western border towards Kumaon. In main group II, "southern" features predominate in the Chetri and especially the Brahman group (see plate 29), while in the Thakur group "northern" features are equally represented. These three groups are to be found in Terai, and in the lower parts of the Middle Range below c. 2000 m., where they are the latest settlers.

The ethnic groups belonging to main group III were established earlier. Here the mongoloid features are more pronounced: most marked with Tamang and least with Tharu. Apart from Tharu, who now live in Terai, all the other groups inhabit the Middle Range and the lower parts of the highlands, at altitudes of c. 600 to 2700 m.

Finally we have Bhotia, Sherpa and Thakali, main group IV, of predominantly Tibetan culture and origin. They almost exclusively inhabit the higher valleys of the Great Himalayas and the regions north of it, i. e. between c. 2000 and 4000 m.

As already suggested, each ethnic group prefers a definite level of altitude. The horizontal dispersion of these groups is therefore rather complicated, because even locally their distribution reflects the remarkable variations in height which characterise the Nepalese landscape.

3. Migration from the North and South and the Formation of the Ethnic Groups. Religion

The first inhabitants of Nepal were presumably primitive hunters, whose origin is unknown. At a very early date mongoloid people seem to have forced their way over the Himalayan passes into Nepal, attracted by its fertile areas and its agreeable climate. Unrest in their native countries and military expeditions have also sent many people down to Nepal. The numerous people in main group III are the descendants of early immigrants from the north, who mingled in various degrees with already established tribes and immigrants from the south. Bhotia and Sherpa belong to the most recently established peoples in Nepal, and they have not mixed with the groups to the south of the Great Himalayas to any noteworthy extent.

The immigrants from Tibet brought with them the age-old Shamanism of Central Asia. Significant survivals of this and other folk religions still flourish in Nepal (*Jangrism*, *Bonism* etc.) especially in isolated regions. *Buddhism* reached Nepal, first and foremost Terai and the Kathmandu Valley, from the south about the beginning of our era. In its older form it has practically died out in Nepal. Most Newars still call themselves Buddhist, but in fact they have to a large extent adapted themselves to Hinduism (cf. for example SNELLGROVE, 1957, chapter III).

Only quite late, from A. D. 800 to 900, did Buddhism begin to gain a firmer foothold in Tibet, yet many years were to pass before Tibetan Buddhism, synthesised with Shamanist beliefs into *Lamaism*, penetrated Nepal. To-day Bhotia and Sherpa are Lamaists, as are sections of Thakali and of main group III.

The immigration and building up of the Thakur, Brahman and Chetri groups (main group II) from the south was a consequence of the subjugation of the Indian Hindu states by Mohammedan armies. The last Hindu kingdom was conquered about A. D. 1200. Great contingents of defeated, mostly high-caste Hindus, took refuge in Nepal. Particularly in the towns they often managed to preserve their high caste and social position, indeed even to improve it. However, in many districts their adaptation was less successful, and here their standard of life to-day is often inferior to that of their neighbours.

As a result of this immigration from the south, more and more of the ethnic groups in III began to worship the *Hindu* deities. They even went so far as to copy the Indian caste system, influenced by the kings of Nepal, who seem to have had close relations with the principalities of India at a very early stage. This caused some of the groups in III each to divide into two subgroups, one consisting of people believing in the Hindu deities and one being Lamaist, each often having its own social organisation.

As a result of this development—especially in the towns of the Middle Range with their many different ethnic elements and occupations—a confusion of groups and castes has emerged. In the Lamaist societies in the north this division does not exist. Here they are opposed to the caste system, and hold that anyone is free to change his occupation and to take almost any job.

The immigrations from the south have forced the early established groups in III to move to higher altitudes. Below c. 1200 m. the predominant part of the population to-day embraces Hinduism and above c. 2000 m. it is Lamaist. Between these two limits there is a transitional zone, where the two main religions thrive side by side, often blended to such an extent that it is difficult to distinguish one from the other. Hinduism is the official religion of Nepal and seems to be steadily gaining ground. Visible proof of this development are the many dilapidated Buddhist shrines and temples to be found in those districts where to-day the population worship Hindu deities.

In the following pages *the two main groups III and IV will be dealt with more closely, because it is pre-eminently these groups who have produced, traded with, and themselves used paper.* We still know very little of when and from approximately where the main immigration from Tibet into Nepal took place, simply because the mountain people have left only few inscriptions, manuscripts etc. The question, though, is of great interest here, because the use and production of paper seem to have reached Northern Nepal towards the end of the main immigration from the north. HODGSON, 1874, part II, p. 31, writes summarily about the date of this event:

"It must suffice at present to observe that the legends of the dominant races [ibid sub-Himalayan] indicate a transit of the Himalaya from thirty-five to forty-five generations back—say 1,000 to 1,300 years, and that I prefer the remoter period . . ."

If, then, we take the whole interval suggested by Hodgson's sources, the main immigration from the north of the people to-day dominant in the Middle Range should have taken place about A. D. 600–900. It will be shown later that this information is in accordance with other data.

Before mentioning the separate ethnic groups and their origin, we must look at the most important migration routes in Himalaya, as they seem to have a close connection with the spread of paper-making.

4. Migration Routes in Himalaya and the Spread of Paper-Making

Research throwing light on the migration routes in Asia and especially in Himalaya during the last two thousand years has been elegantly set forth in a work by Sasuke Nakao entitled: "*Transmittance of cultivated plants through the Sino-Himalayan Route*" in KIHARA, 1957, pp. 397–442. As Nakao writes on p. 416:

"The cultivated plants must be diffused through human agencies, so that human racial migration or contact will be necessary for the diffusion of cultivated plants."

This research is based on the collection of plants and seeds, as well as morphological and cytological studies, whereby it is possible to trace the geographical distribution and route of diffusion for every species of cultivated plant; the outcome being that the diffusion is concentrated at the so-called "*arcs*" which, as far as single arcs are concerned, connect areas with similar climates and vegetation.

S. Nakao shows all the arcs of diffusion in Asia on a map (op. cit. p. 411). Two of them are of special interest to us. One, the "*Tibetan arc*", runs from Southwest China north of the Himalayas through Tibet, where it follows the Tsangpo river valley and the Indus valley to Ladakh. The other, the "*Himalayan arc*" also starts in Southwest China, but runs directly south of the Great Himalayas, i. e. it passes Northern Assam, Bhutan, Sikkim, Nepal and Kumaon, and ends in Kashmir (see map p. 12). The diffusion of cultivated plants along the two arcs not only reflects the interchange of culture along each of the two arcs, but as previously mentioned, also indicates routes of racial migration.

Substantial racial migration along large sections of the Himalayan arc, across the deep river gorges, is difficult to imagine. More probably, various tribes penetrated westwards along the more easily accessible Tibetan arc, whereupon bigger or smaller groups came across the passes of the Great Himalayas and settled in or immediately south of these mountains, i. e. on the Himalayan arc. The principal movements along the Tibetan arc have taken place from east to west, viz. up along the Tsangpo river valley. Further west and to the north the valley is in fact surrounded by an almost completely desolate mountain desert. To the east, however, the Tibetan arc leads through South Tibet to Szechwan and Yunnan, i. e. towards lower-lying, more fertile regions, which were earlier and more densely populated. The existence of these migration routes is further verified by historical and ethnographical sources.

It is remarkable that we find the same archaic and very primitive method of paper-making used along the Tibetan and Himalayan arcs (and also along the northern parts of the *"Malayan arc"* starting likewise from Southwest China and running south to Thailand). It seems probable, then, that the manufacture of paper has followed the routes of racial migration, a theory that is further supported by the following evidence.

As one of the most important results of his research S. Nakao points out op. cit. p. 414 that almost all the arcs, including the three mentioned here, meet in an *"arc centre"* in Southwestern China, i. e. in Yunnan, Sikang and Western Szechwan. In this arc centre there were—even before the beginning of our era—rich, densely populated regions, already penetrated by Chinese culture from Central and Northern China. According to CHÊNG TÊ-K'UN, 1957, p. 13, the capital of Szechwan, Ch'eng-tu, was said to have as many as 380,000 inhabitants in the first century A. D.: "second in size only to the imperial capital of Ch'ang-an." The art of making paper had certainly arrived here from Central China already by the 2nd or 3rd century A. D. and this, together with other circumstances (see pp. 21 and 31), *points to Szechwan as the gateway between China and Tibet as well as the Himalayan states for the craft of paper-making.* (SANDERMANN, 1965, pp. 401–405, mentions Szechwan as an intermediate station for the migration of paper-making to Burma, Thailand and so on, but on p. 404 he writes, oddly enough, that the art reached Tibet, Bhutan and Nepal from the more distant Yunnan, without giving any reasons for this supposition.)

5. Newar

This group lives mainly in the Kathmandu Valley i. e. at an altitude of about 1300 m. Until the middle of the 18th century the Newars were the predominant population group of the valley. The name *"Nepal"* signified the valley area only, a denomination that is still used by the population outside the valley.

According to *"Census of Population, Nepal, 1952/54", The Department of Statistics*, Kathmandu 1958, the Newars then numbered almost 400,000. The statistics of the other ethnic groups, quoted below, derive from the same source. However, it should be noted that it must have been difficult to distinguish between the many ethnic groups, and that the census obviously does not include the total population. Moreover it has certainly increased since then. All in all, the number of persons in each of the different groups to-day must be estimated as considerably higher than the numbers from 1952–54 (an increase of about 30 % till 1970).

To-day the Newars are people with both mongoloid and Indian features. On the whole they are smaller and with more refined features, than the surrounding mountain people (plates 7, 107 and 175). Their own language, *Newari*, appears to belong to the Tibeto-Burman group of languages, and it is the only language of the country that possesses a considerable literature. Most Newars also speak *Nepali*, an Indo-European language which is the official language of Nepal. The Newars are divided into two subgroups, viz. those who believe in the Hindu deities and those who are Buddhists, yet there is only a slight distinction between them since members of the latter category have increasingly adopted Hindu beliefs and way of life. Both subgroups have their own religious and until recently also social organisations.

The great majority of Newars live by cultivating rice, also wheat, maize, vegetables, fruit etc. They utilise the soil better than the other peoples of Nepal, though unlike the rest of the population they do not as yet use the plough. Trade and many kinds of handicraft are important occupations too, and are also practised in the small Newar groups that exist in most of the trade centres. Right up to our own time there were even such colonies in several Tibetan towns.

Most of the intercourse between India and Tibet seems to have taken place from the earliest times through the Kathmandu Valley, because the route via Kashmir was longer, and the route via Sikkim only became really serviceable about a hundred years ago. This explains, too, why the Kathmandu Valley maintained a large population at an early date, and how it was possible for a large cultural centre to be founded there. Moreover the Newars have long been masters of many different crafts, such as wood-carving, stone-carving and modelling in terracotta, not to mention all kinds of metal work; these crafts gradually found their way into large parts of Asia.

It was probably also the Newars who at an early stage built the many temples and great palaces which even impressed Chinese visitors to the Kathmandu Valley in the 7th century (cf. p. 25). Pagoda-like buildings are found in great numbers in Nepal (plates 4 and 12) and many Nepalese assert that the Chinese pagoda-style really originated there. Others claim that the style derived from India and reached China together with Buddhism in the first centuries of our era (see for example SNELLGROVE and RICHARDSON, 1968, p. 141), and others again believe that the pagoda was a Chinese invention. Evidently there is no simple answer to this difficult problem, as many interacting styles from various parts of Asia are involved (cf. for example WILLETTS, 1958, 723–735). However, there is a striking similarity between the very ancient *t'ing*-type Chinese towers (plate 6) and some Nepalese buildings constructed about 1500 years later (plate 4) but definitely according to old traditions. The *t'ing* towers are known from numerous models found in tombs; and the tile, plate 6 (shown in CHÊNG TÊ-K'UN, 1957, plate 29) is from the Han dynasty, i. e. from about the beginning of our era, and was found en Szechwan, the Chinese province lying nearest to Nepal. As mentioned above, this province was already densely populated then, and Chinese culture was well established there (see for example YU YING-SHIH, 1957).

Apart from the pagoda style and the ordinary style of house-building, the Chinese influence is evident in art objects and in everyday articles (e. g. the special yoke, plate 11, used in Nepal solely by the Newars). *But nothing indicates that paper-making was introduced directly from China or ever became a special Newar skill*, probably because from very early times they used palm leaves as their writing material. However, it is from this people that most of the inscriptions and literature stem. It is just for this reason that the group is of special interest to us, since it was to become—even if rather late—the only large-scale purchaser of paper in Nepal south of the Great Himalayas for the production of books.

Origin. The origin of the Newars is still unknown; they are probably very much a mixture. Language, physical appearance etc. suggest, however, that most of the immigration into the valley has taken place from the northeast (see for example LEVI, I, 1905, p. 220). There is also great doubt about the age of the Newar culture. The argument for a very early date is strengthened by two main considerations: their principal area is the largest and most fertile valley of the country, and their craftsmanship even impressed Chinese officials visiting Nepal as early as the 7th century.

6. Sunwar, Rai, Limbu and Tharu

The *Sunwar* group is small and found chiefly in the river valleys of Likhu Kola and Tamba Kosi. *Rai* and *Limbu*, who are both called *Kiranti* and both speak Tibeto-Burman languages, were once perhaps one people. The Rais are found in East Nepal, west of the Arun river around Sun Kosi at 1000–2200 m. According to the census of 1952–54 they numbered more than 260,000. The Limbus amounted to c. 196,000; they also live in East Nepal, but further to the east, between Arun and the border of Sikkim, and at a somewhat lower altitude than Rai. The Limbus have their own written language. In all three groups "northern" features predominate, but in the east traces of Indo-Chinese features are also found. The groups are among the earliest established peoples of Nepal. It is not known whether the three groups traditionally make paper, but *Rai and Limbu are asserted to make it.*

The *Tharus* live chiefly in Terai. They amounted in 1952–54 to more than 360,000 and are considered the oldest inhabitants there. *They do not make paper.*

7. Tamang

This group comprises about half a million people and is found in many parts of the country. *The Tamangs being, according to my investigations, the paper-makers par excellence they will be dealt with more closely.*

In the literature their distribution is indicated very differently. According to the census of 1952–54 the "Tamang or Lama" amounted to about 495,000. Out of these c. 284,000 were living in East Nepal, with 240,000 in the Middle Range and the highlands, 27,000 in Inner Terai and 17,000 in Terai. In the Kathmandu Valley there were c. 19,000 and finally in West Nepal c. 192,000 with 112,000 in the Middle Range and the highlands and 80,000 in Central Inner Terai. FÜRER-HAIMENDORF, 1956, p. 166, says that there are Tamangs in the Langtang area and around the Kathmandu Valley, but that they are mainly to be found in East Nepal in the area enclosed by the rivers Sun Kosi and Likhu Khola, and in the south by Mahabharat Lekh. According to the same author their preferred zone of altitude is 1500–2000 m., but the density of the population in the lower-lying area has caused the upper limit to shift higher, so to-day it is c. 2700 m. KARAN, 1960, p. 65, indicates that their main habitat is only a small area north and northeast of Kathmandu. HAGEN, 1960, p. 66, writes that to-day they are found at Mahabharat Lekh south of Kathmandu, in East Nepal and even in Terai, but that their original Nepalese home is Ganesh Himal's southern flank between the rivers Trisuli and Buri Gandaki in West Nepal, where both type and culture have been preserved at their purest. MAC'-DONALD, 1966, p. 27, also deals with the problem and furthermore on p. 29 he gives a quotation from a small book published in Darjeeling in 1959, written by the Tamang Sri Santabir Lama: "Le pays d'orgine (kendrasthān) des Tāmang se trouve dans East nos 1, 2 et 3 et dans West nos 1 et 2." According to these references and my own observations by far the greater part of the Tamangs live between the river Dudh Kosi in the east and Marsyandi in the west, at altitudes from 200 m. to 2700 m. but principally in the upper half of this zone.

The Tamangs mostly have markedly mongoloid features, with broad faces and pronounced slit eyes (plates 30, 62–90). They look somewhat like Sherpas, but may be distinguished from the latter by their somewhat darker complexion, wider-set eyes, and their dress, which is more reminiscent of that used in the Middle Range. A not unimportant difference observed during my travels in Nepal is that—unlike the Sherpas—they nearly always go bare-footed.

The Tamang language belongs to the Tibeto-Burman language group and it is closely related to Tibetan. Most Tamangs are nominally Buddhists like the Sherpas and Bhotias. Although they have Lamaist temples, chortens, monks and ceremonies, they still practise old Shamanist rites, and in the isolated northern areas the magician plays a prominent role (plate 36). In the lower-lying areas the original Tamang religion has mixed with or been replaced by Hinduism.

As the group inhabits both high and low areas, it cultivates rice, maize, wheat, barley and potatoes and uses several kinds of domestic animals. Furthermore, the Tamangs are skilled in many crafts. They do not, however, belong to the more well-to-do among the ethnic groups of the country, and particularly where they live among others their "caste" has a low status. Here they are rarely prosperous merchants, but often porters. This is in keeping with the fact that the Tamangs produce the paper and transport it down to bazaars and towns (plate 82), but do not deal in it. The sale of paper to Tibet has chiefly been effected with Bhotias, Sherpas and Thakalis as middlemen. The Tamangs not only produce paper but use it themselves, mainly for ceremonial purposes.

Origin. It is not yet known from where the Tamang people originate. About the name *Tamang* itself (in Tibetan *rta-mañs*) MAC'DONALD, 1966, p. 28, writes that translated literally it means "horse many". BISTA, 1967, p. 48, writes that the Tamangs were originally called *Bhote*, i. e. "the people from Tibet", but that the designation

Tamang was later given them because they were horse traders. A. W. MAC'DONALD points out that Tamangs are neither horse breeders, nor riders nor horse traders. Yet they may once have possessed horses, particularly at the time when they penetrated into Nepal. This point of view is also advanced by my Tibetan acquaintance, who asserts that these people were once called *rta-dmag*, which means "horse soldier", i. e. cavalry (DAS, 1902, p. 532).

The Tamangs are also called *Murmi*, which may be translated as "border people", implying the people immediately south of the Great Himalayas. FÜRER-HAIMENDORF, 1956, p. 166, writes: "... the name Murmi is current among those members of the tribe who have settled in the region of Darjeeling." MAC'DONALD, 1966, p. 28, adds: "Le professor von Fürer-Haimendorf n'a pas entendu le mot Murmi employé spontanément au Népal même et mes propres sondages confirment cette impression" (see further op. cit. note 10, p. 43). My guide, the Sherpa Urgen, writes however: "In Kathmandu the *Yolmalis* are called Murmi." These people live three to four days' journey northeast of Kathmandu and seem to comprise both Tamangs and Sherpas, as well as the descendants of mixed marriages (plate 32 and 34).

FÜRER-HAIMENDORF, 1956, p. 167, writes on the origin of the Tamang people: "... their own traditions point to an immigration from a region situated north of their present habitat," and later on: "The Tamangs have nevertheless a firm belief in the common origin of their races." HAGEN, 1960, p. 67, takes a further step by saying that tradition has it that they originally came from the interior of Tibet, and in a caption to illustration no. 19 he states that they are supposed to be of Tartar origin. Toni Hagen also says that the Tamangs are called *Bhote*, i. e. from Tibet, by the surrounding ethnic groups (main group III, see p. 15); also Sherpas, I heard, spoke of Tamangs as Bhote.

In KIHARA, 1957, p. 417, Sasuke Nakao gives some interesting information about this people, who seem to have contributed to the migration of cultivated plants along the Himalayan arc, i. e. the lower lying parts of the Great Himalayas and the areas immediately to the south thereof:

"The Tamang tribe who inhabit central Nepal, eastern Nepal, Sikkim, Bhutan, Assam and Upper Burma, may be the best example for such studies. They live mainly on the southern middle slopes of the Himalayan Range, and not in the plains of India or the plateau of Tibet. The half of the Himalayan arc is really covered by the Tamang tribe. Thus the Tamang tribe can be qualified to become the actual agency of diffusion of cultivated plants in the Himalayan arc."

To this observation it may be added that is has hardly been proved that the Tamangs live along the Himalayas all the way from Nepal to Upper Burma, even though they have close links to the peoples living there. According to my investigations, they are only known by this name in Nepal and Sikkim but not further eastward. There are, however, a remarkable series of coincidences to be considered:

a. Among the many ethnic groups to be found in Nepal the Tamangs are the chief practitioners of paper-making.
b. The Tamangs, and people evidently closely related to them, are primarily found along large sections of the Himalayan arc.
c. Much the same very primitive and very early method of paper-making has been practised along the whole of the Tibetan and the Himalayan arcs.
d. These two arcs start from Southwest China, where the art of making paper must have arrived by the second to third centuries A. D.

Time of arrival. At what time the main wave of Tamangs came to Nepal is not known except that it was a long time before the Sherpas, for example, arrived in the country. According to KARAN, 1960, p. 66, the Tamangs are considered to be among the earliest immigrants to Nepal. More cautiously FÜRER-HAIMENDORF, 1956, p. 167, writes:

"... there can be no doubt that for many centuries the Tamangs must have been living in Central and Eastern Nepal, and this is borne out by the proprietary rights claimed by individual Tamang clans in respect of particular tracts of country."

Sri Santabir Lama, mentioned earlier, also refers to the problem, suggesting that his people must have already been living in Nepal before the 7th century (cf. MAC'DONALD, 1966, p. 32 and note

34, p. 47). In support of this it is alleged, that if they had arrived with the famous Tibetan king Srong-btsan-sgam-po, and had invaded Nepal some time in the 7th century, a tradition to this effect among the Tamangs should have survived. But they have not—it is said—even heard of this king. The objection might be made that the Tamang people are quite capable of having lost all such traditions; 1300 years is certainly a considerable length of time. Finally, they may have arrived later, or over a long period of time.

Altogether it is most probable that the expansion of the Tibetan empire during the 7th–9th centuries brought most of the Tamang people down to Nepal. This is also in keeping with Hodgson's statement that the immigration from the north of the most important tribes ("sub-Himalayan") took place at this period. If we accept what several independent sources indicate, that paper-making did not spread through Tibet until the 8th or 9th century (cf. THOMAS, 1951, II, p. 331), and also that the Tamangs were the mainstay of this craft, *then the immigration of the paper-makers into Nepal can hardly have taken place before the 9th or 10th century. The paper-makers must therefore belong to the latest arrivals among the Tamangs, as also suggested by their settling in the highest part of the area inhabited by the group.* Furthermore in Sri Santabir Lama's account of this people in Yolmo (Helambu), cf. MAC'DONALD, 1966, p. 31, it is said: "Dans les parlers (bhāṣā) des Kāgate, qui vivent entre le pays tāmang et celui de Yolmā, se mêlent les parlers (bhāṣā) yolmāli et tāmang." In other words the Tamang paper-makers, *Kāgate*, are specified here as a separate subgroup, placed between the lower-dwelling and earlier established Tamangs on the one hand, and the higher-dwelling and later established Yolmalis and Sherpas on the other. TURNER, 1931, p. 84, also states: "kāgate . . . a caste of paper-makers (= kāgate bhoṭe)," i. e. the paper-makers from Tibet. The Sherpa Urgen, with whom I visited the Tamang paper-makers in Tumbu in East Nepal, called them *Kagadi*, but claimed that to-day they do not constitute an ethnic subgroup. MAC'DONALD, 1966, note 28, p. 46, comes to the same conclusion.

8. Gurung

According to HAGEN, 1960, p. 67, the original area of this rather big group is the south flanks of the Annapurna massif, but it has spread to large parts of the Middle Range and is found as far away as the eastern border of Nepal. The Gurung-speaking population, according to the census of 1952–54, amounted to c. 163,000, of which 90 % lived in the mountains of West Nepal. The Gurungs are generally quite small with marked mongoloid features (plate 15). Their language has many dialects and according to Jiro Kawakita (cf. KIHARA, 1957, p. 84) it appears to be related to Thakali and Tamang. The same writer distinguishes between "Lama-Gurung", who are Lamaists and whose culture is Tibetan, and "Cho-Gurung" who dwell in lower areas, many of whom worship Hindu deities. According to HAGEN, 1960, p. 68, most Gurungs believe in Hinduism. *The Gurungs produce paper*, but it is not known to what extent.

9. Magar

The main area inhabited by this big group is the western and southern spurs of the Dhaulagiri-massif, but smaller groups are also found both further west and in East Nepal. According to the census of 1952–54, out of 274,000 more than 180,000 were living in the mountains of West Nepal. The mongoloid element is less dominant in the Magars (plates 91–104) than in the Gurungs. They also dwell at somewhat lower altitudes and believe in Hinduism. HAGEN, 1960, p. 69, and BISTA, 1967, p. 62, mention smaller groups of Magars who are Buddhists. The language belongs to the Tibeto-Burman family. *The Magars produce paper in the Baglung region in West Nepal.*

10. Thakali

A small group concentrated in the area where Kali Gandaki cuts through the Great Himalayas. According to Kawakita, see KIHARA, 1957, p. 87, it numbers about 10,000, but according to BISTA, 1967, p. 81, only 3,300. Appearance, religion and material culture all bear the stamp of the location of this group on the border of the Middle Range and the Lamaist highlands, but the "northern" features are dominant (plates 14 and 16) and their language is related to Tibetan. It is noteworthy that they sometimes call themselves Tamang. Widespread trade has made this people more wealthy and influential than the surrounding ethnic groups. *The Thakalis do not seem to have produced paper,* but they have traded in it.

11. Bhotia

This group, which actually consists of several different peoples, lives in the northernmost part of Nepal and it differs only a little from the Tibetans on the other side of the border in both appearance and culture (plates 24 and 25). Tibetans (plate 33) are also found in small numbers in Nepal, mostly as exiles after the events in Tibet in 1959. The Bhotias number about 70,000.

The Bhotias speak only Tibetan and are Lamaists but, on account of their isolation, they have retained many pre-Buddhist characteristics in their faith (plate 18). The Bhotias are frugal people, who cultivate barley and potatoes and keep yak, sheep etc. Furthermore they take part in long-distance trade between the lowlands and Tibet.

As the group inhabits only very high areas, it lives above the upper limit of growth of those species of plants whose bast is commonly used for paper-making in Nepal. For this reason *the Bhotias rarely make paper, except perhaps in the easternmost region of Nepal. According to Corneille Jest,* Musée de l'Homme, *they once made paper in the Dolpo area in West Nepal.* The Bhotias were once middlemen in the paper trade between Nepal and Tibet and they also make considerable use of it themselves.

Origin. The immigration of Bhotias into Northeastern Nepal is supposed to have taken place comparatively late, while there is every indication that it occurred fairly early into Northwestern Nepal. In this connection it is worth noting that the arid, barren land there was once apparently more fertile. Present conditions may be explained by the gradual deterioration of climate in Central Asia and India during the last two to three thousand years, perhaps mainly caused by the excessive felling of trees over very wide areas. The mountain valleys of Northwestern Nepal, where conditions were never very favourable, must have been very severely affected by such a climatic deterioration, to which the number of remarkable ruins of ancient castles bear witness (plate 22; see also PEISSEL, 1965, p. 590).

Several historical sources mention small, ancient kingdoms along the northwestern border of Nepal. SNELLGROVE and RICHARDSON, 1968, p. 112, write that one of the noblemen entitled to the Tibetan throne had to flee as a result of the civil war in Central Tibet in A. D. 866. He and his descendants then founded three kingdoms, *Mar-yul, sPu-hrangs* and *Gu-ge*, situated along the Tibetan border from Mustang to Ladakh. According to TUCCI, 1956, pp. 108–109 and 129, invasions from West Nepal into West Tibet took place between the 11th and 13th centuries. Considerable parts of these areas united to form a bigger state in the 13th century.

It is interesting, and also typical, that connections with Tibet have extended not only across the border, but often to far distant provinces of Tibet. For instance, many places in Northwestern Nepal have old religious and family links with the Kham province of Eastern Tibet; similarly, linguistic evidence also indicates close connections with the east (TUCCI, 1956, p. 29, and KIHARA, 1967, pp. 93–94, 161 and 217). This is consistent with what is said on p. 8 about the existence of the Tibetan arc.

12. Sherpa

A small group which in appearance and culture does not differ much from the Bhotias (see plates 31, 35 and 36). In their way of life as in other aspects the Sherpas have to some degree adapted to the peoples to the south of their districts, but their language is Tibetan and they are exclusively Lamaist. They dwell in three adjoining valley systems of the Everest-massif and are also found in smaller groups along the Great Himalayas, but not much further west than the meridian of Kathmandu. They live primarily at altitudes of over 2500 m. and there are about 10,000 of them in Nepal.

The Sherpas cultivate barley and potatoes and keep cattle and sheep etc. just as the Bhotias. Long-distance trade with Tibet and India, however, has made them more prosperous than the

Bhotias and other neighbouring peoples. *Opinions are divided even among the Sherpas themselves, as to whether or not they produce paper at all.* MAC'DONALD, 1966, p. 46 (see also plate 90 from Yolmo), and one of my Sherpa acquaintances state that they do sometimes make paper. But in their main area they consider it beneath them to participate personally in its manufacture. They will order the paper from the Tamangs or lend them money to start production, just as they used to resell the paper at the time when it was delivered to Tibet in large quantities.

Origin. It is not known from where the Sherpas derive except that they must have come from Tibet. Translated literally *Sherpa* means "East people", but according to FÜRER-HAIMENDORF, 1964, p. 1, a more exact interpretation of the name is difficult. HAGEN, 1960, p. 73, writes that the name suggests an origin from East Tibet. The Sherpas themselves claim that they came originally from the Kham province in East Tibet with which they still have family bonds. It is not known when the Sherpas reached Nepal, but they are not believed to have been there for more than 500 years at the most. This is confirmed, inter alia, by the fact that contrary to West Nepal there are no very old temples or ruins in their areas.

D. History

The following survey will concentrate on those features of the history of Nepal which are of interest to our main topic, especially Nepal's relation with its neighbours, principally Tibet, from where the craft of paper-making came to Nepal. As already mentioned, the historical sources confine themselves mainly to the Kathmandu Valley. This is primarily due to the fact that the valley was densely populated at an early date and had a very differentiated social structure. Thus a need arose for a written language, which manifested itself in inscriptions, manuscripts etc., and moreover the Kathmandu Valley was the only part of Nepal accessible to Western explorers until the middle of this century. From the researches of Guiseppe Tucci and others, we now know that quite big states existed in West Nepal at a comparatively early time.

The ancient history of Nepal, up to about the 4th century A. D., is still hidden in myth and legend. Buddhist literature has particularly early references to Nepal, but these are difficult to date. They seem, however, to show that the valley was a goal for tradesmen and pilgrims from India at a very early date (LEVI, 1905, III, pp. 181–185). Several temples and shrines in the valley are of considerable age, such as the four neglected and primeval-looking stupas in Patan (plate 3), which according to tradition were built by the famous Emperor *Aśoka*, i. e. about 250 B. C. The Svayambhūnāth sanctuary (plate 1), just outside Kathmandu, is likewise considered very old. Only excavations will settle these questions.

The first reliable record concerning Nepal dates from the 4th century A. D.—the inscription on the stone column of *Samudra Gupta* in Allahabad. Here the king of Nepal is placed in the lowest rank among those princes who pay tribute, obey orders etc. From here onwards, according to PETECH, 1958, p. 1, the history of Nepal may be divided into four periods corresponding to the ruling dynasties:

1. *Licchavi* and their successors	(c. 400– 750)
2. *Thākurī* and early *Malla*	(c. 750–1480)
3. The three *Malla* kingdoms	(1480–1768)
4. The *Gurkha* dynasty	(1768–)

1. Licchavi and their Successors (c. 400–750)

The kingdom of the *Licchavis* comprised the Kathmandu Valley together with a number of small principalities of varying degrees of adherence lying close to the valley; a state of affairs that was quite common up to the time of the Gurkhas' conquest of the valley in the 18th century. When the term "*Nepal*" is used in the following, it implies this rather modest and not very well-defined region.

One of the Licchavi kings deserves particular mention: *Aṃśuvarman*, who ruled from c. 620 to 640. He is known not only as a commander but also for the buildings erected during his reign. LEVI, 1905, II, pp. 166–167, points out that inscriptions which go back to these times mention methods of irrigation, temples and their possessions, flourishing trade, taxes and the work of the scribes of the royal chancellery.

From the famous Chinese pilgrim, *Yüan Chüang*, who visited India A. D. 629–644 during the reign of Aṃśuvarman, we have the first Chinese records of Nepal. He did not himself reach the country, but during his long journey he collected information about the valley, which was recorded in the reliable Chinese Imperial Annals. Here, among other information about the kingdom of *Ni-po-lo*, we are told that a variety of cereal crops are cultivated, the land is rich in flowers and fruits, red copper is mined and coins minted from it for trade. The capital is 20 li (c. 4 km?) in circumference; monasteries and temples are numerous. The inhabitants and their customs are described as primitive; they are without literary knowledge, but are skilful craftsmen. There are two thousand monks studying the "*Lesser*" and the "*Great Vehicle*" (the two most important Buddhist schools, *Hinayana* and *Mahayana*). The number of Brahmins (Hindus) and other believers is not exactly known (LEVI, 1905, I, pp. 154–155).

Several Chinese, some of whom were pilgrims, visited Nepal in the 7th century. The famous general *Wang Hiuen-ts'e*, who received 7000 horsemen from Nepal to assist in the Chinese punitive expedition against *Magadha* in Bengal in the year 648, visited India three times and each time he passed through Nepal. Fragments of his description of the valley have been preserved in the form of quotations in later works. It is interesting that, although familiar with fine buildings, he was fascinated by the royal palace of Nepal, which is described in detail. A later version of the Imperial Annals has the surprising but surely somewhat exaggerated observation, that there are a great many tradesmen but only a few farmers; furthermore that they have a good knowledge of astrology and the making of calendars (LEVI, 1905, I, pp. 156–166). The fact that King *Narendradeva* sent a tribute to the Chinese emperor in the year 651 shows that contact with the Celestial Empire was not altogether negligible.

Manuscripts were probably written on palm leaves in Nepal at the time of Aṃśuvarman. It is difficult to imagine that they had astrologers, scribes and Buddhist monasteries, but no books, especially as books had been used in India far earlier. We have, however, no manuscripts from this period. LEVI, 1905, II, pp. 149–150, relates that the Nepalese princess who married the Tibetan king *Srong-btsan-sgam-po* in A. D. 639 brought with her a complete collection of the holy Buddhist texts from Nepal. Here, however, it seems to be a question of legend; indeed it is possible that this princess is not historical. On the other hand, it may be taken for granted that the Nepalese learned about paper and paper manuscripts from their Chinese visitors, even though several hundred years were to pass before they themselves started to produce manuscripts on paper.

THE DEVELOPMENT IN TIBET

The formation of the Tibetan empire and the introduction of paper into Tibet. About the time of Aṃśuvarman important events took place in the north; Tibet began to act as a great power. Already long before the beginning of our era Chinese sources mention some non-Chinese nomads near the western border of China, who were presumably precursors of the Tibetans. The Chinese called them the *Ch'iang* tribes; they came to know them partly because of their raids and partly through trading with them. From the 1st century A. D. onwards they spread further west and reached Western Tibet. Gradually they united and created a state, centered around the kings of Yarlung in South Tibet (see HAARH, 1969). Large parts of Tibet were united under *gNam-ri-srong-btsan*. According to Chinese sources he is said to have commanded an army numbering 100,000 men (HOFFMANN, 1950, p. 265) which is most likely a somewhat exaggerated figure. His son, the illustrious *Srong-btsan-sgam-po*, conquered even more of Tibet. His forces invaded China, and the Chinese tried to pacify him by giving him a Chinese princess for a wife. Young Tibetan noblemen were allowed to attend the Imperial School in China, and Buddhism slowly began to make its way into Tibet from India and China.

The Tibetan alphabet was constructed with northwest-Indian alphabets as a model—perhaps also based to some extent on the Nepalese (cf. e. g. THOMAS, 1951, II, pp. 151–165 and SNELLGROVE, 1957, pp. 141–144). It was intended to be used for translating the holy Buddhist works brought home from India and Nepal into the Tibetan language. But more important, it was used after the Chinese precedent, for issuing orders and decrees in the new empire. Before the year 650 the king asked for experts from China to establish rules for the drawing up of documents, notes and orders. *He asked also for craftsmen who could teach the Tibetans to make wine, water mills, paper and ink* (PELLIOT, 1961, pp. 5–6).

Under *Khri-srong-lde-btsan* (755–797) the Tibetan empire attained the peak of its power and size. Until the middle of the 9th century Tibet remained united, after which it was divided as a result of inner strife. By that time Tibetan-speaking people had settled in the western provinces of China, occupied great parts of Chinese Turkestan in the north, and gained Ladakh, Kashmir and even Swat in the west. In the south they had penetrated most of the Himalayas and reached the Indian lowlands (cf. SNELLGROVE and RICHARDSON, 1968, pp. 31–32 and 49).

Finds of early Tibetan manuscripts. The reproduction of the holy writings and the administration of monasteries and government must soon have required a considerable amount of writing material. Numerous finds of early Tibetan manuscripts in Chinese East Turkestan, great parts of which were occupied by Tibet from the 8th to the 10th century, confirm this supposition. It would carry us too far away from our subject to go into detail about these finds to trace the earliest history of paper in Tibet, even if the history of paper in Nepal cannot be satisfactorily explained without a knowledge of the former. But from the available evidence it can be concluded that in the lower-lying areas in the east, near the caravan routes leading to China, the older writing material i. e. wooden tablets, was soon abandoned in favour of Chinese paper at first, and native paper later. But far away from China or in isolated areas, wooden tablets continued to be used for a very long time, even as late as the 10th century. Here the import of paper was expensive or its manufacture still unknown. In many places both kinds of writing materials were used side by side.

It is interesting that the Tibetans in East Turkestan not only used Chinese paper, but also possessed manuscripts on *Daphne* paper entirely different from the Chinese, possibly made in South Tibet (STEIN, 1921, pp. 810, 814, 816, 914 and 919). Not only the writing materials but also the extant texts prove that the consumption of paper in Tibet must have soon reached considerable proportions. The texts contain many references to paper, about its delivery, settling of accounts and storage (THOMAS, 1951, II, pp. 72–84). *Paper was certainly produced in several places by the 8th and 9th century in the lower-lying valleys of East and Central Tibet not far from Northeast Nepal.*

The immigration from Tibet to Nepal. The expansion of the Tibetan empire in the 7th–9th centuries caused many people to move, and extensive migrations into Nepal from the north probably occurred during this period and some time thereafter. Nepal seems to have been under Tibetan suzerainty in the reigns of Aṃśuvarman and succeeding kings. In 704, however, Nepal rose successfully in rebellion, and it is said that King *Rudradeva* drove the Tibetans from the country (i. e. the Kathmandu Valley and adjoining areas) and brought about peace (PETECH, 1958, pp. 29–30). The last waves of migration from Tibet towards the end of the first millennium may have included paper-makers. As we shall see later, however, another five hundred years were to elapse before the palm leaf was completely abandoned south of the Great Himalayas in favour of paper. *If paper —at any rate for manuscripts—was produced in Nepal already in the 9th or 10th century, nearly all of it must have gone to Tibet.*

2. Thākurī and Early Malla (c. 750–1480)

Little is known of the history of Nepal between 750 and 1000, probably because of the unrest and confusion caused by the invasions from the north. The introduction of a new era, called *Newari Samvat*, beginning October 20th in the year 879 remains unexplained.

In spite of many upheavals the country benefited from trade between India and Tibet, most of which passed through Nepal. Not only trade but also craftsmanship steadily increased and several towns were founded, including Kathmandu, Bhatgaon and Sanku (Patan existed long before Aṃśuvarman's time).

Nepal's contacts with China between 750 and 1000 are but little known. LEVI, 1905, I, p. 166, mentions a group of Buddhist monks, who between 964 and 976 travelled through Tibet and Nepal to India in search of holy writings. The unification and expansion of Tibet during the 7th–9th centuries had probably cut off communications between Nepal and China during the greater part of this period.

During the 10th century, and in any event during the greater part of the 11th century, Nepal was divided between two rulers of almost the same rank, each ruling one half of the valley and its surrounding areas; nevertheless the valley must still be regarded as one state. Occasionally one of the two kingdoms was subdivided between two more kings (PETECH, 1958, pp. 30–33). We shall find this peculiar form of rule within such a limited area on many occasions later on. It naturally created rivalry and many minor wars, which made Nepal vulnerable to foreign attack.

Nepalese craftsmanship reached a florescence during the 11th–14th centuries and also found its way into Tibet. Many of the best paintings and bronzes from Tibet show a marked Nepalese influence and often appear to have been made by Newar craftsmen, or with their work as a model. Nepalese bronzes even found their way to China. One Nepalese, *A-ni-ko*, actually employed by *Qubilai Khan*, became general director of all the workers in bronze, and in 1278 he was appointed controller of the Imperial Manufacturers.

Under the illustrious *Anantamalla* (c. 1274–1310) Nepal was exposed to heavy invasions from both west and south. After his reign the state was again divided and once more invaded by foreign forces. Feudal anarchy and confusion dominated the country.

The Mohammedan invasion. As a consequence of the prevalent discord and weakness in the country, this otherwise extremely well-sheltered valley became exposed to the incursions of the much feared Mohammedan armies. In the year 1346 Sultan *Shams ud-dīn Ilyās* of Bengal invaded the valley and plundered, burned and destroyed the towns. Not even the greatest sanctuaries, Paśupatināth and Svayambhūnāth, were spared. The devastations are supposed to have surpassed those of any earlier strife and, in addition to the violent earthquakes that constantly afflict Nepal, this contributes to the fact that no large building from before the 15th century exists anywhere in the valley.

The country was reconstructed under the succeeding rulers. Hinduism still progressed, and the prevailingly Buddhist Patan now entirely lost its political supremacy, and never regained it.

Political contacts between Nepal and China were resumed in the years 1384–1427. On several occasions embassies were dispatched from China with different tokens of honour and gifts to Nepal, which reacted each time by sending tribute to the Chinese court, consisting of coveted products from the country (such as Buddhist manuscripts, see LEVI, 1905, II, p. 228). In 1427 an emissary was again sent from China, but after this Nepal stopped sending tribute.

With *Jayayakṣa Malla* (1428–1480) the Malla reign reached its climax. Not only did he gain control of the Kathmandu Valley and its extensions eastwards and westwards as far as Gurkha, but he also invaded a number of areas in North India, including Bengal. Furthermore, he went to the north and conquered Shekar Dzong in Tibet, on the important trade route to Lhasa. Under Jayayakṣa Malla the national language, *Newari*, was encouraged and temples etc. were built.

3. The Three Malla-Kingdoms (1480–1768)

It proved a catastrophe that Jayayakṣa Malla made all three of his sons heirs to his kingdom. Thus the foundation was laid not only for the resulting quarrels between their principalities, but also for the subjugation of the valley by a foreign power.

Commercial intercourse with India and Tibet was steadily developing. Even merchants from Kashmir came through Tibet to the Kathmandu Valley around the year 1500. At the beginning of the 17th century an agreement was made with the authorities of Lhasa regarding the Newar colony there. Now the journey to Lhasa was no longer considered a difficult enterprise (LEVI, 1905, I, p. 172). Trade with Tibet had become so important, that rites of purification were instituted for the merchants who returned from Tibet. *In fact it is at this period that we are able to trace strong influences from Tibet—thereby also indirectly from China—in the book-craft.*

The invasion of the Gurkhas. The town of Gurkha is situated about 60 km. to the west of Kathmandu, and was only one of many such small duchies which had joined in a form of union. *Pṛthivī Nārāyaṇa* ascended the throne in 1742. Little by little he conquered more of the adjoining duchies and steadily made his way towards the Kathmandu Valley. In the palaces of Patan, Kathmandu and Bhatgaon, all kinds of intrigues and conspiracies were going on, and these the Gurkha king did not hesitate to profit by. Through blockade, cunning and terror just as much as through fighting, first the town of Kirtiphur fell, and then Patan. Worried by Pṛthivī Nārāyaṇa's progress, the British sent a detachment to the Kathmandu Valley. Bad lines of communication and malaria in Terai, however, compelled the relieving force to retire. Kathmandu then fell without resistance in 1768, and Bhatgaon in 1769. The victory was complete; the Newars were no longer their own masters.

4. The Gurkha Dynasty (1786–)

Pṛthivī Nārāyaṇa made Kathmandu the capital of his new kingdom. After the fall of Bhatgaon it was the turn of the small principalities in the west. The kingdom was also extended further to the east, and even Sikkim was invaded. In the north the country was subjugated as far as Kuti (Nyalam) and Kirong, and in the south Terai was gained. Only then did Nepal begin to acquire something of the extent it has to-day. The maintenance of armies cost the country much money, most of which the merchants were forced to provide. The king's hatred of Europeans was so strong that he closed the frontiers of the country not only to them but also to their goods. *Gurkhali* or *Nepali*, an Indo-European language, now became the official language.

After Pṛthivī Nārāyaṇa's death the Gurkhas penetrated Kumaon and Sikkim and entered Bhutan. Not even Tibet escaped; Shekar Dzong was plundered in 1790. The Chinese emperor intervened, however, and pursued by a large Chinese force the Nepalese army had to plead for peace, when the enemy was only 30 km. from the capital. But the conquests continued, and Garhwal, towards Kashmir, was made a Nepalese province in 1794. Finally, the British lost their patience and demanded that Nepal should relinquish the subjugated areas in Terai and elsewhere. Nepal answered by declaring war in 1814, but was beaten in 1816 in spite of stubborn resistance. Nepal then lost Sikkim, Kumaon, Garhwal and Terai west of Gandaki but recovered a great deal of the latter area later. Furthermore Kathmandu was to have a British Resident. In 1855 Nepal once more attacked Tibet, and in 1856 after hard struggles, the Tibetans had to agree to a number of truce terms, including the abolition of duty on Nepalese goods.

In 1856 under the famous anglophile prime minister *Jang Bahadur*, the office of prime minister, under which the country had already been governed for some years, was made hereditary. The *Ranas*, as the new ruling class was called, were on the whole unprogressive. They were not at all interested in seeing Western ideas gain a foothold in the country, and apart from the British Resident and his staff, the entry of foreigners was prohibited. Under the Ranas the nobility lived a luxurious life without much concern for the poor conditions of the population as a whole. A few rulers, such as *Chaudra Shamsher* (1901–1929), were to some extent an exception.

In 1951 the Rana oligarchy was overthrown after an almost bloodless revolution, and the then king, *Tribhuvana Bir Vikram Shah Deva*, declared Nepal to be a constitutional monarchy. For the first time the country was opened to foreigners, but certain restrictions were, and are still, imposed. In 1955 Nepal became a member of the United Nations. The crowning of King *Mahendra Bir Vikram Shah Deva* took place in 1956. In 1959 he proclaimed a new constitution, and in the same year Nepal's first free elections were held.

E. Transport and Communications with Tibet

Only a few other countries in the world have such difficult conditions of transportation as Nepal. The immensity of the problem is evident when we consider that there are more than 10 million inhabitants and only about 500 km. of good "all-weather" roads. These consist mainly of the road from India to Kathmandu and from there to the Kodari pass on the new road to Lhasa, and the road from the south to Pokhara. The remaining roads are only accessible by car in the dry season and they are almost all in Terai. Beyond this there is merely a railway about 80 km. long, and an aerial ropeway 30 km. long for the transport of goods from the south to Kathmandu, plus some airline connections. No wonder that many regions of Nepal are virtually isolated from the rest of the country.

1. The Caravan Routes

The remaining transport facilities of Nepal consist of narrow roads and trails, of which the caravan routes must particularly claim our attention. The most important ones are indicated on the map at the back of the book. They often follow the great rivers running north-south, thus making it possible to avoid the many exhausting variations in height, and at the same time to serve the trade across the Himalayas. Only in the southern half of the Middle Range, immediately north of Mahabharat Lekh, do the rivers run in various directions, and likewise the caravan routes. Here they often run east-west, thus connecting the densely populated areas of Central and East Nepal.

With the exception of a few asphalted roads and the paved streets of towns and villages, the caravan trails rarely have any paving. Most of them are just uneven earthen or stony trails. Streams and shallow rivers are usually crossed by jumping from stone to stone or by wading across in waist-deep water. Bridges have to be used across deep rivers; only exceptionally, where the current is less strong, are there ferries (plate 28). Across big spans the bridges are always suspension bridges, usually consisting of two iron wires, under which wooden planks are hung. Bridges may also be made of bast. They are often far from safe, and it is quite understandable that many Nepalese say a prayer before they cross. Nearly all goods must therefore be carried to-day, as formerly, on the backs of animals or men. Beasts of burden are in fact only common in the highlands north of the Great Himalayas. It is noteworthy that the use of the wheel for practical purposes, such as transport, has been almost unknown up to quite recent times.

Many caravan routes are obviously very old. In several places they have worn deep into the ground, and along them old temples and holy shrines are found. The rest places, situated at short, convenient intervals along all the more frequented caravan routes, are remarkable; a long shelf of flat stones is made, on which tired porters may place their burden or just support it for a few minutes before walking on. Big trees offer shelter against rain or strong sunshine. Larger rest places lie mostly in or near a village, by the riverside, close to a stream or a mountain pass. The long stone shelves may then be replaced by square, stepped landings, a few metres high, covered with flat stones. Here the sheltering trees are often big, very old and gnarled (e. g. gigantic *banyan* trees, plate 13). Their appearance and position indicate that such rest places—and therefore the caravan routes—are very old.

2. Travellers

In spite of the rugged, often narrow and sometimes unsafe caravan routes, people and merchant goods travel long distances. The various merchant goods from India, Nepal and Tibet, such as rice, wheat, barley, tea, spices, tobacco, paper, cotton, wool, hides, oil, kerosene, the all-important salt (plate 35), metals and industrial goods, have been very profitable for the north-south trade. Furthermore, pilgrimage and small trade in local products have caused many families to travel, frequently to the north in the summer season and to the south in the winter season.

By far the largest number of travellers in long-distance traffic have been the high-dwelling mountain people (Bhotia, Sherpa, Thakali, Tamang, Gurung etc.). There are several reasons for this.

They have no troublesome caste regulations, and trade can be carried out by anybody, even by the monasteries and their lamas. At one time these people were nomadic or semi-nomadic and many of the characteristics of this way of life are still evident. Thus travelling for months is quite usual and indeed a normal part of their life. *Their great mobility has also had the effect of spreading the knowledge of paper and its uses.* If they are large-scale merchants, they often have depots and places of transshipment along the caravan routes (plates 12 and 16) using yaks, mules etc. for the transport of goods. Many highland dwellers trade by bartering. For example, they buy salt and wool in the highlands and take it southward to the Middle Range, where it is bartered for rice and kerosene. This is then transported back to the highlands, where it is either sold or exchanged for other goods, but at a price many times that of the salt and wool with which the merchant started out.

The population in the lowlands and in the lower part of the Middle Range are predominantly the followers of Hinduism, and their troublesome caste regulations make longer journeys far more difficult. If they are shopkeepers they usually settle down in a town or village, where they sell various goods to the local population from stalls. They rarely go any further north than the upper part of the Middle Range. *A special position is held by the Newars, who have settled down as craftsmen or shopkeepers in most commercial centres, until recently even in several towns in Tibet.*

3. The Most Important Caravan Routes towards Tibet

Immigration from Tibet to Nepal, and the trade between these two countries and between Tibet and India, have generally taken place over the few low passes in the north. The most densely populated parts of Nepal are situated exactly south of the easiest passes over the Himalayas.

The Kathmandu Valley with adjoining valleys are the most densely populated. To the north lie the two lowest and easiest caravan routes towards Tibet via the border passes Rasua Garhi and Kodari, both at an altitude of only about 2000 m. The Pokhara area is also densely populated, and from there to the north an easy and important route makes its way through the Great Himalayas. It leads between the giant peaks of Annapurna and Dhaulagiri, passing the trading stations of Lete, Koprang and Tukucha (plate 16) as well as Mustang, the capital of the small duchy of the same name, finally leaving Nepal across a wide, easy pass at a height of about 4000 m. SNELLGROVE, 1961, p. 182, writes about this route:

"In earlier times (8th to 13th centuries) this must have been one of the main routes by which Tibetan, Nepalese and Indian teachers travelled, painstakingly importing Buddhist teachings into Tibet."

Also rather densely populated are large parts of the Middle Range in East Nepal. The passes north of this area are all situated at an altitude of more than 5000 m., but are important because they lead to the central parts of Tibet; the passes Nangpa La, Rakra La and Khang La should be specially mentioned. Finally, the parts of Terai lying south of the three mentioned regions of the Middle Range are also thickly populated.

Mahabharat Lekh and Northern Nepal are thinly populated, and likewise large parts of the Middle Range in West Nepal west of the Pokhara district, where the ethnic groups III (see p. 15) are not found.

There is an interesting correspondence between the caravan routes into Tibet and paper-making in Nepal. As previously said, the consumption of paper in Tibet must already have been quite considerable before A. D. 1000, while in Nepal south of the Great Himalayas, paper does not seem to have been used in large quantities until much later. The paper consumption of Tibet soon increased to such an extent, that it was presumably necessary to produce paper in new areas which had plenty of suitable plant fibres. It is therefore reasonable to assume that Nepal's first production of paper took place in the neighbourhood of the caravan routes, which could carry it to the consumers in Tibet comparatively easily. This is proved by the fact that *even to-day the production of paper is concentrated around the most important caravan routes in Northern Nepal leading to Tibet.*

4. Caravan Routes to Tibet and China according to Early Sources

The caravan routes leading northwards to Tibet and China (apart from the new road between Kathmandu and Lhasa) are to-day much longer and more inconvenient than the roads leading southward down to the North Indian lowlands. Conditions were quite different in former times. It made no difference whether the roads were broad or narrow, since all transport had to be undertaken on foot or with beasts of burden. The then much thicker jungles of the lowlands, with their wild animals and dangerous tropical diseases, had a more deterrent effect on the inhabitants of the Middle Range and the highlands than the expanses of Central Asia.

Probably the Kathmandu Valley already had links northwards with Tibet about the beginning of our era, and by the time of Aṃśuvarman and Srong-btsan-sgam-po such links must have been comparatively well-known. Sources which supply detailed information concerning the routes across the mountain passes in the north, however, are not particularly old. Some of them should nevertheless be mentioned, because they speak of connections with Lhasa and China which are evidently much older.

In the years 1661–62 Grueber, a Jesuit monk, travelled from China via Lhasa and Nepal to India keeping note of his route and the time it took. He says that from Lhasa to Kuti (Nyalam) in Tibet the journey lasted a month, that 5 days later he came to Listi in Nepal and in another 5 days reached Kathmandu. From here the route went across Hitaura to Benares, and this part of the journey took 32 days in all (LEVI, 1905, I, pp. 83–84). In other words, Lhasa and Benares were at that time almost equidistant from Kathmandu if the journey was measured in days.

On several later occasions Roman Catholic monks travelled through Tibet (until 1754) and through Nepal (until 1759). Observations from these journeys were collected by Georgius in the work "*Alphabetum Tibetanum*", edited in Rome, 1762. Here two routes are mentioned: one leading to the Kathmandu Valley from India and the other to Lhasa via Kuti. The monks also mention another pass further east, but did not know the Rasua pass, which is the easiest one between Nepal and Tibet and can be travelled on horseback. LEVI, 1905, I, p. 131, writes that mutual distrust between the two countries made them agree to close Rasua. It was incidentally through this pass that Chinese armies penetrated deep into Nepal in 1793. After the defeat of Nepal it was agreed that the country should send tribute to China every five years. Rigid laws were ordained regarding the character of the tribute, the number of participants and, which is of special interest to us here, the route to be taken and the distances of the stages all the way to Peking.

Georgius says that 12 stages (one stage equals a day's journey) separated Kathmandu from Kuti. From here the journey continued to Lhasa via Tingri and Shigatse; this distance was 28 stages. In the capital of Tibet they rested for 1½ months, whereupon the journey continued to Ta-tsien-lou (Ta-chien-lu) on the border between Tibet and China. This section amounted to 64 stages, and they passed through Detsin dzong, Gya-la, Gyamdo (Giamda) dzong, Artsa (Archa, Acha), Lhari (Lhariguo), Alamdo (Alado), Chor-kong-la, Lhatse, Nganda (Ngemda), Lagong, Tchamdo (Chiemdo, Chamdo), Tag yab (Draya, Ch'aya), Nyeba, Batang (Patang) and Litang. From Ta-tsien-lou the journey went on through Szechwan to Peking, a distance of 72 stages. After a rest of 45 days the mission returned to Nepal by the same route, but this time taking via Kirong and the easier pass Rasua Garhi (LEVI, 1905, I, pp. 182–184. The names in brackets I have added from various maps).

This link was the shortest one with China. According to HODGSON, 1874, II, pp. 94–95, 87 days were needed for the journey from Kathmandu to Szechwan. This route claims our special interest, not only because it was the shortest between Nepal and China, but also because ever since prehistoric times it had passed through inhabited regions and led to rich areas of China. From Szechwan the Tibetans bought tea, iron, silk, porcelain etc. at an early date (tea was not grown in India until the beginning of the 19th century).

The route running northeast from Lhasa to North China has certainly much fewer variations of height and is easier to pass. (It is described in the *T'ang* Annals, cf. BUSHELL, 1880, pp. 538–541, and PELLIOT, 1961, pp. 141–142). It leads, however, through more desolate, cold and thinly populated areas and, above all, it does not lead to those areas of China in which the materials and methods of paper-making are found that have been used along the whole of the Himalayan range.

According to my investigations into Tibetan paper-making, *paper was in fact produced in or near a number of the above-named localities on the route between Kathmandu and Szechwan until the events in 1959, viz. near Tengri, Shigatse, Lhasa, Giamda Dzong, Ghiamdo, Batang and Litang* (map. p. 12). The ordinary method of production seems to have corresponded in broad outline to the primitive Nepalese one. (There also existed more recent and advanced methods, but they never reached Nepal.) Therefore everything seems to indicate that the art of making paper reached Tibet and hence Nepal along the route from Szechwan situated on the Tibetan arc, defined p. 17.

Summary

Paper has been made in the upper parts of the Middle Range and the lower parts of the Great Himalayas at altitudes from about 1500 to 3500 m. and mainly by *Tamang*. *Rai* and *Limbu* in the easternmost regions of Nepal are said to make paper, and in West Nepal west of the Marsyandi river, where the Tamangs are not found, *Magar* and *Gurung* make it. The higher-dwelling *Bhotia* and *Sherpa* have only made paper sporadically but they have traded in it with Tibet, to which most of the paper production in Nepal has gone. Paper-making has only been introduced quite recently in the lower parts of the Middle Range and in Terai.

Geographical, botanical, linguistic, ethnographical and historical evidence show that the migration and cultural contacts of the Himalayan people have mainly taken place along two stretches of rather different character. Both start in Southwestern China, but whereas "*the Tibetan arc*" is situated north of the Great Himalayas "*the Himalayan arc*" runs south of this mountain chain. The few caravan routes across the Himalayas have acted as bridges between the two arcs.

As a result of the investigations it can be stated that:

1. The Tamangs and closely related people are found all along the Himalayan arc.
2. Their features, language and culture leave no doubt that their main stock came from Tibet, viz. from the Tibetan arc.
3. The Tibetan and Himalayan arc both start in Southwestern China, where paper and paper-making probably were known already by the 2nd–3rd centuries A. D.
4. Almost the same very simple and very ancient paper-making method has been used along great parts of both arcs but especially along the Himalayan arc around the routes leading to Tibet (see moreover chapter IV).
5. Paper-making first became common in Tibet in the 8th or 9th century. There are no ancient written records from Nepal about paper but the oldest extant Nepalese manuscripts on paper are from the beginning of the 12th century (see chapter V).

On this evidence paper-making seems to have reached Tibet and Nepal in the following way. The art came to Southwestern China (Szechwan) in the first centuries A. D. From there it spread along the Tibetan arc to Central Tibet in the 7th and 8th centuries, because the administration of the Tibetan empire and the introduction of Buddhism brought about a great demand for writing materials. Due to the expansion of the Tibetan empire up to the 10th century big waves of migration swept westwards and southwards over the Himalayan passes down to Bhutan and Nepal. In Nepal the people living in the upper half of the Middle Range like Tamang, Gurung and Magar are largely the descendants of these migrations. Paper-makers seem to have been among the latest arrivals of these people about the turn of the millennium. This explains why we find the earliest method of making paper along most of the Himalayan arc whereas more advanced methods, which developed later in China or Tibet, are found only along the Tibetan arc.

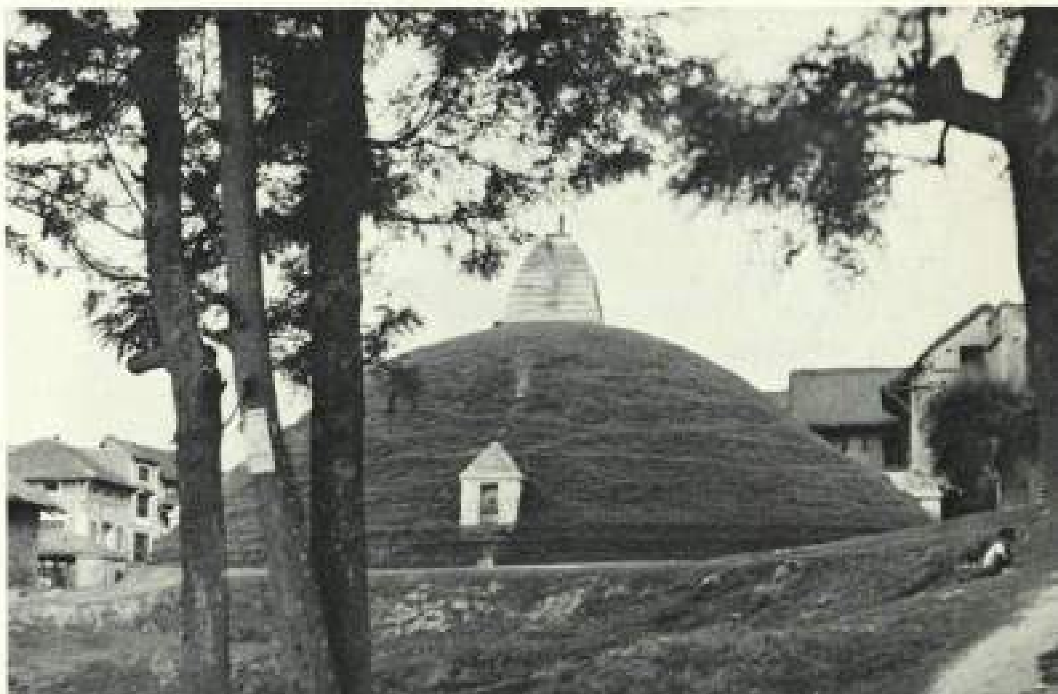


Plate 1. The Svayambhūnāth stupa near Kathmandu; one of the oldest and most important Buddhist shrines in Himalaya. Photograph by Ulrik Söchting.

Plate 2. The Bodhnāth stupa 4 km. from Kathmandu; an important Lamaist place of pilgrimage in Nepal for Tibetans and Sherpas. This stupa is presumably not much earlier than the 14th century. Notice the prayer wheels in the wall. Photograph by "The Nepal Group".

Plate 3. One of the four stupas in Patan which according to legend are said to have been erected by Aśoka i.e. about 250 B.C. Photograph by "The Nepal Group".

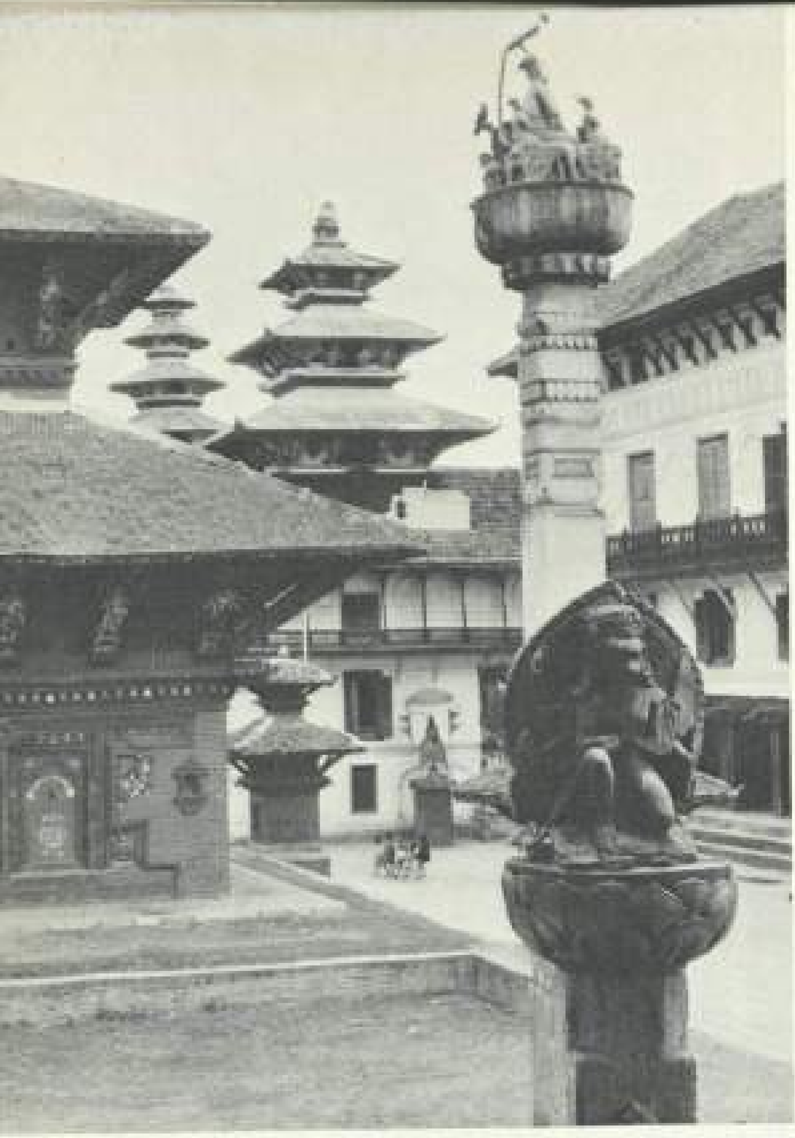


Plate 4. Hanuman Dhoka, a palace in the centre of Kathmandu. The woodwork on the temples is very elaborately carved and painted.

Plate 5. Boy with his paper kite during the "kite festival" that takes place in October. Kathmandu.

Plate 6. A tile with pagoda-like towers from Szechwan, made in the Han-dynasty (206 B.C. – A.D. 221). This style closely resembles that of many Nepalese temples (see p. 19).

Plate 7. A Newar reading a holy book. Bungmati, 6 miles south of Kathmandu. Photograph by "The Nepal Group".

Plate 8. Hindu mendicant friar carrying a stick and stringed instrument. Note his framed paper print. Kathmandu.

Plate 9. From an evening ceremony outside Hanuman Dhoka (23rd September 1970). The masks are made of papier mâché.

Plate 10. Kamalaksmi, shopping street in the centre of Kathmandu.

Plate 11. The west gate of Bhatgaon. Notice the Newars with carrying poles and the two fabulous beasts in stone (protectors of the town).

Plate 12. The main street through Pokhara, 900 m., the largest town in Nepal outside the Kathmandu Valley.

Plate 13. Lay-by with stepped landings of stone under a large banyan tree near Kusma, 1200 m.; like the banyan trees these structures are probably very old.

Plate 14. Thakali children from Koprang, 2500 m. From Ghasa in the south to Jomosum in the north the population is Thakali.

Plate 15. Gurung woman. Khare, 1700 m.

Plate 16. Tuche or Tukucha, 2500 m. Along the caravan trail to the north towards Tibet there are many large houses which once belonged to rich merchants.

Plate 17. A prayer wheel turned by the wind, on the roof of a house. Marpha, 2600 m.

Plate 18. A demon trap over the entrance to a house to keep away evil spirits. Cheego, 3600 m.

Plate 19. Dancing "black hat" monk in a temple courtyard. The hat is made of papier mâché. Opposite Thini, 2800 m.

Plate 20. The temple in Kakbeni, 3000 m, and as fortress-like as the other temples in the area. From here and to the north the population is Bhotia.

Plate 21. Chorten in Kakbeni. The main range of the Great Himalayas now lies to the south.

Plate 22. Ruins of a medieval castle in Cheego, 3600 m. The tower in the foreground is about 25 metres high.

Plate 23. The temple grounds in Muktinath, 3800 m. In the building to the right is a big prayer wheel with block-printed prayers. The wheel is turned by water power from the famous springs.

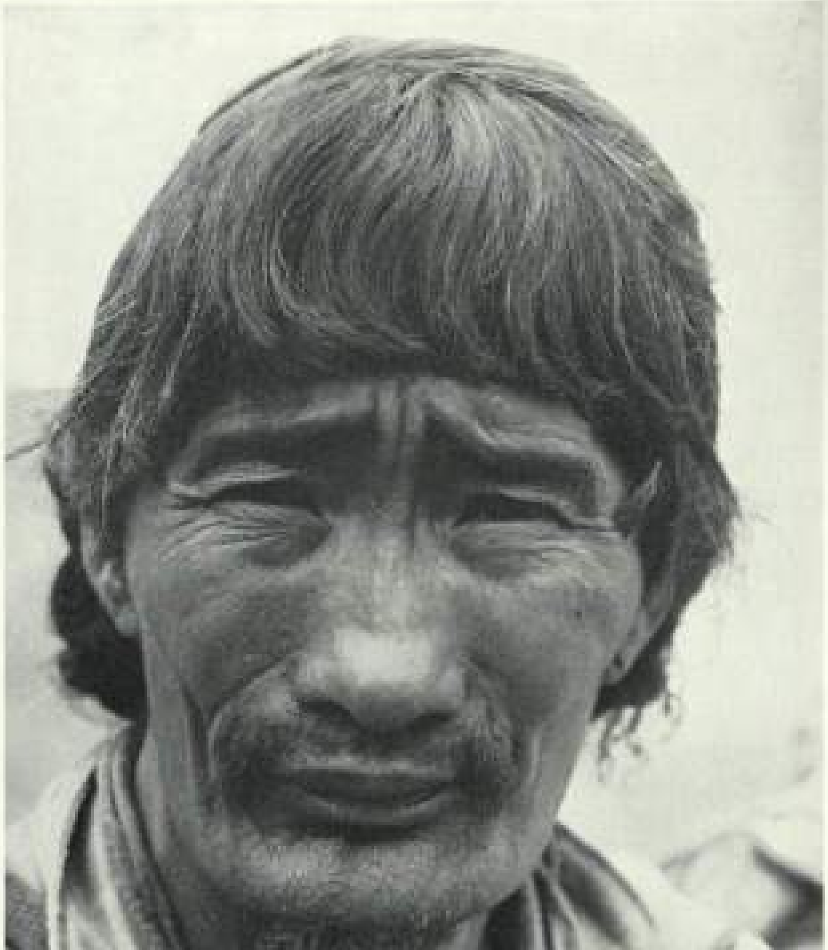


Plate 24. Interested onlookers. Notice the amulet bag of leather with paper woodcuts carried by the woman to the right. Muktinath, 3700 m.

Plate 25. Bhotia from Manang, travelling through Muktinath.

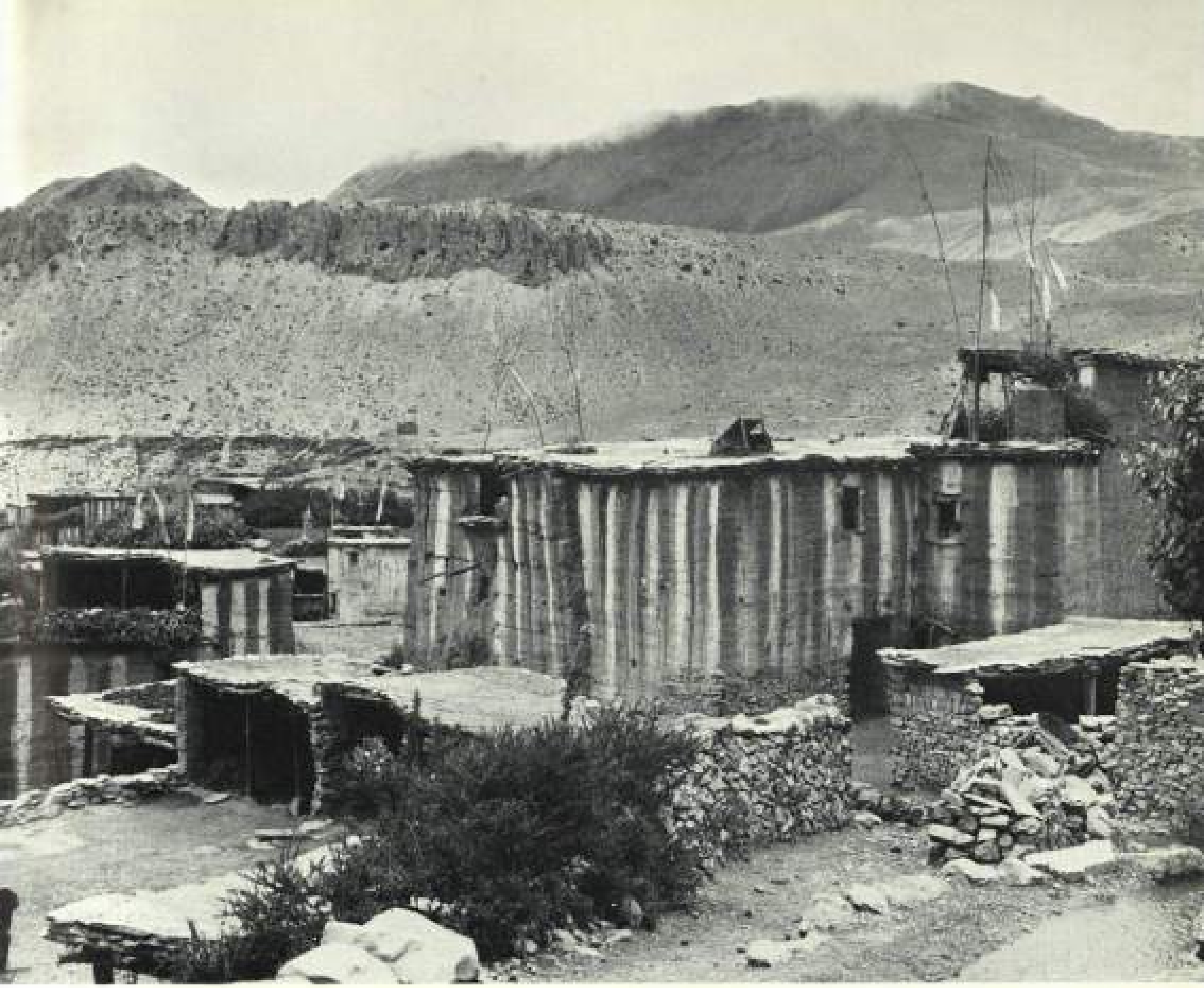


Plate 26. The houses in Muktinath have vertical multi-coloured stripes; man-made caves can be seen in the mountain face. Opinions are divided as to their use; according to TUCCI, 1956, p. 10, they are possibly prehistoric winter-dwellings but many other possibilities have been suggested (e. g. refuges in times of strife).

Plate 27. View towards south-southwest where the Great Himalayas merge into the Middle Range. In the far distance Mahabharat Lekh. (Chaunri Khola?, at about 1500 m.).

Plate 28. A ferry across Sun Kosi river at about 600 m. The canoe is a hollow log.

Plate 29. A Brahmin at Bhota Kosi river near Mungitar, 600 m. Notice the unmistakable Caucasian features.

Plate 30. A Tamang girl from the mountains a little north of the Kathmandu Valley, Mulharka, 2000 m.

Plate 31. Sherpa girl with a boy servant, Notice his features and dark complexion (paleomongoloid?). Tarke Ghyang, 2600 m.

Plate 32. A chapel, two hours' walk from Tarke Ghyang, 2600 m. Paper prayer flags are hung up. Photograph by Ulrik Söchting.

Plate 33. A monk, a refugee from Tibet photographed 1961 in Tarke Ghyang.

Plate 34. The big prayer wheel near the temple in Tarke Ghyang which is said to contain 6666 paper wood cuts.

Plate 35. A Sherpa selling salt from Tibet in Dopu Bazar, 2400 m. Until about 1960 most of Nepal was supplied with salt from Tibet, but to-day it is almost exclusively imported from India.

Plate 36. Itinerant magician or yogi (lit. Tibetan *rnal-'byor-pa*), who performs certain minor rituals. Notice, among the many religious objects, the manuscript in a case hanging across his left shoulder. Junbesi, 3000 m.

Plate 37. An old man with a prayer wheel containing one long paper roll like the one shown in plate 163. Tarke Ghyang, 2600 m.

Plate 38. Lamaist temples are the greatest consumers of paper in Northern Nepal. The Thyangboche monastery. 4000 m.

CHAPTER II

Fibres for Paper-Making

Right up to our time the paper-makers in Nepal have almost exclusively used the white inner bark, the bast, of some closely related species of shrubs of the family Thymelaeaceae as fibre-materials for making paper. These are found in China, Tibet, Himalaya, North India and Further India, in other words in just those areas in which paper has been produced by almost the same primitive methods. The paper in a few early Nepalese manuscripts and in some modern paper is made of quite different fibres, but these are well-known and with a few exceptions will not require further mention here.

More or less detailed descriptions of paper-making in Nepal have been given in previous studies, including plants, methods etc. The greater part of this material, however, is based on second-hand information, partly because the area was closed to Europeans for a long time. This is also the case in TSCHUDIN, 1964, pp. 3–10, which nevertheless carefully enumerates those species of Thymelaeaceae that have been used for paper-making in Nepal. In TSCHUDIN, 1966, p. 313, there is a list of these species, covering the Himalayan States, India, China, Japan etc.

As the Himalayan species of Thymelaeaceae have not yet been fully investigated, and the source material is so diffuse, their most distinctive features, distribution etc. are given below, followed by bibliographical references and details of the material collected by myself. Microscopical investigations of the bast fibres are given in detail in chapter VI. Most species of Thymelaeaceae used for paper-making in Nepal are so much alike that the paper-makers do not generally make much distinction between them, and therefore have no specific name for each species. As a rule one name includes several species; for this reason and for the sake of clarity the local names of plants are mentioned and commented upon in a separate section at the end of this chapter.

A. The Family Thymelaeaceae

DOMKE, 1934, who investigated this family very thoroughly, divides it into 4 subfamilies, including Thymelaeoideae, which again is subdivided into 4 tribes including Daphneae (see table). Daphneae, which according to the same author comprises 13 genera and c. 150 species, has spread to nearly all parts of the earth. The area of origin of this tribe as well as of the rest of the family is, according to DOMKE, 1934, p. 48, the Asiatic "Paläotropis".

Daphneae is divided into 5 subtribes, of which three must be mentioned: Wikstroemiinae (including the species *Wikstroemia canescens* and *Wikstroemia chamaejasme*), Daphnopsinae (including *Lagetta lintearia*) and Daphninae.

Daphninae is divided into two subseries, of which the first comprises *Daphne* and *Erisolena* (with its single species *Daphne involucrata*) and the second *Edgeworthia* (comprising the two species *Edgeworthia gardneri* and *Edgeworthia chrysantha*).

Daphne comprises c. 70 species and is divided into 3 sections, viz. *Daphnantes, Laureola* and *Mezereum* (including *Daphne mezereum*).

Subfamily	Tribe	Subtribe	Subseries Ramus	Section	Subsection
Gonystyloideae					
Aquilarioideae					
Gilgiodaphnoideae	Dicranolepideae	Wikstroemiinae	Daphne	Daphnantes	Daphnanthoides
Thymelaeoideae	Phalerieae	Dendrostellerinae	Erisolena	Laureola	Alpinae
	Daphneae	Daphnopsinae	Edgeworthia	Mezereum	Pseudomezereum
	Gnidieae	Daphninae			Oleoides
		Rhamnoneurinae			Collinae
					Cneorum

Daphnantes is subdivided into 6 subsections, 4 of which are:

Daphnanthoides (including

a: *Daphne sureil*, *Daphne bholua* and *Daphne papyracea*.

b: *Daphne retusa* and *Daphne tangutica*).

Alpinae (including *Daphne giraldii*).
Oleoides (including *Daphne alpina*).
Collinae (including *Daphne sericea*).

With regard to some of those species from which paper has been made, it should be mentioned that there has been some doubt about their exact botanical classification as well as their names. Thus, according to HOU, 1960, p. 37, *Daphne involucrata* ought to be classified with *Daphne* (see however p. 197).

Domke's treatise, moreover, is of interest because it gives the distribution of all the species of Thymelaeaceae (arranged in subgroups) according to geographical area, which is illustrated in maps; furthermore he emphasises the great similarity between certain species in Asia, the Middle East and Europe, and also between species from the same area but growing at different altitudes (DOMKE, 1934, pp. 72–78).

B. Species of Thymelaeaceae used for Paper-Making

1. *Edgeworthia gardneri* (Wall.) Meisn.

An evergreen shrub (plate 42) like the other species mentioned below. It is much branched, and grows into a broader shrub than *Daphne bholua* and *Daphne papyracea*. The leaves are 7–3 cm. long, elliptical lanceolate and acuminate, glabrous above, pubescent or silky beneath; unlike *Daphne bholua* and the other species of *Daphnanthoides*, the midrib is hairy. The flowers are joined, 40 or more in densely crowded, ball-shaped, sweet-scented, golden-yellow or yellow-brownish pedunculate heads.

Distribution. Several botanists count *Edgeworthia* as only one single species, viz. *Edgeworthia gardneri* (Wall.) Meisn. found in Central and East Himalaya, northern parts of Further India, China and Japan. However, TSCHUDIN, 1964, p. 5, distinguishes between *Edgeworthia chrysantha* Lindl. (synonym *Edgeworthia papyrifera* Sieb. et Zucc.) and *Edgeworthia gardneri* (Wall.) Meisn. (synonym *Daphne gardneri* Wall.). The last mentioned is found in Nepal (but not West Nepal) and the northern border regions of Further India probably including Southwestern China. The shrub is also found along the Tsangpo river in Tibet. It grows wild and, like the *Daphne* species, it is not cultivated in Nepal. It is found here between 1500 and 2400 m. and is rarer than *Daphne bholua*.

According to Wallich the bast has better fibre properties for paper-making than bast of *Daphne bholua* and *Daphne papyracea*. My own investigations show that *paper made from* Edgeworthia *bast is indeed softer than paper made from the two other species but, on the other hand, with less satisfactory properties for writing purposes.*

References

WALLICH, 1820. The botanist Nathaniel Wallich was the first to give detailed information on the plants used for paper-making in the Himalayas. He was born in Copenhagen, where he studied medicine and botany, and was for a number of years superintendent of the Botanical Gardens in Calcutta. He described the flora of India in several finely illustrated works. Wallich named the plant *Daphne Gardneri* Wall. after Edward Gardner, the first to draw attention to this shrub. P. 390: "I am informed it grows to be a large shrub and is cultivated extensively about Kathmandu, both on account of its beauty and perfume, and also on account of the utility of its bark, affording a material of which a superior sort of paper is made in Napoul." The observation that the plant was cultivated extensively around the Kathmandu Valley in Wallich's time is interesting, but it has not been possible to verify it. None of the Nepalese I asked have heard of such cultivation, which for other reasons does not seem very likely. Possibly the information is due to the fact that the collectors of bark usually cut off the branches in such a way that the plant is able to regenerate in the course of one or two years, which involves a certain care of the bushes; a procedure all the paper-makers I met with in Nepal laid stress upon.

HOOKER, 1855, p. 195, near Taptiatok in farthest East Nepal: "*Elæagnus* was common here, with *Edgeworthia Gardneri**. *A kind of *Daphne*, from whose bark the Nepal paper is manufactured, a beautiful shrub, with globes of waxy, cowslip-coloured, deliciously scented flowers; . . ."

HOOKER, 1890, p. 194: "Central and Eastern Himalaya. Nepal, Wallich. Sikkim, alt. 5–7000 ft., J. D. H. & C. Bhotan, Griffith. Dist. China, Japan." Plant briefly described. It is finally remarked: "I find no character whereby to distinguish the Chinese and Japanese plant from the Himalayan."

CURTIS, 1891, TAB. 7180 description and a drawing: ". . . the British Provinces west of Nepal [i. e. Kumaon etc.] where the *Edgeworthia* does not exist." This however is not tantamount to the non-existence of the plant in West Nepal, as mentioned by TSCHUDIN, 1964, p. 5, from the same source. Nevertheless there is some indication that it does not in fact grow there.

BRANDIS, 1911, p. 545: "Nepal (common, . . .). Sikkim, 3–7,000 ft. Assam . . ."

MARQUAND, 1928, p. 220: "Bush of 3-4 m. in thickets. Tsangpo Gorge, Tibet 2100-2400 meter."

SMYTHIES etc., c. 1940, p. 5: ". . . a common evergreen shrub *(Edgeworthia Gardneri* a species of *Daphne)*, that grows in the damp forests of 4,000 ft. to 8,000 ft. altitude."

TSCHUDIN, 1964, p. 9. According to Mr. K. von Gunten the paper-makers at Jiri, East No. 2 in East Nepal, use bast from *Edgeworthia gardneri:* "Diese *Daphne* soll außerhalb der großen Wälder in Lagen über 1800 m. wachsen. Sie überzieht ganze Hänge als Reinbestand und gedeilt auch im losen Buschwald."

Present material. Judging from microscopical analyses and the easy divisibility and the red-brown colour of the bast, a piece of bark sent from Kalimpong on the border between India and Sikkim seems to derive from *Edgeworthia gardneri.*

2. *Daphne involucrata* Wall.

A tall shrub (plate 43) or a small tree which may grow to a height of 6 m. The leaves alternate (are rarely opposite); blade oblong lanceolate, pale beneath, thin and with many secondary nerves. The shrub or tree flowers in January or February. The flowers are white and the fruits black. *Paper made from the bast fibres is coarse and of inferior quality.*

Distribution. Further India, Northern Assam, East Bengal, the Khasia Hills, East Himalaya, including East Nepal from 1200 to 1800 m.

References

WALLICH, 1820, p. 385: According to M. R. Smith, Sylhet: ". . . a very good and durable kind of hemp is prepared of its fibrous bark." The plant is described and shown in an engraving (plate 43).

WATT, 1890, p. 24: "A shrub of Eastern Himalaya, the Khâsia Hills, Upper Assam, East Bengal, and Burma. . . . Gamble, however, distinguishes between *Daphne Wallichii*, Meissn. (the chhota aryili) and *D. longifolia*, Meissn. (the Shedbarwa), and he states that while they both flower at the same time the latter does not mature its black fruits till November and December. . . . The Bark is used in the manufacture of Népal paper."

HOOKER, 1890, p. 194: "Sikkim Himalaya, alt. 6000 ft. Khasia Mts. alt. 4–6000 ft. common. Patkoge Mts. in Upper Assam, Griffith. . . ." Nepal not mentioned. Short description of the plant.

BRANDIS, 1911, p. 545: "A tall shrub, attaining 20 ft."

TURNER, 1931, p. 23: "argeli, or aryili (?), s. Name of a plant used for making paper, *Daphne cannabina* or *Edgeworthia Gardneri*, -choṭo a° *Daphne involucrata*." P. 203: "choṭo, adj. Small, short, inferior." I. e. *choṭo argeli* or *choṭo aryili* seems to signify a less suitable plant for making paper.

Present material. G.B. Shah writes that he has heard that paper-makers in East Nos. 2 and 3 sometimes mix bast from baruwa (probably *Daphne bholua*) with the hard bast fibres from the *arghali*-tree and that this tree may grow to be 6 m. high. The paper-makers, it is said, mix these fibres to produce more paper, but the paper is not so good and is mainly used as wrapping paper. The tree is certainly the same as that which the Sherpa Urgen says has a more brownish and coarse bast than that of *Daphne bholua*. He adds that the paper-makers in Tumbu, East No. 3, used this bast for the production of wrapping paper. Urgen has sent me a piece of bark, said to be from this tree. The specimen was gathered near Likhu Kola in the area south of the Everest massif. It is very hard and tough and difficult to divide. The appearance of both the bark strip and the fibres corresponds entirely to that of a herbarium specimen of *Daphne involucrata* from the Botanical Museum in Copenhagen.

3. *Daphne sureil* W.W. Smith et Cave

An upright shrub (plate 44), 1–2½ m. high, with branches almost in whorls. The bark is greyish-brown and smooth. The leaves alternate; blade stalked, lanceolate to oblong lanceolate, acutely acuminate, 5–13 cm. by 1.6–3.5 cm. (according to SMITH and CAVE, 1913, p. 49, average 9 cm. by 2.5), thinly leathery, glabrous, dark green and somewhat glossy above, and paler light green beneath; secondary nerves very oblique, 9–12 on each side.

Inflorescences of about 12–20 flowers in a rather lax head borne on terminal or lateral branches, up to 4 cm. long. Flowers faintly scented, borne on densely finely tomentose stout stalks up to 3 mm. long. Perianth 4-lobed, up to 2.5 cm. and of a dull ivory white. The shrub is in flower from October to the end of January. Fruits mature in February and are red-orange.

Daphne sureil differs from *Daphne bholua* in the colour of the flowers and of the fruits, and in the form of the perianth. *Daphne sureil* differs from *Daphne papyracea* in the leaves being less coriaceous and more pointed and in the longer and narrower perianth.

Distribution. Southern Assam, Bhutan, Sikkim and the Darjeeling area and also easternmost Nepal from c. 1300 to 1700 m. The paper probably is very similar to that of *Daphne papyracea*.

References

SMITH and CAVE, 1913. A very thorough description with drawings. Distribution and many properties of *Daphne sureil* and *Daphne bholua* are compared, the latter being replaced by *Daphne sureil* below 1800 m. in the Darjeeling area. P. 49: "... a not uncommon plant of the upper belt of cultivation. 4,500–5,500 ft. ... Both equally yield paper and string from the tough fibrous bark."

CURTIS, 1933, TAB. 9297. Description and a coloured drawing (plate 44). Distribution: "India, Sikkim Himalaya and Southern Assam." In Sikkim from 1350 to 1650 m.

TSCHUDIN, 1964, p. 6. In addition to the areas of distribution mentioned by Curtis, East Nepal is also given.

4. *Daphne papyracea* Wall. ex Steud. emend. W.W. Smith et Cave

Daphne papyracea (plates 39, 41, 45 and 47) and *Daphne bholua* have been known to science as raw materials for paper-making since their first botanical descriptions at the beginning of the last century. As they grow side by side and resemble each other fairly closely, many writers have not made a clear distinction between them or have described them simply as one species. They are consequently treated together in references.

A shrub, 1–3 m. high with branches up to 3 cm. thick. The leaves alternate; blade oblong lanceolate, rather corrugated, very dark green, smooth, mat shining and thinly leathery. When dry they become a dark bluish-grey. They measure up to 15 cm. by 3–4 cm. (average 9 cm. by 2¼).

The flowers, 10–16, are in sessile bracteate heads terminating the branches, white and with either a faint scent or none. The perianth is longer than in *Daphne bholua* (but shorter than in *Daphne sureil*). They flower from November to the end of February. The fruits are showy, red, and ripen from April to May.

Distribution. The shrub is found in Northern India, including Kumaon and Simla, as well as West and Central Nepal, in other words not only in West Nepal as noted by W. W. Smith and G. H. Cave and most others. In Nepal it is found from c. 1600 to 3000 m. and is less frequent than *Daphne bholua* both horizontally and vertically.

It has been claimed that paper made from its bast fibres is not as good as that made from *Daphne bholua*. However, according to the paper-makers in West Nepal and my own investigations it seems, on the contrary, to *yield a finer and whiter paper*. Probably the tough paper made from *Daphne involucrata* has been believed to derive from *Daphne papyracea*.

5. *Daphne bholua* Ham. ex D. Don

A shrub (plates 40, 41, 45 and 46), 1–3 m. high with branches at the most 2–3 cm. thick. The leaves are oblong lanceolate, very green (but not as dark green as *Daphne papyracea*). On the average they are shorter, up to 11 cm. (according to SMITH and CAVE, 1913, p. 49, they measure on the average 7.6 cm by 2.0, which corresponds quite well with my own samples).

The small flowers, 6–12, joined in heads terminating the branches are sweetly scented. The perianth segments are violet to reddish and blunt, thus quite different from *Daphne sureil* and *Daphne papyracea*. (For the identification of dried samples it should be noted that the filament of the stamen is very short in *Daphne bholua and* quite long in *Daphne papyracea*). Flowering takes place from December to May (incl.) depending on altitude etc. The fruits ripen from March to June and become purple or almost black.

A variety, *Daphne cannabina* Wall. var. glacialis Smith et Cave, according to SMITH and CAVE, 1913, p. 52, is reported to replace *Daphne bholua* above 3000–3500 m. The plant here is a very small shrub, as little as 15–20 cm. high. It flowers in April and May at the same time as the leaves unfold, or even before. *If this variety can be maintained at all, it ought to be called* Daphne bholua *Ham. ex D. Don, var. glacialis Smith et Cave considering that the species* Daphne cannabina *Wall., from which it was originally derived, is to-day called* Daphne bholua *Ham. ex D. Don.*

Distribution. The shrub is found in China, Southern Tibet, Northwestern Assam, North Bengal, Bhutan, Sikkim, Nepal and Kumaon; it thus occurs along the whole of the Himalayan arc. It is found from c. 1800 m. to 3600 (4000) m. in East Nepal, but only up to c. 3000 m. in West Nepal where the rainfall is noticeably less, and the upper timber line correspondingly lower. It grows wild and like the other species is not cultivated in Himalaya. *On account of its wide distribution, both horizontally and vertically, the bast fibres from* Daphne bholua *have been an important raw material for paper-making in Nepal.* The unbleached paper is brown, almost skin-coloured.

References
(Daphne papyracea and *Daphne bholua)*

MOORCROFT, 1816, p. 379 from Kumaon west of Nepal: "I observed a common plant something resembling butcher's broom, which was said to be the Setbarua, from which the mountaineers make a paper . . .".

WALLICH, 1820, p. 385–387. Here *Daphne bholua* is described and pictured in two engravings, one on handmade Nepalese paper (plate 46). Wallich identified the plant as *Daphne cannabina* Loureiro? (which is *Wikstroemia indica* C.A.Mey.), but pointed out that Loureiro's description indicates opposite leaves, hence the question-mark, and also that the plant strongly resembles *Daphne odora* Thunb. Wallich's description, however, also partly covers *Daphne papyracea*; thus it is said p. 386: "It appears there are two varieties, one with perfectly white the other with reddish flowers; . . ." (see also discussion Smith and Cave, 1913, pp. 46–47). It is said further that the plant is in flower between December and March and is in fruit between April and May. On p. 387 it is said that according to H. R. Murray in Kumaon the plant is 5–6 feet high, it flowers in January and February, and that the fruit matures at the end of April.

DON, 1825. Buchanan-Hamilton was a painstaking botanist, who in his notes gave the names *Daphne papyrifera* and *Daphne Bholua* for the two plants. His specimens and notes were accessible to Don before the latter published "*Prodromus Floræ Nepalensis*" in 1825. DON, p. 68, supposed the former to be identical with *Daphne odora* Thunb. The description of the plants is not quite correct (see also SMITH and CAVE, 1913, p. 47).

JACQUEMONT, 1844, pp. 143–144. Description of *Daphne papyracea* with a drawing Pl. 148 (see plate 47). It is said inter alia: The plant is a small shrub, the branches are round, as thick as a rather coarse goose-quill with an evil smelling, almost ash-grey bark . . . Leaves alternate, gathered at the ends of the twigs, oblong lanceolate, narrower towards the ground, not infrequently indistinctly retused, ..., with quite short stalks, 8–9 cm. long, and 2 cm. broad, directed upwards, quite smooth, a little thick and leathery, when dried mat greyish-blue on the upper side, paler with a narrow edge rolled backwards on the lower side. Leaves are moreover feather-ribbed, with midribs on the upper side depressed, on the lower side prominent and rather pale, secondary nerves are quite fine disappearing towards the tip. Flowers white without scent ... Flowering in November, fruits ripening in May. In the forests of Ghiounla, beyond the mountain range of Rari-Ka-Teibi at 2317 m. and in Kohauti near Ilahabad at 1800 m.

SMITH and CAVE, 1913, pp. 47–48, write on the same source: "The figure of Decaisne in Jacq. Voy. Bot. t. 148 is evidently taken from dried material and appears to us to be *D. odora* Don; this is partly confirmed by 'Flores nivei inodori. Calyx pilis subadpressis vestitus,' though evidently there is a disagreement regarding the perfume." However in my opinion the description and drawing by Jacquemont does cover *Daphne papyracea*.

MADDEN, 1848. A list is given of the vegetation of Nynee Tal (Naini Tal) near Almora in the Kumaon area. Here we find, p. 368: "*Daphne cannabina:* 'Set-burwa' both the white and purple flowering varieties", evidently *Daphne papyracea* and *Daphne bholua* (name quoted as sét barwá by HORNE, 1877, p. 97). Moreover we find: "*Daphne sericea* (*Wickstrœmia salicifolia* of Jacquemont) 'Chamlia'. The Nepal paper is made from this and the purple *D. cannabina*." The former is presumably *Wickstroemia canescens* (Wall.) Meisn., while the latter is obviously *Daphne bholua*, which wrongly indicates that *Daphne papyracea* is less suited for paper-making.

HORNE, 1877, pp. 95–96: "Nainí Tál, Kumaon. ..., being a shrub of generally three to four feet; although, I am told, it often grows higher. The thickness of the stem is not generally greater than one's finger. ... at 5000 to 9000 feet. ... The leaves are small and glabrous, being somewhat glossy; and the flower is insignificant, but with a slightly pleasant odour. The berries, which come on the tree in April to June, are showy, red, and very acrid." Probably *Daphne papyracea*.

WATT, 1890, p. 19, *Daphne papyracea* and *Daphne bholua* taken together: "*Daphne cannabina*, Wall. ... Habitat. —A large shrub or small tree found on the Himálaya from the Indus to Bhután, between altitudes of 3,000 and 10,000 feet; also on the Khásia and Naga Hills; one of the most abundant bushes on the hills between Manipur and Burma." P. 20 according to Gamble, Darjeeling: "... blossoms from November to February, ..." He adds that the flowers are "exceedingly sweetly scented". This seems to be *Daphne bholua*, although the time of flowering is very early. "In the Simla district this species flowers from the middle of December to the end of February or middle of March, but the flowers are then devoid of any smell." This is obviously *Daphne papyracea*. P. 22 Dr. Gimlette, Nepal writes: "This paper, ... is manufactured from two or three forms of *Daphne* and also from *Edgeworthia Gardneri*. ... The barks of the different species are generally mixed together, that of *Daphne papyracea* being seldom used except for cordage." The latter should indicate that the fibrous bast of this plant is coarser and less useful for making paper than the fibres of *Daphne bholua*. Possibly the plant in question is *Daphne involucrata*.

HOOKER, 1890, p. 193 on *Daphne cannabina* (both *Daphne bholua* and *Daphne papyracea*): "Temperate Himalaya, from Chamba to Bhotan, alt. 5–7000 ft. in the west and 6–10,000 ft. in the east. Khasia Mts., alt. 3–6000 ft." Under the same heading the species *Daphne cannabina* Wall., var. glacialis Smith et Cave is mentioned: "Small alpine states 6–8 in. high from Sikkim have broadly elliptic-ovate hard reticulated leaves ½–1 inch long, and dark brown when dry; the stems are half buried in the ground with the few leaves and small greenish-white flowers exserted."

SMITH and CAVE, 1913. A critical survey by two specialists on the Himalayan species of *Daphne* based on earlier sources, and a substantial collection of samples as well as observations in the neighbourhood of Darjeeling. Pp. 46–48 a discussion of the earlier names and descriptions of *Daphne papyracea* and *Daphne bholua*. P. 48: "-*Daphne papyracea* Decne., N. W. Himalaya and Western Nepal, 7–8,000 ft.; *Daphne cannabina* Wall., Nepal, Sikkim, Darjeeling and Bhutan above 6000 ft. and up to 11,000 ft.; ..." P. 49 on *Daphne cannabina* i. e. *Daphne bholua;* found from 6000 ft. to 8000 ft. "... and an alpine variety goes much higher." i. e. *Daphne cannabina* Wall., var. glacialis Smith et Cave. *Daphne bholua:* "... 6–12 ft., bushy, branching somewhat irregularly; the branches horizontal or almost drooping, very dense ... FLOWERING: ... in flower from the end of December to the end of February; flowers numerous from every terminal shoot. ... LEAVES: ... dark shining green in colour; average length 3 in. average width ¾ in.; petiole ¼ in.; ... ; texture rather hard and leaf always rather corrugated." P. 50: "BARK: The bark is covered in *D. cannabina* with a short rough scaly tomentum; the young shoots have a fairly shaggy tomentum. ... INFLORESCENCE: —The flowers of *D. cannabina* are in sessile bracteate heads terminating the branches, very fugacious, ... FLOWER: ... bluish-purple to a rosy white; ... FRUIT: ... It does not show any red or orange tint during the ripening stage, the change of colour is that of ripe grapes, the purple gradually overcoming the green and then darkening in tint."

KIHARA, 1955, p. 183: "*Daphne Bholua* Ham. ex Don. ... Between Sama and Kal Tal (Nov. 29–Dec. 2, 1952, flower). Kakani hill, 1800–2000 m. (March 29, 1953, fruit)." Both localities are situated to the northwest of Kathmandu. "Distr. Himalaya from Nepal to Bhotan; Northern Bengal, Northwest Assam, China, Yunnan. The flowers of our specimens seem to be red."

BEATTY, 1962. From the neighbourhood of Kathmandu. P. 17: "... no effort is made to grow *Daphne* domestically." The drawing on the cover of "*Daphne cannabina*" seems to be *Daphne papyracea*.

TSCHUDIN, 1964, p. 9. A species of *Daphne* is mentioned from Jiri in East Nepal which grows in the conifer forests from 2000 m. upwards. The plant flowers from March to April with reddish, deliciously scented flowers. This is evidently *Daphne bholua*, which is also suggested by the author.

Present material. In both East and West Nepal we often saw *Daphne* plants, presumably mostly *Daphne bholua*. Like the other species, *Daphne bholua* and *Daphne papyracea* thrive particularly well in open forest or on slopes with scattered groups of trees. They prefer a light moist soil; whenever I remember seeing them it was always in a quite humid place. They frequently occur alongside *Quercus*, *Pinus* and *Rhododendron*.

In Tumbu, East No. 3 where paper-making was examined in detail the plants had already ceased flowering in April, even at 3500 m. Here they were only 1–1 ½ m. high. I was told that the paper-makers used two species. The species growing here *(Daphne bholua)* has a quite white bast, and the paper is only slightly brown. The other kind does not occur around Tumbu but is brought there dried. The flowers, it was said, are white only, and the paper is thick and brownish and is used for printing Tibetan prayer books and as wrapping paper. Judging from the flowers it could be *Daphne involucrata*, but from the paper it is rather *Edgeworthia gardneri*. Later microscopical analyses showed that during our visit to the area paper was only made from *Daphne bholua* but, on the other hand, bast fibres from *Daphne involucrata* and *Edgeworthia gardneri* might occasionally have been used as well. The dried plants from Tumbu are *Daphne bholua*.

Mr. Ulrik Söchting has collected two specimens of *Daphne bholua* from the *Yolmo district in East No. 1* situated northeast of the Kathmandu Valley.

1. Tarke Ghyang, 28th April 1968, at 2600 m. on a slope facing west, plants up to 2.0 m. high, only a few still with flowers but all with fruits.
2. Tjamn Tang, 6th May 1968, at 3200 m., in a pass, plants smaller and still in flower (plate 40, notice that the flowers are completely unfolded, while the leaves have not yet reached a comparable stage of development).

G. B. Shah writes that the designation baruwa *in and around the Kathmandu Valley* includes two or three different species. From G. B. Shah I have received three specimens, all from the forest c. 5 km. north of Sundarijal on the northern side of the valley. The plants were gathered at heights a little above 2000 m. and all seem to be *Daphne bholua:*

1. Collected around 1st February 1966, with reddish flowers.
2. The beginning of May 1965, ceased flowering and fruits immature.
3. 25th May 1965 with fruits, some immature others mature.

Near Godawari, c. 13 km. south of Kathmandu on a steep, north-facing slope leading up to the peak Phulchok I found *Daphne papyracea* from c. 1700 m. upwards. It was now on the 21st November 1970 at the end of the flowering season (which starts in the beginning of November). The photograph, plate 39, was taken on the 15th November in the botanical garden only 1 ½ km. further down.

Two specimens with flowers have been sent from a relative of G. B. Shah, Mr. K. B. Malla, living in Nanglibang in the *Baglung area in West Nepal* (see map plate 94). One has reddish flowers with a very delicious scent even when dried; it is called *kālo baruwa*. *Kālo* means black, which may be because the paper made from this species is less white. This is certainly *Daphne bholua*. The other one has white flowers with acuminate leaves of the perianth and without scent when dried. It is called *seto baruwa*. *Set* means white, possibly because the paper made from this plant is whiter. This is *Daphne papyracea*.

A plant brought home from Nepal was found on the trail from Tatopani to Pokhara a few km. north of the village of Ulleri at c. 2300 m. The plant was without flowers or fruits on the 4th August 1964. Compared with *Daphne bholua* the leaves are a little longer, broader (up to 4 cm.), less hard and stiff and considerably darker on the lower side than on the upper side, which in a dried state is mat shining, dark bluish-grey. All things considered this seems to be *Daphne papyracea* (plate 45).

Following the same trail on the 9th November 1970 we found *Daphne bholua* in the pass 100 m. above the small village of Ghorapani (2800 m.). We saw it all the way down the southern side of the mountain to c. 2200 m., where the zone of cultivation starts above Ulleri. The shrub was not yet in flower; the leaves measured up to 10 ½ cm. by 3. Just outside Ghorapani we also found *Daphne papyracea*, and the two species were growing side by side in many places downwards towards Ulleri. The leaves of *Daphne papyracea* measured up to 14 ½ cm. by 4, and the flowers had just appeared. Even at 2800 m. the shrub attained a height of 2 m. Three living samples of each species were brought back to the Botanical Gardens of Copenhagen (plate 41).

Other species of Thymelaeaceae grow in Nepal besides those already mentioned, but they do not seem to have been much used for paper-making here (though some of them are used in Assam, Tibet, Kumaon etc.). They are, inter alia:

6. *Daphne retusa* Hemsl.

A small, low shrub, which according to DOMKE, 1934, p. 75, grows in the Himalayas from c. 3000 to 4300 m. In the Botanical Gardens of Copenhagen it is a small shrub 40 cm. high.

7. *Wikstroemia canescens* (Wall.) Meisn.

A small shrub with yellow flowers and black fruits, occurring in the Himalayas from 1500 to 3000 m. and used for making paper in Kumaon.

References

MADDEN, 1848, p. 368, says that "*Daphne sericea* 'Chumlia' (*Wikstrœmia salicifolia* of Jacquemont)" is used in Kumaon for paper-making. Here, however, it is a question of *Wikstroemia canescens* because according to INDEX KEWENSIS, 1895, Part IV, p. 1230: "*Wikstroemia salicifolia*, Decne, in JACQUEM. VOY. BOT. 144 t. 149 = *W. canescens*." In INDEX KEWENSIS, 1893, Part II, p. 717 we find: "*Daphne sericea*, D. Don, Prod. Fl. Nep. 69 = *Wikstroemia canescens*." (According to the sources investigated *Daphne sericea* Vahl is not found further east than Asia Minor.)

8. *Wikstroemia chamaejasme* (L.) Domke

(synonym *Stellera chamaejasme* L.; regarding the name see e. g. HOU, 1960, pp. 28–29). The plant is shown plate 48–50.

An entirely glabrous shrublet which produces numerous slender leafy upright annual shoots, 15–40 cm. high from a woody, up to 6 or 7 cm. thick branched root-stock. Leaves almost sessile, very variable in shape, linear-lanceolate to elliptic-oblong, 1–2 cm. by $2^1/_2$–5 mm., the uppermost crowded below the flower-head into an involucre. Flower-heads globular, many-flowered, $2^1/_2$–$3^1/_2$ cm. in diameter. Receptacle more or less pink. Perianth-lobes 5, rarely 4, elliptic, blunt, forming a white or slightly pinkish limb, up to 8 mm. across. Fruit a small blackish nut. The colour of the flowers is sometimes described as yellow, sometimes purple. However, KASHYAP, 1930, p. 209, writes that they become yellow when dry. *Paper is made from bast fibres of the roots of this plant. It is grey, soft and good for writing on.*

Distribution. China, North and Central Asia towards the west as far as the Caucasus. Occurs in Tibet, North Nepal, Kumaon, Garhwal and undoubtedly the rest of the Great Himalayas on grassy mountain slopes from 2500 to 4500 m.

References

HOOKER, 1890, p. 195; CURTIS, 1924, TAB. 9028 drawing in colours; KASHYAP, 1930, pp. 208–210; KIHARA, 1955, p. 183.

Present material. We found this shrublet in North Nepal in bare and arid places where almost no other plants thrive. A sample from Muktinath in Northwestern Nepal was collected by the Sherpa Dawa at about 3700 m. (plate 49). The shoots, c. 70, are only 10–20 cm. high, 1 mm. thick and have on each shoot 30–60 small, c. 1 cm. long and 3 mm. broad elliptic-oblong leaves. The root-stock is branched, up to 30 cm. long and 4 cm. thick. Thus only a very small part of this interesting shrub is above the soil. It was at the end of flowering at the beginning of November 1970.

It is the abnormally thick roots that have been used for paper-making in Tibet. Many regions there are situated so high up that the roots from this shrub were the only raw material available for the paper-makers. In any case, paper made from the bast fibres of *Wikstroemia chamaejasme* was regarded as high quality in Tibet and used for special purposes such as paper money. In Nepal, in or south of the Great Himalayas, where other fibres are abundant, *Wikstroemia chamaejasme* has not been used for making paper. Its characteristic fibres, very easily recognisable under the microscope, are found in paper used for manuscripts, letters etc., but they derive—and this is worth noticing—from Tibet and Northwestern Nepal. In not one of some 500 different samples of paper from the rest of Nepal, analysed under the microscope, have I found *Wikstroemia chamaejasme* fibres.

According to Mr. Corneille Jest, Paris, the root fibres have been used for paper-making in Dolpo in Northwestern Nepal, which agrees with the fact that one manuscript bought in Tukucha is on this paper, although it could have come from Tibet. *Wikstroemia chamaejasme* paper from Tibet has been used to some extent by Bhotias and Sherpas in Nepal (see also p. 146). The roots of the shrub have also been used for medical purposes all over Central Asia.

9. Other Species of Thymelaeaceae

In INDEX KEWENSIS, 1893, Part II, p. 716, we find: "*Daphne alpina*, Linn. Sp. Pl. 356. – Reg. Mediterr.; Himal." However, I have not found any other sources which indicate the Himalayas as an area of distribution.

According to HEGI, 1926, p. 701, referred to by TSCHUDIN, 1964, p. 9 and 1965, p. 312, *Lagetta lintearia* Lam. (= *Daphne lagetta* SW) is used for paper-making in Nepal. In INDEX KEWENSIS, 1893, Part II, two different plants of the same name are mentioned viz.: "*Daphne Lagetto*, Bonpl. ex Kunth, Syn. Pl. I. 447 = *Daphnopsis Bonplandii*" and "*Daphne Lagetto*, Sw. Prod. Veg. Ind. Occ. 63 = *Lagetta linteraria*." Both plants are alleged to occur only in Central America, they are therefore hardly likely to be found in Nepal.

C. Other Fibres for Paper-Making

Besides the species of the family Thymelaeaceae, experiments have probably been made from time immemorial with other kinds of fibres for paper-making in Nepal. However, my systematic fibre analyses of both new and old manuscripts, as well as other samples of paper from the whole country, show that before the 19th century paper was only seldom produced from fibres other than Thymelaeaceae. BEATTY, 1962, p. 14, also writes about manuscripts investigated at "the Royal Treasury" and the King's Museum in Kathmandu:

"All of these older papers were of pure bark fibres."

On p. 15 he says however:

"In earlier times paper was made in Nepal from rush grass, probably the Sabai grass. Some of the sheets of antique paper collected by the author were made from rush grass; they were rough in texture and a dirty gray in color, being without benefit of any bleaching."

Here it is probably a question of some other fibrous material, as *sabai grass* was apparently only used for this purpose at a much later period. Anyway, none of the early Nepalese or Indian paper manuscripts that I have investigated contains this fibre.

Of the comparatively few preserved 13th–15th century manuscripts on paper, some of the oldest of which I have had the opportunity of analysing, most are executed on paper made of *ramie* or *hemp* (*Boehmeria nivea* and *Cannabis sativa*). (According to BRANDIS, 1911, p. 617, concerning *Boehmeria nivea:* "A variety with the leaves green on both surfaces ("Ramie") is distinguished as *B. tenacissima*, Gaud.") It is surely such fibres to which W. B. Beatty alludes. The paper for these manuscripts was probably imported from Northern India, where these fibres have been used for paper-making ever since the invasion of the Mohammedans, through which the art of making paper was really brought to India. It is a well-known fact that hemp also grows in Nepal. According to TURNER, 1931, p. 473, it is: "bhāṅ², s. (obl.-a) *Cannabis sativa*, the hemp leaf" and p. 583: "san¹, s. Hemp, *Cannabis sativa*."

It should be mentioned that *sabai grass* is gathered in the Siwaliks in South Nepal and from there sent to India, where it is used for paper-making. Some time after 1940 the fibre was used for this purpose in the Kathmandu Valley as well. HAINES, 1921, II (*"The Botany of Bihar and Orissa"*) writes about sabai grass, *Pollinidum augustifolium* comb. nov. Syn. *Ischæmum augustifolium*, p. 1020:

"A much tufted grass 1–2 ft. high, with long drooping wiry leaves when old and clothed with wool at the base of the tuft. ... It is used locally for strings, ropes and mats and it is very largely employed for paper-making."

Again it seems to be a question of sabai grass etc. in TURNER, 1931, pp. 115 and 419:

"khar, s. (obl.-a). Dry grass, straw, hay; thatch; the plant used for making paper;" "ban-kas, s. A partic. kind of plant with a long stalk and slender sharp-edged leaves growing in the Terai and used for making paper."

Finally G. B. Shah writes that sometimes in the small paper factory at Sunderijal in the Kathmandu Valley (see p. 88) a certain kind of bast was used of what is described as "a long vine", called *chiuli*, which is mixed with *Daphne* fibres for the manufacture of cardboard. This plant is said to grow in the jungle from c. 1500 to 2000 m. As the bast is hard and stiff, is it not considered an important raw material. G. B. Shah maintains that the use of this fibre is rather recent, and microscopical analyses corroborate this. I am not able to identify this plant with certainty, although it is probably the plant mentioned by TURNER, 1931, p. 174:

"ciuri or cyuri, s. A partic. kind of plant from which fibre (pāṭ) is obtained, *Sterculia coxinia* ..."

BRANDIS, 1911, p. 83, presumably describes the same tree, *Sterculia coccinea*, Roxb., which is said to occur in Sikkim up to 1000 m. (J. D. H. gives 3000–6000 feet), in Bhutan, Assam, the Khasi Hills and Burma. The bast of this family of plants is very strong and is known to have been *used for making paper*.

With regard to fibre materials, other than sabai grass, which have come to be used in the Kathmandu Valley in recent times, viz. *rice straw*, *wood pulp* and all sorts of *waste paper*, see chapters IV and VI.

D. Local Names of Species of Thymelaeaceae

A great many different local names of plants are quoted in the literature about the species of Thymelaeaceae used for paper-making in Nepal. These are listed below according to source, together with the name of the species they seem to represent.

MOORCROFT, 1816, p. 379, in Kumaon: *Setbarud (D. bholua* and *D. papyracea?)*. P. 445, in the border regions towards Tibet: *Latbarisa*, presumably *Wikstroemia chamaejasme*.

WALLICH, 1820, p. 385: "*Nomen Set-Burooa*" probably *D. papyracea*. "Nepalensibus *Bhulloo-Soang*", *D. bholua* presumably also *D. papyracea*. Footnote: "I understand from Mr. Gardner that Soang, Soan and Swa are synonymous terms in the language of Nepaul, and signify 'flower'." This agrees with JØRGENSEN, 1936, p. 174: "swan, s. a flower, blossom . . ." in classical Newari. Set moreover means white from seto = white. P. 387, from Mr. H. R. Murray, Kumaon: *Set-burooa*; one of the names quoted by Wallich, which presumably comes from Murray. The short description of the plant indicates that it is *D. papyracea*. P. 388 concerning *Daphne Gardneri*, thus *Edgeworthia gardneri*: "Nomen vernaculum *Chuckmaree Soah*" which possibly means the plant with reddish-yellow flowers, from Tibetan dmar-po = red, reddish.

DON, 1825, p. 68: "1. *D. Odora . . . Set Buroa*", probably *D. papyracea*. "2. *D. Bholua . . . Bholua Swa*, Nawaricè." which is *D. bholua*.

MADDEN, 1848, p. 368 on Kumaon: "*Daphne cannabina: 'Set-burwa:'* both the white and purple flowering varieties." viz. *D. papyracea* and *D. bholua*. (The name is quoted as *sèt barwā* by HORNE, 1877, p. 97). Also mentioned is *Wikstroemia canescens: "Chumlia"*.

WATT, 1890, p. 19: "*Daphne cannabina*", here both *D. papyracea* and *D. bholua*: "*Set bāruwa, satpira*, HIND.; *Dunkotah, gande, kaghuti, bhullu soang*, NEPAL; *Dayshing*, BHUTIA; *Balwa* or *bholua, chambol, barua*, KUMAON; *Niggi, mahadeo-ka-phūl* (God's Flower), *jeku* (SIMLA), PB.; . . ." Dunkotah is the town mentioned by HOOKER, 1855, p. 181, near which paper is made, and not the name of a *Daphne* plant. The mistake is repeated in TSCHUDIN, 1964, p. 4, and others. The name *gande* is not found in other sources but possibly derives from gandhe = stinking (bark), see TURNER, 1931, p. 135. P. 20: "*Setburosa*"; the cited material to which the name belongs comes from Wallich's article in Asiatic Researches. The name there, however, is *Set Burooa*. P. 22 quotes Dr. Gimlette, Nepal (i. e. the Kathmandu Valley): "*Shosho, arbadl, shedbarwa*, or *letbarwa*, are names given by the Bhotias to the *Daphne* shrubs;" Shosho probably means a bunch or roll of paper; in Tibetan paper is written śog. (THOMAS, 1951, II, p. 82, writes: "śog-śog, reduplicated, occurs frequently as, perhaps, a sort of plural"; these sources are all earlier than A.D. 1000.) Furthermore: "*Kaghuti, bara kaghuti*, and *chota kaghuti* are names also used . . ." all derivations from the same word, paper, which in Hindi is called kāgad, in Urdu kāghaz and in Arabic kāghadh according to WADDELL, 1914, p. 136. According to TURNER, 1931, p. 84, paper in Nepalese is kāgat, kāgaj or kāgad. P. 24 according to Gamble, Darjeeling, *Daphne involucrata* is called: "*Shedbarwa, chhota aryili*" for explanation see TURNER, 1931, below.

SMITH and CAVE, 1913, p. 49 concerning *D. bholua* and *D. sureil*: "Both are called *Deyshing* by the Bhutiyas [shing from Tibetan, a shrub or a small tree], *Dhenok* by the Lepchas, and both have in Nepalese the two names of *Argaley*—the name of the plant itself—and *Kagati*—in allusion to paper being made from its bark."

TURNER, 1931, p. 23: "(?)*argeli*, or *aryili* (?), s. Name of a plant used for making paper, *D. cannabina* [probably both *D. papyracea* and *D. bholua*] or *Edgeworthia Gardneri*, -*choṭo a° D. involucrata*." P. 203: "choṭo, adj. Small, short, mean, inferior." P. 84: "*kāgate*, s. The name of various trees from which paper is made, *Daphne cannabina, Daphne involucrata, Edgeworthia Gardneri*;—a caste of paper-makers (= kāgate bhoṭe)."

SEN, 1940, p. 3, the Kathmandu Valley and surroundings: "Raw Materials: (1) Green bark of '*Kāgaj Pāt*' (also known as '*Swet Varowa*', Newari: *Bhonlu*)." Kāgaj = paper and pāt = fibres.

BEATTY, 1962, p. 14: "In Nepal the bark of the particular species of *Daphne cannabina*, long known as 'The Nepal Paper Tree' is also called *Barua*, or sometimes, *Lokta . . .*"

TSCHUDIN, 1964. Besides referring to many of the above names it is said of *D. papyracea* and *D. bholua* p. 4: "Die Hindus nennen beide . . . *setburwa, setburosa . . .*" P. 9 concerning Jiri, East No. 2 in East Nepal: "Das Volk nennt die *Daphne Loto-rug* (rug = Baum)." This according to the author includes *Edgeworthia gardneri*, and what seems to be *D. bholua*.

Present material. Junbesi, East No. 2 in East Nepal: Tamangs, who were kakadi i.e. paper-makers, called the plant *lokodo*. The sherpa Urgen, on the other hand, used the name *dahl* which he wrote rdal in Tibetan; but he used this word principally for the bast. Surprisingly enough, I never heard any of the many specific Tibetan names for the *Daphne* species. Both the Tamangs and Urgen called paper kāgas; Urgen too, like the Tibetans, called it sjugu (written śog-bu, properly a piece of paper).

In the Yolmo-district, *East No. 1 near Tarke Gyang*, according to Ulrich Söchting, the *Daphne* species are called *sjugu mendo* in Sherpa (from Tibetan śog-bu me-tog = paper plant, pronounced sjugu meto), *lokodo pul* in Tamang (= bast plant) and *chargat pul* in Nepali (from kāgat pul = paper plant).

In the *Kathmandu Valley* I heard *lokoda* or *lokda*. G. B. Shah gives *baruwa* as the most common term for the species used, but also mentions *lokata* and *kagate*, adding that the term kāgadi is wrong, and that paper is called kāgat in Nepali. If one wishes particularly to indicate *Daphne papyracea* it is called *set baruwa*. Finally Shah states that in East Nepal in East No. 3, as already mentioned, *Daphne* bast is sometimes mixed with bast from the *arghali*-tree, which is probably identical with *Daphne involucrata*.

In *Nanglibang in the Baglung district* our paper-maker, who is a Chetri, called the plant *baudoar* and he added that lokodo was an old-fashioned term. The two plants sent from this area were called *kālo* (black) *baruwa* which is *D. bholua* and *seto* (white) *baruwa*, which is *D. papyracea*.

Summary

The local names of plants are listed below, with omission of a few uncertain names and of the special phonetic signs which are only included in a few sources. Only where the name refers to a special species of *Daphne* is this added.

From the survey it will be seen that comparatively few, really different names have been used for the various species of Thymelaeaceae in Nepal. In the Middle Range the name *barua* with variants is preferred, often with *set* in front, which may particularly designate *Daphne papyracea*. In the highlands, e. g. among the Tamangs the term *lokoda* (dental d) with variants is most frequently used and both here and in the Middle Range *kagate* with variants. *Argeli, aryili, arghali* etc. seem to have been used specially to denote *Daphne involucrata*. Sherpa and Bhotia mostly name the plant according to their use or special characteristics and seldom use any commonly adopted names.

List of Local Names of Species of Thymelaeaceae

BHUTAN:	deyshing			
SIKKIM:	dhenok			
NEPAL:				argeli
barua	set baruwa	kagate	lokta	aryili
baruwa	shedbarwa	kagati	lokda	argaley
baudoar	letbarwa	kaghuti	lokota	arbadi
bhonlu	swet varowa	kagaj pat	lokoda	arghali
bhulloo-soang	seto baruwa	kagajipat	lokodo	choto argeli
	(often *Daphne*	chargat pul	lokodo pul	choto aryili
	papyracea)	chota kaghuti		(often *Daphne*
kalo baruwa		bara kaghuti	loto-rug	*involucrata*)
(*Daphne bholua*)				chuckmaree soah
	gande	shugu mendo		(*Edgeworthia*
				gardneri)
KUMAON:		chamboi		
balwa	setbarua	chumlia (*Wikstroemia canescens*)		
bhalua	set-burwa			
barua	set-burooa	latbarisa (*Wikstroemia chamaejasme*)		
NORTH INDIA:	set buroa	niggi		
	set baruwa			
	satpura	mahadeo-ka-phul		
	setburwa			
	setburosa	jeku		

CHAPTER III

The Literature on Paper-Making

This chapter cites and comments on the literary sources which mention paper-making in Nepal, where and by whom the paper has been produced, its sale etc. In order to avoid repetition and further division of the source material the various subjects will not be treated separately, but all sources are arranged chronologically. The facts that can be extracted from this material may often seem fragmentary, but taken together they nevertheless give a good picture of the history of paper in Nepal during the last 150 years, at a time when Nepal still had very little contact with the West.

MOORCROFT, 1816, p. 379 on Kumaon:

"... the Setbaruá, from which the mountaineers make a paper that is sold at Srinagar and Almora, and from thence finds its way into Hindústan although not in large quantity."

WALLICH, 1820. Wallich's short description of the paper-making process does not come from his contacts in Nepal, but from Lieut. M. R. Murray, who travelled in Kumaon (west of Nepal) and observed the method there. Murray says p. 388:

"After scraping off the outer surface of the bark, what remains is boiled in fair water with a small quantity of the ashes of the oak, a most necessary part of the ingredients, which has the effect of cleaning and whitening the stuff. After the boiling, it is washed and immediately beat to a pulp with small mallets on a stone, so that when mixed up in a vat with the fairest water, it has the appearance of flour and water. It is then spread on moulds or frames made of common bamboo mats."

The method described is very much like the ordinary Nepalese one, yet it is remarkable that *bamboo mats* were used for the moulds, a material which has never, or only very rarely, been used in Nepal for this purpose. Probably they have been *grass mats* which are often mistaken for bamboo mats. Murray furthermore reports:

"It is generally made about one yard square [c. 90 by 90 cm.], and of three different qualities. The best sort is retailed at the rate of 40 sheets for a current rupee [Indian R.] and at wholesale 80 sheets. The second is retailed at the rate of 50 sheets for a current rupee and 100 at wholesale. The third of a much smaller size, is retailed at 140 sheets and wholesale 160 to 170 for the rupee."

Wallich obviously received various specimens of paper besides plants and seeds from Edward Gardner, Resident in Kathmandu. Wallich writes p. 386:

"The common kind measures generally about two feet square [c. 60 by 60 cm.]. The finest kind measures ten feet in length by 4 feet in breadth [c. 300 by 120 cm.]; and is manufactured chiefly in Dotee, a province to the eastward of Kumoon."

The province of Doti is situated in westernmost Nepal (e. g. shown in KARAN, 1960, on the detachable map at the end of his book). Probably the larger sizes of paper have been produced in Doti. However, to-day it is only the Baglung area, also situated in West Nepal, that has a reputation for making this quality.

Of *Daphne Gardneri*, i. e. *Edgeworthia gardneri*, it is said p. 390 that the bast from this plant furnishes:

"... a material of which a superior sort of paper is made in Napoul. The process of this manufactory, as well as the essential qualities of the paper, ... does not differ from those of the other species."

None of my Nepalese acquaintances seem to know of the finer quality made from this species and neither have I encountered it. A certain kind of paper is indeed made of fibres that in all probability come from *Edgeworthia gardneri*, but this is poorly sized and very soft, though it is suitable for the production of woodcuts. Probably the finer paper Wallich heard about was the paper made from *Daphne papyracea*, said to be less knotty and whiter.

HODGSON, 1832. Quite surprisingly, the most detailed description as yet of the commonest and undoubtedly the oldest method is the excellent $3^1/_2$ page article by Brian H. Hodgson in the *"Journal of The Royal Asiatic Society of Bengal."* Moreover he is the only one to have investigated the question of which peoples in Nepal make paper. He even discusses the problem of how and by whom the art reached the country. For these reasons Hodgson's article is quoted below in full (minus two foot-notes and a postscript). It appears that the method I examined in East Nepal (see pp. 69–78) is practically identical with the one described by Hodgson p. 8–11:

"For the manufacture of the Nipalese paper the following implements are necessary, but a very rude construction of them suffices for the end in view.

1st. A stone mortar, of shallow and wide cavity, or a large block of stone, slightly but smoothly excavated.

2nd. A mallet or pestle of hard wood, such as oak, and in size proportioned to the mortar, and the quantity of boiled rind of the paper plant which it is desired to pound into pulp.

3rd. A basket of close wicker work, to put the ashes in, and through which water will pass only drop by drop.

4th. An earthen vessel or receiver, to receive the juice of the ashes after they have been watered.

5th. A metallic open-mouthed pot, to boil the rind of the plant in. It may be of iron, or copper, or brass, indifferently; an earthen one would hardly bear the requisite degree of fire.

6th. A sieve, the reticulation of the bottom of which is wide and open, so as to let all the pulp pass through it, save only the lumpy parts of it.

7th. A frame, with stout wooden sides, so that it will float well in water, and with a bottom of cloth, only so porous that the meshes of it will stay all the pulp, even when dilated and diffused in water; but will let the water pass off, when the frame is raised out of the cistern; the operator must also have the command of a cistern of clear water, plenty of fire-wood, ashes of oak, (though I fancy other ashes might answer as well,) a fire place, however rude, and lastly, quant. sufficit of slips of the inner bark of the paper tree, such as is peeled off the plant by the paper makers, who commonly use the peelings when fresh from the plant; but that is not indispensable. With these "appliances and means to boot," suppose you take our seers of ashes of oak [1 seer = 2.06 lbs. = 0.934 kg.], put them into the basket above-mentioned, place the earthen receiver or vessel beneath the basket, and then gradually pour five seers of clear water upon the ashes, and let the water drip slowly through the ashes and fall into the receiver. This juice of ashes must be strong, of a dark bark-like red colour, and in quantity about 2 lbs.; and if the first filtering yield not such a produce, pass the juice through the ashes a second time. Next, pour this extract of ashes into the metal pot, already described, and boil the extract; and so soon as it begins to boil, throw into it as many slips or peelings of the inner bark of the paper plant as you can easily grasp, each slip being about a cubit long [1 cubit = 46 cm.] and an inch wide; (in fact the quantity of the slips of bark should be to the quantity of juice of ashes, such that the former shall float freely in the latter, and that the juice shall not be absorbed and evaporated with less than half an hour's boiling.) Boil the slips for about half an hour, at the expiration of which time, the juice will be nearly absorbed, and the slips quite soft. Then take the softened slips and put them into the stone mortar, and beat them with the oaken mallet, till they are reduced to a homogeneous or uniform pulp, like so much dough. Take this pulp, put it into any wide-mouthed vessel, add a little pure water to it, and churn it with a wooden instrument like a chocolate mill for ten minutes, or until it loses all stringiness, and will spread itself out when shaken about under water. Next, take as much of this prepared pulp as will cover your paper frame, (with a thicker or thinner coat according to the strength of the paper you need,) toss it into such a sieve as I have described, and lay the sieve upon the paper frame, and let both sieve and frame float in the cistern; agitate them, and the pulp will spread itself over the sieve; the grosser and knotty parts of the pulp will remain in the sieve, but all the rest of it will ooze through into the frame. Then put away the sieve, and taking the frame in your left hand, as it floats on the water, shake the water and pulp smartly with your right hand, and the pulp will readily diffuse itself in an uniform manner over the bottom of the frame. When it is thus properly diffused, raise the frame out of the water, easing off the water in such a manner that the uniformity of the pulp spread, shall continue after the frame is clear of the water, and the paper is made.

To dry it, the frame is set endwise, near a large fire; and so soon as it is dry, the sheet is peeled off the bottom of the frame and folded up. When (which is seldom the case) it is deemed needful to smooth and polish the surface of the paper, the dry sheets are laid on wooden boards and rubbed, with the convex entire side of the conch-shell; or, in case of the sheets of paper being large, with the flat surface of a large rubber of hard smooth-grained wood; no size is ever needed or applied, to prevent the ink from running. It would probably surprise the paper-makers of England, to hear that the Kachár Bhoteahs can make up this paper into fine smooth sheets of several yards square. This paper may be purchased at Kathmandu in almost any quantity, at the price of 17 annas sicca [Indian] per dharni of three seers [1 R. = 16 annas and 1 Dharni = 2.7 Seers = 5.56 lbs.]; and the bricks of dried pulp may be had at the same place, for from 8 to 10 annas sicca per dharni. Though called Nipalese, the paper is not in fact made in Nepal proper. It is manufactured exclusively in Cis-Himalayan Bhote, and by the race of Bhoteahs denominated (in their own tongue) Rangbo [DAS, p. 1194: "Rôn-yul the country of ravines; gen. Nepal, Sikkim, Bhutan, etc., are so called." Rongpa is the people living south of the Great Himalayas], in contradistinction to the Trans-Himalayan Bhoteahs, whose vernacular name is Sokhpo† [Sherpa]. The Rangbo or Cis-Himalayan Bhoteeahs are divided into several tribes, (such as Múrmi [Tamang], Lapcha, &c. &c.) who do not generally intermarry, and who speak dialects of the Bhote or Tibet language so diverse, that, ignorant as they are, several of them cannot effectually communicate together. They are all somewhat ruder, darker, and smaller, than the Sokhpos or Trans-Himalayan Bhoteeahs, by whom they are all alike held in slight esteem, though most evidently essentially one and the same with themselves in race and in language, as well as in religion.

To return to our paper-making,—most of the Cis-Himalayan Bhoteahs, east of the Kali river [Kali Gandaki], make the Nipalese paper; but the greatest part of it is manufactured in the tract above Nepal proper, and the best market for it is afforded by the Nipalese people, and hence probably it derived its name; a great quantity is annually made and exported southwards, to Nepal and Hindústan, and northwards, to Sakya-Gúmba, Digarchi [Shigatse], and other places in Tramontane Bhote [Tibet]. The manufactories are mere sheds, established in the midst of the immense forest of Cis-Himalayan Bhote, which afford to the paper-makers an inexhaustible supply, on the very spot, of the firewood and ashes, which they consume so largely: abundance of clear water (another requisite) is likewise procurable every where in the same region. I cannot learn by whom or when the valuable properties of the paper plant were discovered; but the Nipalese say that any of their books now existent, which is made of Palmira leaves, may be safely pronounced, on that account, to be 500 years old: whence we may perhaps infer that the paper manufacture was founded about that time. I conjecture that the art of paper making was got by the Cis-Himalayan Bhoteahs, viâ Shassa [Lhasa], from China. A paper of the very same sort being manufactured at Shassa; and most of the useful arts of these regions having flowed upon them, through Tibet, from China; and not from Hindústan."

The only item in Hodgson's description of the technique of manufacture which I have not encountered in the paper-making of to-day in Nepal is the *sieve*, which he says is placed on top of the floating mould to keep back the uncooked or unbeaten, knotty parts of the pulp. The reason surely is that no one now manufactures much of the finest sorts, which were so amply produced for export to Tibet in earlier times. A sieve with the same function is described and photographed in *"Paper & Prints"*, 1945, pp. 260–262, where it is said that it is used by a "Bhutane-Tibetan tribe inhabiting the Assam Himalaya immediately east of the Bhutanese frontier ... The tribe is called *Monba* [or rather *Mon-pa*, for this name see DAS, 1902, p. 976]."

According to Hodgson the price of paper of the ordinary quality was "17 annas sicca per dharni of three seers." 1 R. (Rupee) is equivalent to 16 Annas, 1 R. sicca was then c. 16/13 Nep Rs (Nepalese Rs) and 1 Seer c. 2 lbs. Thus about the year 1830 c. 4½ lbs paper cost 1 Nep R. LEVI, 1905, I, p. 310, quoting CAMPBELL, 1839, states that in 1832–35 one bought 9 kg. rice per Nep R. in the Kathmandu Valley; i. e. *paper then cost about 4½ times as much per kg. as rice.*

Another interesting detail in Hodgson's account is the sale of *dried pulp made into bricks* which may have found their way into both Tibet and India. On the other hand, it is hardly likely that it was a normal practice to send dried pulp across long distances in Himalaya, since the paper itself must have fetched larger profits. Certainly pulp bricks are no longer made in Nepal.

Hodgson's remarks about where paper was made in his time, and by whom, are of special interest. He says that production takes place exclusively in "Cis-Himalayan Bhote", i. e. by people who live immediately south of the Great Himalayas, and mentions as examples *Murmi* and *Lapcha*. Murmi according to p. 21 is mainly the same as Tamang, the ethnic group which, as my own investigations show, is still the main paper manufacturer in Nepal. The Lapchas or Lepchas live mainly in Sikkim. Finally, Hodgson alleges that most of "the Cis-Himalayan Bhoteahs" who live east of Kali Gandaki (precisely the western limit of the area populated by the Tamang people) make paper, but that the greater part is produced north of Kathmandu, the best market. Hodgson's reflections on when and from where the art first came to Nepal do not require comment here, as the subject has already been discussed in chapter I.

CAMPBELL, 1836, p. 225. This source does not deal with paper-making, but it is interesting because textiles are mentioned made from bast fibres, by methods that have much in common with paper-making. According to Campbell the material is called *bhangara* and is used as sackcloth etc. He writes:

"The poorer people of the hills, who subsist chiefly by woodcutting and carrying, make this cloth in their houses and wear it. . . . The hill people say that several different trees furnish the appropriate bark, and that it is necessary to beat and pound it, as for papermaking."

G. B. Shah writes: "Bhangra is made of coarse jute. The common hill men also weave the cloth for their domestic use, making mattresses etc." According to TURNER, 1931, p. 474, the material is called *bhā̃iro* or *bhā̃gro*. On p. 565 we even find a garment made of bast fibres: "*valkal, or b-,* (l.) s. Bark of a tree;—garment made of bark and worn by ascetics". *In Himalaya, as well as in great parts of the rest of Asia, bast fibres were probably used for making ropes, implements and textiles long before our era. Here one merely had to modify already well-known working processes in order to make paper.*

HOOKER, 1855, p. 181, mentions paper-making near Dunkotah (Dhankuta in East Nepal).

HODGSON, 1874, II, pp. 91–121 describes Nepal's trade—i. e. that of the Kathmandu Valley—with India and Tibet, giving much valuable information about the nature and extent of this trade. In a list, p. 102, of some of the most important articles of export to India with their respective duties, we also find "Bhotea and Nepalese paper . . . per cent 4 11 1 Nepal Rupee & 3 13 9 Siccas" (indicated in Rupees, Annas and Pies. 1 R. = 16 Annas = 64 Pies). In the lists, op. cit. pp. 105–113, of imports from India we notice that Indian or European paper does not occur. This agrees with information from G. B. Shah, that only in the second half of the 19th century did a few businessmen begin to import European or Indian factory-made paper on a small scale.

P. 115 Hodgson states that the price of paper in Kathmandu was 5–6 Nepalese Annas per Seer or c. 6 lbs. per Nep R. Furthermore he estimates the annual import of paper from North Nepal to the Kathmandu Valley at 8,500 Nep Rs, the re-export to the south amounting to 5,000 Nep Rs. These figures from 1830–31 are interesting, not least because they give an idea of the number of paper-making workshops in Hodgson's time. Importation into the Kathmandu Valley, according to the above, amounted to 8,500 Nep Rs which corresponds to c. 50,000 lbs. Supposing that each workshop (commonly consisting of husband and wife) produced an average of 5 lbs. a day and 1,000 lbs. a year, the 50,000 lbs. would be equivalent to 50 workshops sending their production exclusively to the Kathmandu Valley in Hodgson's time. The greater part of Nepal's paper production, however, went to Tibet, and besides a certain amount used locally in the mountains, paper was exported to India by other routes than those from the Kathmandu Valley. *Altogether it is estimated that about 400 paper-making workshops must have been at work all over Nepal in Hodgson's time, as against not much more than 100 to-day and with a much larger population.* The annual production per workshop is now even smaller on account of fluctuating demand, restrictions and competition from modern machine-made paper.

HORNE, 1877. In a 4-page article the material of Wallich and Hodgson etc. is cited, and the author deals with the problem of whether *Daphne* fibres might be used as a supplement, at a time when raw-materials were lacking in England. P. 98 Horne writes:

"Near the residence of a Lâmâ at Kardang, in Lâhûl [a province east of Simla near the Tibetan border] we saw a number of Bhotiâs making paper from the bark of a tree they say they get in Kûllû, called "Bujil," a species of *Daphne*."

The short description of the method of production which follows, i. e. of pouring pulp onto a piece of cloth stretched under a wooden frame, seems to correspond to the Nepalese method.

WATT, 1890, p. 22 quotes Dr. Gimlette, Kathmandu:

This paper, justly celebrated for its toughness and durability, is manufactured from two or three forms of *Daphne* and also from *Edgeworthia Gardneri*, the last mentioned producing the finest and whitest paper [possibly cited from WALLICH, 1820] . . . The barks of the different species are generally mixed together, that of *Daphne papyracea* being seldom used except for cordage [probably confused with *Daphne involucrata*, because paper made from the bast of *Daphne papyracea* is the finest and whitest]. . . . The paper sells in the Kathmandu bazar at the rate of six annas per twenty-four large sheets. [I.e. at that time one had 200 big sheets at 3 Nep Rs some time before 1890.] Dr. Campbell reported in 1837 that the price was then 160 sheets, per Nepalese rupee, to 400; or from 9 to 13 Company's rupees per maund [i.e. 15 to 22 Nep Rs per 40 Seers or c. 82 lbs.]

In other words, some time before 1837, for 1 Nep R. one bought 160 sheets weighing 3³/₄ lbs. (each sheet weighing c. 10 g. corresponding to the good heavy quality of the ordinary size 48 by 64 cm.) or 400 sheets weighing 5¹/₂ lbs. (each sheet weighing c. 6 g. corresponding to the thin commonly used quality with big bundles of rough bast fibres, holes etc.). *The paper-makers in Nepal today operate with the same two qualities.* We notice, too, that Hodgson's and Campbell's indications of prices are quite consistent with each other. P. 22:

"The transport to Patna (a distance of 200 miles) he estimated at R 1–12 [Rupee and annas], and the price in Patna only a little more than in Catmandoo. This latter fact he explains by the circumstance of there being a monopoly of the sale of paper kept up by the Nepalese Government.

Throughout the greater part of India *Daphne* paper may be purchased, so that the manufacture by the hill tribes must be very extensive. Around Simla it is not made; indeed, the people seem utterly ignorant of the value of the plant—one of the commonest of wild plants. They prefer to make their ropes from *Grewia oppositifolia*, and alike neglect the *Daphne* and the wild hemp. This seems to be the state of affairs on most of the outer ranges. At Nagkanda (some 40 miles to the north of Simla) the writer came across some men carrying loads of *Daphne* bark, and was told it was being carried to the east where it was made into paper. This fact is in support of Stewart's statement that the Panjâb Himâlayan tribes do not make the paper, though it is well known to be extensively made in Kumâon."

This agrees with the observations of other travellers. *Thus Thymelaeaceae paper, in the area south of the Great Himalayas, seems to have been made only to the east of Simla, but thence all the way along the Himalayan arc to Szechwan.*

WESSELS, 1924. In this work on *"Early Jesuit travellers in Central Asia 1603–1721"* we find on p. 250, the following comment by Desideri:

"From Yee one passes into regions with a somewhat more temperate climate, which are called Takpó [about 150 km. east of Lhasa]. Takpó produces the best kind of writing paper, which is used throughout Tibet and is exported to Nepal. It is made of the inner bark of shrubs."

This information from about 1715 is interesting, but also rather strange, because paper had already been made in North Nepal for several centuries; the Takpo-province is also about 50 days' journey from the Kathmandu Valley. *Surely this is a question of an "export" of small quantities of special Tibetan paper to Nepal* such as *Wikstroemia chamaejasme* paper, of which I saw specimens during a stay in East Nepal.

SMYTHIES, DAWSON & HAVERBECK, c. 1940. In this booklet about Nepalese stamps there is mention on p. 5 of the paper on which they are printed:

"The main raw material is the inner bark of a common evergreen shrub *(Edgeworthia Gardneri*, a species of *Daphne)*, that grows in the damp forest at 4,000 ft. to 8,000 ft. altitude. This inner bark is stripped and collected chiefly by women and children, who bring it to the villages."

The short description of the manufacture of the paper which follows will not be cited, as it contains some strange misunderstandings.

"When finally ready, 60 to 70 lbs. of the paper are made into loads and carried by men for 20, 30 or 40 miles up and down the mountain passes to the nearest big town or market, where it is sold or bartered for other goods, cloth, salt, matches, oil, and all sorts of articles."

SEN, 1940. A 5-page article about Nepalese paper. P. 460:

"Paper-making is a fairly wide-extended cottage industry in Nepal. Districts Nos. 1, 2 and 3 in the East; 'Bâglung' and 'Pokhrā' in the West, are noted for the manufacture of paper. This particular handicraft is never concentrated with any special caste. Tāmāng, Chattri, Brâhman, Newar, etc., of the said localities earn their livelihood by this . . . art."

It is true that anybody may start making paper. However, it is generally the Tamangs who produce paper in Nepal. But in West Nepal, west of the Marsyandi-river, where there are hardly any Tamangs, and in the Kathmandu Valley (where Sen presumably comes from) other ethnic groups are engaged in paper-making. It may be noted, too, that the author mentions the Tamangs first, and moreover that three of the four captions to photographs of paper-makers specially mention the Tamang paper-makers.

"This industry has a great market at home and the Nepal Government is one of the best patrons of it. Tibetans import this paper for copying and printing books . . ."

S. N. Sen's brief but well-arranged description of the method of production is accompanied by drawings of implements and photographs of the paper-maker's workshop, which might well be situated in or near Kathmandu.

P. 461 the names of the paper-maker's tools are listed: "Nepali equivalent" (transcribed): copper kettle, *ngyaṃgi kharkalo;* stone slab, *dhumga;* mallet, *mugro;* bamboo churner, *mandāni;* container where the beaten bast is mixed with water into pulp, *tyalam;* ladle, *tāpke* (TURNER, 1931: tāpke = Iron frying pan); mould, *jālitāna* (TURNER, 1931: *jāli* = net, and *tān* = cloth, tissue).

"Raw materials: (1) Green bark of 'Kāgaj Pat' . . . (2) Wood of 'Bānj'; or 'Kharsu'; or 'Phlānd'; or 'Banset'. Alkali is made out of the ash of these woods. Of these "Bānj" is supposed to be the best for the purpose. Process: First stage: Ash of any of the four varieties of wood (Bānj, Kharsu, Phlānd, Banset) is first pressed into a basket and placed over an earthen jar. Then hot water is percolated through the ash—the basket serving the purpose of a sieve. A dark-brown solution is collected in the jar. This is a sort of carbonated-alkali."

The rest of the process will not be commented on, as it does not differ from the description from Tumbu in East Nepal, mentioned in the next chapter. P. 463:

"When still in solution any dye could be used to make coloured papers. Vegetable dyes (such as: -Tarmaric to make yellow; Manjistha to make red; etc., etc.) are the best and the cheapest."

GONDHALEKAR, 1952, p. 185, writes that the art of making paper was introduced into Nepal via Tibet in the 7th century, but no arguments are given in support of this very early date.

H. R. H. PRINCE PETER OF GREECE AND DENMARK, 1954.

An article on Tibetan book art. On p. 22 it is said about the paper:

"Some is also imported from Nepal, Bhutan and Assam, the best kind even coming from Walung in the extreme north-eastern corner of that Indian state."

RAY, 1956, p. 234. Here it is said that the art of making paper reached Nepal in the period 7th–9th centuries, which is somewhat early and is moreover unproved.

SPOHEL, 1956. This article in two pages about paper-making in Nepal is probably the most misleading to be written on the subject. But as the material has been used by other writers some of it will be cited and commented on. Both from the captions, pp. 8 and 9, and from the text, p. 9, it appears that the author supposes the paper to have been made from wood shavings:

"Die Bäume werden nicht gefällt, sondern man spaltet sie der Länge nach in millimeterstarke Späne auf. . . . Es ist das uralte System der Papierbereitung aus Holzstoffaser."

Making paper of such chips requires far more thorough mechanical and chemical treatment than that which the Himalayan paper-makers have at their disposal. The mistake is presumably due to the fact that, at a distance, the dried strips of bast look a good deal like long wood shavings. P. 9:

"Sie [the paper-makers in one workshop] werden in Laufe ihres Lebens ein paar tausend Blätter Papier herstellen . . ."

Each workshop, however, produces c. 2000 sheets in just one week! The photos show that the process in question is almost identical with that described in the next chapter from East Nepal, and the female paper-maker in the pictures is to all appearances a Tamang.

BEATTY, 1962. A well-written article of 12 pages about handmade Nepalese paper, but somewhat inaccurate in places and with sweeping statements. Thus it is said on p. 13:

". . . the art was introduced from China and Kashmir by traders who visited the country regularly."

Where does this piece of information come from? It is most unlikely that traders brought the art to Nepal, and it can hardly have come from Kashmir, where quite different techniques were used (see e. g. CLAPPERTON, 1934, pp. 47–52).

Concerning the antiquity of the art in Nepal, W. B. Beatty maintains p. 13 that in the *Asutosh Museum* in Calcutta there is a block-printed book dated A. D. 1105:

"... on paper that originated in Nepal and is distinctly different from Chinese paper of comparable calligraphic time. This independent development of paper suited to printing indicates that paper had been made in Nepal for some time."

In the first place it is not block-printed but a manuscript (see plate 121). Secondly, as shown in chapter I, there is no question of an independent development in Nepal, and so the paper does not necessarily derive from there, even if other circumstances would seem to indicate that the paper was made in North Nepal.

W. B. Beatty describes pp. 14–22 the paper-making in Sundarijal, 10 km. from Kathmandu (see map plate 105). The enterprise is owned by Chuda Bikram Shah, G. B. Shah's father. The author's vivid description of the manufacturing will not be quoted and commented on here, as this will be treated in detail in the next chapter. But it should be mentioned, that neither the workshop nor the methods in Sundarijal represent typical examples of the original procedures still practised in the mountains. Many special tools had been introduced a long time before W. B. Beatty visited the small factory, and many stages in the processes of manufacture had been modified. That does not, however, make the report less valuable. On the contrary it describes paper-making in Nepal at an interesting transitional stage.

PULP & PAPER, 1964, p. 232:

"Population: 10,050,100 (est.). Per capita paper and paperboard consumption: 2 lbs. Paper and paperboard mills: more than 200 small manual mills.

Production (in short tons)	1962	1963
Paper and paperboard	300	360 (est.)
Imports–Exports (in short tons)		
Paper and board imports	9600	10100.«

The annual production in 1962 of 300 short tons or c. 270,000 kg. of handmade paper and paperboard, distributed among 200 workshops, would correspond to an annual production of 1350 kg. per workshop. However, a yearly production half this size, or 700 kg. per workshop, is closer to the average, corresponding to 200 working days and $3^1/_2$ kg. per day. This might suggest that the yearly production is overrated, even more so as the number of active workshops was presumably closer to 100 than 200 in 1962.

"-Kathmandu. A paper mill to produce 6000 tons a year was planned for construction during this year and next at Nepalgunj on the Indian border, according to Nepal's Industrial Development Corp. The corporation reportedly has also been sponsor of a feasibility study of establishing 10-ton plants to replace some of the many small handmade paper mills in the country. ... For instance, rice straw has been suggested as a raw material for a large, efficient mill ..."

TSCHUDIN 1964. A sound 7-page article on paper-making in Nepal, primarily about the fibres of Thymelaeaceae used. On p. 6 is mentioned the production near Jiri in East Nepal, about 5 days' journey from Kathmandu and $1^1/_2$ km. above the model Swiss farm SHAG:

"Mit dem Abschneiden der Zweige und Abschälen der Rinde und der Entfernung der äußeren, dunkelbraun gefärbten Rindenschicht werden bei Jiri dauernd zwei Leute beschäftigt, desgleichen mit dem Kochen, Waschen und Schlagen der Rindenmasse und mit deren Weiterverarbeitung zu Papier. Täglich werden von diesen vier Leuten etwa 400 Bogen Papier erzeugt, die einen Wert von rund 1600 Peisas bzw. etwa 16 Nepal-Rupien oder etwa sFr. 9,50 entsprechen [to-day 1 Nep R. is divided into 100 pais]. ... Die Papiere messen 50 × 60 cm, auch 80 × 100 cm[!]. Blätter von 50 × 60 cm wiegen im Mittel 5,5 g (1 m² im Mittel = 18 g). 400 Bogen (= eine Tagesproduction) wiegen 2,2 kg, was etwa 2,5 kg weißer, innere Daphnerinde entspricht [for the production of 2.2 kg. of paper, more than 3.0 kg. of bast strips is needed, see further p. 204]. Ein Rindenstreifen (innere Rinde) weigt rund 20 g. Für 2,5 kg Rinde, entsprechend 125 Rindenstreifen, müssen somit rund 60 Papiersträucher zur Verfügung stehen, wenn je Strauch auf einmal nicht mehr als zwei Zweige abgeschnitten werden. Man macht kleine Bündel zu zehn Blättern und größere zu 100 Blättern. 8000 Blätter, entsprechend 44 kg, also zwanzig Tagesleistungen, bringt ein Träger in fünf Tagesmärschen nach der Hauptstädt Kathmandu.

Beim Dorfe Bene am Fuße des Dhaulagiri werden von Bauern im Nebenverdienst nach dem gleichen Verfahren Blätter vom Format 59 × 127 cm mit einem Quadratmetergewicht von 25,5 g hergestellt."

In note 12 on p. 9 it is said:

"Immerhin konnte abgeklärt werden, daß in Sundarijal nach dem Eingießverfahren und nicht nach dem Schöpfverfahren, wie Herr BEATTY irrtümlicherweise annahm, gearbeitet worden ist. Herr BIKRAM [Chuda Bikram Shah] hat seinerzeit Papiermacher aus dem Dorfe Bene am Fuße des Dhaulagiri zugezogen. Sie sind aber wieder in ihre Heimat zurückgekehrt.

However, W. B. Beatty undoubtedly saw the paper-makers in Sundarijal making paper by dipping the frames into the pulp. According to G. B. Shah there had already been experiments with new materials and methods (introduced from Japan by Mr. H. B. Baruwa, see p. 90) before Beatty visited Sundarijal; for example, instead of the traditional technique of pouring the pulp into the mould the technique of dipping the mould deep into the pulp and slowly lifting it out was used.

GEORG JAYME and M. HARDERS-STEINHÄUSER, 1965. An article of 6 pages discussing the possibility of wood shavings having been used for paper-making in Nepal. It quotes, moreover, several of the above-mentioned sources and refers to some microscopical analyses of paper from Nepal.

Their chief source on the production of paper from wood shavings is the book by NORMAN D. HARDIE: "*In Highest Nepal; our life among the Sherpas*" London 1957. N. Hardie writes that in the village of Thudam in East Nepal (see map on last page) paper is made in considerable quantities from shavings of spruce and juniper. The workshop is made entirely of wood with the exception of a stone grinding-plate, and is driven by water-power. It is described in the text and shown in a drawing. The wood shavings, it is said, are pressed into bales, so that they can be transported to Tibet. The paper is light, strong and somewhat transparent, with small splinters of wood here and there (these are also common in *Daphne* paper!). In addition to the drawing, the authors reproduce a photograph of the workshop, pp. 3–4, and some supplementary information furnished by N. Hardie, including the remark that: "... I was told, that juniper and yew was sometimes used for making paper."

Finally, Hardie says in a letter of 16th May 1961, after another visit to Nepal in 1960, that the manufacture of paper from wood shavings had ceased because the frontier to Tibet had been closed 15 months earlier, viz. in the autumn of 1959, just after China's definite assumption of power in Tibet.

H.-Steinhaüser's investigation, op. cit. pp. 4–5, of several samples (including a sheet of paper from Thudam) shows that these are made exclusively of bast fibres from Thymelaeaceae. However, a sample of paper sent from Mr. Ove Nordstrand, Copenhagen, consists of three layers, and the inner layer contains a considerable quantity of conifer cellulose. Of this sample it is said: "Es ist viel eher anzunehmen, dass in diesem Falle, wie von Beatty berichtet, Altpapier verwandt wurde." This agrees with the fact that the sample in question was bought in Kathmandu, where paper of this kind was already being produced at that time. But on p. 5 it is said:

"Trotzdem halten wir es für sehr wahrscheinlich, daß diese Kunst des Schleifens von Holz schon seit sehr langer Zeit in Nepal ausgeübt wurde."

This may be right, but it seems very unlikely that the use of wood shavings as a raw material for making paper was an Asian or even Himalayan invention. N. Hardie has not seen this procedure, and his description of the paper seems to deal with the ordinary quality made from the bast of a species of *Daphne*. Moreover, I have found no wood fibres in any of the 500 samples of paper from Nepal I have examined, apart from paper made in the Kathmandu Valley within the last 30 years.

Wood shavings from Thudam, however, have been put to quite another use. Thus BISTA, 1967, p. 149, writes about the peoples of Thudam, a Bhotia-like people:

"To further their economy they made incense by pulping juniper wood. The incense of juniper has a pleasant scent in great demand in Tibet. Each of the twenty wood-pulping water mills produces about two hundred rupees worth of incense yearly which is traded across the border. The mills are owned by individual families of Thudam."

These primitive workshops for the production of incense by pulping juniper wood are very reminiscent of that described by Norman Hardie.

CHAPTER IV

Field Studies of Paper-Making 1962-1970

This chapter contains my own observations regarding paper-making in East and West Nepal and the Kathmandu Valley, as well as material placed at my disposal by Nepalese and European acquaintances. *The commonest and oldest method is that found in East and Central Nepal. It is probably also the oldest in the world and can be traced back to the origin of paper-making in China about 2000 years ago,* for which reason it is the most elaborately described. A less widespread method used in West Nepal is then dealt with. Finally, an account is given of the methods used in the Kathmandu Valley, where paper-making is at a transitional stage.

Imported factory-made paper is by far the most used nowadays in the greater part of Nepal. But in many places you will find stalls with piles of the beautiful reddish-brown, strong, textile-like paper lying in a corner of the shop, either for sale or for wrapping the goods sold. Several small workshops also fashion the paper into writing pads, envelopes, albums etc. In Kathmandu it was difficult to learn where the paper was made. Even in a shop which sold nothing but handmade paper, they said that it came from the mountains, but they could not say precisely where.

After a week of preparations in Kathmandu we set out from the capital to find the paper-makers. Our little group, which included the Sherpa Urgen and four porters, followed the south-eastern route to Okhaldunga in East Nepal, where we had been told that paper was made. But we did not encounter any paper-making localities during this first ten days' walk. In Dopu Bazar, two days' walk north of Okhaldunga, we reached an area where we were told that paper was normally made, but that production had just been suspended. The government's ban (in about 1960) on the removal of anything whatsoever from the forests without special permission, in order to prevent ruthless exploitation, was evidently just beginning to be enforced. The paper-makers were thus prevented from procuring bast and especially wood for drying the wet paper. With the assistance of an influential Sherpa we nevertheless succeeded in finding five paper-making workshops which had not ceased production.

Finally one late afternoon when we were toiling up a steep and very densely wooded mountain slope above Tumbu, near Junbesi, our eyes caught sight of the thin columns of smoke that disclosed the paper-makers. Soon we were standing in front of their huts, and they came forward to greet the peculiar stranger. They were all Tamangs, shy but obliging people who lived here in the spell of the forest.

Urgen and I stayed in the Sherpa village Junbesi (plate 51) about an hour's walk from the paper-makers. The subsequent two weeks were spent in studying and photographing the method of production and the huts, as well as questioning the paper-makers.

A. Paper-making near Tumbu, Solu District (East No. 3)

1. The Region

The Solu district (plate 52) is situated where the Middle Range and the Great Himalayas meet. The area is covered with magnificent jungle, and cultivated land is found chiefly along the rivers (plate 51). Solu, Khumbu and Pharak is the main territory of the Sherpas. Altitudes above 2700 m. are almost solely inhabited by Sherpas, whereas below this altitude there are other ethnic groups, mainly Tamangs.

Two of the most important and probably the oldest caravan routes of East Nepal cut through Solu. One leads from Tibet across the Nangpa La pass to the caravan centre of Namche Bazar in Khumbu and further via the Takśindhu-temple, Dopu Bazar and the big village of Okhaldunga to the south towards India. The other branches off from this route not far from Ringmo, leading via Junbesi, Bandar Bazar etc. westwards to Kathmandu.

Paper is preferably made from the inner bark of *Daphne bholua*, and in Solu this shrub is very common. We were told that formerly when the demand was heavy, paper had been made in many places in the district, e. g. in Gunikhop, Lapcha, Juke, Taklor, Tumbu and Gunba (Gunbu on the map), but now in 1964 it was only made in Tumbu. We were further informed that *the paper-makers, anyway in the Solu area, were exclusively Tamangs* (calling themselves *Kakadi Tamangs*).

2. The Huts

Four couples were working near Tumbu, each in their own workshop, and in a fifth was a young man with his small brother and sister. Four of the five huts were by the same steeply falling stream, while the fifth was a few hundred metres west of the others. The position of the five workshops is shown in the site plan, plate 53, in which three of the workshops (I, II and III) are included. The photographs plate 54–56 show the character of the area chosen by the paper-makers. It is situated at about 3400 m. The workshops themselves, except V, are shown in plates 57, 59, 60 and 86. Workshops I and III were measured and the groundplans are seen in plates 58 and 61.

The paper-makers live in the hut adjoining the workshop. They move when there is no longer sufficient wood for the big fire to dry the wet moulds, i. e. after 3 or 4 months. All paper-makers are domiciled in villages further down, where they generally have a farm, which some relatives take care of while they are away. Urgen and I stayed mostly in hut III with Ganza and his wife Seili, in order to follow the daily working process more closely.

3. The Shrub

In this area, as mentioned in chapter II, besides bast of *Daphne bholua*, that of *Daphne involucrata* and *Edgeworthia gardneri* has also presumably been used. However, we only found *Daphne bholua*, perhaps the sole species of *Daphne* growing on the mountain slope near the huts. At an altitude of 3500 m. it was still a $1^1/_2$ m. tall shrub and it may even have grown a few hundred metres higher up. The paper-makers call all *Daphne* species *lokodo*.

4. Collecting and Cleaning of Bast

One day near his workshop, Ganza demonstrated how the plant was stripped. He chose plants at least 1 m. high and 2–3 years old. With a big *kukri* knife (for tools, see plates 87 and 88 and descriptions p. 76) the longest branches were cut off about 10 cm. above the ground so that the plant could regenerate, after which the lateral branches were removed (plate 62). When a bunch had been gathered Ganza sat down and, grasping a branch with his right hand, forced the severed end down into the soil with his left big toe, and then tore off the bark with his left hand (plate 63). Subsequently the dark green outer layer was separated from the almost white inner layer. The bast was finally cleansed of impurities with a short knife, chiefly the dark circular spots left from severed or dead lateral branches (plate 66). It is easiest to do this work while the bast is still fresh, as it gets very hard after drying.

Several times I saw women and children cutting off *Daphne* branches on the mountain slope where the workshops were situated, and in many places we found small heaps of thin, white sticks from the stripped branches. Ganza, however, mostly bought the bast in bunches of dried strips from people who came to his hut, or in Tumbu. It was not worth his while to collect the bast himself, as there were not sufficient areas with big shrubs in the vicinity. He paid $1^1/_2$ Nep Rs per bunch or 1.30 Eng. sh. for c. 5 lbs. (c. 2.3 kg.). In such a bunch, chosen at random, I counted 104 strips, which would be the cuttings from about 40 shrubs. The strips were 0.9 to 1.6 m. long (average 1.3 m.), therefore the plants must have been 1.3 to 2.0 m. high. Plate 64 shows a woman bast collector on her way to Tumbu with a big bunch of bast strips.

5. Division of Work

The paper-makers do not adhere to any fixed time-table during the day's work. Their procedure is to some extent dependent on the weather, the quality of the paper to be made, whether pressing orders exist and so forth. Normally, paper is scooped every morning from a portion of bast that has been cooked and beaten on the previous day. The scooping process is continued in the afternoon, but from a portion of bast cooked and beaten in the morning of the same day, while at the same time still another portion is prepared for the next morning. As we shall see, there is a marked division of labour between husband and wife, and the work is adjusted so that neither of them has to wait for the other.

6. Soaking and Rinsing

12 hours before being cooked the bast is put in the mountain stream in front of the workshop to soak (plate 65). The bast strips are then rinsed to remove sand and earth particles, and hung over a branch. If necessary dark stains and the circular, knotty thickening in the bark from lateral branches are cut off once more, especially if a particularly fine, white paper is to be made. Finally a portion corresponding to one bunch or about 5 lbs. (2.3 kg.) is put into a big copper cauldron (plate 69), standing on the hearth inside the hut.

7. The Cooking (Digesting) Lye

The liquid to disintegrate the lignin substances which bind the fibre bundles together is prepared in the following way: A bunch of about a hundred leaves of *Rhododendron arboreum* (plate 68) are placed in an almost cone-shaped bamboo basket (inner depth and diameter at the top both 45 cm., see plate 67); they are renewed every three days. Early in the morning before the big drying fire outside is lighted, the basket is filled about two-thirds full of ashes (preferably from *Quercus*), or with 5 to 10 kg. The lye is then made by pouring water into the basket at intervals all day long; it oozes through the ashes dissolving their alkalies. The lye of ashes then passes through the rhododendron leaves, drips from the bottom of the basket and collects as a red-brown liquid in the wooden vessel on which the bamboo basket stands. (The *pH* value of the liquid was 12.5 to 13.5.) If the lye is not red i. e. alkaline enough, part of it is scooped up into the basket once more.

The paper-makers call the rhododendron shrub, which grows everywhere on the mountain slope, *gurance*. TURNER, 1931, p. 145, writes: "gurā̃s, or gorā̃s, s. The name of various kinds of rhododendron ...—cimāl g° *Rhododendron arboreum*." Urgen on the other hand called it *dogmar*, which is probably derived from Tibetan and simply means "plant red", i. e. the plant with red leaves.

The paper-makers did not quite agree as to what purpose the leaves served besides being a kind of filter, and in V, the westernmost hut, they were not used at all. Urgen wrote later: "The dahl [bast strips] are of two kinds; one is white and the other yellow. ... The white dahl has white and purple flowers [*Daphne bholua*]. Paper made from white dahl is fine and white. Yellow dahl only has white flowers [possibly *Daphne involucrata*]; paper made from yellow dahl is thick and brownish. ... The paper-makers put gurance only in yellow dahl to make the paper red, and any dirty substance contained in the liquid [the pulp] will disappear." However, according to my observations most of the paper-makers, even if they only used *Daphne bholua* bast, also used rhododendron leaves.

The leaves undoubtedly colour the paper. Comparing pulp and paper made in II and III where the leaves were used, with samples from V where they were not used, it is quite obvious that both pulp and paper from V are more white than from II and III. It is, however, not inconceivable that the leaves serve other purposes which are now forgotten, and their use has survived as part of the paper-making tradition. The following possibilities may be considered:

1). *The plant is sacred.* According to J. Kawakita (cf. KIHARA, 1957, pp. 112, 127 and 130) rhododendron leaves are used at several religious ceremonies, though rarely, as in our case, in the Buddhist highlands.

2). *The sap of the leaves is poisonous.* The leaves of several rhododendron species are poisonous and the extract from these could conceivably make the paper poisonous too, and thus protect it against attacks from insects. However, cultivation on Petri glasses of samples of paper from Tumbu and other sites showed no significant differences in the growth of various cultures.

3). *The sap contains deflocculation agents.* For more than 1300 years the mucilage of various plants has been used in China and Japan as an admixture to the pulp. *Thus it has been possible to make the scooping of the paper easier and the sheets more uniform in thickness, because these interesting compounds, even in extremely small amounts, reduce the formation of tufts and flocks.* By no means all plant mucilage possesses this useful effect. In Japan, for instance, an extract from the roots of *Hibiscus manihot* is applied for the purpose. Also in the Kathmandu Valley a similar admixture is known and used; here it is the sap of the *Daphne* bast fibres themselves that supplies the mucilage (see further p. 86). The rhododendron leaves are certainly thick and could contain such agents, but in our case the sap is not pressed out of the leaves and added to the pulp. The lye of ashes just oozes through the leaves and the red-brown liquid is then boiled for some hours, so that most of the mucilage presumably decomposes, and the deflocculation effect from the sap of the rhododendron leaves is therefore probably negligible during the scooping of the paper.

8. Cooking (Digesting)

8 or 9 full vessels of the lye of ashes (c. 20 litres) are poured into the big cauldron (diameter c. 40 cm., height 28 cm. and contents about 33 litres) so that the liquid just covers a big bunch of bast or 5 lbs. The cauldron is put on the hearth in the hut itself (plate 69).

The cooking lasts 3$^{1}/_{2}$ to 4$^{1}/_{2}$ hours. It takes that long because at this altitude (c. 3400 m.) the pressure is only about 2/3 of that at sea level. The boiling point of the lye was measured at 88° centigrade which means that since the chemical reaction rate is reduced to about one half of what it would be at sea level, the cooking time must be approximately doubled.

The bast strips are turned a few times with a forked stick during the cooking and if necessary more lye is added. Ganza decided whether the cooking was finished by testing with his fingers whether the bast strips could be easily divided both lengthwise and transversely.

9. Rinsing

When the cooking is over, the cauldron is moved to a thick wooden slab opposite the hearth, where it is turned upside down so that the remaining lye, c. 15 litres, trickles away from the bast strips. The liquid is now dark red and thick. The steaming hot mass of bast is cleansed of its worst impurities, which only takes 5 minutes. Ganza used his hands for this work as they were horny from the labour of wood cutting and almost insensitive to the hot, alkaline liquid.

10. Beating

The beating of the bast takes place on the above mentioned wooden slab, and in this district it is always executed by men (plate 70). It is hard work. In order to be able to hammer nearly uninterruptedly for the 1–1$^{1}/_{2}$ hours required for the beating process, the paper-makers shift their wooden mallet now and then from one hand to the other. Moreover, the beating is carried out in such a way that all parts of the mass are equally covered. First the mass is beaten until it is quite flattened in the middle, then the far section of the mound at the circumference thus produced is lifted with a sweeper towards the middle and beaten, whereupon the near section is lifted towards the middle and beaten, and finally the right and left sections are treated in the same way. This five-stage cycle is repeated, so Ganza told us, about 5 times in the course of the 1$^{1}/_{4}$ hours when making paper of the ordinary quality. The bast fibres for the best quality have to be beaten one and a half times as much, i. e. for over 2 hours.

11. Rinsing and Mixing with Water

When the beating of the bast strips is finished the mass is carried out to an upright hollow log—the mixer, which stands to the right of the scooping basin. About 50 litres of water have previously been poured into the mixer. The bast mass is now crumbled into it, and at the same time cleansed of impurities which are thrown away, while solid lumps of bast go back to be beaten with the next portion.

The pulp is then produced by mixing the beaten bast mass and the water thoroughly, passing a mixer up and down quickly through the cylinder (plate 71). The mixer consists of two bamboo canes bound together and each split in two at one end. The four legs thus created are kept extended by means of a cross (plate 88). This implement combined with the container is in principle somewhat reminiscent of the Tibetan butter-tea churn used everywhere in Nepal by people of Tibetan culture, i. e. by Bhotia, Sherpa etc. This is hardly coincidental and once more indicates from where this method of making paper reached Nepal. After the mixing, which later has to be repeated now and then, a certain part of the pulp is placed in a smaller wooden trough which can hold about 12 litres of pulp and stands directly to the right of the basin. (The *pH* value of the pulp was now about 9.)

The cooking and beating was done by Ganza (in the meantime Seili scooped and dried paper made from an earlier prepared portion of pulp). Then Seili normally undertook the working up of the pulp into paper. Only if she was behind in her work did Ganza carry out the final cleaning and the mixing with water. Moreover he scooped paper and took care of the drying of the paper when Seili stopped to eat.

12. Scooping

Seili took 3 or 4 moulds, put one into the basin and leaned the others to the right against the mixer. The moulds are simple wooden frames. In each of the long sides two holes have been made for the two short sides which are secured with wooden wedges. *A primitive, wide-meshed piece of coarse flax-like, locally made fabric is extended under the frame,* to which it is attached with bamboo sprigs (plate 87). The cloth, according to G. B. Shah, is made of "the nettle", perhaps the plant which according to TURNER, 1931, p. 610 is called *sisnu* "The nettle *Girardinia heterophylla*."

Seili squatted in front of the basin and filled a wooden scoop with pulp from the trough, which was poured into the mould floating in the middle of the basin. During the pouring the paper-makers used their left hand as a sprinkler (plate 74). With her hands held like two rakes she spread the pulp by making fast circular movements of the hands, the finger tips being thrust only just a little below the surface of the water and under no circumstances touching the cloth (plate 72). Thus the plant fibres are stirred up, distributed over the whole mould, and settle in a fairly uniform layer on the mesh. In the mornings and on cold days, when the water in the basin was cold—even in the middle of the day it was only 8°–10° centigrade—they used small *bamboo stirrers* in hut I and II to distribute the pulp (plate 88).

10 to 15 seconds after the pulp has been poured into the mould, it is slowly raised from the basin in about 10 seconds with some characteristic tossing movements of the frame (plates 73 and 75). First one side or corner and then another is lifted a few centimetres above the water which causes the water to flow to and fro over the surface of the film of pulp. By these means small currents are set up in the mould which further distribute the fibres; this is necessary if a uniformly thick sheet of paper is to be produced. Nevertheless, holes could form in the tangled layer of bast fibres on the mesh, and if this happened Seili put the mould back into the basin, taking a little extra pulp which she poured over the hole, again distributing the fibres and lifting the mould. Finally, the wet mould was leaned against a stick standing in the left side of the basin.

The distribution of the pulp and the lifting of the mould are the most difficult parts of the process of paper-making. Ganza said that it required years of training before one really learned to scoop the paper, and also that Seili was much more skilled at this work than he was.

13. Drying

Even on sunny days it is seldom really warm at this altitude, so *the paper has to be dried by a big fire*. This was done by placing the moulds with the wet paper sheets against 7 thin sticks arranged in a semicircle around the big fire just behind the basin (plate 78). The paper-makers here used 10 moulds, in three batches of 3, 3 and 4 moulds, so that while pulp was scooped in one batch, the two others were drying round the fire.

The moving of the moulds was done as quick as lightning and in a way that seems at first rather complicated. We leap into the middle of the process, and assume that 3 moulds have just been scooped and are dripping off to the left of the seat, and also that the remaining 7 are drying around the fire. Then Seili rises and moves all 10 moulds (plate 78) with the following result:

1) 3 now dry moulds, which were standing just in front of the fire where the heat is strongest, have been placed to the right of the basin.
2) 4 only half-dried moulds are turned 180°, but so that the paper side still faces the fire. During this turning of the moulds, 3 of them have been moved from their outer places to the three empty places in front of the fire, while the fourth stays where it is and has only been turned.
3) 3 dripping wet moulds are moved to the outer places at the fire.

Actually the placing of the moulds was only partly carried out in the order given above, the order being in fact "mixed", so that, for example, 2 dry moulds may be moved to the right of the basin, 2 half-dry moulds turned and placed in front of the fire, the third dry mould moved to the right of the basin etc. These manoeuvres are of course meant to ensure the even drying of all the paper sheets. The turning may also ensure that the upper part of the sheets does not get too thin, because the still wet fibres might flow a little downwards. When Seili replaced the moulds in front of the fire, she moved her palm over the cloth to loosen the paper on the other side.

Finally she removed the sheets from the cloth with her hands. This has to be done with great caution, as the paper is apt to stick to the cloth (plate 77). The paper sheets are hung on a bamboo holder, placed on the wall of the hut (plate 79).

Seili did not take many rests in the course of the day. During the scooping and shifting of the moulds the pulp had to be mixed and poured into the small trough, more wood put on the big fire etc. On the average 18 minutes passed from the moment Seili poured pulp into a batch of moulds, until she refilled the same moulds, i. e. about 12 minutes is allowed for the drying of the paper. Seili scooped paper from about 7 a. m. till 5 or 6 p. m. With the 10 moulds about 30 sheets an hour or 300 sheets a day were thus produced. In hut 1 they said they were able to make 500 sheets a day, because they used a larger drying fire and were more experienced.

14. Wood-Cutting

Large quantities of wood are required for the drying of the paper. When Ganza was not watching the cooking of bast or beating it, he was busily cutting wood and taking it down to his workshop. So much wood is consumed, that the forest around the huts already had great gaps in it. Oak was preferred for the fire (here *Quercus semecarpifolia*, in Nepali *kharrsu* and in Tamang *baena*) besides birch (here *Betula utilis*, in Nepali *budsopath*).

Wood-cutting is hard work. With an axe, where the blade was only 8 cm. broad, Ganza felled trees of up to one metre's thickness and divided the trunks into pieces about 1–1½ metres long (plate 76). The trees are felled near the huts or above them. Cleared tracks, 3–4 metres broad, lead down through the steeply sloping forest to each of the huts, so that the logs may slide down conveniently to 5–10 metres from the drying fire.

15. Folding

A couple of times a week the paper sheets were folded. Ganza sat down cross-legged in front of a big heap of paper (plate 80). Each of the two short edges of 10 sheets together were folded to the middle of the sheets and then again folded on this symmetrical line. 20 × 10 such folded sheets were tied with a thin strip of bast into a bundle.

16. Production and Sale

Here only one size is normally made measuring c. 50 by 65 cm. and in 3 or 4 qualities (see table p. 226):

1. *Sakari*. The ordinary quality has a basis weight of 15–20 (weight in grams of one square metre). The production of 250 takes 5 lbs. of bast. A distinction is made between two subqualities, viz. good and bad sakari. Both qualities are thin and rather brownish, but in a bundle of the inferior kind there are many very thin and defective sheets with cracks, holes, impurities and big lumps of bast. Price: bad sakari 5–6 Nep Rs per 200 sheets; good sakari 7–9 Nep Rs.

2. *Bāikāga* (from bāi = 2 and kāgat = paper). The basis weight is 22–27 (g./m.²), so the paper is only a little thicker than the ordinary quality, but cleaner. Price: 10–13 Nep Rs per 200 sheets.
3. *Sumsjang* (presumably from Tibetan *gsum* = 3, pronounced *sum*). The paper is thick and only faintly brownish. Ganza characterised it as being fit for writing on both sides and added that the production of 250 sheets consumes about 10 lbs. of bast strips. This is consistent with the basis weight being 33–35 or nearly twice that of the ordinary quality. Price: 14–15 Nep Rs per 200 sheets. (With regard to other properties of the three qualities see the tables pp. 226 and 227. Photographs of qualities seen in transparency, see plates 183–185.)

Ganza said that many sheets of sumsjang had been scooped earlier (before 1959), but that now sakari paper was produced almost exclusively. Ganza and Seili made a little over 300 sheets a day on the average, or with 25 days of production a month about 8000 sheets, which fetched a little less than 300 Nep Rs. This is in keeping with Ganza's statement that they had 200 Nep Rs a month with rain and bad prices, and 400 Nep Rs with fine weather and good prices.

Ganza made most of the tools himself. Cloth for the moulds he bought in Bhandar Bazar (East No. 2, see map plate 52) at 2 Nep Rs a piece. The wooden frames came from the local bazaar. The greatest expense was the cost of bast, 1½ Nep Rs per bunch (5 lbs.), which reduced their net profit to about 200 Nep Rs per month. As they worked from 6 a.m. till 6–7 p.m., the rate by the hour was about 0.30 Nep Rs or 0.25 Eng. sh.

On Fridays, when Ganza often went to Dopu Bazar, Seili stayed in the hut and tidied up. The cloth was removed from the wooden frames and boiled in the same red-brown lye of ashes in which the bast was cooked. Seili said that if they did not do this once every 7–10 days there would be holes in the paper sheets, evidently because the cloth would by then be filled with impurities. Furthermore she had to darn the holes etc. *These repairs are in fact often to be seen as a sort of watermark in the paper.*

Finally Ganza stated that they only made paper 4–5 months every year, from the end of February to some time in July. Yet they sometimes worked beyond this period, when traders ordered larger quantities. Otherwise they sold the paper (by weight, see plate 81) to buyers who visited the hut, in Dopu Bazar or in the nearby villages. That year (1964) they did not think they would be permitted to continue beyond the middle of May on account of the new laws concerning the state forests, and this proved to be the case.

17. The Construction of Workshops

The choice of a site for the workshop depends first and foremost on easy access to sufficient quantities of big oak logs for the drying fire, which must burn regularly all day long. Water too is necessary. As will be seen from the site plan (plate 53) huts I, II, III and IV are placed a few metres from the same steeply falling stream. If necessary the water may be led through canals quite a long distance to the workshop, as was the case with hut V.

The two ground-plans and the photographs reveal that none of the workshops are arranged in quite the same way. But it is worth noticing that the position of the basin, the churn, the vat and the big drying fire is the same in all the workshops, just as they all used 10 moulds and the same tools. The most primitive was the uppermost workshop, IV, where they were still beginners in the trade.

Ganza said that the building of the hut and the arrangement of the workshop (hut III) had taken a week to accomplish, and had taken place in the beginning of March. The big drying fire had to be covered in the middle of April, as there were then showers every day. In the middle of July, he said, they got so heavy that he usually had to stop production, although it continued in a few places during the whole of the monsoon (which lasts from about the end of June till the middle of September). So great is the consumption of wood for the drying fire that the paper-makers have to move with their tools to another place every 3–4 months and build a new workshop there. Strolling one day across the mountain slopes I came across the remains of many former paper-making workshops. In one place they had even built two adjoining workshops.

18. Tools

The size and weight of the paper-makers' tools are indicated below together with the hut to which they belonged. The species of wood used will be mentioned in the next section. Photographs of the tools are shown in plates 87 and 88.

Pan of iron with handle, for carrying ashes and pulp; length 40 cm.; diameter of vessel 18 cm.; 740 g.; III.

Cauldron of copper; outer diameter 42.3 cm.; inner 39.3 cm.; inner depth 28.0 cm.; III.

Forked stick for stirring bast strips; length 89 cm.; 500 g.; III.

Mallet for beating bast; total length 44 cm.; handle 40 cm.; head 25 cm.; total weight 650 g.; head 560 g.; III.

Sweeper used during the beating of the bast strips; length 47 cm.; 130 g.; III.

Pulp mixer; length 125 cm., cross 19 by 19 cm.; 230 g.; III.

Mould: total length 106 cm.; exterior of the frame 53 by 68 cm. (interior same size as the sheet of paper); 1210 g.; III.

Mould: total length 106 cm., exterior of the frame 53 by 68 cm.; 750 g.; I.

Pulp ladle of wood; length 28.5 cm.; contents about 325 cc., maximum 375 cc.; 200 g.; III.

Pulp bowl of bronze; diameter 14 cm.; contents about 300 cc., maximum 350 cc.; 270 g.; III.

Pulp stirrer of bamboo with four legs and a cross; length 25 cm., cross 8½ by 8½ cm.; 30 g.; II.

Pulp stirrer of bamboo, split at one end into many legs, separated from each other by a cork; length 25 cm.; 50 g.; I.

Kukri; length with sheath 48 cm., without 46 cm.; weight with sheath 1100 g., without 830 g.; III.

The paper-makers also use: an *axe* for the felling of trees, length about 70 cm. and blade 8 cm. broad; an *ash scraper*, length about 130 cm.; and a *poker*, length about 200 cm.

19. Species of Wood Used for Huts and Tools

The paper-makers in hut I were questioned about which species of wood they had used for building their hut and for tools; Urgen wrote down the names and I the pronunciation. A few weeks later we visited the place once more and photographed the various trees and shrubs with the assistance of a Tamang whom we met near the workshop. A couple of species remain unidentified.

Quercus semecarpifolia Smith.

Nepali: written *kharrsu*, pronounced *khoarsu*. Tamang pronounced *baena*. BRANDIS, 1911, p. 625: "*Q. semecarpifolia*. Vern. ... kharshu, Hind. Himalaya ... occasionally to 12,000 ft." TURNER, 1931, p. 131: "khosro, s. ... *Q. semecarpifolia*." According to wood anatomist E. Tellerup: mallet head of *Quercus* sp.

Application: *firewood* (big logs, high heating value), *foundations*, *mallet head* and *beating slab* (hard and tough).

Betula utilis Don

Nepali: written *bûcopat*, pronounced *budsopath*. BRANDIS, 1911, p. 622: "*Betula utilis*, Don. ... Bhuja pat, Nep. ... Himalaya 10–14,000 ft." TURNER, 1931, p. 479: "bhuja-patra, s. Bark of the birch (used for writing on)."

Application: *firewood* (big logs, high heating value).

Tsuga brunoniana Carr.

Nepali: written *dĩŋri*, pronounced *dinggrae*. BRANDIS, 1911, p. 693: "*Tsuga Brunoniana*, Carr. -Syn. *Pinus Brunoniana* Wall. ... Vern. Tengre Salla, Nep.", Himalaya up to 3,000 m.

Application: *roof beams*, *vessel for the lye of ashes*, *pulp container (the churn)*, "*pipeline*" for water (as it is easily hollowed out), *head of ash scraper*, *sitting board* at basin.

Abies spectabilis Spach.

Nepali: written *ghobir* (ghobri), pronounced *gaubrae*. BRANDIS, 1911, p. 692: Here three species are mentioned under *Abies*: "3. The East Himalayan Silver Fir. Vern. Gobre Salla, Nep.; ... Sikkim 10–13,000 ft." According to BOR, 1953, it is *Abies spectabilis*. According to E. Tellerup the pulp ladle is of *Abies* sp., probably *A. Pindrow* or *A. spectabilis*.

Application: *frames for moulds* (I), *pulp ladle* (III), *upper foundations of the hut* (light wood, highly resinous).

Pinus excelsa Wall.

Nepali: written *sala*, pronounced *salla*. BRANDIS, 1911, p. 689: "*Pinus excelsa*, Wall. ... Leaves in clusters of five." P. 690: "... up to 12,500 feet ..." P. 690: "*P. longifolia*, Roxb. ... Leaves in clusters of three. ... Occasionally to 7,500 ft."

Application: *trough, framing of water basin, walls* (light and easily hollowed out, resinous).

Pinus longifolia Roxb.

According to wood anatomist E. Tellerup the *frame for mould* (III) is of a kind of *Pinus*, probably *Pinus longifolia*.

Viburnum erubescens Wall.

Nepali: written *asari*, pronounced *asarae*. Tamang: pronounced *sjinga*, possibly from Tibetan *śiṅ-dkar* = white tree (pronounced sjingkar), which is in keeping with the very light colour of the trunk. BRANDIS, 1911, p. 363: "*V. erubescens*, Wall. ... A small deciduous tree ... Wood close grained ... Himalaya from Kumaon eastwards, in Sikkim ... 6–10,000 ft." Drawing in Brandis consistent with photograph. TURNER, 1931, p. 28: "asāre, old asārhe, adj. ... *V. erubescens*."

Application: *supporting rafters for roofs, supporting sticks for moulds around the drying fire, poker etc.* (stiff, resistant to heat).

Rosa sericea Lindl.

Nepali: written *supat* or *sumpat*, pronounced *sumbath*. BRANDIS, 1911, p. 288: "*Rosa sericea*, Lindl. ... A large shrub ... with hard close grained wood ... Flowers white or pink ... Himalaya 7,500–14,000 ft." Description consistent with photograph.

Application: *supporting sticks for moulds* around the drying fire (does not bend when exposed to strong heat from fire).

Acer hookeri Miq.

Nepali: written *kāšiṅ*, pronounced *kasjing*. Brandis, 1911, p. 181: "*Acer Hookeri*, Miq.; Lal Kabashi, Nep. Sikkim, Bhutan, 7–10,000 ft." According to E. Tellerup the forked stick is from a kind of *Acer*.

Application: *Fork for turning the bast strips during cooking*. (According to Ganza the wood has to be seasoned for 5 years.)

Rhamnus purpurea Edgw.

Nepali: pronounced *tinbur*. Tamang: written *kûuṭum*, pronounced *kutung*. BRANDIS, 1911, p. 173: "*Rhamnus purpureus*, Edgw. ... A middle-sized tree, ... Outer North-West Himalaya, ..., 4,500–10,000 ft." According to Kitamura in KIHARA, 1955, *Rhamnus purpurea* is called *ku-tun* in Tibetan.

Application: *firewood for cauldron* (easily combustible, dries easily).

Arundinaria sp. (? *racemosa* Munro).

Nepali: pronounced *ma*. BRANDIS, 1911, p. 664: "*Arundinaria racemosa*, Munro; ... Vern. Ma-ling, Nep. ... East Nepal and Sikkim 6–8,000 ft. ... is largely used for mat-making, for the roofs of houses, for fences etc. ... Gambles unites it with a small high-level bamboo ascending to 12,000 ft."

Application: *mats for roofs, pulp mixer, pulp stirrer* etc.

The following two kinds of wood have remained unidentified:

Nepali: written *kūkurpāilāi*, pronounced *kukurpeile* (named from the shape of the leaf, which is palmafilobate, *kūkur* being a dog and *pāilo* a footprint, thus the footprint of a dog).

Application: *supporting rafter for roofs, supporting posts for walls, handle of ash scraper*.

Nepali: pronounced *silingae*.

Application: *supporting rafters for roof, handle of mallet*.

Even if the huts and tools are simple, it is obvious from the above that the paper-makers are familiar with many kinds of wood and their special uses. For many centuries the Tamangs have occupied the extensive forests and jungles of East and Central Nepal, and many of them have made a living by gathering and working wood, and selling wood products—including paper.

20. The Paper-Makers

Hut I. In the lowest-situated hut a married couple worked from March till September and produced up to 500 sheets a day. They had made paper for 15 years and were the quickest and most skilful of the paper-makers.

Hut II. Here lived a married couple with two small children. Like the other paper-makers they bought bast in the village. Once there was bast enough, they said, but now one had to travel a day's journey to find it in abundant quantities. Usually they worked from the beginning of March to the end of September, i. e. for nearly 7 months, and produced about 400 sheets a day. Before 1959 they had often made *sunsjang*, the best quality, one year even exclusively. This accords with the fact that export to Tibet has been drastically reduced since 1959. The couple had made paper for 12 years. She was 14 years old and he was 15 when they first learned the craft. He had learned it from his father, who had in turn learned it from his father. They came from the village of Lothing (possibly Lodimkhani, see map plate 52), where his father took care of their small farm while they were away.

Hut III. Seili had learned the craft at the age of 14 and was now about 20 years old. She said that all her family had been paper-makers for as many generations back as anyone could remember. Ganza her husband, Seili's cross-cousin, was 21 years old, born out of wedlock and did not know his father. Ganza had learned the craft at the age of 19 from his mother, who had learned it from her mother when she was 15 years old.

They owned 13 cows and some land, where they grew potatoes, onions etc. When the married couple made paper, the family took care of the farm, which lay in Lothing. They ate barley, rice, maize and onions, but like Bhotias and Sherpas they do not care for vegetables or fruits. On special festive days they had chicken and chang (fermented barley). They considered paper-making a rather hard job and would gladly have given it up if they had had enough land.

Hut IV. Here two brothers and a sister were working. The oldest, Sangebahadur, a young man of 20, beat the bast and cut wood for the drying fire, while the brother of 15 scooped paper and the sister of 10 looked after the drying of the paper. They hoped to produce about 300 sheets a day and said they got 5–6 Nep Rs for 200 sheets. The quality of their paper was decidedly the most inferior of the five workshops. To get the initial capital they had associated themselves with a Sherpa "lama" (a lay monk, not to be confused with a real lama), who also procured bast and the cloth for the moulds from Bhandar Bazar. Sangebahadur said that they had learned the art from their parents, that their father had died, and that they were now living with their mother in the house of their paternal grandfather in Boaldo, where they had a few cows etc.

Hut V. In this hut, which lay 200–300 metres west of hut I, a married couple worked. They lived here with their two small children and a goat. The man, Lhakpadordje, was 24 years old, and, incidentally, the brother of Seili (hut III). He said that they usually worked from the middle of March till the middle of September, and also that they were obliged to move to another area every 3–4 months in order to find enough big logs for the drying fire. They produced up to 400 sheets a day and got 5–6 Nep Rs for 200 sheets. Here, too, they said that bast was bought in Tumbu and the cloth for the frames in Bhandar Bazar. The previous year they had worked near Dakto, but they were told in the village that they would not be allowed to continue there because they damaged the forest, so they had moved to Tumbu.

Lhakpadordje finally stated that he had made paper for 8 years and his wife for 7, and also that all the family had once been paper-makers, but that only one other out of the 9 brothers and sisters made paper now (i. e. Seili). The whole family lived in the same house in Lothing and did a little farming.

B. Paper-making near Jiri, District of Melung (East No. 2).

Ib Heller, a Danish journalist, visited some paper-makers near Jiri in 1964 and has very kindly let me see his notes concerning the paper-makers there. Ib Heller gives the following information.

Three married couples had each established their workshop on a jungle-covered mountain slope about 4 hours' walk from Jiri. Usually they bought the bast in the valley and they cut it themselves only when they could not buy it. They paid 1 Nep R. per "armload", probably 5 lbs.

For making the lye of ashes, they used a mixture of ashes from the trees *dingri* (or dingae) and *kasru* (or kusru), preferably in the proportion 3 to 1. We recognise these names from Tumbu (p. 76), and they seem to signify respectively *Tsuga brunoniana* Carr. and *Quercus semecarpifolia* Smith. The ashes were put in a kerosene can in the bottom of which many small holes had been made. Water was poured over the ashes, and the alkaline liquid oozed slowly into a wooden jar upon which the can was placed. The bast strips were cooked for 5–6 hours and the beating took 2–4 hours, depending on how fine the paper was to be.

The moulds (plate 89), like all the other tools, seem to correspond exactly to those used near Tumbu. The size of the paper was about 50 by 60 cm. Here the paper-making couple visited used 14–15 moulds, obviously with four batches of 3 or 4 moulds each, so that 10–12 moulds (3 batches) would always be round the fire.

The division of labour does not altogether correspond to that in Tumbu. In the morning the paper-maker Dil cut wood and took it to the drying fire, while his wife Mangari beat a portion of bast, cooked on the previous day, and took care of the children. About noon she mixed the bast mass with water, and he scooped paper for the remainder of the afternoon, while she changed the moulds at the drying fire and removed the paper from the moulds.

The couple only made 200 sheets a day, and for this they received 5 Nep Rs, i. e. less than 4 Nep Rs a day net profit, corresponding to an hourly income of c. 0.20 Nep R. or 0.15 Eng. sh. The paper was supposed to be delivered to a particular person, who had the resale monopoly in the district. The paper-makers circumvented this by selling directly to the merchants in the bazaar and sharing with them the profit thus made.

The paper-makers near Jiri made paper most of the year, including the monsoon. After 3–4 months it was necessary to move to another place, because there were no longer sufficient big logs for the drying fire; therefore a new workshop had to be established at least 3 times a year.

It is finally stated that the paper-makers near Jiri were all Tamangs, and this appears to be confirmed by the photographs. From the above information and photographs, it appears that the methods of production, workshop and tools near Jiri correspond on the whole to those studied near Tumbu.

C. Paper-making near Malemchigaon, District of Yolmo (East No. 1).

Yolmo (Helambu) is a valley situated to the north-northeast of the Kathmandu Valley, about three days' journey from the capital. A number of Tibeto-Burman speaking tribes, mostly Tamangs and Sherpas, live in this area. I visited Yolmo in 1961, but did not notice the paper-makers during my short stay in and about the village of Tarke Ghyang (plates 32–34 and 37).

However, the anthropologist Alexander W. MacDonald, who stayed in Yolmo in 1962, encountered on the 12th January a group consisting of one man, two women and two children, who made paper in a workshop a little south of Malemchigaon, i. e. opposite Tarke Ghyang. MacDonald has most kindly let me have his notes and photographs concerning the production. This material shows that the methods and tools are practically identical with those of the paper-makers from Tumbu and Jiri.

Here the bast strips are cooked in lye of ashes for more than two hours, and the pulp is beaten with a wooden mallet on a flat stone. "The pulp is then churned like milk and with nearly the same type of instrument (plate 90). The churn was called *ldoṅšiṅ* (pronounced *dong-sjing*, see also DAS, 1902, p. 713: "ldoṅ-mo = a tea churner."). Pulp is then put in a wooden trough alongside a pool of water, an artificial pool in the bend of a stream. A ladle 2/3 full of pulp is then poured out onto a frame which is floated on the surface of the pool. The pulp is evenly distributed over the jute-like material inside the frame." The whole frame, it is said, is called *šog-šiṅ* (pronounced *sjo-sjing* and meaning paper-wood in Tibetan) and the cloth *šog-*

khri (DAS, 1902, p. 170: "khri = couch, frame etc."). Also the drying of the paper, according to this description, corresponds to that of the Tumbu paper-makers. "Using in all 19 frames the people observed reckon on making 400 sheets of paper in one day's work. 20 sheets are sold for 8 Annas i. e. they reckon on making 10 Nep Rs for one day's work."

With regard to the people who made the paper, A. W. MacDonald states that some of them were Sherpas and others Tamangs, but he adds: "The general ethnic pattern seems to be more confused in the western area than in the east." i. e. Khumbu, Parak and Solu.

In Sundarijal, where the caravan road to Yolmo leaves the Kathmandu Valley, I bought a number of different kinds of paper in 1964 which were said to have been produced in Yolmo. Some of this paper was quite a dark reddish-brown in colour. (Photograph of this quality seen in transparency, see plate 187). Mr. Ulrik Söchting visited the Yolmo area in February 1968. He states that paper-making near Malemchigaon had then ceased.

D. Paper-making in Nanglibang, District of Baglung (West Nepal).

After returning to Kathmandu from East Nepal I went to the Baglung district in West Nepal. Half an hour's flight took us to Pokhara (plate 12), the second largest town in Nepal, a distance that would have taken about 10 days to cover on foot. Three days' walk further west brought us to the small town of Baglung, around which the best Nepalese paper is produced (map, plate 94).

We met a paper-maker in the bazaar who told us that paper-making had ceased in this area only 3 weeks before, i. e. about June 1st, because the rains and the sowing season were due. Nevertheless he, *Purnabadur*, consented to demonstrate the method of production and conducted us to the village of Nanglibang, situated on the opposite side of Kali Gandaki's river gorge just opposite Baglung. Here at a height of about 1500 m. he had his house and his fields, where in winter and spring he made paper. Unfortunately he had no bast left, so I was not able to follow the process in full detail to check that I had understood the paper-maker's explanations correctly. But I photographed his demonstration of the process without bast twice, with a day's interval between, and it was explained through Sherpa Passang Kami from Namche Bazar, my very able interpreter. The four photographs, plates 91–93 and 95, were taken on this occasion and the ground-plan drawn (plate 96).

However, in the autumn of 1970 I revisited Nanglibang and this time photographed the paper actually being made (plates 97–104). The position of the workshop, the tools, and the technique corresponded on the whole to those observed six years earlier. But the paper-makers now only cooked the bast strips once (again with lye of ashes and in the same way as the second cooking observed in 1964, see p. 81).

Dr. Sigrid Lechner-Knecht, Freiburg, Germany, visited the paper-makers in Baglung on the other side of Kali Gandaki in 1968–69. The manufacture, as she describes it, is essentially the same as that used by the paper-makers in Nanglibang, except that the cooking in Baglung was done with soda for one hour, and from what I heard in Baglung, the production there is on a somewhat larger scale.

The following description is the one recorded in 1964 at Nanglibang.

1. Fibres

The paper-makers here call the two species of *Daphne (Daphne papyracea* and *Daphne bholua)* which provide the fibre material, *baudoar*, which is almost the same word as *baruwa*, the term most commonly used in the Kathmandu Valley. Purnabadur declared that he knew the name *lokodo*, but that this was an old-fashioned term. *Of the two species,* Daphne papyracea *was said to give the finest and whitest paper.*

The paper-makers do not themselves collect the bast in the forests. People bring it to them from Lespar half a day's journey away, from Ramche $1^1/_2$ days away (see map plate 94, both places are situated at about 2300 m.), from Tarakani and elsewhere. Purnabadur said that he used about 300 lbs. a year and paid 3 Nep Rs for 5 lbs. of bast (2.3 kg.), twice the amount paid in East Nepal. The price level of most things in West Nepal is, and oddly enough has been for a long time, about 50 % higher than in East Nepal.

2. Position of the Workshop

The paper-makers here in Nanglibang establish their workshops close to their village and on their own land. They do not build huts, but *arrange workshops in the open air in the terraced fields* (plate 95 and ground-plan plate 96).

Purnabadur had chosen the spot where he made paper for three reasons. It should be close to a stream and high enough up for the water to be free of mud and the remains of plants from higher fields. Furthermore it should preferably be in a windy place, as the paper is sun- and air-dried, therefore the workshop was placed near a mountain crest.

Purnabadur said that he often worked alone, but most frequently with his wife. If they had plenty of bast the couple were helped by Purnabadur's brother or some acquaintance.

3. Soaking

Bast strips are soaked in water (plate 97), and if necessary dark parts of bast are cut off (plate 99).

4. First Cooking

A big copper cauldron is set over a fire, and 12 lbs. of ashes, water, and 5 lbs. of bast strips are put into it. They are cooked for a 1/2 hour and then turned. After another 1/2 hour of cooking, when the strips can be torn with the fingers, the cauldron is carried to the wash place. (During the cooking another portion of bast, previously cooked and cleansed, has been beaten and worked.

5. Washing and Rinsing

The bast strips are placed on top of a stone slab (1) where abundant water from the flume can wash them. To remove all the ash particles the paper-maker tramples on the strips with his bare feet. This takes 5–10 minutes. Then the strips are wrung dry and put on another stone slab (2). Here black and coloured impurities are cut away very thoroughly; it takes one man about an hour to clean a portion of 5 lbs.

6. Second Cooking

The liquid for the second cooking is obtained in the following way. A sawn-off kerosene can, formerly a bamboo basket, is placed on a stone shelf near the water basin. The bottom of the can has been perforated with numerous holes about 1/2 cm. in diameter. It is half filled with wood ash, on which cold water is poured. The water oozes through the ash, out onto the stone shelf and down into the cauldron (plate 98). This is once more placed upon the fireplace and the bast strips put into it. This time the cooking (plate 100) only lasts half an hour. After 15 minutes the strips are turned, and they are also stirred from time to time.

7. Rinsing

The cauldron is carried to the wash place, where the bast strips are put into a big bamboo basket. The paper-maker squats, and with his hands makes sure that all the lye of ashes is rinsed away with water from the flume (plate 101), which takes about 5 minutes.

8. Beating

The bast strips are then carried to the stone slab (2), and with a wooden mallet he beats a little more of the bast mass than is needed for the number of moulds to be filled (plate 102). For example, working with 10 moulds it takes about 1 1/2 hours to beat the necessary portion of bast, which equals about 1/5 of the cooked bast strips. Thus all in all, it takes about 7 1/2 hours to beat 5 lbs. Then the beaten mass is carried to the basin and placed in a big wooden vessel containing about 50 litres.

The head of the mallet is made from the tree called *sāl*. According to BRANDIS, 1911, p. 69: "*Shorea robusta*, Gaertn. . . . The Sāl tree. Vern. Sāl, Hindi; . . . heartwood . . . hard, heavy, strong, and tough." The handle is made of a light sort of wood, called *tilauni*.

9. Scooping

The paper-maker squats down between the basin and the vessel and scoops water from the basin into the vessel. For the production of 3 sheets, which takes about 1/20 of the cooked portion of bast, 40 litres of water are poured into the vessel. Then the bast mass is mixed with water simply by stirring with a wooden stick.

The moulds are big heavy frames, under which a piece of fine-meshed Indian cotton cloth is stretched. They are of various size; their inside measurement being about 60 by 120–140 cm., they are 2 to 3 times bigger than the moulds from East Nepal measuring about 48 by 64 cm. The total length of the mould I brought home is 151 cm. The cloth itself measures 62 by 122 cm. The mould weighs 3400 g., or about 3 times as much as the moulds from East Nepal. The moulds differ too from those usually used, in the fastening of the cloth to the wooden frame. In each of the four sides of the cloth a seam has been stitched, just wide enough to allow some long, about 1/2 cm. thick sticks to pass through. The cloth is attached to the wooden frame by fastening the sticks to the frame with 30–40 small iron or bamboo sprigs (plate 91).

Purnabadur said that for making the frames the wood they preferred had to be fetched from the forests higher up. He called the tree *salla*. It is presumably one of the *Pinus* species mentioned on p. 77, either *Pinus longifolia*, Rox. or *Pinus excelsa*, Wall. The frames were also made from the tree *utis*, which according to BRANDIS, 1911, p. 623 is: "*Alnus Nepalensis*, Don . . .; *Utis*, Kumaon, Nepal." The tree grows near Nanglibang, but is was less suitable for the purpose.

Squatting or standing (plate 103) the paper-maker pours 6–7 pots full of pulp (the pot holds about 2 litres) into the mould, one portion in each corner and the rest in the middle. He pours with his left hand through the extended fingers of his right hand, thus distributing the pulp still further.

Standing astride the basin the paper-maker then grasps the two long sides of the mould and lifts it from the water. If there are two persons, they do it squatting, each raising one of the short sides of the mould (plate 104). As previously mentioned, this operation demands a great deal of skill and experience to get a fairly uniformly thick paper sheet, especially with the bigger size. The effective cooking, thorough cleansing, prolonged beating of the bast and greater dilution of the pulp not only facilitate the scooping but are also decisive in getting a cleaner, more homogeneous and whiter paper than that made in Central and East Nepal.

10. Drying and Folding

In Nanglibang they only dry the wet sheets of paper by sun and wind. The climate of West Nepal is essentially dryer than that of East Nepal, and here on the southwest slopes at about 1500 m. the sun almost burns. As previously mentioned, a place is chosen near a windy mountain crest if possible. The moulds are placed at about right angles to the sun's rays. It was said that they are not turned during the 1–1 1/2 hours required to dry the sheets (plate 93). However, I think that some paper-makers turn the mould 180° once during the drying to get an even thickness of the paper.

If it starts raining, even only a little, the paper-makers stop scooping paper and go home, but return and continue when the weather clears. If the wet sheets of paper are rained on or if there is a strong wind, it may result in holes in the paper. The cloth is not washed regularly as in Tumbu.

When the paper has been loosened from the cloth, it is folded at once on the mould, the paper-maker squatting in front of it. First it is folded twice across the long edge of the sheet, then it is turned 90° and folded twice across the newly created long side. The paper receives no further treatment at the paper-maker's hand (such as smoothing or sizing). Finally the sheets are tied into bundles of 20 pieces each by means of thin bast strips.

11. Production and Sale

When Purnabadur worked alone, he used 2 moulds and made 4 sheets in 2 hours, or in a normal working day from 8 a.m. to 5 p.m. about 15 sheets. When he worked with his wife they used

4–6 moulds and produced about 30 pieces a day. If they had plenty of bast Purnabadur's brother or others helped, so that with 10 moulds they were able to produce 60 sheets a day. From 5 lbs. of bast strips they only got about 60 sheets or 1.2 kg. of paper. (In Tumbu they had 200–250 sheets, weighing about 1.4 kg., of the ordinary quality from the same quantity of bast.) The rather great loss of material from bast strips to paper is of course due to the scrupulous removal of impurities and the rinsing in the stream.

The paper-makers from Nanglibang sold the paper at Baglung bazaar, where there were several stalls selling paper and even one trading exclusively in it. Here they distinguished between 3 qualities:

1. *The ordinary quality* has a basis weight of c. 17 (the weight in g. of one square meter). The sheets often have tears and holes and are much more brownish than the best quality. In the bazaar the paper cost 3 Nep Rs per bundle (20 sheets) of which the paper-maker got 2 Nep Rs (1964).
2. *The medium quality* has a basis weight of c. 22 (g/m.^{2}). The paper is only a little thinner and less white than the best quality, and without holes, but it cannot take ink on both sides as can the best quality. It cost 4 Nep Rs per bundle in the bazaar, of which the paper-maker got 3 Nep Rs.
3. *The best quality* has a basis weight of c. 26 and will take writing in ink on both sides. The paper is free from blemishes and whiter than the ordinary qualities. It is the finest paper of Nepal and in the bazaar it cost 6 Nep Rs per bundle, of which the paper-maker got 5 Nep Rs. (With regard to other properties of the three qualities see the tables pp. 226 and 227. Photographs of two samples seen in transparency, see plates 189 and 190).

Purnabadur said that out of 120 sheets, on the average 50 were of ordinary quality, 40 of medium quality and 30 of the best quality. From this it appears that the different qualities resulted from sorting rather than from planned production, though the latter may well take place, especially with the best quality. Moreover it will be seen that Purnabadur got an average of 3 Nep Rs per bundle. He did not work to order but produced as much as the weather and his other work permitted.

In the bazaar one could also buy "horoscope paper", i. e. paper for drawing up horoscopes on (plates 169 and 170). It consisted of two sheets of the best quality, pasted together (see table p. 226, sample no. 18). It cost 7 Nep Rs for 10 sheets from the retailer, who did the gluing himself. It was excellently done, without lumps or bulges.

Purnabadur finally stated that paper was usually made from December to May, i. e. for 4–5 months, and that he used 300 lbs. of bast each season, corresponding to a production of c. 3600 sheets of paper. Considering that he went to market once a week, and that another day must be allowed for bad weather, he made an average of 30 sheets per working day. This agrees with what we were told, that he mostly worked with his wife. In addition, one can see that Purnabadur and his wife only earned about 350 Nep Rs in a season or 3 Nep Rs a day by making paper, when expenses for bast etc. had been deducted from the gross income. From these calculations it is obvious that *paper-making is a secondary occupation*, while the principal activity is agriculture. The object of making paper is evidently to obtain ready money for purchasing a number of necessities which have to be imported into the area, such as steel, cloth, salt and kerosene.

Thus paper-making around Baglung (and perhaps also near Doti in westernmost Nepal) *differs on many points from paper-making in Central and East Nepal in the size and quality of the paper, methods of production and organisation. The Baglung method is somewhat less primitive and more reminiscent of Tibetan paper-making. This seems to suggest that paper-making around Baglung was introduced later from Tibet.*

12. The Paper-Makers

Purnabadur is a Chetri and thus he worships Hindu deities. He grew maize, wheat, rice and millet and had four buffaloes and one ox. On feast-days they had meat, rice, butter, bread and pickles, but no alcohol, which is tabu according to caste laws.

Purnabadur's father, grandfather and great-grandfather had all been paper-makers, therefore the occupation is at least a hundred years old here. Purnabadur had learned paper-making at the age of 12. On his wife's side there were no paper-makers; she had learned it at the age of 10. He said that near Nanglibang 14 or 15 families were working at paper-making, but that paper was also made in other places in the district including Maladji (Malaj on the map, a village north of Nanglibang). This last point has been confirmed by G. B. Shah. Most paper-makers, Purnabadur went on, are of the Chetri caste, but Magar (Mangar), *Kami* (or *Karmi*, the blacksmith caste) and *Dami* (or *Dumai*, the tailor caste) also make paper. It should be noted that the latter two occupational groups have a low social status. As the Chetri caste has a high status, however, paper-making does not seem to be subject to caste restrictions.

The tradition for making paper in the Baglung area is probably due to its position on one of the most important and earliest north-south caravan routes connecting Western Tibet and Nepal with India.

E. Paper-making in the Kathmandu Valley

The Kathmandu Valley, past and present political and cultural center of Nepal, has within its 565 square kilometres over half a million inhabitants. The valley has for many centuries been a consumer of paper, ever since the palm leaf was given up for good as a writing material and replaced by paper at the end of the 16th century. But a few manuscripts from the beginning of the 12th century are on paper, and presumably it was also used for other purposes at an early date. It is worth noting that according to Purna Harsha Bajracharya paper is called *bhoṅ* (pronounced *jong*) in Newari, a word that is not used by any other ethnic group in Nepal and may well originate from the valley's early contacts with China.

There is however no tradition of paper-making nor any other indication of an early production of paper in the valley. Whereas all other crafts and professions have had their own caste, the paper-makers occur in neither the old lists of castes nor the newer ones. Brian Hodgson observed already in 1832: "Though called Nipalese, the paper is not in fact made in Nepal proper [the Kathmandu Valley and adjoining valleys]. It is manufactured exclusively in Cis-Himalayan Bhote, ..." *Thus everything indicates that paper has been brought to the valley primarily from North Nepal right up to our time.*

Until 1860–70 native paper was used almost exclusively although occasionally supplemented by handmade Indian paper. Later, traders began to import machine-made European and Indian paper on a small scale. Even up to 1934 Nepalese paper was used by the government without exception. But on account of insufficient supplies, the administration then started using imported paper, which was also the cheapest.

Probably owing to the outbreak of World War II in 1939, the demand for local handmade paper increased in and around the capital, and for this reason production was started in the valley. It was also there that most of the foreign paper had been used, which it was now impossible to obtain.

The first mention of paper-making in or near the Kathmandu Valley is found in S. N. Sen's article: *"Handmade paper of Nepal"*, published in 1940 (see p. 65). The method of production described corresponds to that most frequently found, viz. the East and Central Nepalese.

1. Bhurungkhel and Chetrapati

G. B. Shah says that his father Chuda Bikram Shah started to produce paper at Bhurungkhel (Burangkha) in Kathmandu about 1940. It was done with the co-operation of G. B. Shah's maternal uncle, Dirgha Bahadur Malla, who came from Mallaj in the Baglung-area, and who also sent paper-makers to the capital from his village. *Therefore the method first used in Bhurungkhel is said to have corresponded to that of the Baglung papermakers* (obviously not the same one as described by S. N. Sen, see p. 65). G. B. Shah adds that until his father started production in Kathmandu, paper-making was unknown there, and also that at this time most of the paper came from the mountains of East No. 1.

That the paper-making in Bhurungkhel was the first in the Kathmandu-area has been confirmed by Purna Harsha Bajracharya, who writes that Nepalese paper was first made in the valley at Bhudhangkhel and then in Paknajole.

They began at Bhurungkhel by making writing paper from bast fibres, but since this was too expensive they soon also started to make cardboard from *waste bast paper*. The Nepalese government of that time had a special arrangement with G. B. Shah by which its office waste paper was handed over to his factory. But writing paper was very seldom made from it since it was discoloured and traces of letters remained faintly visible in the paper. It was mainly used as wrapping paper in the bazaar. G. B. Shah has sent me a sample of the cardboard which is very thick, slightly yellow-brown and appears to have several layers; he writes that it was made from 20 % raw bast and 80 % waste bast paper, and that the sheet size was 32 by 66 inches or 81 by 166 cm.

After six months the method of production was modified, so that now only chemicals were used for cooking the bast, and the so-called *dhiki*-stampers for beating the waste paper (see p. 87). It became necessary to use *chemicals* because it was not possible to get enough wood ash.

After two years the workshop was moved about 1½ km. north, to Chetrapati, as there were no longer sufficient quantities of pure water at Bhurungkhel. Otherwise the method of production remained unaltered. The workshop exported a total of 50 tons (Eng.) of cardboard to India, especially to Lucknow and Kanpur (to Bhimpedi by carrier, from there to Amlekhganj by lorry and then by train). As the factory suffered great losses due to extensive damage to the goods during transport to India and as, in addition, there were difficulties in procuring the bast, production ceased about 1944.

2. Sundarijal

In 1950 production was resumed but now at Sundarijal about 10 km. north-east of Kathmandu, where the Bagmati river comes down from the mountains and runs out into the valley, and incidentally where the road to Yolmo leaves the valley. The spot is ideally suited for the purpose, being protected to the north by mountains where the *Daphne* species grows. Furthermore there is an abundant supply of water all the year round.

The manufacture of paper in Sundarijal took place on the estate of C. B. Shah, on the left of the road when coming from Kathmandu. The cooking and beating of the bast was done indoors in a large house, which also served as a store room for moulds, ready-made paper etc. The remaining part of the manufacture took place out of doors, in fields around the house (see sketch plate 105).

Until 1959 quite large amounts of paper of various kinds were produced in Sundarijal. During this period many improvements in production methods were introduced in co-operation with D. B. Malla. W. B. Beatty saw the place shortly before production ceased and he has given a vivid description in text and photographs of the workshop in operation (see p. 66). I visited Sundarijal in 1964 after paper-making had ceased, but the method of production was explained to me. After my return from Nepal G. B. Shah sent a more detailed account of the production of the four most important kinds of paper, which is given below. Here we can follow the age-old skill as it approaches the threshold of modern manufacture.

The quantities given of raw materials, number of persons employed at each stage of the process etc. apply to a working unit of one scooping and drying field. Between 1950 and 1954 two such units were in operation, and four units until 1959. Amounts produced and prices for the different kinds of paper are given after the description of the various methods of production. (Various properties of four samples from Sundarijal see pp. 226–227. Photographs of these four qualities seen in transparency, see plates 191–194).

a. PRODUCTION OF THE FINEST QUALITY OF WRITING PAPER FROM *DAPHNE* BAST.

Procuring the bast. People from the mountains (Tamangs) came a distance of one or two days' journey from Sundarijal, and sold the *Daphne* bast at 2 Nep Rs per 5 lbs. Approx. 10 % of this had to be fresh bast owing to the plant sap content used in the production.

Soaking. 24 hours before the bast was to be manufactured into paper, 20 lbs. were placed in a tall square concrete tank and about 40 litres of water added. When the 24 hours had passed two boys trampled the wet bast strips either alternately or together for nearly half an hour. By doing this the bast was further softened, but even more important, a thick red-brown liquid, viz. water mixed with *the sap of the plant*, could be drawn off afterwards. *This was in turn used as sizing for the production of ordinary writing paper*, made of 50 % bast and 50 % waste paper (see p. 87).

Cooking. The 20 lbs. of bast were then placed in an iron cauldron and cooked for $2^1/_2$–3 hours in 20–25 litres of water mixed with 1 lb. of soda (Na_2CO_3). Caustic soda ($NaOH$) could not be used as the paper would then lose its smooth surface. One man at each fireplace fetched wood, looked after the cooking and now and then stirred the bast strips. To test whether the cooking was finished small portions of bast were taken out and beaten.

Rinsing. The bast strips were then put in a square tank (sides made of sāl-wood and bottom an iron plate). Two boys saw that the strips got well rinsed in running water for 20–30 minutes. They also picked out impurities and lumps of bast which went back for further cooking.

Beating. This operation took place indoors to prevent the wind from blowing dust onto the bast. In a room of the house 8–10 persons (nearly always women) sat in a big circle beating the bast strips on a stone or iron plate with a wooden mallet. Everybody beat about a pound at a time, and when a lump was finished it was thrown into the middle of the circle. The 8–10 persons were able to handle 20 lbs. of bast in 4–5 hours, therefore 1 person could beat 5 lbs. in approximately 10 hours (6 hours if efficiently done).

Storage. The bast mass was finally stored in a wooden chest. Putrefaction was partly prevented by keeping the bast from the open air, so the mass did not turn dark.

Mixing with water. When the bast mass was to be used $^1/_4$ of the 20 lbs. i. e. 5 lbs. was placed in a big iron pot into which 300–350 litres of fresh water had been poured. Two boys then stirred the pulp very thoroughly with long sticks. As in Nanglibang this quantity of water and the small amount of bast facilitated the even distribution of pulp during scooping.

Scooping. The moulds used were big wooden frames under which a comparatively fine-meshed, light piece of Indian cotton cloth was stretched. The size of the paper depended on the order; sometimes it was 50 by 75 cm., but more often 68 by 105 cm., i. e. a little smaller than that of the Nanglibang paper-makers. The scooping basin was either of the same kind as the rinsing tank or a concrete basin sunk into the ground. The scooping was now performed by a specially trained boy, who carefully distributed 3–$3^1/_2$ litres of pulp all over the cloth of the floating mould by pouring the pulp through his extended left hand. Two other boys then lifted the mould slowly, each holding a short side, and passing it on to one of three other boys, who carried it dripping to the drying field.

W. B. BEATTY, 1960, p. 19, describes the method thus: ". . ., the mould, worked by two people, is held wrist deep in the stirred pulp, given a few sidewise shakes, then lifted slightly tilted from the tank and allowed to drain for a few seconds."

G. B. Shah states that towards the end, *i. e. 1958–59, this more advanced method, the dipping process, was used in Sundarijal*, because they were experimenting a good deal just then, both with new raw materials and new methods.

A batch of 100 moulds was thus scooped and carried to the drying field. From the whole portion of 20 lbs. about 100 moulds could be scooped and dried four times a day if the weather was fine. Thus from 20 lbs. of *Daphne* bast 400 sheets of paper were produced, which was the average production per scooping and drying unit per day. During the scooping and drying the boys also cleaned cooked pulp etc.

Drying. As in Nanglibang the paper was dried by sun and wind. Here at only 1500 metres it is comparatively warm most of the year and the paper dried in 50–70 minutes. The wet moulds were placed leaning on one of their long sides against sticks just as in Nanglibang. After about a quarter of an hour, when the upper half of the sheets was dry, the moulds were turned and placed on the other long side. Usually the moulds dried with the paper turned towards the sun; however, when there was a dusty wind the paper sides of the moulds were turned away from the wind.

Removal. The paper was next removed from the cloth by means of a bamboo stick, 20 cm. long and flattened at one end, because the boys would otherwise cut their hands. The same three boys who carried moulds to the drying field, turned them and took off the paper. Finally the paper was piled without being folded, and put in a storeroom in the house.

b. PRODUCTION OF ORDINARY WRITING PAPER FROM 50 % *DAPHNE* BAST AND 50 % WASTE PAPER. Waste paper was procured from the big government block of offices, *Singha Durbar* in Kathmandu and was transported to Sundarijal by lorry. The cost for this was 60 Nep Rs for 1600 lbs.

Cooking. 10 lbs of waste paper cut into narrow strips, $^1/_2$ lb. of caustic soda (NaOH) and about 20 litres of water were cooked for an hour in a huge iron pot. The strong alkaline solution was needed to cleanse the waste paper and dissolve writing and print.

Rinsing. The cooked mass was washed out in the water tank for 30–40 minutes; wooden sticks were used for the stirring on account of the causticity of the mixture.

Beating. Since caustic soda injures the skin, the waste paper could not be beaten manually with a wooden mallet. Therefore it was taken to the *dhiki*-stamper. This simple treadle stamper is used everywhere in Nepal for peeling rice, barley etc. and has been used since time immemorial in many parts of Asia, including China where it had also been used for beating paper fibres (see e. g. CLAPPERTON, 1934, p. 4). In Nepal the dhiki consists of a 3–4 metre long beam, which moves up and down like a seesaw, mounted on a horizontal axis 1–$1^1/_2$ metre from one end of the beam. Every time this end is trodden down, the mallet of hard wood (or a stone) at the other end is raised, and when the beam is released, the mallet falls into a hole in the ground or into a stone trough (it works at about 25 beats per minute). In Sundarijal two men trod alternately, while a woman at the other end of the beam pushed the escaping paper slurry back into the trough with a wooden stick. The work was time-consuming, as the mass soon became very thin. Thus it took three persons 6–8 hours to beat 10 lbs., i. e. to separate the fibres in the waste paper.

Rinsing. The mass was rinsed in running water once more, now for 15–20 minutes.

Addition of bast fibres. $^1/_4$ of the waste paper mass (dry weight $2^1/_2$ lbs.) and beaten bast from $2^1/_2$ lbs. of *Daphne* bast were thoroughly mixed in 300–350 litres of water in a big iron pot or tank by two boys. Into this was poured 18 litres of sizing liquid, called "thick water", made by soaking fresh *Daphne* bast (see p. 86). From the whole portion of 10 lbs. waste paper and 10 lbs. *Daphne* bast about 400 sheets were made, which equals the average production in one scooping and drying field.

Scooping and drying. These processes were carried out exactly as described above. The paper was stored unfolded.

c. PRODUCTION OF WRAPPING PAPER FROM WASTE PAPER. Here 20 lbs. of waste paper were cooked with 1 lb. of caustic soda in 40 litres of water for rather more than an hour. The first washing lasted an hour or a little longer, the beating with 2 dhiki-stampers took 6–8 hours and the second washing about $^1/_2$ an hour. Scooping and drying was carried out as described above, and similarly about 400 sheets were made from the 20 lbs. of raw material. This kind of paper was folded immediately after its manufacture.

d. PRODUCTION OF CARDBOARD FROM 50 % *DAPHNE* BAST AND 50 % *CHIULI* BAST. The *chiuli* bast was received in the same way and at the same price as the *Daphne* bast. Chiuli fibres (see p. 57) were not regarded as an important raw material, because the plant is not as common as the *Daphne* plants and also the bast is twice as hard. Chiuli was not used in Sundarijal until 1954, and it was regarded as something of an experiment.

Cooking. 10 lbs. of chiuli bast together with $^1/_2$ lb. of caustic soda were cooked in 15–20 litres of water for one hour.

Rinsing. The bast strips were then rinsed in running water, this time for 10–15 minutes.

Beating. The beating was done either by women or with the dhiki, which was cheaper. With this instrument it took only 3 hours to beat 10 lbs. of bast.

Washing. Once more the mass was rinsed in running water, this time for 10–15 minutes.

Addition of Daphne bast. The beaten chiuli bast and 10 lbs. of beaten *Daphne* bast were put in a big iron pot with 100 litres of water. For 5–10 minutes two men stirred the pulp, from which only 20 sheets of cardboard could be made.

Scooping and drying. When 20 moulds had been scooped and put to dry, the boys got on with other jobs, such as rinsing cooked *Daphne* bast, waste paper or chiuli bast, repairing old and defective moulds and cleaning the cloth for the moulds with soap, before they continued the scooping and drying of a new portion of fibre mass. The finished sheets of cardboard were stored unfolded.

e. ORGANISATION 1950–54 (number of workers given under normal conditions).

Leader:

D. B. Malla, who besides running the factory obtained orders for the paper.

Superviser:

D. B. Malla's son, who supervised the production and arranged payment of wages and the like.

Cookers:

1 man at the cooking place.

Beaters:

6 women and 2 men, who operated the *dhiki*-stamper.

Field workers:

12 boys of the ages of 10–17, working on 2 scooping and drying units, each with 6 boys, washing cooked bast, scooping and drying moulds etc. Normal good production about 800 sheets per day.

Extra assistance:

On busy days 5–8 persons from D. B. Malla's family helped with odd jobs (unpaid).

f. ORGANISATION 1955–59 (the wages quoted refer to 1959).

Leader and superviser as above, plus 1 clerk.

Cookers:

2 men at the 2 cooking places. 2 Nep Rs a day for about 4 hours' work.

Beaters:

12 women. Wages according to amount of bast beaten, about $3^1/_2$ Nep Rs for 5 lbs. of bast (for the finest writing paper), on the average they earned about $2^1/_2$ Nep Rs a day. 4 men, who operated the two dhiki-stampers. Average wages 3 Nep Rs a day.

Field workers:

24 boys. 4 scooping and drying units each with 6

boys. Wages varying, about 1 Nep R. a day. Normal good production about 1600 sheets a day (400 moulds needed for this production; in all 900 moulds were available).

Extra assistance: voluntary workers as above.

g. PRODUCTION AND SALE. G. B. Shah states that during 1950–59 the total production of paper and cardboard in Sundarijal amounted to about 150,000 lbs. If we reckon with about 200 working days a year (October to May), then in the course of these 10 years an average of 75 lbs. of fibres must have been consumed per day, or in the course of the first 5 years about 50 lbs. a day and during the last 5 years 100 lbs. a day. If these figures seem rather high, it must be remembered that great quantities of fibres were required for the production of cardboard.

The paper from Sundarijal was sold almost exclusively in the Kathmandu Valley. Here it was bought partly by stores for resale, partly by makers of pads, envelopes, filing folders etc. The biggest customer was the governmental administration. When a large amount of paper was required special offers were solicited, subject to conditions of quality, price and time of delivery. Against a small advance, often 10 %, the paper was made and delivered according to such an agreement. Big firms used the same procedure. Only seldom was business done through middlemen.

According to G. B. Shah middlemen can operate in the following way. When paper is not to be had in the market, businessmen visit the various localities in the mountains where paper is made and present their orders. The paper-makers receive an advance of 50 %. When the paper has been delivered the businessmen will resell it at a good profit to bigger purchasers. Even if there is no question of an officially recognized monopoly, it functions as if the buyers have a monopoly of resale. However, if the paper-makers are dissatisfied with the agreement, they sometimes sell the paper in the bazaar themselves.

h. PRICES OF PAPER IN THE BAZAAR

Sundarijal paper,	prices per sheet in Nep Rs:		
	1950–53	1953–56	1956–59
Finest writing paper:	0.14	0.18	0.22
Ordinary writing paper:	0.10	0.12	0.14
Wrapping paper:	0.04	0.06	0.08
Pasteboard (production started 1954):		1.25	1.50

For the finest writing paper G. B. Shah also gave the following prices per lb. (size 65 by 105 cm.). 1940: 2 Nep Rs; 1950: 4 Nep Rs; 1960: 7 Nep Rs and 1965: 12 Nep Rs. (If the basis weight is 22, one lb. of paper equals about 30 sheets.)

It may serve as a comparison that in 1964 the ordinary quality of paper from the mountains (size 48 by 64 cm.), corresponding to the wrapping paper from Sundarijal, was sold at about 2.5 Nep Rs per lb. in Kathmandu, while the price of rice was 0.60 Nep R. per lb. In 1968 paper from the mountains cost 0.05 Nep R. per sheet for the ordinary quality or about 4 Nep Rs per lb. The price of rice was now 0.8–1.0 Nep R. per lb.

Prices of paper of the ordinary quality and of rice in 1832–35 were respectively 0.21 and 0.05 Nep R. per lb. (p. 63). Thus up to 1940 the prices of paper as well as of rice rose by a factor of 3, but from 1940–1968 by a factor of 6, while *the proportion between the prices per kg. of paper and of rice has been almost constant at 4 : 1 during the last 150 years.*

3. Tripureswar, Kathmandu

In 1948 a paper-making workshop was established as part of a development centre for a number of local crafts: *"The Cottage and Small Industries Department"*, situated in Tripureswar on the outskirts of Kathmandu. The object was to train people in an occupation in danger of dying out. To begin with tools and methods of production were very similar to the traditional ones, but little by little more modern methods were introduced and experiments were made with new fibres.

In 1961 the following machines were acquired: a cutting machine, a boiler, a hollander (for mixing and mechanical treatment of fibres, trade mark Vulcan, Bombay), a calender (to give paper sheets a smoother surface), and a machine for grinding fibres with a stone drum without substantially shortening them. Plate 106 shows a sketch ground-plan of the works. The model for the factory was a similar one in Poona in India. The idea was to introduce modern methods of production, so that people with a professional background would be available when the first proper paper-factories are established in Nepal. A paper-making workshop with an almost identical set of machinery is said to exist at Panauti in East No. 1.

When I visited Tripureswar in July 1964 production was temporarily suspended as is always the case during the monsoon, when the workers are in the fields. But in the winter season about 30 people work there, 20 of them being more or less specially trained, people from families who are traditionally paper-makers being preferred for these posts. The superintendant was H. B. Singha Raya Majhi and the manager H. B. Baruwa, who studied the advanced technique of production of handmade paper during a stay in Japan.

In Tripureswar many different types of paper have been produced, including writing paper, wrapping paper, blotting paper, serviettes, wall-paper and cardboard. *Apart from* Daphne *bast,* Daphne *waste paper and machine-made Indian and European waste paper, the fibres used have been rice straw, sabai grass and imported wood pulp.* Two or more fibres have often been combined to obtain special properties or where it has been an economic advantage.

The various procedures of manufacture will not be described in detail, as in most cases it is a question of the methods already described or recently introduced ones from abroad. I shall just mention briefly the production of *Daphne* paper and paper from rice straw to show how the ancient handicraft has been adapted to a more advanced technique.

a. PRODUCTION OF WRITING PAPER FROM *DAPHNE* BAST. After the bast strips are cooked in lye of ashes for 2 hours and the ash particles have been removed by rinsing, the strips are beaten with a wooden mallet. It takes one man 4–5 hours to beat 5 lbs. of bast. Then follows a grinding of the mass to improve the sizing of the paper which incidentally is considered the most difficult process. After that a concrete tank is filled with 1000 litres of water and pulp from the 5 lbs. of bast, and very thoroughly stirred.

The moulds are wooden frames under which a piece of fine-meshed cotton cloth is extended (the imprint of which is slightly noticeable in nearly all of the paper samples brought home) or a wire net (as in the moulds I saw, possibly for making the heavier qualities). *The scooping is performed by dipping the moulds in the pulp* for about 3 seconds. Finally, the mould is turned and the wet sheet is transferred to a sheet of felt lying on the top of a pile of alternate wet paper and felt sheets. By pressing this "sandwich" most of the moisture from the paper sheets is driven out, and the final drying takes place out-of-doors in the sun. On account of the grinding the finished product is much more suited for writing than that which is produced in the mountains, but less glossy and not so attractive in appearance.

For the production of writing paper *Daphne* waste paper has also been used, frequently with straw fibres added. Waste paper is mostly used for making coloured, lower quality paper and cardboard.

b. PRODUCTION OF RICE STRAW PAPER. H. B. Baruwa writes that paper from rice straw is made in the following way: Bunches of rice straw are cleaned and cut into pieces about 8 cm. long, which are cooked in water with caustic soda ($NaOH$). Then the mass is placed in a basin with water, and rinsed 3–4 times.

The beating is done with a wooden mallet on a base of wood or concrete. Often wood pulp or waste paper pulp is added to the straw pulp (in the proportion 1/8–1/10). If the paper is to be made fit for writing, resin soap can be mixed in.

Rice straw is very cheap, but rice straw paper is not nearly as good as the *Daphne* paper and is therefore less used. H. B. Baruwa states too, that rice straw and sabai grass were not used in the production of paper in Nepal until 1940.

c. VARIOUS QUALITIES. The different kinds of paper mentioned below are samples brought home from Tripureswar. Fibres, basis weight, opacity, properties of strength etc. of some representative samples have been examined and are given in the tables pp. 226–227. With regard to the content of the various fibres see also p. 197. Unless otherwise indicated, the mould is made of fine cotton fabric with about 70 threads per 50 mm. (Four different qualities are seen in transparency, plates 195–198.) In Tripureshwar the paper is also coloured or treated with starch paste (see plate 107) and glazed (plate 109).

Writing paper

1) A good, white paper made of two layers glued together, 0.09 mm. thick, glazed (*no. 37*). Made solely of *Daphne* fibres.

2) Rather brownish, hard, for office use, 0.09 mm. thick (*nos. 31 and 33*). When held up to the light a great many black dots are visible. Fairly thoroughly ground *Daphne* fibres.

3) Fairly white and very soft, 0.13 mm. thick (*no. 32*). About 1/3 of the material is *Daphne* fibres and 1/3 straw fibres *(this species is unidentified; found in many samples and marked (x)*. Perhaps it is a question of straw fibres from *sabai* grass). The sample also contains fibres of conifer and mechanical pulp (fir) and a few fibres of hardwood.

4) An almost white paper, glued and glazed on one side, 0.19 mm. thick (*no. 38*). Consists chiefly of conifer fibres (fir), but also smaller quantities of fibres from hardwood and straw (*x*). The paper is said to be made partly of waste paper and is amply coated with starch.

5) Grey, 0.19 mm. thick (no. 36), also used as wallpaper. Very short-fibred and chiefly made of rice straw fibres (in Sundarijal it was claimed to be made of fibres from sabai grass). Contains moreover small quantities of *Daphne* fibres. The paper is amply treated with starch.

Envelope. Fairly white, 0.20 mm. thick. It is said to be made of choice white waste paper. Consists mainly of conifer fibres and mechanical pulp (fir), but also of fibres from hardwood and straw (*x*). The paper is treated with starch.

Serviette. Fairly bright, soft, 0.10 mm. thick. About 50% *Daphne* fibres besides conifer fibres and mechanical pulp (fir) and also straw fibres (*x*).

Wrapping paper. Very brown, glazed on one side, 0.18 mm. thick (*nos. 34 and 35*). When held to the light many dark lumps and knots can be seen. Made exclusively of *Daphne* waste paper.

Cover paper. Thin as well as heavy qualities from 0.1 to 0.4 mm. thick, both coloured and uncoloured qualities:

1) 0.11 mm. thick, coated with a yellow colour, orpiment. The paper is called *ais* in Kathmandu and is made of somewhat shortened and thoroughly beaten *Daphne* fibres.

2) A lilac, streaked, glazed, 0.11 mm. thick paper made of mixed waste paper. When held to the light, a few big lumps of fibres are to be seen in a short-fibred mass. The paper consists mainly of straw fibres (*x*) besides *Daphne*, conifer and hardwood fibres and also a good deal of mechanical pulp (fir).

3) This paper is dyed by putting together one undyed sheet and one dyed sheet, still wet, and then pulling them apart, so that a marbled effect is produced. The paper, 0.16 mm. thick, is made of waste paper and the fibres are much shortened and damaged. There are fibres of hardwood and conifer (including a portion of mechanical wood pulp from fir) as well as *Daphne* and straw fibres. The paper is very starched.

4) A red-lilac paper like blotting paper, 0.23 mm. thick, also made of waste paper. It contains mostly straw fibres (*x*), but also fibres of pine and fir (mostly as mechanical wood pulp) and *Daphne* fibres.

5) A slightly brownish, soft paper, 0.28 mm. thick, made of straw fibres (*x*), conifer fibres and mechanical wood pulp (fir) and smaller quantities of fibres from hardwood and rice straw (?).

Pasteboard

1) Slightly brownish qualities for less fine binding or the like, 0.25–0.30 mm. thick. They contain chiefly straw fibres (*x*) but also a portion of conifer fibres and mechanical wood pulp (fir).

2) Mat, black-coloured, 0.53 mm. thick. Dye has been added to the pulp (I.C.I. Cotton-Black Extra). The paper contains straw fibres of conifer and a few fibres of hardwood. It is made of various types of waste paper.

3) Thick, stiff, qualities, glazed and more white on one side than the other, 0.6–0.7 mm. thick. It is said to be made of waste paper covered with writing. Contains on the whole the same fibres as the previous sample.

4) Fairly white, soft drawing paper, sheet 44 by 55 cm., 0.75 mm. thick. The imprint of the mould is from a metal wire net with 30 to 36 wires per 5 cm. Besides straw fibres (*x*), the paper contains a portion of rice straw fibres and fibres from both hardwood and conifer (including mechanical wood pulp of fir).

5) Black-coloured, 0.83 mm. thick. The dye is coated on. Contains the same fibres as the previous sample.

4. Names

The Newars call paper *bhoṅ* (pronounced *jong*), a name which is not known in Indian or Tibetan sources. It may have a Chinese origin. CLAPPERTON, 1934, p. 4, thus quotes an early Chinese source, which calls the unfolded paper *fan*. TURNER, 1931, gives the following names for blank paper:

p. 84: "kāgaji, adj. white."
"kāgat, or kāgaj or kāgad, s. Paper."

p. 219: "jistā, or distā, s. A quire of paper."
p. 264: "ḍhaḍḍi, or ḍhaṭṭi, s. Bundle (only of paper); ḍhaḍḍa, s. Bundle of paper, file, list."
p. 334: "natthi, s. File of papers, bundle, packet."
p. 419: "banḍil, s. Bundle or ream (of paper); loanword Eng. bundle."

F. Pasting, Dyeing, Impregnation and Glazing. Manufacture of Ink

Machine-made paper and pasteboard are usually made so that they do not need to be built up into more layers or further worked to obtain a special surface etc. later. This is not the case with the handmade paper. Apart from the paper workshops in or near the Kathmandu Valley, *the papermakers always deliver the paper in whole, undyed and unimpregnated sheets of a single layer.* To make the paper fit for a number of different uses further treatment is undertaken by small workshops or the consumers themselves. This is necessary because in an untreated state the paper is too thin and porous.

1. Pasting

Many applications, such as for mss., demand paper consisting of multiple layers. G. B. Shah writes that wheat flour paste is used for this purpose, whereas P. H. Bajracharya states that rice flour paste is also used. Both have been employed, especially in the Kathmandu Valley, where rice and wheat are grown. In mss. wheat flour starch occurs most frequently. This also applies to mss. from the Lamaist highlands. There rice is common, but not rice flour, and barley is unsuitable owing to its brownish colour. The pasting together of the single layers (plate 107 from Tripureswar) is usually carried out with great care, and it is sometimes extraordinarily difficult to determine how many layers a sheet consists of.

2. Dyeing and Impregnation

In the treatment of paper with various substances the aim is generally to obtain two or more of the following properties: *colour, toxicity, sizing and strength.* Among Nepalese mss. there are various frequently recurring methods of treating the paper. Most of them have been in use up to quite recently and are also encountered in other uses of the paper.

a. THE BLUE-BLACK PAPER. Ever since the beginning of the 13th century, probably even earlier, mss. with gold or silver writing on blue-black paper have been made in the Kathmandu Valley. Such paper is still produced and is called *hakubhoṅ* (pronounced *hakufong*), which in Newari simply means black paper. P. H. Bajracharya says that the black colour is called *nīladuto* (TURNER, 1931, p. 350: "nil, s. Indigo." and: "nilo, adj. Blue.") and that it is much more poisonous than orpiment, i. e. the yellow arsenic used for the yellow mss. Mrs. Ruth Christensen gives the information that the blue-black dye is extracted from a plant called *nilotho*. This is probably the vegetable dye used since early times for the blue-black mss. Its toxity is seen from the fact that even very old mss. on this paper are never worm-eaten or damaged by mildew etc.

PINDBORG, 1967, p. 23, writes that the black colour is obtained after treatment with a special extract from the *Areka* palm. BRANDIS, 1911, p. 646, mentions: "The Areca Palm, *Areca Catechu*." The dye is applied without using starch paste. This is the reason why it has been found necessary to glaze or lacquer the leaves (generally only the squares with text) before writing on them; this procedure is also usual in the case of the Tibetan blue-black mss. The blue-black paper is still being made; in the paper factory in Tripureswar an I. C. I. dyeing chemical was used to colour the paper black.

b. PAPER TREATED WITH ORPIMENT. Yellow arsenic, orpiment (As_2S_3), has certainly been known and used for many purposes in most of Asia even from prehistoric times. LEVI, 1905, Vol. III, p. 182–83, indicates a source from the 4th century mentioning the sale by merchants in Nepal of cotton and "*hioung-hoang*", which seems to be orpiment. GULIK, 1958, p. 137, states that *tz'û-huang*, orpiment, was used in China in the 5th century for the impregnation of scrolls in order to keep away insects; the material is also mentioned in several sources from Tibet.

According to my investigations (see the table p. 248) none of the Nepalese mss. on palm leaves, which are all from before the 17th century, have been treated with orpiment, and with regard to the paper mss. this treatment does not become general until about the 16th–17th century. *After that time, however, nearly all mss. from the Kathmandu Valley are treated with orpiment, with the exception of the rather less common mss. on blue-black paper.*

At Jorganesh Stationary Works, Kathmandu, which produces writing blocks, envelopes, covers etc., they explained how the yellow paper is made. The mineral *haridall* (hardall) is bought in the bazaar (plate 109). This almost insoluble mineral (in water) is crushed into powder with a mortar and sprinkled into a pot with ground rice. With water added the mixture is cooked into a paste until it reaches a suitable consistency—almost as tooth-paste. Finally one or both sides of the paper are coated with the paste either with a brush or merely with the fingers. This simple procedure is undoubtedly the one that has always been used. This impregnation with poison as protection against mice, rats, insects and mildew is certainly effective. Paper treated with orpiment is rarely gnawed along the edges and it is never worm-eaten or mildewed, not even when only one side has been treated with the material. After many hours of work with such mss. I have often felt a curious stinging at the finger-tips.

The paste adds other properties to the paper. The rice paste fills up the spaces between the fibres in the surface of the paper, which makes it smoother, less easily soiled and, what is especially important, more suitable for writing on. In addition the paper becomes stiffer.

In time the orpiment is oxidised into arsenious trioxide, As_2O_3, which is white but may turn grey-white due to absorption and reaction with water that results in recrystallisation. Old mss. treated with the yellow mineral are sometimes grey-white, except in the middle of the leaves, where the yellow colour has remained. When in the literature on the subject mention is made of early mss. prepared with white arsenic, the paper may quite well have originally been treated with orpiment. (This is perhaps the case with some of the Weber-mss. from before the 8th century, described by HOERNLE, 1893, p. 3, and found in Kugiar in Chinese Turkestan a little north of Leh in Ladakh. As Hoernle suggests, it could also be a question of treatment with the above mentioned very poisonous arsenious trioxide. According to Dana's "*The System of Mineralogy*", 1946, Vol. I, this mineral is found in nature as arsenolite and claudelite, and is the result of the chemical reaction of different arsenious minerals. Moreover, it may be produced from orpiment by roasting.)

Orpiment is mined in several places in Himalaya. KARAN, 1960, p. 90, writes: "The principal imports into Nepal from Tibet are shawls, wool, salt, borax, musk, yellow arsenic, gold dust, antimony . . ."

TURNER, 1931, p. 632, calls orpiment *hartāl*. JØRGENSEN, 1936, p. 175, gives the words *haritāl* (Tirh.) and p. 178 *heladhāl* (*haritālaka*) all from mss. dated to the year 1711.

c. PAPER TREATED WITH STARCH. Formerly, when manuscripts were meant to last for generations, surface treatment with only starch paste was unusual. To-day it has however become general. Such a treatment is shown in plate 107 at the paper factory in Tripureswar. Here it seems that starch powder is sprinkled on a sheet of paper, which is then moistened with water.

d. PAPER COATED WITH LIME. Some paper mss. from the Lamaist highlands have a grey-white, chalky surface. X-ray spectrographic investigations show that in these cases it is a question of paper impregnated with ground limestone (see

p. 248). This treatment first and foremost sizes the paper, but it also makes it whiter and protects it against mould. The grey-white paper, however, is most frequently merely heavily impregnated with starch. Treatment with poisonous materials is less necessary in the cold and dry areas of Northern Nepal.

e. PAPER COATED WITH OCHRE. Some few early mss. from the Kathmandu Valley are treated with the orange-red mineral, ochre. This material presumably has the same effect as lime, and red is also a sacred colour.

f. VARIOUS COLOURS. Dyeing of the handmade paper merely for the sake of a colour effect is much more common to-day than formerly, probably owing to the recently introduced Indian taste for gaudy colours. Some decades ago the paler vegetable dyes and earth dyes were still quite commonly used. SEN, 1940, p. 463, thus writes in connection with paper-making in or near the Kathmandu Valley:

"When still in solution [the pulp] any dye could be used to make coloured papers. Vegetable dyes (such as: *-Tarmaric* to make yellow; *Manjistha* to make red; etc. etc.) are the best and the cheapest."

3. Glazing

After having been glued together, possibly dyed or impregnated, paper for writing or paintings is usually glazed, using a stone, a block of wood or glass, or a conch. Most Nepalese paper mss. have distinct streaks from such treatment. Plate 109 shows the glazing of paper at the paper factory in Tripureswar. It was done with a conch on a wooden board.

4. Manufacture of Ink

G. B. Shah states that the fine, very durable Nepalese ink, was made in the following way (in the Kathmandu Valley):

"It is made out of the leaves of a certain plant, called *amala*, a kind of *myrobalan* mixed with a piece of *catechu*. 80% leaves and 20% catechu are cooked together in an iron pot and then purified by passing through a piece of cloth.Its color is brownish-black."

TURNER, 1931, p. 21, writes: "amalo, or āmlo, usu. pl.-ā. ... The hog-plum, myrobola, *Phyllanthus emblica*." According to "*Nepal Trade Dictionary*", 1959, p. 162: "*Acacia catechu* = Cutch Tree" and "*Phyllanthus emblica* = Emblic Myrobolan."

G. B. Shah further states that gold and silver ink is no longer produced in Nepal, but is imported from India.

Another recipe for ink originates from the Lamaist Bodnath near Kathmandu. Here the method is as follows: Soot from pinewood *sgron-me-šiṅ* (according to DAS, 1902, p. 338: "*Pinus picea* (Tibet); in Sikkim *Pinus longifolia* is so called.") and sugar are mixed and thoroughly ground. Borax, *tscha-le* (DAS, 1902, p. 1019) is roasted until it becomes slightly reddish, whereupon it is ground and mixed in. Moreover a glue is added—an extract made of leather boiled in water and filtered; finally flower pollen is added to make the ink fragrant.

G. The Prospects for Nepalese Handmade Paper

The paper-makers in Northern Nepal are likely to continue their ancient craft for a few decades yet. However, it will surely come to an end, as it has done in India. The paper will be less and less able to compete commercially, and more decisively, the new laws concerning the nationalised forests will probably bring production to a standstill. Nepal has, according to G. B. Shah, 14 provinces and in each one of these a Divisional Forest Officer, who together with his men makes sure that the new laws are observed, often with the help of informers. In many places paper-making has been prohibited especially where the paper-makers use wood for the drying of the moulds, because valuable virgin jungle is destroyed with disproportionately small profit.

Modern paper industry does not seem inclined to make *Daphne* paper, primarily because it is difficult to cultivate the plants on a large scale. Moreover, to-day it is possible to make paper more suitable for most purposes from much cheaper fibres. Some handmade paper will probably still be used but merely for special purposes, such as important documents, special writing paper and for art.

Summary

Paper-making in East and Central Nepal (the most common method)

The manufacture is mainly done by Tamangs at altitudes from 1800 m. to 3500 m. around the caravan routes to Tibet. It is the main occupation of most paper-makers, who live 3–10 months in the forest, during which period their family (brothers, sisters, parents and grandparents) take care of their farmsteads and fields further down. A temporary hut is made in the forest near a stream. It houses the workshop as well as the paper-makers, usually a married couple with their children. The method is the simplest possible and the most primitive existing, but it is quite efficient. There are the following stages:

1. *Harvesting* of bast usually done by women and children. One bunch of 5 lbs. costs 1 Nep R. (1964).
2. *Soaking* and cutting away of black flaws in the bast.
3. *Cooking* in lye of ashes (often with the sap of *Rhododendron arboreum* leaves). For 5 lbs. of bast about 20 litres are used.
4. *Beating* with a wooden mallet, which takes $1^1/_2$–3 hours.
5. *Removal* of lumps of bast.
6. *Mixing* with water (dilution approx. 1/40 according to weight) which is carried out with an instrument resembling a butter-tea churn made of bamboo.
7. *Scooping* of the pulp into floating moulds. They are simple wooden frames under which coarse-meshed locally made linen fabric is extended (18–35 threads per 50 mm.). The sheets measure 40–50 cm. by 60–65 cm. Each hut possesses 10 or more moulds and produces about 200–500 sheets a day.
8. *Drying* around a big fire, during which the moulds are turned 180°. So much wood is consumed that the paper-makers have to shift to another site every 3–4 months.
9. *Folding* of 10 sheets. 20 of such small bundles or 200 sheets which are then tied into a larger bundle.

The paper is made exclusively of Thymelaeaceae fibres and in 3 (4) qualities. The common quality has a basis weight 15–20 $g/m.^2$, and from the 5 lbs. of bast about 250 sheets are obtained. The paper is brown to red-brown, thin and often with holes and pieces of bast etc. Price 5–6 Nep Rs per 200 sheets (1964). The best quality is less brown and has a basis weight of 30–35 $g/m.^2$ From 10 lbs. of bast about 250 sheets can be made. The paper can be written on in ink on both sides. Price 14–15 Nep Rs per 200 sheets.

Paper-making in the Baglung district in West Nepal

The manufacture is mainly done by Magar and Gurung and in altitudes from about 1200 m. to 2000 m. around the important caravan route via Mustang to Tibet. It is only a secondary occupation performed together with other work in the fields for 3 to 4 months during spring (February to the end of May). The workshop is temporarily established in one of the fields belonging to the paper-maker near his house. Both the paper and the method are different from those of East and Central Nepal, and bear witness of some improvements which resemble paper-making in Central and West Tibet. There are the following stages:

1. *Harvesting* takes place higher up the mountain, by people who sell the bast to the paper-makers at $1^1/_2$ Nep Rs for 5 lbs. (1964).
2. *Soaking* and cutting away of black flaws in the bast.
3. *1st cooking* in water together with about 12 lbs. of wood ashes.

4. *Rinsing* the bast in a stream to remove ash particles. This is done by trampling the bast for 5–10 minutes.
5. *Cutting away black parts* thoroughly, which takes about half an hour.
6. *2nd cooking in lye* of ashes for 20–30 minutes (1964). In 1970 another paper-maker cooked the bast for about 2 hours in lye of ashes leaving out the 1st cooking.
7. *Rinsing* in a bamboo basket under running water.
8. *Beating* with a wooden mallet on a stone slab for 4–8 hours, usually done in small portions.
9. Mixing with water (dilution approx. 1/600 according to weight) which is carried out with a wooden stick.
10. *Scooping;* the pulp is poured into floating moulds. These consist of a big simple wooden frame under which a fine-meshed cotton fabric is extended (40–60 threads per 50 mm.) using 4 thin sticks sewn into the 4 edges of the fabric. The sheets measure about 60 cm. by 120–140 cm. The paper-makers (often man and wife) mostly use 4–6 moulds and produce only 30 big sheets a day, which require about $2^1/_2$ lbs. of bast.
11. *Drying* of the sheets by sun and wind.
12. *Folding* takes place on the mould just after the paper has been loosened from the fabric. It is made into bundles of 20 sheets.

The paper is made exclusively of Thymelaeaceae fibres and in 3 qualities. The common quality has the basis weight 17 g/m.^{2} and is brownish, often with holes, but seldom with pieces of bast etc. Price 3 Nep Rs for 20 sheets (the paper-maker receives 2 Nep Rs). The finest quality has the basis weight about 26 and it is almost white and with no flaws. It can be written on in ink on both sides and is the best paper in Nepal. Price 6 Nep Rs per 20 sheets (the paper-maker receives 5 Nep Rs).

Paper-making in the Dolpo district in Northwest Nepal

Bhotias have made paper from *Wikstroemia chamaejasme* but ceased making paper about 15 years ago. The method was probably not different from the Tibetan one when using this special raw material.

Paper-making in the Kathmandu Valley

Paper-making in the Kathmandu Valley is not known to have taken place before 1940, and it possibly began here because of the scarcity of paper after the outbreak of World War II. It was started in Kathmandu, first at Bhudankhel and then in Chetrapati. The manufacture was on the whole the same as in the Baglung-district because the paper-makers were fetched from there. The paper was made from Thymelaeaceae bast and waste paper. Treadle stampers and chemicals were soon introduced.

Paper-making was stopped from 1945–50 but continued in Sundarijal 1950–59. Many new raw materials and methods were introduced, for example the dipping process (from Japan). A small factory was established in Tripureswar almost within Kathmandu in 1948 to train people in paper-making. The manufacture first took place in the traditional way, but in 1961 various modern machines were installed and many new raw materials introduced, including rice straw and mechanical wood pulp. However, the paper is still scooped by hand (1970).

Plate 39. *Daphne papyracea* Wall. ex Steud. emend. W. W. Smith et Cave, as found in the Botanical Gardens in Godawari, 12 km. south of Kathmandu. It was found wild on the nearby slopes from 1700 m. upwards, and it was at the end of the flowering season, 21st November 1970.

Plate 40. *Daphne bholua* Ham. ex D. Don, found near Tjamn Tang, East No. 1 at 3200 m., 6th May 1968. The flowers are in full bloom, but the leaves are still in bud.

Plate 41. *Daphne papyracea* and *Daphne bholua* plants collected at a locality between Ghorapani and Ulleri, 30 km. southwest of Pokhara, at an altitude of about 2500 m. where we found them side by side.

Plate 42. *Edgeworthia gardneri* (Wall.) Meisn.; engraving from WALLICH, 1820.

Plate 43. *Daphne involucrata* Wall.; engraving from WALLICH, 1820.

Plate 44. *Daphne sureil* W. W. Smith et Cave; drawing in colours in CURTIS, 1933, TAB. 9297. Notice the very long, pointed lobes of the perianth.

Plate 45. Dried samples of leaves of *Daphne bholua* (above) and *Daphne papyracea* (below). Scale 1:3.

Plate 46. *Daphne bholua* Ham. ex D. Don; engraving on Nepalese paper from WALLICH, 1820.

Plate 47. *Daphne papyracea* Wall. ex Steud. emend. W. W. Smith et Cave; drawing from JAQUEMONT, 1844, Pl. 148. Notice the pointed lobes of the perianth in contrast to those of *Daphne bholua*.

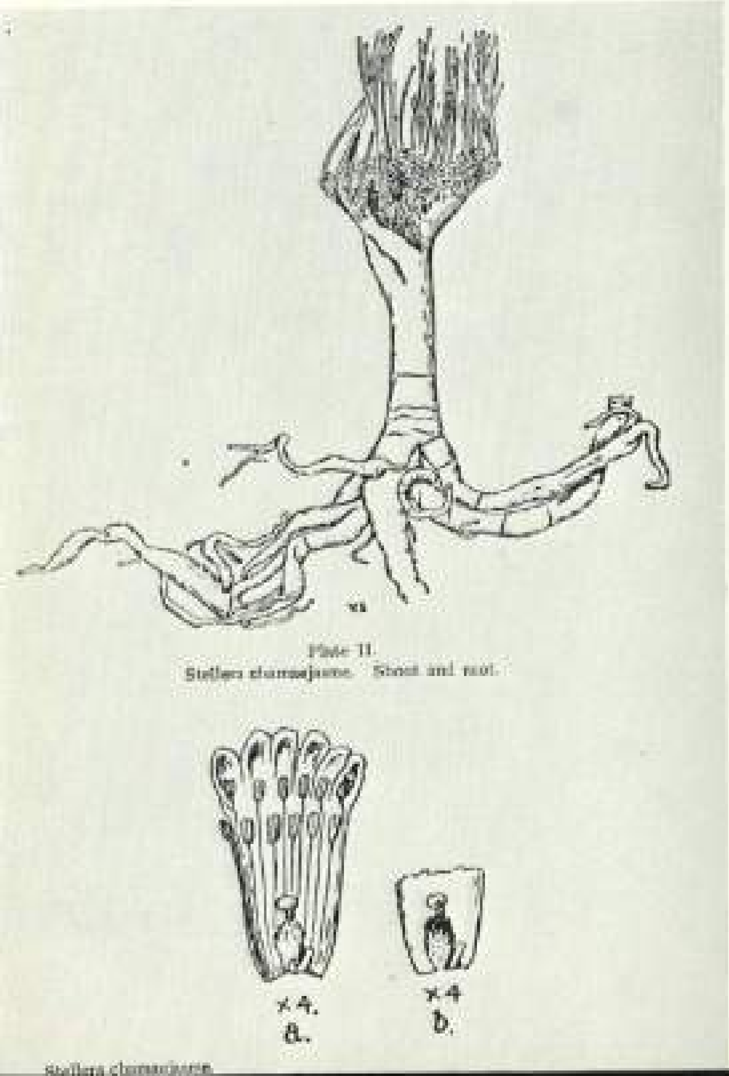


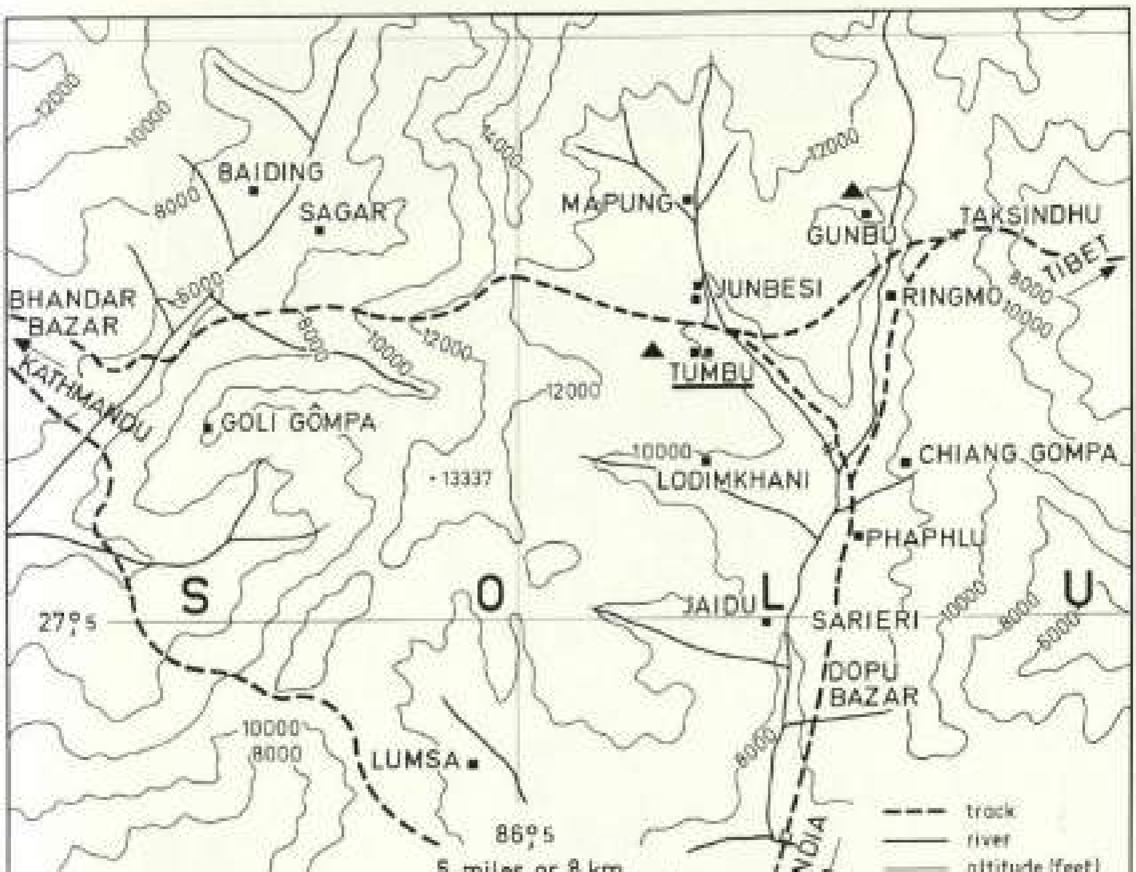
Plate 48. *Wikstroemia chamaejasme* L., drawing in colours from CURTIS, 1924, TAB. 9028.

Plate 49. A sample of *Wikstroemia chamaejasme* L. found near Muktinath in Northwestern Nepal at about 3700 m. It was at the end of flowering at the beginning of November, 1970.

Plate 50. *Wikstroemia chamaejasme* L.; drawing from KASHYAP, 1931, plate III.

Plate 51. The village Junbesi, 3000 m. (see map below), only a few km. north of the paper-making locality (plates 53–81) near Tumbu, East No. 3.

Plate 52. Map of the Solu district. Elevations are indicated in feet (10,000 feet is approx. 3,000 metres).



BAIDING
SAGAR
BHANDAR BAZAR
KATHMANDU
GOLI GÖMPA
MAPUNG
GUNBU
TAKSINDHU
TIBET
JUNBESI
RINGMO
TUMBU
LODIMKHANI
CHIANG GOMPA
PHAPHLU
JAIDU
SARIERI
DOPU BAZAR
LUMSA
INDIA
S
O
L
U
27°5
86°5
13337
12000
10000
8000
6000
5 miles or 8 km
track
river
altitude (feet)

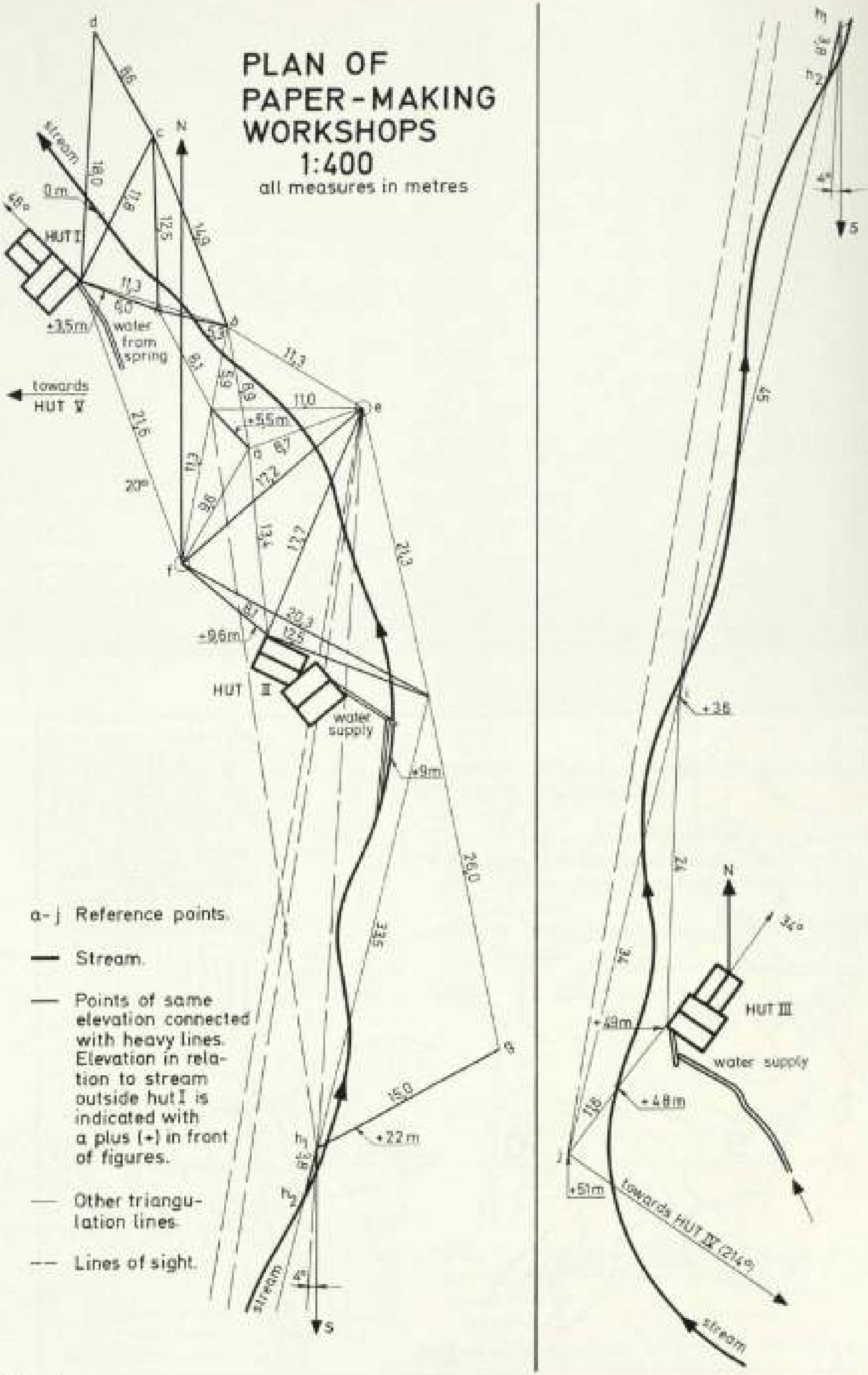
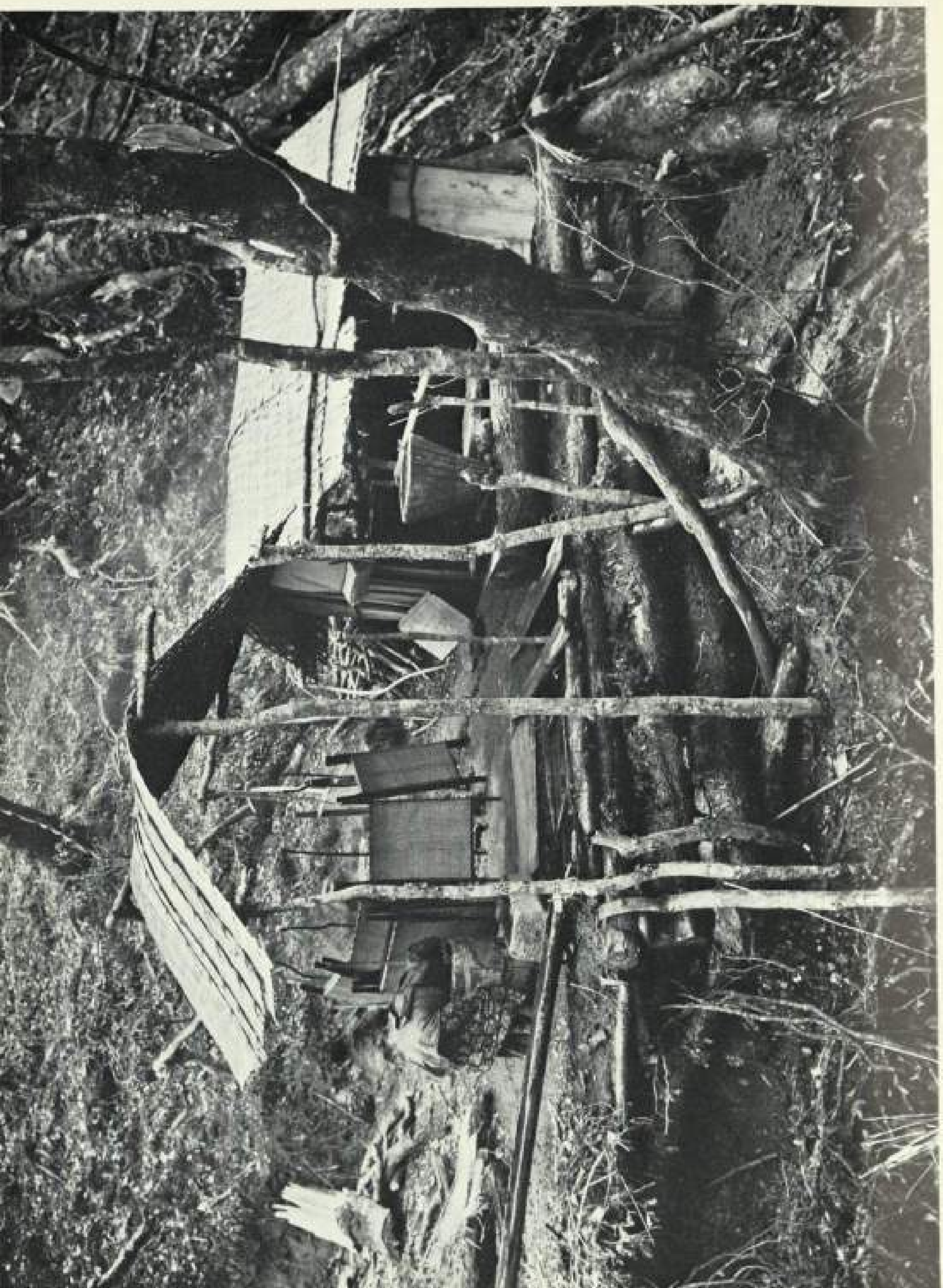

PLAN OF
PAPER-MAKING
WORKSHOPS
1:400
all measures in metres
HUT I
HUT II
HUT III
towards HUT V
towards HUT IV (214°)
water from spring
water supply
stream
N
S
a-j Reference points.
Stream.
Points of same elevation connected with heavy lines. Elevation in relation to stream outside hut I is indicated with a plus (+) in front of figures.
Other triangulation lines.
Lines of sight.

Plate 53.

Plate 54. Hut II seen from point *i* (see site plan on opposite page). Point *e* and the direction towards h_1 and h_2 are indicated.

Plate 55. Hut III seen from point *i*; point *j* is indicated.

Plate 56. Hut I seen from point *b*. Camera and foot of corner post (see mark) are on the same horizontal level, and the distance from camera to corner post is 11.3 m.



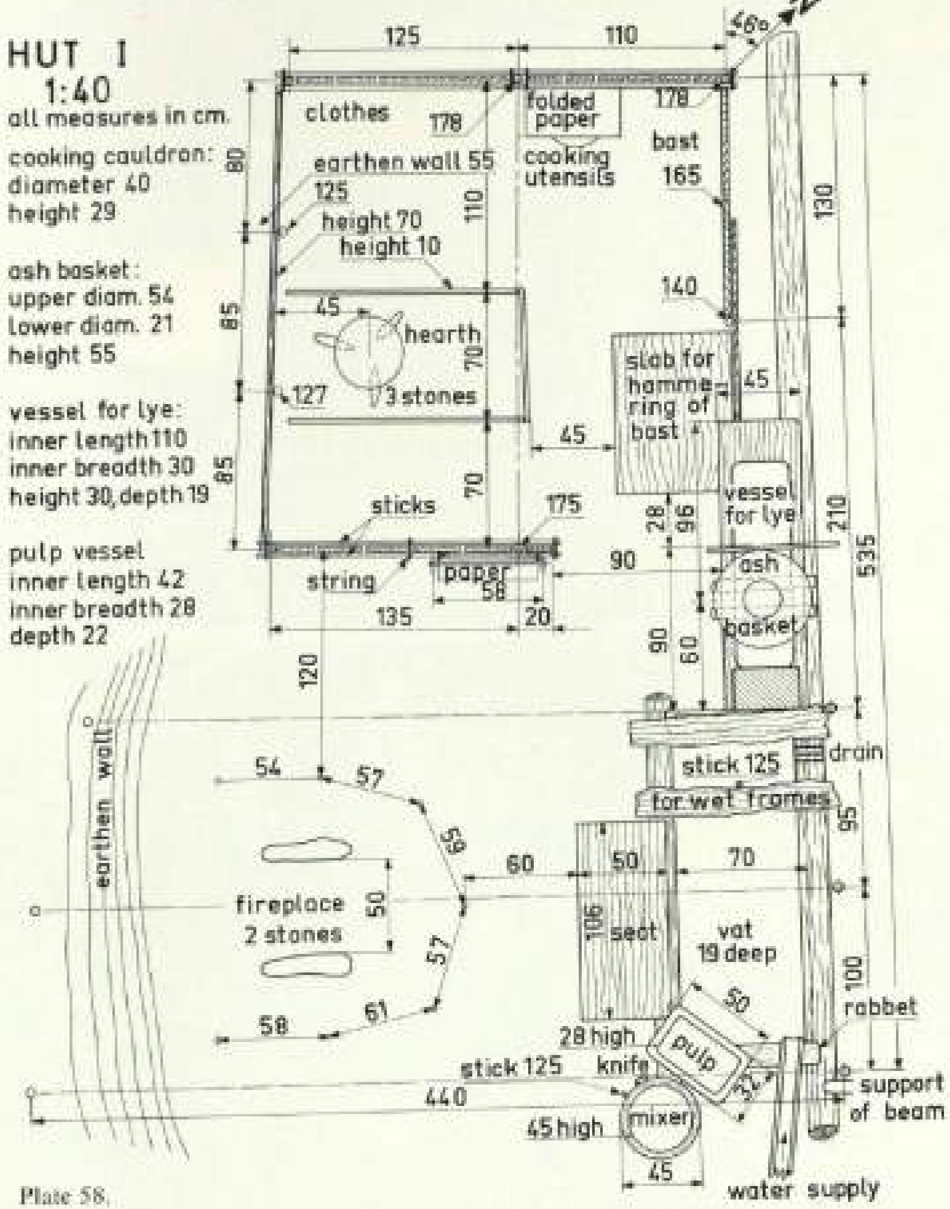
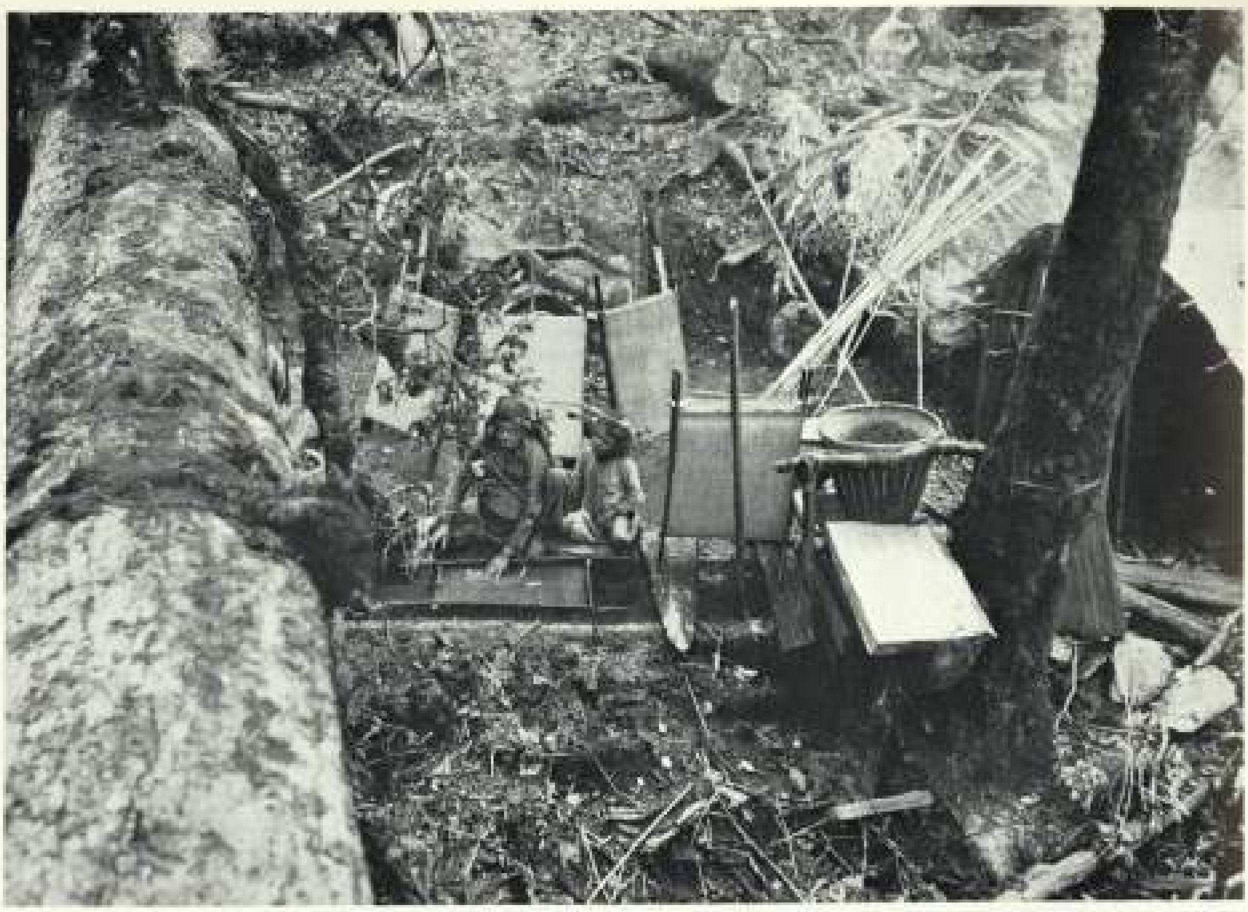

HUT I
1:40
all measures in cm.
cooking cauldron:
diameter 40
height 29
ash basket:
upper diam. 54
lower diam. 21
height 55
vessel for lye:
inner length 110
inner breadth 30
height 30, depth 19
pulp vessel
inner length 42
inner breadth 28
depth 22
N
48°
clothes
folded paper
cooking utensils
bast
earthen wall 55
height 70
height 10
hearth
3 stones
slab for hammering of bast
vessel for lye
ash basket
sticks
string
paper
drain
stick 125
for wet frames
earthen wall
fireplace
2 stones
seat
vat
19 deep
pulp
28 high
knife
stick 125
mixer
45 high
rabbet
support of beam
water supply

Plate 58.



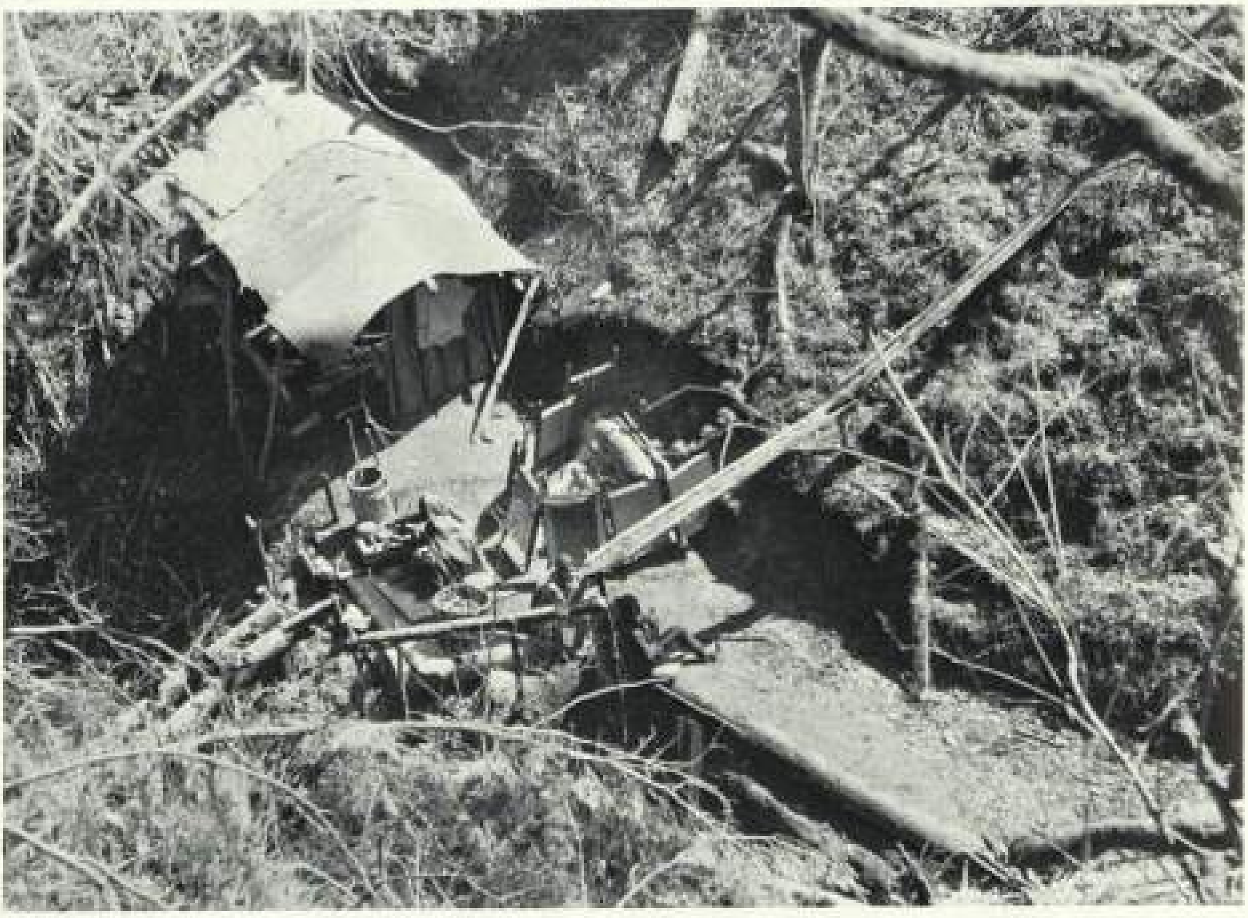
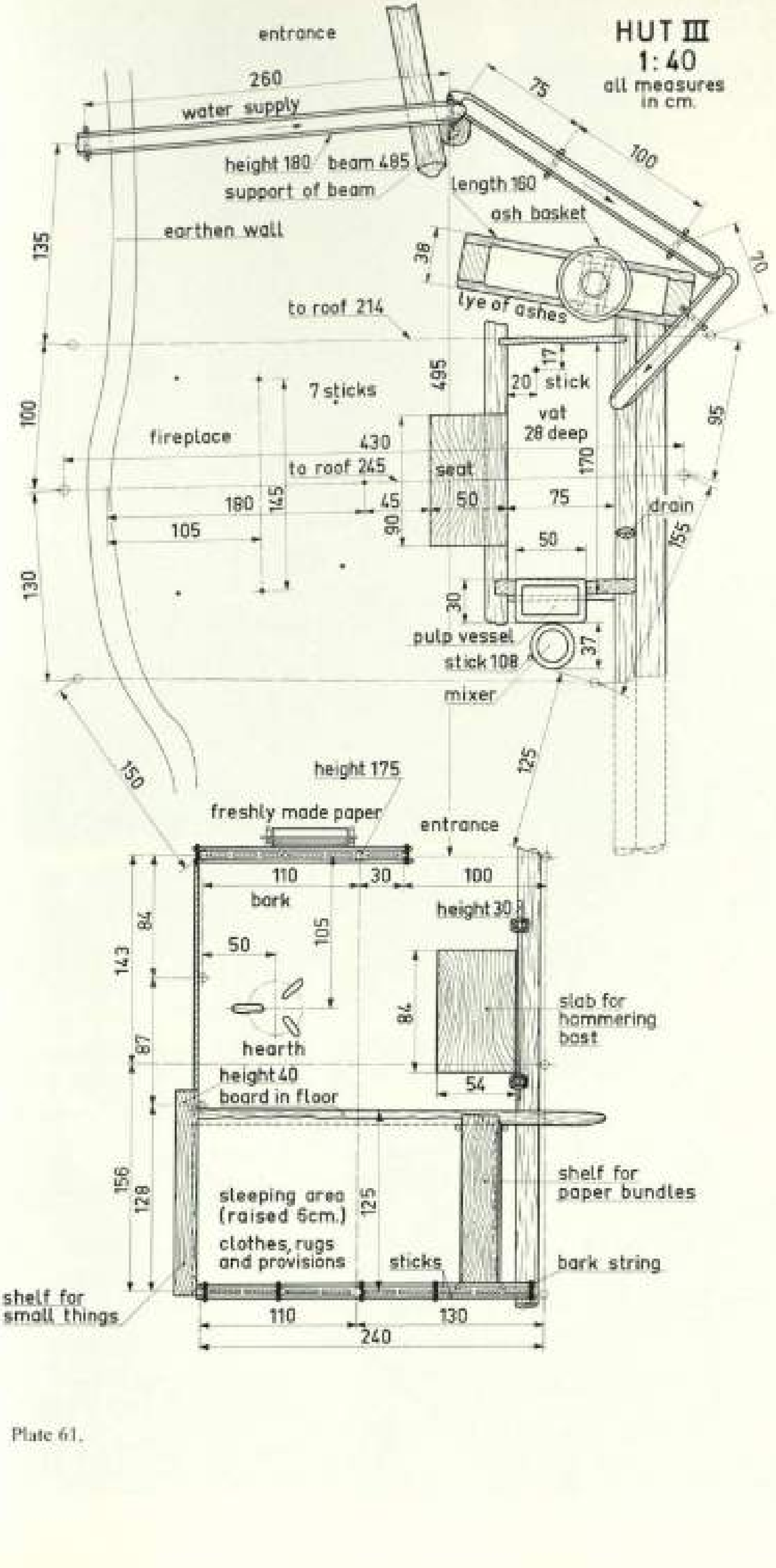


Plate 59. Hut II.

Plate 60. Hut III, where the couple Ganza and Seili worked.



HUT III
1: 40
all measures in cm.
entrance
260
water supply
height 180
beam 485
support of beam
length 160
ash basket
75
100
70
earthen wall
135
38
lye of ashes
to roof 214
495
17
20
stick
7 sticks
vat 28 deep
100
fireplace
430
to roof 245
seat
170
95
180
145
45
50
75
drain
105
90
50
155
130
30
pulp vessel
37
stick 108
mixer
125
150
height 175
freshly made paper
entrance
110
30
100
bark
105
height 30
143
84
50
slab for hammering bast
86
hearth
87
height 40
board in floor
54
shelf for paper bundles
156
128
sleeping area (raised 6cm.)
125
clothes, rugs and provisions
sticks
bark string
shelf for small things
110
130
240

Plate 61.

Plate 62. Lateral branches of *Daphne bholua* are cut off with a *kukri* (Ganza, III).

Plate 63. The bark is separated from the wood and the white inner bark (the bast) from the green outer bark.

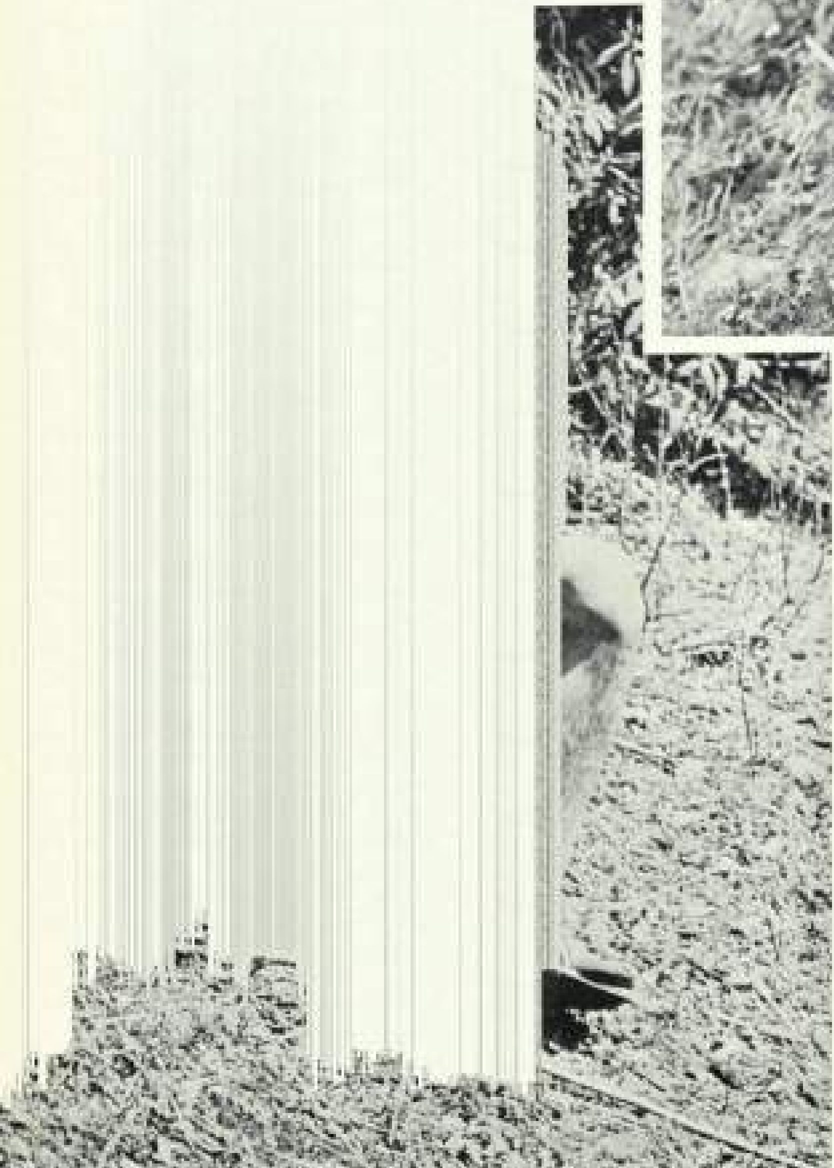


Plate 64. Woman bast collector on her way to the paper-makers with dry bast strips.

Plate 65. After 12 hours' soaking in a pool of water the bast strips are cleansed of impurities (Seili, III).

Plate 66. Dark parts of bast are cut off, especially around dead lateral branches (I).

Plate 67. The ash basket under which lye of ashes is collected (III).

Plate 68. Leaves of *Rhododendron arboreum* after use, taken from the bottom of the ask basket. They were renewed every third day (I).

Plate 69. The bast strips are cooked in lye of ashes and turned from time to time (Ganza, III).

Plate 70. The bast strips are then heaped, beaten flat, re-heaped, beaten and so on (Ganza, III).

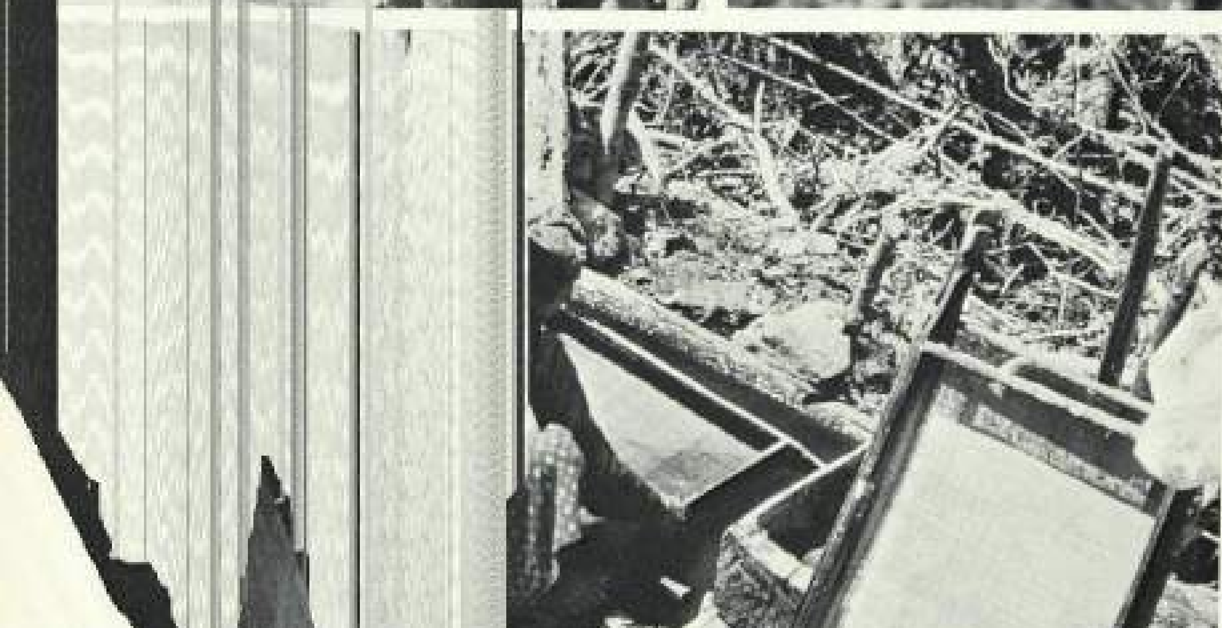


Plate 71. After removing impurities and unbeaten lumps of bast, the mixing with water takes place in a hollow log with the instrument shown plate 88 (Ganza, III).

Plate 72. Pulp is scooped into the floating mould and evenly distributed with the fingertips (Seili, III).

Plate 73. To distribute the fibres further the mould is lifted slowly from the vat with certain characteristic tossing movements, during which the four corners are raised in rotation above the water level (Seili, III).

Plate 74. The pulp is scooped into the mould through the left hand to spread the bast fibres over the fabric (II).

Plate 75. As plate 73 (II). This is the most difficult stage of the entire paper-making process. It requires years of practice to make an even sheet of paper.



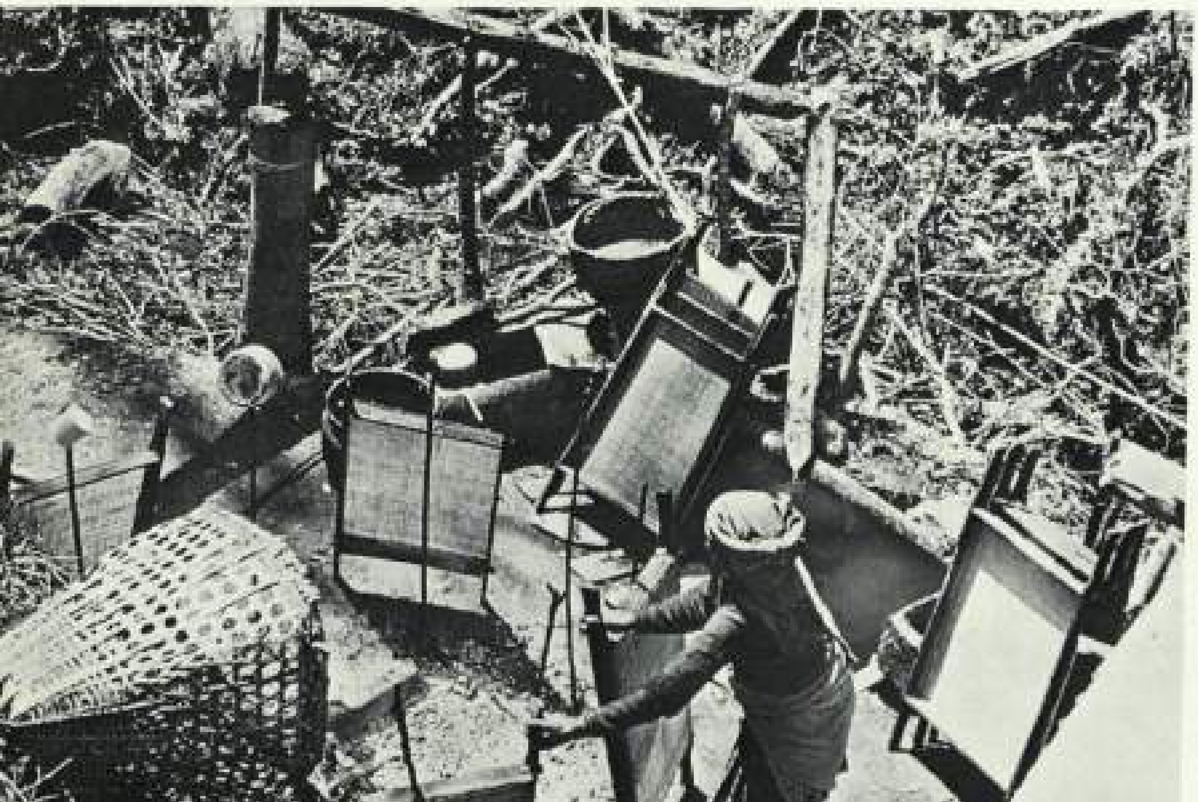


Plate 76. Trees are felled higher up the mountain slope, cut into logs about 1 metre long and rolled down to the big fire (Ganza, III).

Plate 77. The paper is cautiously peeled from the fabric (Seili, III).

Plate 78. Three moulds with dry paper have been taken from the outer places around the fire and propped against the mixer to the right of the vat. Four half-dried moulds are turned and put in front of the fire. The three wet moulds to the left of the vat will next be moved to the outer places around the fire (Seili, III).

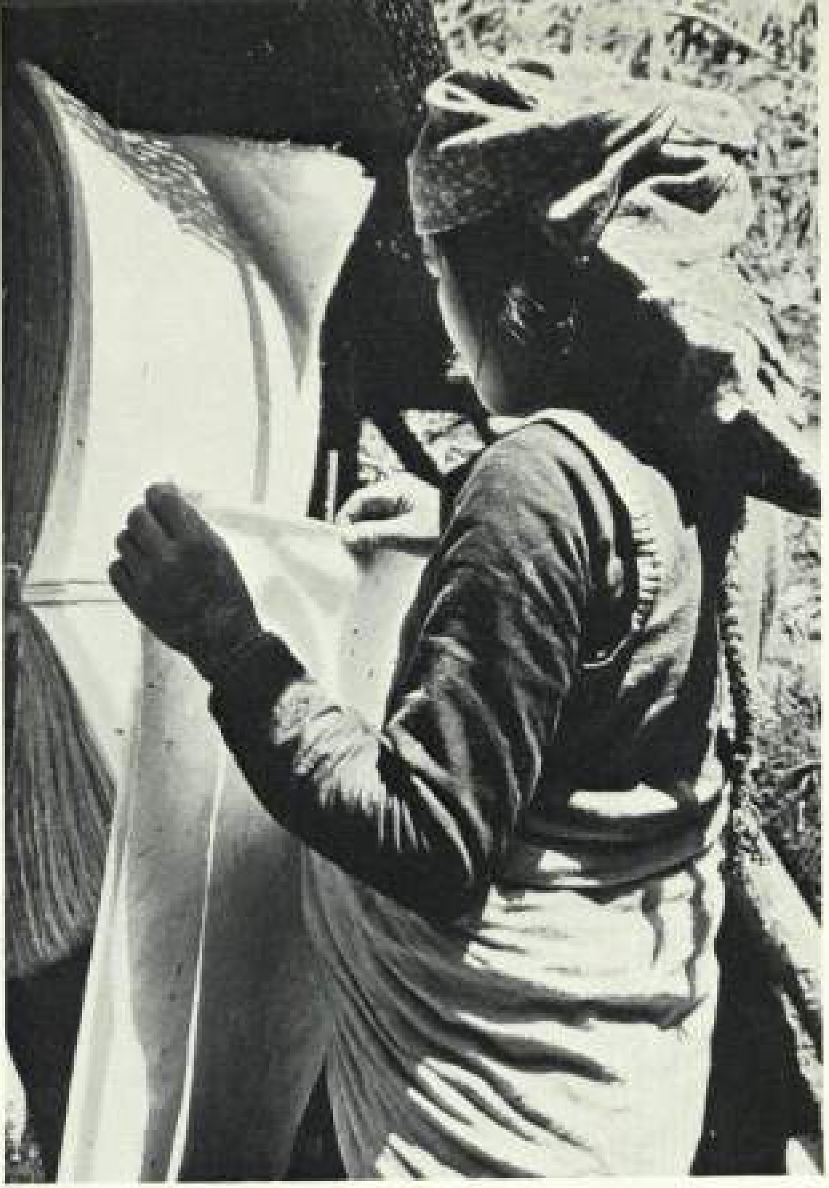


Plate 79. The paper sheets are pierced at one corner with a bamboo stick and hung up to dry (Seili, III).

Plate 80. The paper is folded 10 sheets at a time; 20 by 10 sheets are tied into a bundle with a thin bast cord (Ganza, III).

Plate 81. The paper is sold by quantity and weight either in the bazaar or, as here, to a buyer (also a Tamang).

Plate 82. Transport of handmade paper from East Nepal to Kathmandu. We met the porters near Ramechap (East No. 2).

Plate 83 and 85. Four Tamangs. Notice their wide-set eyes, thick lips and clothing.

Plate 84. Two Sherpas, presumably with some Tamung blood.

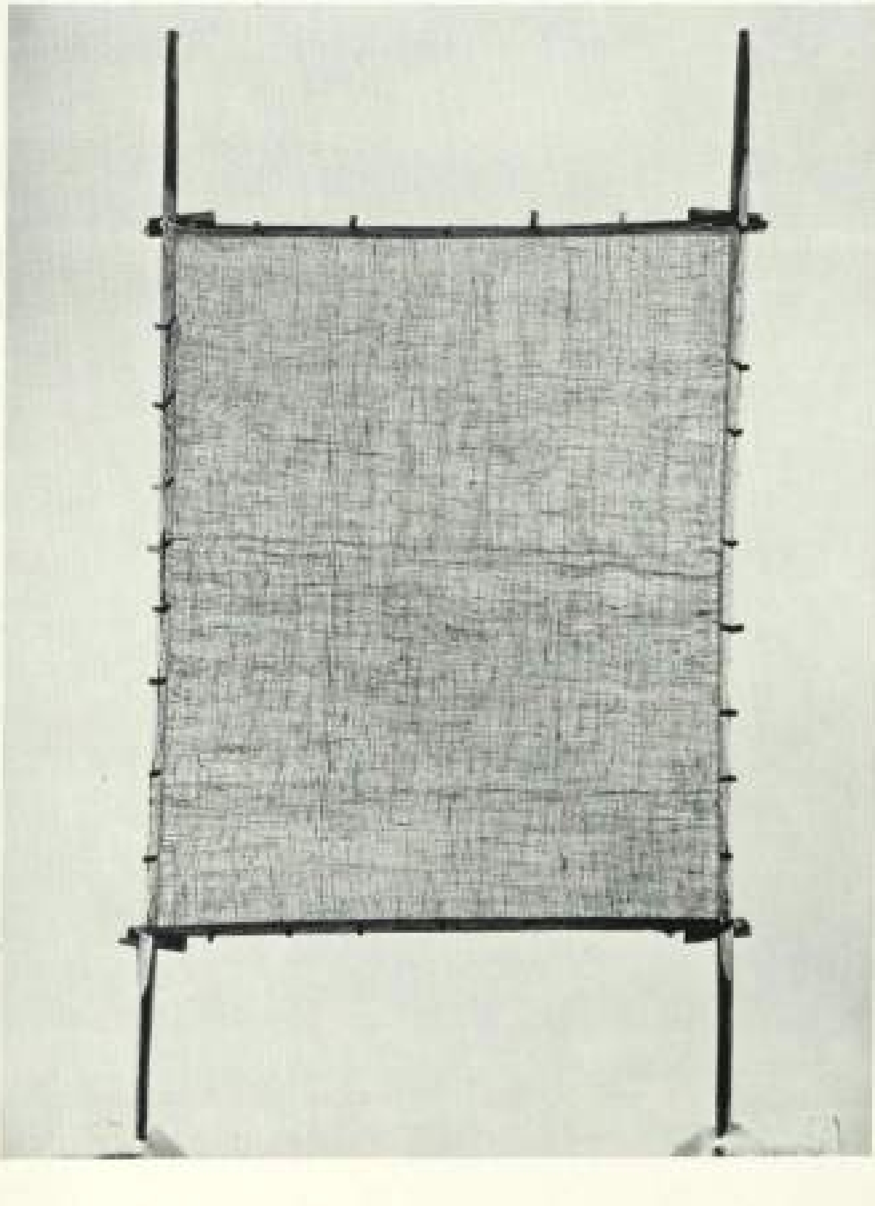


Plate 86. Paper-making workshop IV.

Plate 87. Mould (I). The primitive wide-meshed fabric (probably made of fibres from *Giradinia heterophylla*) is fastened to the frame with small bamboo sprigs. The outer dimensions of the frame are 55 by 68 cm., the total length is 106 cm. and the weight 750 g.

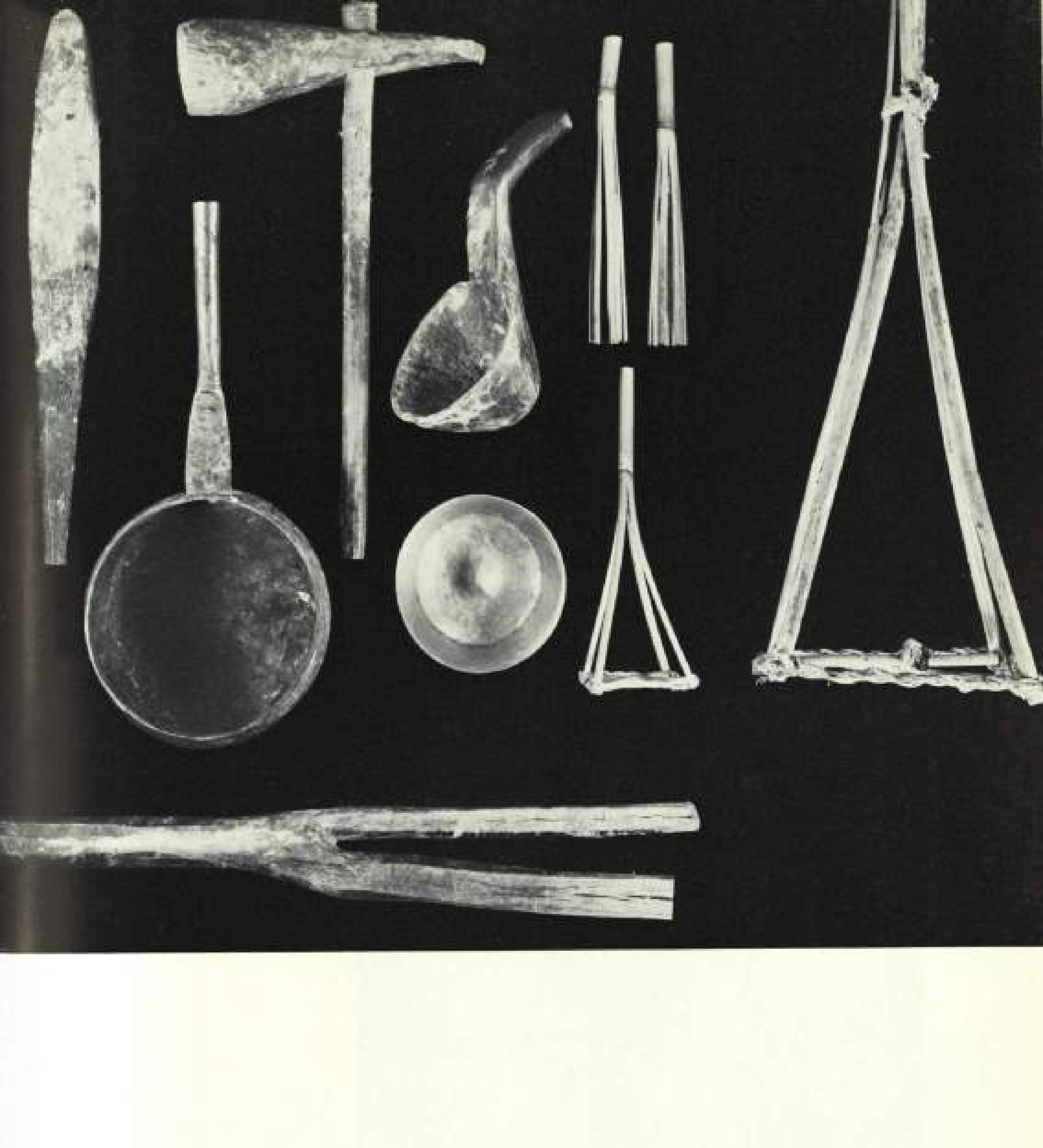


Plate 88. Paper-makers' tools: sweeper, pan for picking up ash and pulp, mallet for beating bast, one pulp ladle of wood and one of bronze (all from hut III). Also two types of small pulp stirrers of bamboo (I), a pulp mixer of bamboo and a forked stick for stirring bast strips (both from III).

Plate 89. From a paper-making workshop near Jiri (East No. 2) at about 3000 m. The paper-makers are Tamangs. Photograph by Ib Heller.

Plate 90. From a paper-making workshop near Malemchi(-gaon) at about 2600 m., opposite Tarke Ghyang (East No. 1). Photograph by Alexander W. MacDonald.

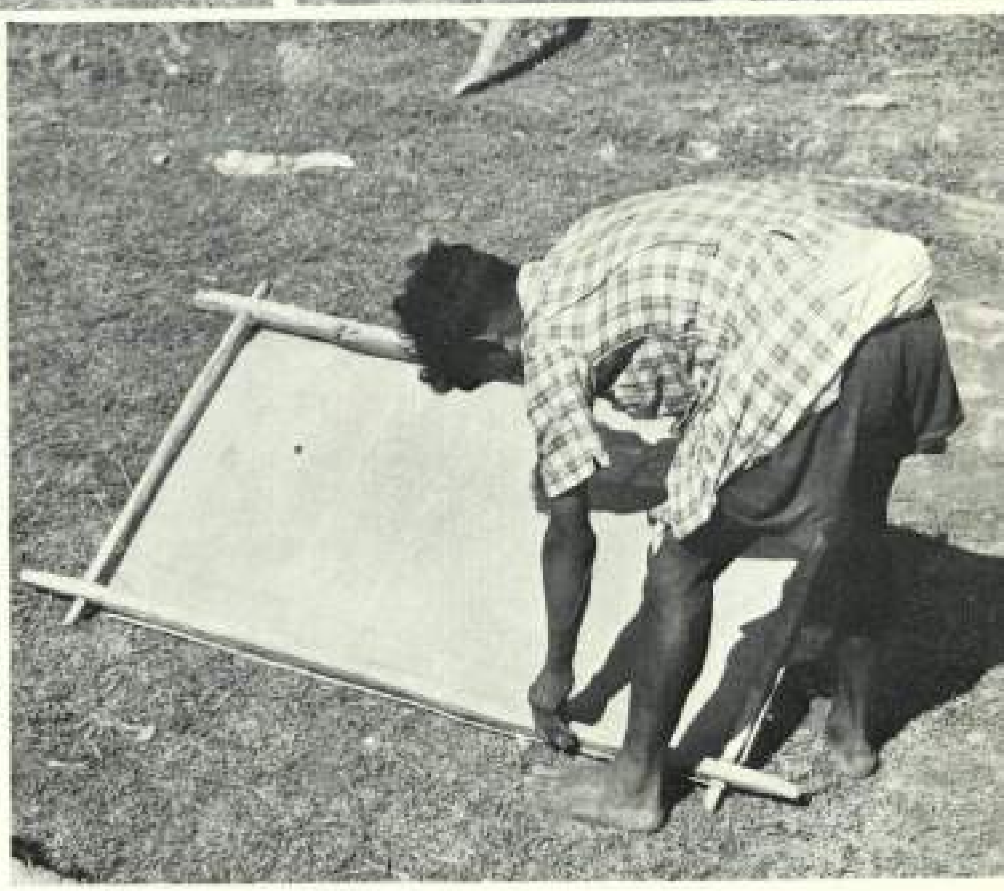


Plate 91. Magar paper-maker (Purnabadur) at Nanglibang, 1500 m., in West Nepal, demonstrates how the cotton fabric is mounted on the frame by means of 4 long sticks pushed into 4 seams along the edges of the cotton and fastened to the frame with iron pegs. Plates 91–96 were taken in 1964.

Plate 92. The big mould may be lifted by one man or by two (plate 104).

Plate 93. The wet mould is dried by leaning it against a stick and letting it dry in the sun and wind.

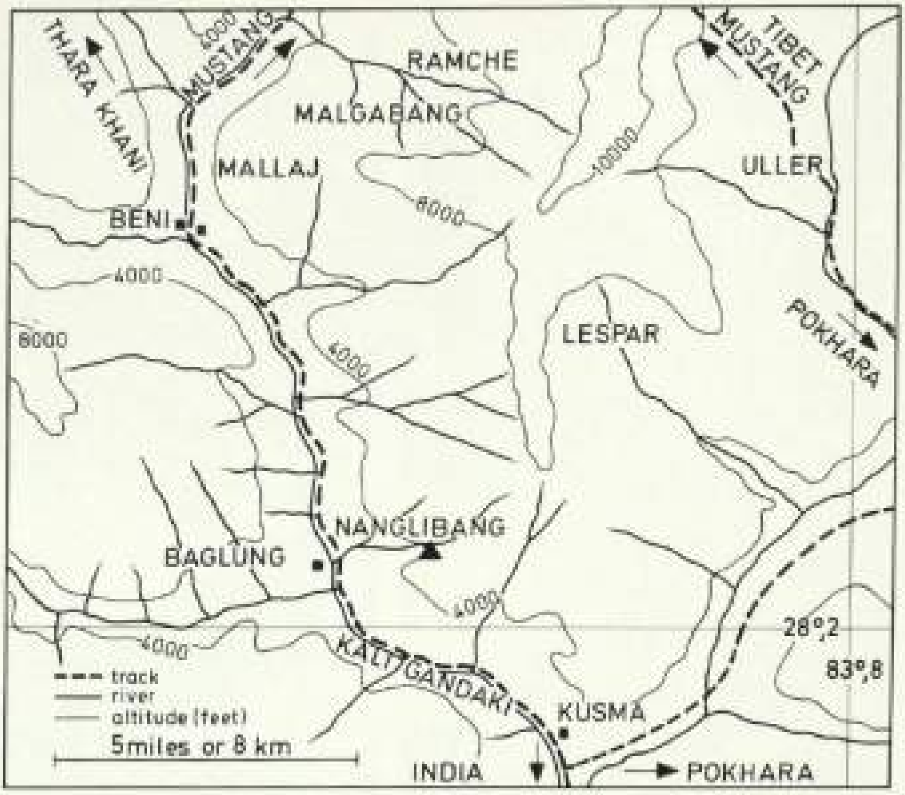


Plate 94. Map of the Baglung district.

Plate 95. The fields in Nanglibang where Purnabadur had his workshop (1964). Plate 96 shows the ground-plan of the workshop.

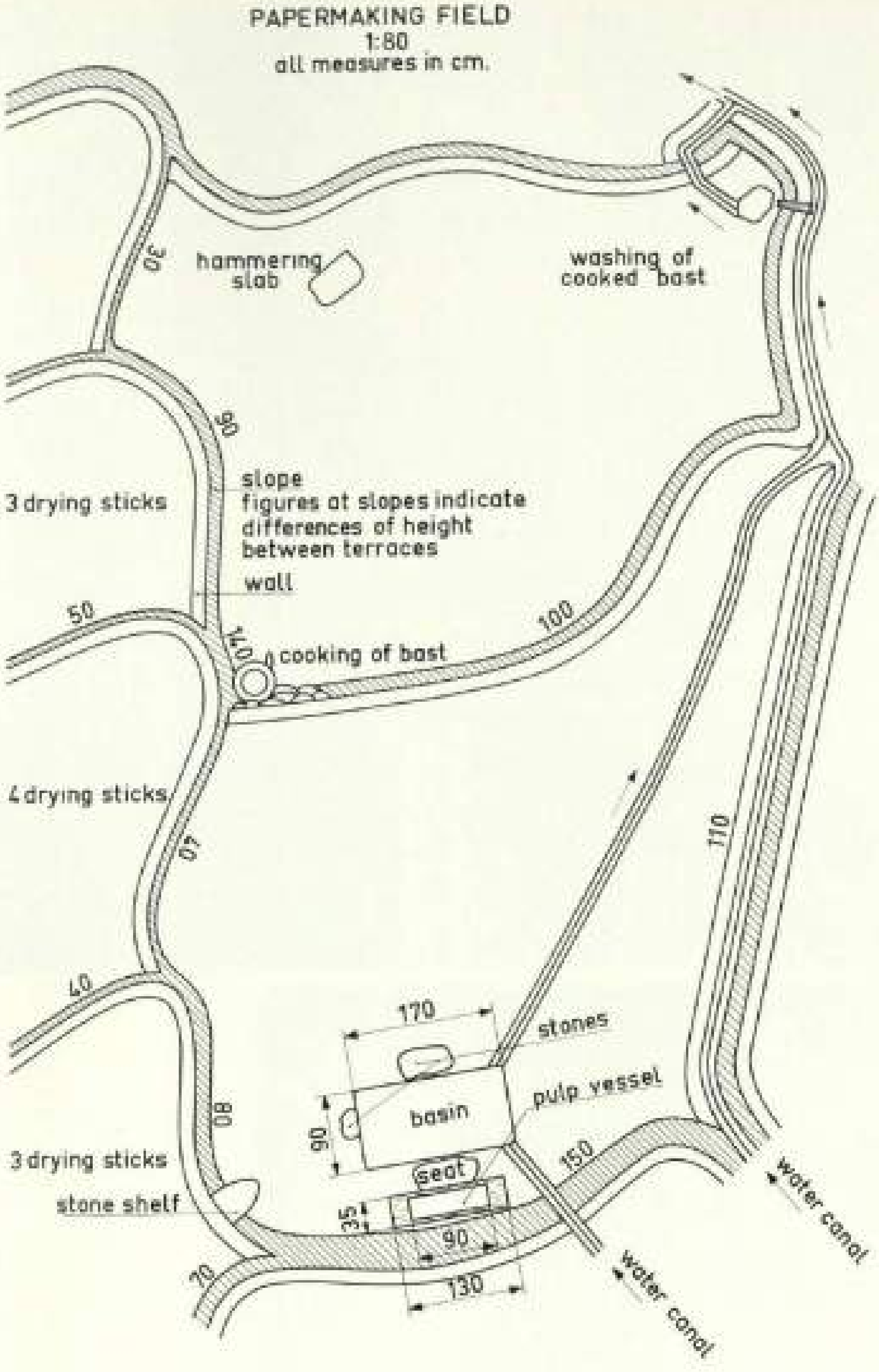

PAPERMAKING FIELD
1:80
all measures in cm.
30
hammering slab
washing of cooked bast
90
3 drying sticks
slope
figures at slopes indicate
differences of height
between terraces
wall
50
140
cooking of bast
100
4 drying sticks
40
110
40
170
stones
basin
pulp vessel
90
80
3 drying sticks
seat
150
stone shelf
35
90
water canal
70
130
water canal

Plate 96.

Plate 97. The bast strips are softened in water and rinsed free of earth particles. Plates 97–104 were taken above Nanglibang in 1970.

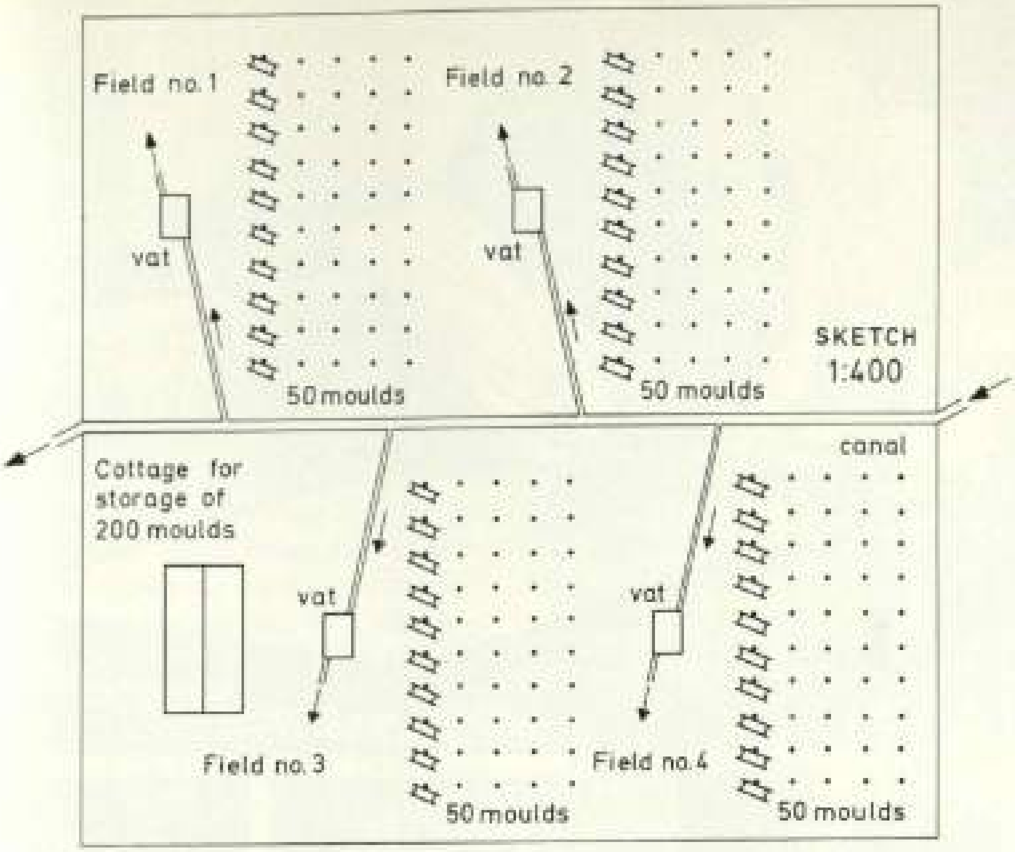
Plate 98. Lye of ashes is made by pouring water several times through an old kerosene can, 1/3 filled with wood ash. The lye escapes through a number of holes in the bottom of the can.

Plate 99. Dark bits of bast and other impurities are carefully removed with a knife.

Plate 100. The bast strips are cooked in the lye of ashes. Now and then it is necessary to stir the mixture.

Plate 101. The bast is rinsed in a flume; to remove all the lye of ashes the paper-maker tramples barefoot on the strips.

Plate 102. The cooked bast strips are thoroughly beaten with a wooden mallet on a stone slab.



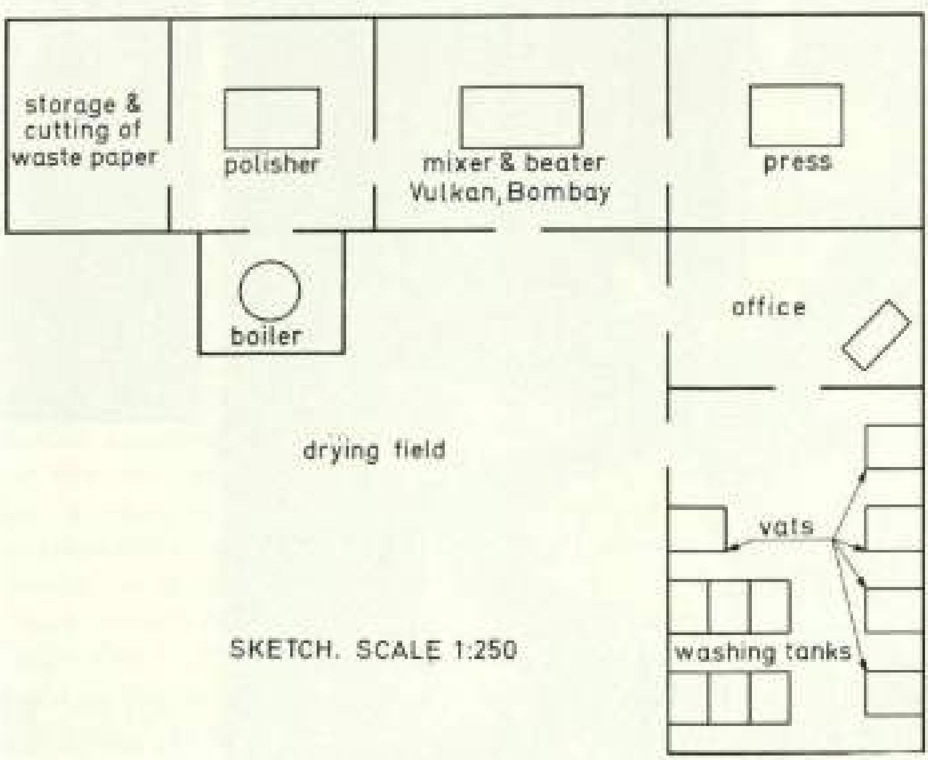


Plate 103. The beaten bast is mixed with water in an oblong wooden container (a hollow log) and two or three pans of pulp are scooped into the floating mould, through the paper-maker's right hand to distribute the bast fibres further.

Plate 104. Two people lift the mould very carefully from the vat and carry it to the drying field where it is propped against a stick to dry in the sun.

Plate 105. Sketch of the paper-making workshop in Sundarijal, situated in the north-eastern corner of the Kathmandu Valley.

Plate 106. Sketch of paper-making workshop: *"The Cottage Small Industries"* in Tripureswar in Kathmandu, from where plates 107 and 109 also derive.

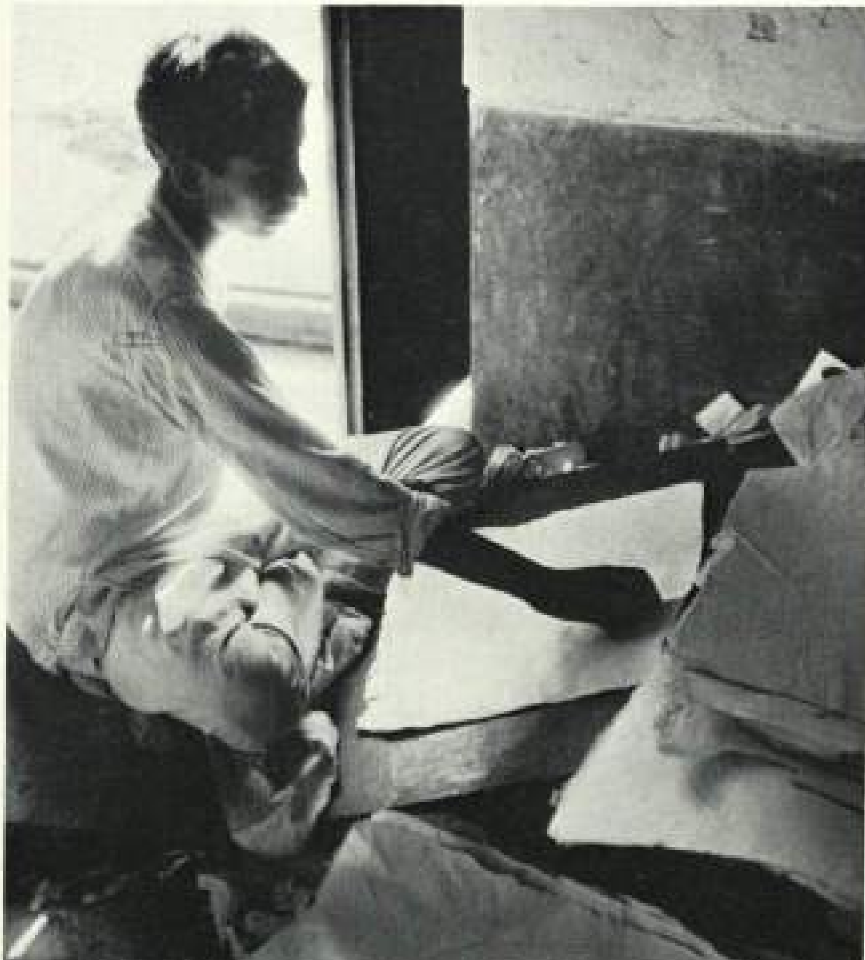


Plate 107. The paper is sized by moistening and dusting with rice or wheat flour. Tripureswar in Kathmandu.

Plate 108. The paper is glazed with a stone or a block of hard wood or glass. Tripureswar.

Plate 109. Sulphur-yellow stone of the mineral *haridal* or orpiment (As_2S_3) used to make yellow paper (process see p. 93).

CHAPTER V

The Uses of Handmade Paper

The art of making paper reached North Nepal from Tibet. Here in the highlands, i. e. in the northern part of the Middle Range and in Himalaya above 2000–2500 m., paper has been most extensively used and it is mainly here that paper is made even to-day. The great differences between the highlands and the rest of Nepal are found, too, in the forms and uses of paper. In the highlands they are akin to those in Tibet, while in the rest of Nepal they mostly have North Indian patterns. But many items of paper also contain local features besides the northern and southern elements, for example the woodcuts from the Kathmandu Valley.

The various applications are enumerated below according to their type and, where possible, according to the area or the ethnic groups involved. However, the use of paper for mss. is of the greatest interest in the present context. Thus we have mss. on paper from Nepal from the beginning of the 12th century, which make them many centuries older than all other preserved forms of paper. Also, mss. are often dated and not rarely provide information concerning where, by whom and for whom they were made. As the manuscripts provide altogether the most important source for the exploration of the past of Nepal and Tibet, the investigations of the mss. will be of the greatest value, namely for determining the origin of the manuscripts in the many cases where it is not indicated in the colophon or elsewhere.

Even if other forms of paper are less valuable for this purpose, they shed light on the specific character of the area. Furthermore, many uses seem to stem from very ancient ones, such as the amulet prints.

Measurements. In order to compare the measurements of the many samples of paper, the results are listed in the tables on pp. 228–234, together with the most important data regarding the type, age, text, writing, size of the mss. etc. The thickness of most of the paper samples investigated varies considerably. Each value in the tables is therefore an average of several measurements.

The number of layers in the paper has often been very difficult to determine, as the pasting and glazing have been done so carefully that the layers are hard to separate. With mss. the task has been further complicated by the fact that the leaves are quite often built up of a varying number of layers, or that different kinds of paper have been used. In such cases either this has been pointed out, or else the measurements quoted apply to the majority of the leaves.

The type of the mould as seen from the imprint left by it in the paper (a sort of watermark) is of special interest, as it may immediately disclose the origin of the paper. By looking through the paper, or by holding it almost parallel to the light beam from an almost punctiform light source, the imprint left by the mould can nearly always be seen on paper which has not been coated. When it is a question of paper pasted together, dyed or coated, the task is considerably more difficult and time-consuming. Nearly all the samples of paper from Nepal investigated have been scooped in simple wooden frames with some kind of fabric underneath—the implement still used everywhere in the mountains. The fineness of the mesh is indicated in the tables by the number of parallel threads per 50 mm. If there is a difference in the two directions of the mesh the mean number is taken.

Some samples of paper are scooped on moulds made of *grass straw* and a few on moulds of *split bamboo canes*. Paper of this kind is noted, and the fineness of the straw or bamboo mat is also indicated as the number of lines per 50 mm.

The microscopical investigations of the plant fibres and paper samples investigated are discussed in chapter VI. In the present chapter only the most important results of these analyses are given.

Other materials. Many paper items were probably once made of other materials. These are only exceptionally mentioned below, in the first place because only few such objects have been preserved. Mss. on *palm leaves* form the most important exception. Practically all extant Nepalese mss. are executed either on palm leaves, which was the preferred material in the Kathmandu Valley until the middle of the 16th century, or on paper, which was almost exclusively used thereafter. In the Copenhagen collection there is a single ms. on bark from the *Aquilaria agallocha* tree (plates 123 and 124).

Various other writing materials have presumably also been known and used. Thus *birch bark* was probably a common writing material in North India long before the beginning of our era. Some manuscripts of this kind have been preserved, going back to the first centuries A. D. (see e. g. HOERNLE, 1900, pp. 125–132). WRIGHT, 1877, p. 316, writes that mss. on birch bark are unknown in Nepal, but that the material is used for "charms and amulets". It is, however, easily perishable and has presumably been used to a certain extent like wood and bark tablets for amulets, letters, mss. etc. before the appearance of paper. Inscriptions or the like on *metal plates*, particularly of copper, are described and pictured by TUCCI, 1956, and others. I have no information as to whether or not metal plates or impregnated pieces of *cotton, hides etc*. have been used as proper writing materials in Nepal (TURNER, 1931, p. 168, cites the name *carmapatra* for parchment, which may merely be the Nepalese term for European or other imported documents of this material).

A. Books

This section contains an outline of the development of the book, century by century, with regard to shape, make-up, and particularly the character of the writing material. The various types of script etc. are also described. Palm leaf mss. are mentioned on a par with paper mss. because they were forerunners of paper mss. in Nepal.

All catalogues and registers of Nepalese mss., including the collection of Nepalese mss. in the *Royal Library* of Copenhagen, consist almost exclusively of books found in the Kathmandu Valley and predominantly mss. written in or near the valley, or by the inhabitants thereof. When the ambiguous term "Nepalese mss." is used without qualification it will be mss. of this kind (with the exception of books in Tibetan). These books, described in section 1, are nearly all dated in *Newari Samvat*, beginning 20th October, A. D. 879. In dating the mss. of the Copenhagen collection I have, however, used January 1st, A. D. 880 as a starting point, which is precise enough for our purpose. For a summary of the development of books in the Kathmandu Valley see pp. 136–137 and 140–141 and the table p. 232. Books in Tibetan found in Nepal are mentioned in section 2, pp. 141–145.

1. Books in Sanskrit, Newari, Nepali etc.

The information below is chiefly based on Cecil Bendall's *"Catalogue of the Buddhist Sanskrit Manuscripts in the University Library, Cambridge"* of 1883, and my own examination of the *Copenhagen collection*. As remarked in the preface to BENDALL, 1883, p. X, his catalogue comprises:

> "... the most characteristic portion of the collection. This includes Buddhist literature in the widest sense, so as to take in on the one hand mystical or religious works of the tantric kind, where debased Buddhism is hardly distinguishable from Çivaism; and on the other, works of no special religious tendency, but merely the supposed products of Buddhistic civilization ..., as well as the local Nepalese literature, some of which bears more on Hindu mythology than on the Buddhist system."

Reference is also made to other lists of mss. from Nepal, including Luciano Petech's "*Mediaeval History of Nepal*" of 1958. This work confines itself to listing dated mss. with indications of ruling kings, but it is compiled from collections in Nepal, Tibet, India, England, France and Russia.

Before A. D. 1000. The oldest stone inscriptions in the Kathmandu Valley go back to the 5th century, and it is very likely that palm leaf mss. were at least as early as that, but the oldest extant Nepalese ms. is a good deal younger. BENDALL, 1883, pp. 27 and 191, describes two palm leaf mss. from the 9th century (Add. 1049 and 1702 in the Cambridge collection, both 400 by 50 mm. and with 3–5 and 6–8 lines per page respectively). BENDALL, 1902, p. 142, mentions an equally early ms., Or. 3568, in the British Museum. SASTRI, 1905, p. 137, mentions three mss. "in Gupta characters", one of which is dated A. D. 908, but according to PETECH, 1958, p. 10, the dating is uncertain. Petech states ibid, that the oldest dated ms. with indication of a ruling king is from A. D. 998 and preserved in the famous Tibetan monastery of Sakya.

STEIN, 1921, pp. 814 and 914, writes the following of his find of a palm leaf ms. in Chinese Turkestan (op. cit. Vol. IV, Pl. CXLII):

"The material clearly showed that this manuscript must have been written in India, and, as the writing is recognized by Dr. Hoernle as an upright Gupta of the Nepalese type, it appears highly probable that it was imported directly from the south, i.e. through Tibet. The fact that the palaeographic features point to the eighth or ninth century A.D. fully agrees with the assumption, as that was exactly the period of Tibetan predominance at Tunhuang."

If, however, the writing is compared with that known from inscriptions and palm leaf mss. from Nepal, the resemblance does not seem convincing.

The 10th (?) century ms. (plate 117) was found in the Kathmandu Valley but its true origin is unknown to me. (Shape, binding and writing point to Northwest India or West Turkestan.) The paper is made of high-level Thymelaeaceae fibres resembling *Daphne bholua*. The ms. is kept in the *National Archives*, Kathmandu.

11th century. L. Petech mentions no less than 26 dated mss. from this century, but with no indication of writing materials, which must surely be palm leaves. 4 of the manuscripts were found in monastic libraries in Tibet. BENDALL, 1883, p. XXiV, writes of 6 dated 11th century Nepalese palm leaf mss:

"These are all written in a square, clear, and often beautifully clean hand, the contrast between thick and fine strokes being strongly marked."

Other mss. from the 11th and 12th centuries found in Nepal are written in a special decorative writing used in Bengal during the same period, and which also appears to derive from there (see BENDALL, 1883, p. XXiV and BÜHLER, 1962, p. 95). Since we encounter far later Nepalese mss. in which this style, *Rāñjanā* (also called *Lañtsa* etc.), has been imitated, its introduction into Nepal is worth a brief mention. Furthermore, this style is still used in North Nepal, Tibet and Bhutan, where it is known not only from mss. but also from inscriptions and decorations on stone, wood and metal.

Until the end of the 12th century rather close economic and cultural relations seem to have existed between Bengal and Nepal as well as Tibet. Nepal, moreover, became a refuge for Bengalese Buddhist monks and others, who fled there due to the Mohammedan invasion of India. This explains why there are mss. written in Nepal in a script precisely similar to that in vogue at the time in Bengal and not in Nepal. Thus Bendall op. cit. mentions 3 palm leaf mss. in *Rāñjanā* script, two of which were written in Bengal about the year 1020 (the Cambridge collection Add. 1464, plate II, 1, with delicate, oblique down strokes) and in 1165 (in the Hodgson collection of the *Royal Asiatic Society*). The third (Add. 1693, plate II, 2) also dates from A. D. 1165 and was written in what seems to be exactly the same hand, but in Nepal.

There is a ms. very much like that of the Cambridge collection Add. 1464 in the Copenhagen collection. It is very finely executed in both script and miniatures, which seem to have reached a culmination in the 11th or 12th century, but unfortunately it is incomplete and contains no colophon (n. 173, plate 110). It was probably made in Bengal, because of the great breadth of the leaves, 69 mm., which is unknown among the

Nepalese palm leaf mss. Similar mss. are found in collections all over the world (see e. g. TUCCI, 1956, plate I, and LEE, 1942, pp. 67–70).

The oldest extant Nepalese ms. on paper that I know of goes back to the 12th century. However WRIGHT, 1877, p. 159, writes of the following event from the time of Raja Śaṅkaradeva:

"At the time when the village of Jhul was burning, Yasödharā, the Brāhmanī widow, fled to Pātan with a small model of a chaitya, the book Prāgyā-pāramitā (written in golden letters in Vikrama-sambat 245[1]), and her infant son Yasōdharā."

[1]) "V.S. 245 = A.D. 188."

BENDALL, 1883, p. XViii, quotes the passage and writes that "Çaṅkara-deva" ruled in the 11th century, but does not deal with the remarkably early dating of the ms. (see further BENDALL, 1902, p. 228, and PETECH, 1958, p. 45. According to the latter Śaṅkaradeva ruled c. 1065–1082). While no palm leaf mss. in gold letters are known, we have many mss. on blue-black paper with gold or silver writing from the beginning of the 13th century onwards. It is undoubtedly this type to which the text alludes. The great age accorded to the manuscript is presumably due to a misunderstanding. Perhaps it is not Vikrama Samvat 245, but V. S. 1245 corresponding to A. D. 1188, or, which is more probable, the ms. is dated N. S. 245 corresponding to A. D. 1125; but in both cases the manuscript post-dates Śaṅkaradeva.

12th century. PETECH, 1958, describes 54 dated mss. from this century, 5 of which were found in Tibet. The mss. are certainly still almost exclusively palm leaf. A palm leaf ms. from A. D. 1145, n. 175 a, is shown in plate 111; notice the pagination added later. It is reminiscent of Add. 866 in the Cambridge collection from A. D. 1008, but in our specimen the so-called "Kuṭila twist" is less pronounced.

BENDALL, 1883, p. XXVi-XVii writes:

"It is from this time, then, that we find Nepalese on the one hand, and Bengali on the other, as distinct alphabets or styles of writing. It has been already observed that the hooked feature cannot be regarded as the distinguishing note of Nepalese, as this was never universally employed, and has now disappeared for several centuries. ... The Nepalese must not, then, be regarded as a distinct and original development of the Indian alphabet in the same sense that Bengali, for instance, is so. The fact rather is that, from the XIIth–XIIIth century onwards, the geographical and political isolation of Nepal resulted in the conservation of early forms, accompanied by the prevalence of several more or less transient embellishments or calligraphic fashions peculiar to the country."

Up to the end of the 15th century the characteristic "hooks" (at the top left corners of letters) are very common in Nepalese alphabets, a feature which is also due to influence from Bengal (see e. g. BÜHLER, 1962, pp. 93 and 95).

Two 12th century mss. on paper are known:

1) D. P. Ghosh, manager of the Department of Museology and supervisor of the *Asutosh Museum*, Calcutta, has kindly sent me a photo of the ms. plate 121 and a tiny fragment of the ms. but big enough to make a microscopical analysis of the fibres. D. P. Ghosh writes that the title of this Nepalese ms. is Pancharaksha (Pañcarakṣā), and that it is dated A. D. 1105 and thus the earliest paper ms. found in the Indian Republic. *It is moreover the oldest known Nepalese ms. on paper*.

Purna Harsha Bajracharya has translated the colophon, from which it appears that the ms. was written under Siṃhadeva in the year pañca viṃsatika dviśata, i. e. 5–20–200 or N. S. 225. This means that *Siṃhadeva already ruled in A. D. 1105*. PETECH, 1958, p. 54, gives the dates: "Siṃhadeva (c. 1110–1125)".

The miniature is typical of the epoch and the writing is good and easy to read, but obviously no attempt has been made to create a masterpiece. A comparison with the "Table of Letters" in Bendall's catalogue of 1883 shows that the writing of the Asutosh ms. corresponds fairly well to the writing in Add. 1886 and 1693 of the Cambridge collection, both from A. D. 1165. This applies e. g. to the letters th, bh, l and sh, but there is only a small trace of the "hooks", which are so distinct in Add. 1886.

The format, c. 380 by 85 mm., is shorter and broader than that of the palm leaf mss. from the same century, and the number of lines is greater; otherwise the ms. is very like the palm leaf mss. of the same period, and there is also a hole for tying it up.

A microscopical analysis (see p. 199) shows that the paper is made of Thymelaeaceae fibre of the high-level type, and that it is not treated with starch paste. The sample shows no distinct imprint of the mould, so probably a fine-meshed cotton fabric was used. The sample, however, is so small that it would be more correct to say that the type of mould is unknown. According to a number of spectrographical X-ray analyses the paper, which is slightly brownish, does not seem to have been treated with inorganic substances.

2) One other ms. on paper is known, and it is from the end of the century. B. S. Parajuli, librarian at *Bir Library*, Kathmandu, has kindly sent me a small piece of paper from the following ms.: Jyautisharanatmala (Jyotiṣaratnamālā), catalogue number D. 161, size 11 by 2 in. or c. 275 by 50 mm., N. S. 302 thus A. D. 1182. The paper is also made from Thymelaeaceae fibres of the high-level type and has not been treated with starch paste. As for the type of mould used, my remarks on the previous ms. and its mould apply equally to this one.

MITRA, 1882, has only two dated paper mss. from before A. D. 1600 in his catalogue and they are both said to belong to the 12th century. One ms. is on yellow Nepalese paper, the leaves measuring 10 by 3½ in. or 255 by 90 mm., character "Newari" and dated N. S. 230 or A. D. 1110. The other ms., B. 21, is also on Nepalese paper, size 11½ by 4 in. or c. 290 by 100 mm. and is dated N. S. 245 or A. D. 1125. The yellow dyeing of the first of these mss., a practice not usual in Nepal until after the 16th century, and the rather broad size of both mss., render these datings very doubtful.

BENDALL, 1883, p. 124, writes of Add. 1544 that it is a paper ms. from the 12th century. The same ms. is shown in the *Palaeographical Society's Oriental Series*, London 1873–1883, Plate LVII. It is a palm leaf ms., presumably from the second half of the 13th century.

13th century. Of 49 dated mss. described by PETECH, 1958, 6 were found in Tibet, thus about the same proportion as in the preceding century. (One more ms. from A. D. 1303 was found in Tibet, but out of 92 later, dated mss. not one). BENDALL, 1883, p. XXVii–XXViii, says of the writing:

> "In the next century, the XIIIth, the hooked form of character is thoroughly in vogue; for there exists, as far as I know, only one dated Nepalese MS. of this time otherwise written. The large bold handwriting usual in the XIIth century, with strongly contrasted thick and fine strokes, continues through most of this century, though in some later MSS. we observe a transition commencing."

Two examples of palm leaf mss. from this century are shown in plates 112 and 113 (n. 168 and n. 91). The first is in the Mithilā script.

Several 13th century mss. are known on blue-black paper:

1) Purna Harsha Bajracharya has sent me the following information concerning one such ms. from the beginning of the century: Ms. Vasudhārā Kalpa, N. S. 339, corresponding to A. D. 1219, size 8¼ by 3 in. or c. 210 by 75 mm. It is identical with the blue-black ms. which PETECH, 1958, p. 86, describes thus:

> "ms. Ārya-Vasudhārāyāḥ Ṣoḍaṣakalpa, Private possession in Nepal. ... The date is verified for Friday, February 1st, 1219."

2) During my own visit to *Bir Library*, Kathmandu, I was shown another ms. on blue-black paper (plate 118), about which P. H. Bajracharya has given the following information: Ms. Viṣṇu Dharma, N. S. 340 corresponding to A. D. 1220. Furthermore the colophon states that the manuscript belongs to Jaitabrahma Jeebaka. Size 21 by 4 in. or c. 530 by 100 mm. PETECH, 1958, p. 86, also mentions the ms.:

> "ms. Viṣṇudharma, Darbar Library, II 51. A fine volume of blue paper written in gold. ... The date corresponds to September 19th, 1220."

The paper is 0.45 mm. thick, has a basis weight of 280 g/m.², and is made of 4 layers, of which only the 2 outer layers are dyed blue-black. There are distinct glazing streaks. It is worth noticing that the mould used seems to have been a grass mat with 35 lines per 50 mm. (see plate 119). Microscopical analysis of the paper indicates that it is probably made of fibres of hemp or ramie. The paper has not been treated with starch paste.

3) In the *National Archives*, where the old mss. from *Bir Library* are now kept, I saw two more blue-black mss. from the 13th or 14th century.

4) In the Copenhagen collection there are 3 damaged pothi leaves of still another blue-black paper ms. with golden letters in Rañjanā writing (n. 176 f, plate 120). These leaves have no colophon, but a systematic comparison with the character of the letters of the previous ms. from A. D. 1220 shows that it is a ms. of about the same period. The leaves measure 276 by 75 mm. The paper is soft and has distinct glazing streaks. It is 0.25 mm. thick and has 2 layers. The mould here seems again to have been a grass mat with 45 lines per 50 mm. The result of the microscopical analysis was exactly the same as that of the previous ms.

5) D. Wright (see BENDALL, 1902, p. 227) writes of no. 537: 6 lines, size 20 by 2½ in. or c. 510 by 65 mm., Lañtsa script from Nepal in silver letters on indigo-blue paper, 12th or 13th century.

6) BENDALL, 1883, p. XXViii, describes 2 mss. on paper, viz. Add. 1412, 1 and 2 from A. D. 1276 and 1278 respectively. From a later remark, p. XXXii concerning Add. 1556, it is obvious that they are not written on blue-black paper, and that the type of writing is not Rāñjanā.

Small pieces of paper from the two blue-black mss. 2) and 4) were carefully soaked and divided into their layers. The paper seems to have been scooped on moulds of grass mats rather than bamboo mats. The grass mat is in fact made up of parallel grass-straws tied together with thread at certain intervals (plate 119). The greater irregularity and softness of the straws cause the lines in the paper to be less regular. We find this type of imprint left by the mould in both old Central Asian and Indian paper, which is undoubtedly due to their having been scooped on moulds of grass mats. This type of mould has been used for making paper in India right up to modern times (e. g. as described in CLAPPERTON, 1934, p. 55, and pictured ibid plate V. 1).

The two mss. mentioned are further distinctive in being the only ones out of about 200 examined mss. on paper found in Nepal before the 19th century, which are not made from Thymelaeaceae fibres. Both the imprint of the mould and the fibres thus suggest that the paper was imported, but from where?

According to GODE, 1944, p. 211, paper does not seem to have been completely unknown in India even as early as the 7th century, probably on account of contact with China through traders and pilgrims. Paper-making, however, was not introduced to the Indian lowlands until the invasion of the Mohammedans about A. D. 1000–1200, and the use of paper first became common there some centuries later. The oldest extant Indian paper ms. derives from Gujurat and is dated A. D. 1223–24. In other words, it is from the same century as the two above mentioned mss. Moreover, it is worth noticing that climate, rodents, insects and devastating wars must have done away with a great many of the earliest Indian mss. From this it appears that the paper from the two mss. may well derive from India, with which Nepal always had close commercial connections. Furthermore, both the fibres and the imprint of the mould in the paper are reminiscent of early Indian paper such as n. 85, which is an Indian Jain ms. on undyed hemp or ramie paper from about the 15th century, but probably brought to Nepal quite recently (plate 125–126, table p. 228).

We cannot ignore the possibility that the paper may have reached Nepal from China, where paper was being made from hemp or ramie fibres on moulds of grass straw or bamboo mats at an early date (see CLAPPERTON, 1934, p. 24, concerning the mention of paper mss. from Tun-huang). The early connections of the Newars with Tibet and China speak in favour of this assumption—against it Nepal's closer links with India.

14th and 15th centuries. BENDALL, 1883, p. XXiX, writes:

"The XIVth and XVth centuries may be treated as a single palaeographic period. Books seem to have been commoner at this time than in the centuries immediately succeeding or preceding. Our MSS. are plentiful and generally written on leaves of serviceable size and quality. We neither find scarceness of literature, as in the XVIth century, nor the merely ornamental MSS. which we shall notice hereafter in the XVIIth century. On the other hand, writing as a fine art seems to be more or less on the decline. We no longer meet with the large written MSS. of early times; nor have we any single instance of illumination. With the diminished size of the material, the handwriting is also diminished. The characteristic hooked form of the letters generally, but by no means universally, prevails."

Two palm leaf mss. from this period are shown in plate 114 and 115 (n. 72 and n. 90). They are dated N. S. 446 and N. S. 552 i. e. A. D. 1326 and 1432 respectively. The hooks are pronounced and the writing is still good, especially in the older of the two. Notice also the small format of the mss. and the position of the hole to the left of the middle for tying up the ms. (on this subject see discussion in HOERNLE, 1893, p. XXiii).

The following paper mss. are from this period:

1) SASTRI, 1905, p. 210: 9 by 2 in. or 230 by 50 mm., 6 lines to the page, "Character, Newari", N. S. 524 corresponding to A. D. 1404.

2) BENDALL, 1883, p. 106: Add. 1478, 6–8 lines, $13^1/_4$ by 2 in. or about 335 by 50 mm., "chiefly Bengali hand", 14th or 15th century.

3) EGGELING, 1889, Vol II, No. 7820: N. S. 594 (597) corresponding to A. D. 1474 (1477), 5 lines, 6 by 3 in. or c. 150 by 75 mm., black paper with gold writing, Rāñjanā or Lañtsa.

4) The Copenhagen collection has an incomplete, undated ms. (n. 117, plate 122) which palaeographically seems to belong to the 15th century. Now a dating based solely on palaeographic investigations will always be subject to uncertainty, but in the present case the palmleaf-like character of the ms. also indicates that it is earlier than the 16th century. The paper is like cardboard, 0.32 mm. thick, with 4 layers. The mould used had about 30 threads per 50 mm. The fibres closely resemble *Daphne bholua* fibres and the paper seems to have been treated with starch paste.

The rarity of paper mss. from the 14th and 15th century is also evident from the fact that only one ms. on this material is found in Bendall's catalogue of 1883. B. S. Parajuli, the *National Archives* in Kathmandu, confirms this impression by saying that they have only very few paper mss. in their collection from this period.

A ms. from the 15th or perhaps the 16th century is the only one in the Copenhagen collection written on *Aquilaria agallocha* bark (see plate 123 and 124). The material is very well polished and there are faint yellowish traces of what a spectrographical X-ray analysis shows to be an arsenious compound which is undoubtedly orpiment (see p. 248). These bark plates were already a common writing material in Assam in the 13th century according to GAIT, 1894, p. 108, who also describes the preparation of the bark. There, as in our specimen, the two outermost leaves are thicker and not polished on the outside or dyed with orpiment like the rest of the leaves.

16th century. BENDALL, 1883, p. XXXi, writes that the Cambridge collection contains only 5 mss. from this century.

"These, nevertheless, have in common the important feature of showing the horizontal top line nearly continuous, while the vertical strokes often slightly project above this line. ... Paper seems to have come into general use at the end of this century."

A palm leaf ms. in this handwriting, n. 167, N. S. 652 or A. D. 1532 is shown plate 116.

Mss. in Rāñjanā writing are still common. Although it is obvious that an attempt has been made to make letters and figures look like the older models, the writing lacks the precision and clarity of the past. Moreover, the miniatures with which they are nearly always decorated are more coarse, and rather crudely coloured. Even mss. in the more usual writing are often reminiscent of Rāñjanā script, with single letters in that style.

BENDALL, 1883, p. XXXi, mentions a palm leaf ms. in Rāñjanā writing dated A. D. 1576 and a ms. Add. 1556 dated A. D. 1583 in the same writing, which is, he points out, the earliest ms. in the Cambridge collection on blue-black paper. As we have seen, however, this type is much older, and it is indeed remarkable that it survived right up to the 20th century.

In the course of the 16th century mss. on paper become more and more common, and *about 1550 palm leaf mss. seem to be superseded by paper mss.* Bendall states that the last complete ms. on palm leaves in the Cambridge collection is the above mentioned ms. from 1576. As mss. on paper become plentiful now, the following will deal almost exclusively with mss. which have been subjected to my technical investigations.

B. S. Parajuli has most kindly forwarded tiny fragments from the following three mss. in the *Bir Library*, all from the first half of the century.

1) Ms. Bhagavat, catalogue number A. 1671, size 221 by 84 mm., in Newari, N. S. 625 or A. D. 1505. Microscopical examination shows that the paper is made from Thymelaeaceae fibres of the high-level type closely resembling *Daphne bholua*, and that it is treated with starch paste.

2) Ms. Tantrākhyānakathā, A. 1593, 267 by 51 mm., in Newari, N. S. 638 or A. D. 1518. Fibre as above. The paper is treated with starch paste.

3) Ms. Yantra Saṅkaravidhi, A. 249, 267 by 114 mm., in Devanāgarī. According to B. S. Parajuli the ms. is dated either Vikrama Samvat 1457 or Śaka Samvat 1457, i. e. A. D. 1400 or 1535. The broad format, like the writing, suggests a North Indian origin. Fibre as above. The paper, like many early Indian mss. (see e. g. n. 85) does not appear to be treated with starch paste, or only lightly.

4) n. 152. A large, magnificent ms. in gold writing on blue-black paper (plates 127–128). Decorative Rāñjanā script, but not distinct, N. S. 631 or A. D. 1511. The paper is fine and nicely cut. It is in 4 layers, stiff, smoothed and lacquered. The mould was a fine-meshed fabric. The fibres are from a species of Thymelaeaceae of the high-level type resembling *Daphne bholua*. The paper is not treated with starch paste, which would have been inexpedient on account of the colour.

Summary. Manusripts from the 9th Century to c. 1550

a. THE PALM LEAF MSS. As demonstrated by HOERNLE, 1900, p. 113, nothing but the leaves of *Corypha umbraculifera* have been used in Nepal for palm leaf mss. According to BRANDIS, 1911, p. 657, the tree does not seem to grow wild in Nepal, and must therefore have been cultivated there.

Formats. The thickness of the palm leaves is 0.02–0.32 mm. The breadth of the palm leaf mss. is determined by the breadth of the *Corypha* leaves, since only two narrow strips on each side of the midrib of the leaf can be cut away and used. The breadth of the mss. is therefore rather constant, usually from 45 to 55 mm., average c. 50 mm. for mss. executed in Nepal (see diagram, p. 234). As shown in the table above the diagram there are 4–8 lines on each page; until A. D. 1200 mostly about 6, and later about 5 lines. On the other hand, the length of the palm leaf mss. greatly decreased through the centuries. Thus out of 19 mss. in Bendall's catalogue from before A. D. 1200, 10 mss. measure more than 400 mm., of which 8 are over 500 mm. From A. D. 1200 to 1400, out of 19 dated mss. only 2 are over 400 mm. long, of which only one is over 500 mm. Finally from A. D. 1400 to 1600 not one out of 17 mss. is more than 340 mm. long. The great reduction of length after A. D. 1200 is probably due to the fact that the longer formats were then considered impractical. A less likely possibility is that, owing to the disrupted contact with Bengal and the rest of India, the Nepalese now had to manage with local supplies of palm leaves.

The diagram p. 234 shows the "average formats" (mean length by mean width; with one corner of the ms. at origin, the opposite corner is marked) of mss. from various Nepalese, Indian and Tibetan collections, the values for Nepalese mss. deriving from Bendall's catalogue of 1883. Except for the so-called "concertinas", the formats of the Nepalese mss. at various periods do not generally conform to the average formats, but are dispersed around the four heavy trend lines in the diagram, which I call the "format curves". However, the changes in average formats from century to century provide a true measure of the tendency in format development.

b. THE PAPER MSS. What is most notable here is the scarcity of paper mss. up to the 16th century; they constitute only a small percentage of the total number of mss. Even if it does not necessarily follow that paper mss. were indeed as rare in Nepal (the Kathmandu Valley) until then, we may assume that for religious and traditional reasons the palm leaf was by far the most favoured writing material for mss. This was the case, too, in India, whence the valley received most of its spiritual and a good deal of its material culture.

All Nepalese paper mss. up to the 16th century known to me, have the same construction and shape as the palm leaf ms., the *pōthī*. Several of them are true copies of the palm leaf ms. with regard to the arrangement of text, position of holes for the cord to keep the loose leaves together etc. Also the thickness of the paper mss. corresponds exactly to that of the palm leaf mss., being from 0.20 to 0.32 mm.

Like most of the other mss. on uncoloured paper from the period, the two oldest paper mss. known were made from Thymelaeaceae fibres of the high-level type on a mould of some fabric. This paper was presumably made in the highlands of North Nepal, in areas which had been invaded by Tibetan peoples and their culture from the 7th to the 10th centuries. Paper seems to have been used only as a substitute in the valley, as there are so few mss. in this material and they are shaped to look like the palm leaf mss.

The fine mss. with gold or silver writing on blue-black paper form a special group. Both this colouring of the leaves and the "ink" are entirely unknown in palm leaf mss. It is characteristic of the blue-black mss. that nearly all of them contain Buddhist texts, and that the writing is predominantly of the Rāñjanā type, the origin of which—as mentioned above—can be traced back to Bengal. But this type of book can hardly derive from there, as very early blue-black mss. with gold or silver writing are unknown in India but fairly common in China.

The paper of the old blue-black mss. is made from fibres of hemp or ramie, on moulds of what seem to be mats of grass straw with 35–45 lines per 50 mm. The paper is not treated with starch paste. It is unlikely that it was made in Nepal, but rather in India or perhaps in China.

Formats. As for the format, the breadth of the paper mss. exceeds that of the palm leaf mss. by about 50 %. Yet they are far from being as broad as Indian paper mss. from the same epoch, see diagram p. 234. (The average format of Indian mss. before A. D. 1600 has been calculated from J. Eggeling's: *"Catalogue of the Sanskrit Manuscripts in the Library of the India Office, 1887–1904"* and agrees quite well with the average format calculated for other collections of Indian paper mss. from the same period.) It now appears that the format curve, which I have computed for the Tibetan paper mss. in the London and Paris collections from Tun-huang (mss. nearly all prior to A. D. 1000) coincides, not just approximately but entirely, with the format curve for Nepalese paper mss. prior to A. D. 1700. While Tibetan mss. have on the whole retained the old formats up to our time, the "average length" of Nepalese palm leaf mss. and equally of paper mss. diminishes very sharply after A. D. 1200. In other words, in both Nepal and Tibet the formats of the paper mss. seem to have been imitated from the very long, early Bengalese palm leaf mss. With the subjugation of Bengal by the Mohammedans about 1200, during which religious connections with Nepal and Tibet almost ceased, the old formats were on the whole preserved in Tibet. In Nepal the little breadth was also maintained for a long time. But the length of both palm leaf and paper mss. was rapidly reduced, probably owing to the influence of the Mohammedans via the Indians.

The superseding of palm leaf by paper. According to Hoernle paper was only little used for mss. in Northwestern India until the last half of the 14th century, but before 1450 the making of palm leaf mss. had completely ceased. In Bengal, paper mss. were not made until about 1450, and only around 1600 did they became the commonest type; in fact here palm leaves were used for mss. well into the 19th century.

In Nepal (the Kathmandu Valley) paper became the most common material for mss. about the middle of the 16th century, i. e. the use of paper for mss. first became general in the valley at almost the same time as in that part of Northern India immediately to the south of the kingdom of Nepal.

17th century. A very great number of mss. on paper are extant from this century onwards. BENDALL, 1883, p. XXXii, writes i. a.:

"The various handwritings fall into two main groups, corresponding to those noticed in the last century. The first may be called the normal or natural style, . . . It includes the great majority of the MSS., and falls into several subordinate varieties, not distinguishable in the form of the letters but in the general character of the hand."

To this main group belongs a form of writing which approaches Devanāgarī (the most common form of script in North India at that time) while still preserving its distinctive Nepalese character.

The other main group is made up of mss. written in an "artificial and partly ornamental style" resembling the style already mentioned in connection with the blue-black mss., and which is constantly, even into the 19th century, especially associated with this type of book. As BENDALL, 1883, p. XXXiii, appropriately characterises the style, it now:

"has the appearance of being written to be looked at rather than to be read. The usual case, indeed, with these MSS. is that the letters are hard to distinguish and the readings corrupt and barbarous."

These features become even more marked in the 18th century (see plates 129, 133 and 134).

It still holds good of most mss. from the 17th century, that writing and miniatures remain well executed. The paper, too, is well treated and precisely cut. Dyeing the book leaves yellow with orpiment first becomes usual in this century, but from then onwards for nearly all mss., apart form those on blue-black paper. Coating with yellow arsenic, as orpiment is also called, has been mentioned above, p. 93. It seems to have been known at a much earlier date in China, whence it surely originates, like most other methods of preparing paper.

It is characteristic of the mss. from this century and onwards that the lines on which the text is written are generally very conspicuous, and also that the margin on both sides is marked by one or two vertical lines. Both sorts of lines are often in red ink.

18th century. Already during the first half of this century, the mss. reflect the violent events which led to the complete subjugation of the Newars by the invading Gurkhas. The quality of the writing soon deteriorates, and is sometimes even primitive. The same is true of the miniatures, where the drawing is clumsy, with crude colours and entirely without the delicacy and lightness of former times. Neither is the paper so carefully pasted together, dyed and cut. These are all signs of the poverty that resulted from the frequent struggles and blockades due to the Gurkha invasion, and the subsequent defeat of the Newars in 1768. More and more mss. are in Devanāgarī writing, because the Gurkhas were Hindus and consequently orientated towards India.

As mentioned, there are also many mss. on blue-black paper from this century. Of these J.T. 26 and n. 184 will be dealt with more closely. They are in fact (perhaps together with n. 172), the only ones of all the Nepalese mss. investigated, which are executed on Thymelaeaceae paper, but scooped on a mould probably made of grass straws (see plates 130 and 131). Similar moulds are used today in Bhutan and made by pushing grass straws into one another in long sections, which are then tied together with thread into a mat. These two or three mss. could have been written by Newars in Tibet on paper imported from Bhutan. If not, moulds of grass straw must also have been used in Nepal in the 18th century, as in Kumaon on Nepal's western border about 1800 (p. 61).

In the 18th century a new type of book, the so-called concertina, became common—i. e. books made of many sheets of paper pasted together to form a long piece, which is folded up and down in equal sections (WW). While the pōthī leaves are read one leaf at a time, first the front and then the back, one reads the whole of one side of the concertina, whereupon the book is turned and the other side is read. As there are no loose leaves, it was not necessary to number the pages.

The concertina was primarily reserved for smaller works, and useful texts of instruction concerning such things as ceremonies, astrology, medicine, songs and dances which were nearly always based on religion.

The concertinas are often very shabby and dirty and some of them must surely have belonged to more ordinary people. Our first dated specimen is n. 27 from A. D. 1714 (plate 138 shows a concertina from 1737), but this type appears also in the preceding century in Nepal. The concertina was used at a very early date in China (known from the Tun-huang finds for example) and later in Tibet too, where the Nepalese probably became acquainted with it.

Among the other mss. from this century n. 67 from 1745 should also be mentioned (plate 141). Here the writing material consists of 5 layers, with 4 layers of soft, poor quality paper, pasted in 2 layers on both sides of a 0.2 mm. thick, finely meshed piece of cotton. The Copenhagen collection contains two more such mss. viz. n. 122 and n. 136, evidently also from the 18th century.

19th century. Here we meet the same script and book forms as in the preceding century, but writing, miniatures and the entire make-up have deteriorated still further. Several mss. are very poorly written, see e. g. plate 147 of n. 84 from 1876. It is evidently not a question of writing exercises or a hurriedly executed ms., since the miniature and the beginning of the ms. are painted with gold. (The three words in French and English at the bottom of the photograph of the ms. are copied from an inscription in Kathmandu from 1654, see LEVI, 1905, Vol. I, plates 87–88.)

The cause of the steady deterioration in bookcraft was not only the wars in the 18th and 19th centuries. Before the Gurkha invasion many monasteries presumably contained people who were specially trained as scribes and book artisans. *The gradual repression of Newar Buddhism caused the dissolution of monasteries and the wane of bookcraft which became homeless and impoverished, because according to Indian tradition more weight was now attached to the spoken word than to the written.*

We have another Nepalese ms. on blue-black paper from the beginning of the century, N. Gl. 1, dated N. S. 922 or A. D. 1802, which is particularly interesting for several reasons (plates 132–134). The writing with gold ink is decorative, but somewhat illegible and the miniature on the first leaf fairly good. The original binding consists of two copper plates, hammered out and coated with gold, which show Buddha flanked by two bodhisattvas on the front cover.

The first 41 leaves, made of paper of 4 layers, have a fine ribbing with 52 lines per 50 mm. and supporting ribs at intervals of 14 mm. The regular and very distinct imprint of the mould shows that the paper has been scooped on a mould of finely split bamboo canes. The fibres of all 4 layers are a Gramineae, probably a kind of bamboo (see the fibre analysis p. 200 and plate 230). The rest of the manuscript's 184 leaves are likewise made up of 4 layers, but scooped on a fine mesh of cloth with 68 threads per 50 mm. The microscopical analysis shows that the paper is made exclusively of Thymelaeaceae fibres of the high-level type, probably from a high-alpine species (plate 231).

The ms. derives from the Younghusband expedition of 1887–88 to Central Tibet. As the ms. was acquired there, and the paper consists of the two mentioned fibres, but chiefly Thymelaeaceae fibres, and as the writing is in Newari and the dating in Newari Samvat, the ms. was most probably produced by Newars in Tibet. In the larger towns of this country it was quite common to find a colony of Nepalese, chiefly Newar merchants and artisans. In Lhasa they even formed a considerable part of the total number of inhabitants in the 19th century (see e. g. WADDELL, 1905, p. 346), and it is quite probable that the ms. was executed there.

Certainly Thymelaeaceae fibres have been the most frequently used material for making paper in Tibet, whereas bamboo paper has no doubt been imported from China or East Tibet. Other Tibetan mss. from the 18th–20th centuries, especially the East Tibetan, which I have had the opportunity of investigating, are also made on bamboo paper. (MEISEZAHL, 1958, p. 23, mentions a Tibetan ms., Tafel 72542, in the Linden Museum in Stuttgart. A microscopical analysis of the fibres undertaken by Dr. M. Harders-Steinhäuser shows that the ms. is partly made on paper made of bamboo fibres. It is presumably from the middle of the 18th century and like our ms. a Suvarṇaprabhāsottamasūtra.)

The first example of Nepalese paper in a book from the West is found in N. Wallich's previously mentioned work from 1820. *Daphne bholua* is pictured on the handmade paper, produced from fibres of the same plant (see plate 46). The paper is consequently some years older, and is very similar to that made to-day in Central and East Nepal. Yet the mesh of the mould was somewhat denser with c. 40 threads per 50 mm., similar to the paper in mss. from the 19th century.

New forms of books and formats begin to emerge in the second half of the 19th century. We now meet with mss. sewn at the back with string (see plate 146 of n. 86 from some time after 1857 and plate 148 of J. T. 38). Ms. n. 88 from 1870 is also sewn at the back, but here the binding is leather, which is highly untraditional and against the religious principles of most Nepalese. This must be due to Western influence. The paper, too, is in fact light blue, machine-made English paper with the watermark MACKAY & KIRKWOOD, BRITANIA 1855. That European paper began to be used on a small scale in the Kathmandu Valley about 1870 is in agreement with the statements on p. 84 by G. B. Shah.

From the same century we also have examples of very worn concertina books with both blue-black and yellow pages in the same book. The blue-black pages bear writing done with a limestone. These were used as blackboards for writing excercises.

Even if the book leaves from this century are seldom carefully dyed and cut, they are often strong and hard, due to a thorough beating of the fibres, and the large amount of starch paste with which the paper was coated. Some mss. are even parchment-like.

20th century. There is not much to be said about 20th century mss., since the number of true mss. has steadily dwindled. Owing to the isolation of Nepal at the beginning of the century, only slight changes took place. But great changes occurred after the second world war and the fall of the Ranas in 1950. *Many innovations were introduced from the West and with these came new forms of books, of writing, and of writing materials.* An interesting transitional form can be seen in J. T. 40 from 1945, which has almost the same format, thickness and binding as a cheap European book, and a printed text, but on handmade Nepalese paper (plate 149).

Printed books in Nepalese first appear about the beginning of the century. However, in Tibet block-printed books are very old and in the Kathmandu Valley the block-printing of amulets etc. took place from an early date. The reason why this technique was never used in Nepal for making books cannot alone be due to the limited market, for printed books do not occur in India either until very late. The explanation is more probably that in this respect, too, the customs of orthodox and conservative India were closely adhered to.

Summary. Manuscripts from c. 1550 to 1970

Throughout this period the thickness of manuscript leaves still corresponds entirely to that of palm leaf mss. They are 0.18–0.32 mm., on the average 0.25 mm. thick. They are usually made of 2, 3 or 4 layers of paper. Leaves of the same ms. are often of varying thickness; in several mss. the leaves consist of 4 layers at the beginning and later of only 2. Moreover the single layers are usually of uneven thickness, between 0.06 and 0.12 mm.

Of the paper mss. described in the table p. 228–231, and just as many from that period which are not included in the table, only 4 mss. have not been scooped on moulds of cloth. It should be noticed that all 4 are executed on blue-black paper, while there is only one among the other mss. on black paper. The moulds with cloth seem generally to have been of more finely woven mesh than that normally used to-day. Apart from the blue-black mss. and some early ones on undyed paper, nearly all mss. are dyed yellow on one or both sides with starch paste containing orpiment.

All the paper, except for part of N. Gl. 1 from 1802 and a few late mss. on straw paper or machine-made paper, is made of Thymelaeaceae fibres, and up to the 18th century they are all of the high-level type (with one exception). From about 1720 to 1870 low-level Thymelaeaceae fibres, probably mainly from *Edgeworthia gardneri*, suddenly become general (see diagram p. 239). In this period the two main types of fibres are often mixed in the paper. This is most likely because the consumption of paper increased so much that even this rather less useful species of Thymelaeaceae had to be adopted until the appearance of European paper at the end of the 19th century.

Formats (see diagram p. 234). The average breadth of the pōthī mss. increases during the whole period due to the steadily increasing influence from the South and gradually approaches the Indian format, although the mss. still remain a little longer and more narrow. As might be expected the number of lines on the page increases with the breadth of the mss.

Concertina books became common in the 17th–18th centuries. The average format of this type of book is also indicated in the diagram p. 234. Although it is considerably smaller than that of the pōthī, it approaches the format curves of the period. It is also seen that it is only a little broader and shorter than the average format of the very early Tibetan concertina books found at Tun-huang, which might suggest that this type came to Nepal from Tibet. Sewn mss. only became common in the 19th century; the later specimens increasingly approach the form of Western books.

The transition from mss. on handmade to machine-made paper. Around 1860–70 some people started to use European paper for mss. in the Kathmandu Valley on a small scale, but not until the 20th century did machine-made paper become common. Since the second world war it has replaced handmade paper for books, just as quite new types of books and printing techniques have been introduced into the valley.

2. Books in Tibetan

a. THE KATHMANDU VALLEY. Books in Tibetan, also found in the valley, have not yet been mentioned. They originate from the peoples of Tibetan culture, who have visited the valley since early times. As already mentioned, one of the most important trade routes between India and Tibet passed through the valley. Also, many Tibetans went on pilgrimages to a number of temples and shrines such as the Bodhnath stupa (plate 2), one of their most important sanctuaries outside Tibet. Sherpas, Bhotias and Tibetans have visited the valley, particularly in the winter season when the climate is agreeable and not harmful for inhabitants of the highlands. After the events of 1959 in Tibet and the strong decline of trade with Tibet, many Tibetans and Sherpas have settled in Kathmandu, Bodnath etc.

Books in Tibetan found in the Kathmandu Valley have been described in many places; two early sources will be referred to here. HODGSON, 1874, pp. 9–11, mentions Tibetan books and literature; on p. 10 he says:

"The poorest individual who visits this valley from the north is seldom without his Pothi (book), . . ."

Books and literacy are thus widespread among the highlanders.

WRIGHT, 1877, p. 317, writes of the Tibetan mss. which he collected in the valley, now chiefly in the Cambridge collection:

"Some of them appear to be of considerable age. Add. Ms. 1666 is a huge book of great beauty, with several large pictures; and Add. MS. 1667 is also deserving a special mention. I bought the former from the son of a merchant, who has brought it many years ago from Lhāsā, and carefully preserved it as a charm till his death."

This passage is interesting because it demonstrates how and from where several of the previously mentioned books may have reached Nepal from Tibet.

During my stay in Kathmandu I saw quite a few books in Tibetan among the Sherpas and Tibetans. They were all comparatively new, but there are said to be some old books in Tibetan in *Bir Library*.

In the Copenhagen collection there are a few books in Tibetan, acquired in the Kathmandu Valley. They are described in the table, p. 233. 7 of them are mss. and 2 are block-printed books. None of them is dated, but they are hardly more than one hundred years old. All of them have the pōthī form, and the format and whole appearance are typically Tibetan. The quality of writing and printing is modest, this is also the case with the paper and its treatment; they are consequently quite ordinary books. The paper is mostly long-fibred and neither coloured nor coated. The book leaves consist of 2–4 layers pasted together. The paper is more or less brownish and has without exception been scooped on cloth moulds.

Microscopical investigation shows that the paper has been made of Thymelaeaceae fibres. With a single exception (n. 137 b) the paper, which has been scooped on moulds of coarse cloth (less than 35 threads per 50 mm.), consists of Thymelaeaceae fibres of the high-level type, while paper scooped on fine cloth is made of fibres from a low-level species, probably *Edgeworthia gardneri*. It should be mentioned here that a fine-meshed mould of cloth was the most commonly used in Tibet.

b. NORTHERN NEPAL. *We find nothing corresponding to the many early mss. from the Kathmandu Valley in other parts of Nepal.* Hardly any of the peoples in these regions had their own literature, and books seem to have been more rare. In Terai this is due to the fact that, as in India, the spoken word is preferred to the written for religious instruction and ceremonies. In the Middle Range, however, it is because the population there has always lived in small and rather isolated communities.

Among the peoples of Tibetan culture in Northern Nepal as in Tibet, the ability to read and write has been more common, because Lamaists regard it as extremely important to read the holy scriptures; in fact books are even thought to have a power of their own. Even very ordinary farmers often possess a whole pile of books. But only a few of the books in Tibetan found in Northern Nepal are of any considerable age. In the following section books belonging to the peoples living there now will be mentioned, although my own material, as well as that already published on this subject, is rather modest.

Yangma. Only one early reference to East Nepal will be noted. HOOKER, 1855, p. 226, writes concerning Yangma, a village in farthest Northeast Nepal:

"The books [in the monastery] were of the usual Tibetan form, oblong squares of separate block-printed leaves of paper, made in Nepal or Bhutan from the bark of *Daphne*, bound together by silk cords, and placed between ornamented wooden boards."

The reference is interesting because it mentions the paper used for making the books. But it is unlikely that they were printed in Nepal, rather in Central Tibet. Usually only big Lamaist monasteries, none of which are found in Nepal, possess the large quantity of wooden blocks required for making this type of book.

Junbesi. As examples of books from East Nepal, some personally collected specimens are more closely described below; with a single exception they all derive from Junbesi in East No. 3. The region has already been mentioned on p. 69. Junbesi (plate 51) is a typical Sherpa village, not very big, with about 30 family houses and with a Lamaist temple in the middle, which is 200–300 years old. The village is situated at 3000 m. and the inhabitants, who are rather well-off, live by cultivating wheat, barley, maize and potatoes as well as by trade.

The books J. T. 12 a, b, c, d, e and J. T. 13–20 (see table p. 233 and plates 150–156) all belonged to the same family in the village. The oldest man in the house explained, that he, his father, grandfather and great-grandfather had been connected with the temple, the two latter as head lamas. Many of the mss. are much worn, but none of them seem to be more than two hundred years old at the most. They are all in Tibetan and are not dated. Only J. T. 20 is block-printed; the others are mss., some in the ordinary lettering (Uechen) others in cursive (Ume). Some books are made on pōthī leaves, the others are sewn along the longer upper edge with a cord. One, J. T. 18, is bound in black cotton fabric (plate 152). All of them have the oblong shape, but as will be seen from the table p. 233, the formats are less oblong than is usual with Tibetan books. The average format, indicated in the diagram p. 234, can be seen to lie halfway between the average formats of mss. from the Kathmandu Valley from the period 1700–1850, and Tibetan books of the same period.

The leaves usually consist of two layers, c. 0.10 mm. thick, and they are all scooped on moulds of fabric with only 20–25 threads per 50 mm. The paper is more or less brownish and chiefly long-fibred, undyed and not coated with starch paste. Yet J. T. 12 a and b are treated with a white powder shown by spectographical X-ray analysis to contain calcium that proved by a diffractometer analysis to be calcite, $CaCO_3$. All the paper is made of Thymelaeaceae fibres of the high-level type. With a single exception then, the paper closely resembles that made in the area to-day, which also suggests that paper as well as mss. have been made locally.

SNELLGROVE, 1957, p. 215, writes about the same region:

"The most profitable item of trade is the coarse, tough paper which is not available on the far side of the Himalayas [in sufficient quantities], where the greatest demand exists, and so Sherpas and Bhutanese can with ease repay the expenses of a pilgrimage to Lhasa, bringing back carpets, Chinese silks and porcelain, or books freshly printed to their order."

Namche Bazar. Here, three days' march north of Junbesi and only two from the Tibetan border lies the once so busy caravan town between Nepal and Tibet.

One day I visited the temple, and noticed that pieces of paper were sticking out from many of the defective prayer wheels mounted on the outer wall of the building, and that more pieces were lying on the ground. One of these, J. T. 11, proved to be a leaf of a ms. It attracted my interest because the paper was Bhutanese, easy recognisable by the striped surface produced by scooping on a mould of grass straw. The paper is very brown, 0.15 mm. thick, in only 1 layer and with 18 lines per 50 mm. The ms. was probably written in Tibet where, until recently, Bhutanese paper was imported because it was highly estimated for making books. As mentioned in chapter I, it was until recently a custom of the highlanders in Nepal to undertake long commercial journeys and pilgrimages in the summer season to Tibet, where books were produced and sold on quite a large scale.

Mss. on *blue-black paper* are well-known in North Nepal as in Tibet. One day when I was passing the house of a well-to-do family, an old man was sitting outside it mending a big magnificent ms. with writing in silver on blue-black paper. It was done by pasting small squares of new paper across the tears and holes in the evidently old pōthī leaves, and then drying the big sheets in the sun on stone fences and in the courtyard.

The fact that books are read industriously is evident. They are used at all sorts of ceremonies, and very often men, mostly elderly, can be seen sitting reading the sacred books. Even a strolling magician carried, together with many other ritual objects, a ms. kept in a case slung from a shoulder-strap (plate 36). He said that he travelled around and performed smaller ritual functions for families who wanted his help. My Tibetan acquaintance says that such people in Tibetan are called *rnal-'byor-pa*. According to DAS, 1902, p. 763, the word means an ascetic, hermit or yogi.

Northwestern Nepal. If many regions of East Nepal are still little explored this is true in no lesser degree of West Nepal. As, with only two exceptions, I neither bought any books while in this area, nor have had the opportunity to study books or collections acquired by others, some passages from the literature will be quoted and commented upon instead.

In G. Tucci's work on West Nepal of 1956 a number of books found in the area are mentioned, but appearance and materials are rarely described in detail. For example, it is reported from Tukucha p. 9:

"In the chapel in the old house of the Sher Chan I found nothing worthy of note except an old copy of the bKa'-ḡgyur written in letters of gold on great sheets of blue paper and the manuscript of a liturgical work with some references to the region; . . ."

The above-mentioned ms. is the most important Lamaist text and it is specially on such mss. that a costly execution is considered worthwhile.

Tucci writes (op. cit. pp. 18–19) that Kun-dga'-bzaṅ-po, who is said to have contributed to the spread of Buddhism in this part of Nepal and Tibet, brought various mss. to Mustang from Tibet on his two first visits. On a third visit in A. D. 1447 he inspected some specimens of bKa'ḡgyur (bKa'-'gyur) written in golden letters on black paper.

J. Kawakita, see KIHARA, 1957, pp. 192–193, describes a few books and their use in religious ceremonies in Tsumje, north-northwest of Kathmandu. On p. 193, two mss. are reproduced about prophecies and also a block-printed calendar, the leaves of which are sewn together on one side. The three books are all in Tibetan and of pōthī form. About the last it is said, p. 201:

"This Dado provides information on the festive days, auspicious days, and agricultural days for the whole year. It originates, we were told, in Hlasa, but is written exclusively by lamas who reside in Solu Gumbu, the homeland of the Sherpas, and is printed at Kathmandu, from whence it is distributed."

To-day such calendars in Tibetan are often machine-printed on poor Indian paper. According to Purna Harsha Bajracharya they are made in the State printing offices in New Delhi and Simla, from where they find their way to many parts of Himalaya. *Thus we see how books in Tibetan become widely distributed, because Tibetan speaking people are, on the whole, united by the same language, religion, and material culture.*

SNELLGROVE, 1961, p. 45, writes concerning West Nepal: "In all these regions printed books are very rare indeed." That block-printed books are chiefly executed in Tibet is furthermore supported by the following from Danzong, p. 97:

"They have just acquired a new set of thirty volumes of block-prints from Lhasa, they told us."

Snellgrove writes on p. 120 about a ms. from Samling in blue-black paper:

"We started with the "Mother" (yum) in sixteen massive volumes. The pages with their gilt and silver letters on a black ground measured about 2' 6" long by 6" wide [or c. 750 by 150 mm.]."

PEISSEL, 1965, p. 595, reports after a visit to Mustang on a collection of books in the monastery:

"Some books were very old and plain. Others had silver covers inlaid with thick gold characters. One day we were lucky enough to stumble onto a manuscript of the history of Mustang from the 1380's to the present day."

During my own stay in West Nepal I was presented with a ms. in Tukucha by the same Thakali (plate 16) as mentioned by TUCCI, 1956, pp. 8–9. It deals with ritual sacrifice and is a rÑiṅ-ma-pa ms. It is finely written in two kinds of cursive (Ume) and with black and red inks (plate 157). It is evident even at first sight that the paper is not of the usual kind. It is very soft and greyish, with small black particles everywhere. Microscopical analysis shows that it is made of fibres from *Wikstroemia chamaejasme*. The black particles are due to the fact that the fibres are taken from the roots of the plant. The black outer layer of the roots is often not scraped off sufficiently before the cooking, beating and scooping of the bast fibres.

The paper may originate in the Dolpo district, a little to the northwest of Tukucha, where the plant grows in many places, and the paper was made only 10 years ago. But both paper and ms. could also derive from Tibet where this sort of paper was produced in many places.

Summary. Books in Tibetan

The above material relating to books in Tibetan found in Nepal is too slight for a detailed discussion of the various types occurring there and the paper used for making the books. Summing up, we may say that the present material can be divided into three main groups.

One group consists of books produced in Tibet and then imported into Nepal. This includes mss. as well as block-printed books. The paper is of a very varying character with regard to colour (whitish, yellowish, brownish etc.), the imprint of the mould on the paper (chiefly fine-meshed but also coarse-meshed fabric, coarse or fine-ribbed mats made of bamboo or grass straw) and the species of fibre (*Wikstroemia chamaejasme*, *Daphne* species, *Edgeworthia gardneri*, *Broussonetia papyrifera*, bamboo, hemp or ramie, etc.). There are also the blue-black mss. and even mss. on machine-made Chinese paper.

The second main group comprises books produced in Northern Nepal. They are practically all mss., the sale of books having been too small to have made it worth while to print even the most frequently used texts, because each page has to be carved out in wood before the block-printing can start. The paper, which is almost all of local origin, is brownish and made from species of *Daphne* or of *Edgeworthia gardneri* on moulds mostly of coarse cloth. All things considered, mss. seem to have been almost entirely fashioned on Tibetan models. With regard to the quality of writing, the presentation and the materials used, the mss. made in Northern Nepal are generally rather simple due to the special character of this area.

The third main group of books in Tibetan consists of machine-printed books, mostly on poor machine-made paper. They have been printed in New Delhi, Simla, Kathmandu, etc., in the 20th century.

B. Letters, Documents and the Like

Handmade paper has been used to a great extent for letters, documents, accounts and the like. Little is known of the appearance of these in earlier times or of the materials used. In North Nepal paper probably replaced older writing materials such as wooden tablets and birch bark at an early date. Even in the Kathmandu Valley it is conceivable that paper was preferred for letters etc. before mss. were made on this material, because these more practical uses were not connected with the same religious traditions as the mss.

HODGSON, 1832, p. 11, writes about the good properties of the paper when used as writing paper:

"The manufactured produce of Nepal is for office records incomparably better than any Indian paper, being as strong and durable as leather almost, and quite smooth enough to write on. It has been adopted in one or two offices in the plains, and ought to be generally substituted for the flimsy friable material to which we commit all our records."

G. B. Shah states the following about the importance of the hand-made paper in the administration:

"However, until 1934 only Nepalese paper was used for Government official correspondence throughout the Nepal kingdom. Even to-day mostly Nepalese paper is used in principal matters and in the judiciary offices (1965). Still many in Nepal superstitiously believe that the Government correspondence, laws or any memoranda etc., written in foreign paper, are not valid. Therefore in all Government offices they use Nepalese paper insofar as it is available. Due to scarcity of the paper and the increasing of the standard of letter-writing they have been compelled to use foreign paper."

Not until well into our century did the postal service develop to any significance in Nepal, and apart from the few sizable towns in the country, it is still very limited. Yet it is worth mentioning that everywhere there are small post offices, and that the postal service is admirably safe even if it is slow on account of the difficult terrain.

Letters and documents, like manuscripts, also play a greater part in the everyday life of the people in the north than they do for those in the Middle Range and Terai. This is of course due to the frequent travelling undertaken by the people of the highlands. In the towns it is especially the Newars who have always been experts in writing. WRIGHT, 1877, p. 44, thus writes:

"The duties of clerks and accountants are performed by a special class of people, chiefly Newars."

Various qualities. For ordinary letters as for official ones quite ordinary, hand-made, and mostly very thin paper is used, which can only be written on on one side. Better quality writing paper is thicker or has double layers and may also be obtained in pads after Western models.

In Junbesi, in East No. 3 (plate 51) I was presented with various letters, one of which is shown in plate 179, and two others were specially examined (see J. T. 5 a and 5 b, and the tables pp. 233 and 246). The documents are 20th century but are drawn up in the old-fashioned manner. They are written in Nepali although found in a Sherpa village, which is due to the fact that Nepali is the official language of the country. Notice the stamps and finger-prints on the specimen shown, and also the series of folds. The letters are in fact sent and kept folded in long narrow formats shaped like small pōthī mss. The folds arise from the habit of making a roll of the paper after it has been written on, and then flattening it. If the roll is too long it is folded in the middle.

To-day letters etc. are increasingly shaped after the Western fashion; this applies to both format and the disposition of the writing. For envelopes a heavier paper is used, usually consisting of 2 layers (J. T. 45 a). Often the inner layer is an Indian machine-made paper, which is glued to a layer of Nepalese paper.

To get an idea of the different qualities of the paper produced in Nepal, a large collection of envelopes belonging to O. Treschow Kühl, Copenhagen, has been examined. The envelopes are mainly from governmental correspondence over the last 20 years, not infrequently from remote regions of the country. Out of almost 1000 samples about 60 % are of Indian paper and the rest of handmade Nepalese paper. Of the latter about 75 % are on the ordinary paper, mostly distinctly brownish qualities scooped on coarse moulds of cloth, whereas the remaining samples are scooped on finer moulds of cloth. Nearly all are made of fibres from high-level Thymelaeaceae species, and only few from low-level species. One sample of these latter fibres, probably from *Edgeworthia gardneri*, is from Ilam in farthest East Nepal, like J. T. 5 b, from Taplejung (see tables).

Certificates, invitation cards and the like are often of 3 layers, with cardboard in the middle and the handmade paper as outer layers (e. g. my passport for travelling in the mountains). Proclamations from local authorities are written on local paper, while public notices about bigger issues, such as governmental proclamations or instructions from the health authorities (e. g. regarding prevention of malaria) are printed on machine-made paper. For forms, bills (J. T. 45 b, plate 180) and receipts thin handmade paper is nearly always used.

Some Tibetan paper has found its way into Nepal, even if most paper has gone in the opposite direction. J. T. 46 is a letter in Tibetan (plate 166 and table p. 233) from a Sherpa family who lived in Kathmandu. The paper is grey and very soft. The fine cloth mould had 85 threads per 50 mm. and microscopical analysis shows that the paper is made of *Wikstroemia chamaejasme* fibres. The paper, like the letter, is from Tibet.

Near Dopu Bazar, East No. 3, I obtained a large sheet of fine white paper of the format 49½ by 127 cm. from a lama who was an exile from Tibet. He told me that it had been made near the town of Shekar Dzong, about 14 days' journey North of Dopu (no. 11 in the table p. 226). Microscopical analysis shows it to be made of *Wikstroemia chamaejasme* fibres, which is in accordance with the drawing of the plant that the lama made. The material is short-fibred and even in an untreated state the paper is fit for writing on, for which reason it is often used for quality writing paper. The head lama of the Thyangboche monastery gave me another piece of Tibetan paper of the format 61 by 146 cm. It is made from the same fibre and was likewise used for writing paper (no. 12 in the table p. 226).

Terminology. JØRGENSEN, 1936, p. 106 states:

"poti, . . . s. a leaf, sheet (of paper), a document. . . ."
"patr (S. pattra) s. a letter . . ."

TURNER, 1931, pp. 84 and 556:

"kagajat, s. Official documents."
"likhat, s. A written document."

C. Single Leaves for Magic and Ritual Purposes

In this section we shall deal with the use of single leaves bearing writing, printing or decorations for magic or ritual purposes.

1. Woodcuts

These are single leaves with pictures or figures, with or without text, made by pressing paper, cloth, birch bark or the like on a carved, blackened, wooden block (very seldom made of other materials such as metal or clay). Woodcuts are particularly interesting not least because they *reflect important aspects of popular beliefs*. In the figures depicted we also find some remarkable survivals of pre-Buddhist religions, indeed *several of them have had very early models*.

It is not known how far back the use of woodcuts on paper dates in Nepal. CHÊNG TE-K'UN, 1957, p. 157, states that a Tibetan woodcut on paper found in Szechwan may be 9th or 10th century. GODE, 1944, p. 210, refers to a mention of prints from a still earlier date. The Chinese pilgrim Itsing, who visited India from A. D. 671–693 thus states:

"The priests and laymen in India make Caityas, or images with earth, or impress the Buddha's image on silk or paper and worship it with offerings wherever they go."

Yet there is nothing to indicate that silk and paper were common articles of trade in the Indian lowlands in the 7th–8th centuries; here it is rather a question of Kashmir, Ladakh and West Turkestan, which were under strong Indian influence and through which the most important caravan routes between India and China passed. If they in India proper did make such prints these were probably done on cotton cloth or birch bark.

To-day the woodcuts are only made on paper or cotton cloth, but WRIGHT, 1877, p. 316, gives the following noteworthy information:

"The bark of birch (bhurja, vulgarly bhoj) is used in Nepal only for charms and amulets, of which I brought home one specimen (Add. MS. 1578)."

Possibly this material was used for amulets before the appearance of paper, especially in Himalaya, where the birch is so common.

The uses of woodcuts in Nepal are manifold. They may be divided into two main groups: those which are used by Lamaists, chiefly in the highlands, and those used by the other peoples of the country at lower altitudes. *The prints are used most extensively in the Lamaist highlands where they are hardly distinguishable from their Tibetan models. At lower altitudes Hindu motifs predominate, but here the woodcuts often have a distinctly local character as in the Kathmandu Valley.* Unless otherwise stated, the material used for the woodcuts is paper.

a. THE LAMAIST HIGHLANDS

As amulets. Many Lamaists have a small bag of leather or cloth hanging round their necks in which, among other things, folded woodcuts are kept (plate 24, the woman to the right). One can also see people, chiefly women, on festive days, or on journeys, carrying such amulets in beautifully engraved metal boxes inlaid with silver and gold. The amulets are carried primarily for protection. They are meant to ward off evil spirits, diseases, the dangers of travel, theft etc. The leather bags or the boxes may contain a very considerable number of different prints. A woodcut from East Nepal for protecting travellers is shown in plate 164 (paper analysis p. 233). The print is stained with a yellow dye, probably saffron.

On buildings. Woodcuts affixed to buildings occupied by men and animals are believed to have the same protective effects as the amulets. J. Kawakita, see KIHARA, 1957, p. 190 and 208, writes:

"At Tsumje [northwest of Kathmandu], when there comes news of an animal epidemic in a neighbouring village, the villagers immediately put up paper charms called khör-lung on the animal shelters. These are supposed to ward off calamity."

"The Gyangong Hrunga is a magic design printed on locally made white paper and pasted on the doorways of each house. The design consists of a male and a female figure joined by a chain with a sacred inscription in the centre which is supposed to ward off evil spirits."

A protective effect is also ascribed to the mandala prints that are to be seen pasted below the ceilings of dwelling houses.

Prayer flags. The extensive use of banners and prayer flags is very characteristic of the Lamaist highlands. They are printed with holy texts, pictures and symbols which, when in motion, are supposed to have the effect of bringing good luck. In front of dwelling houses and temples there are almost always some tall wooden poles, to which are fastened long, narrow pieces of thin cotton cloth, bearing a series of identical prints, one below the other (plate 19, 20, 24, 32 and 38). *So widespread is the use of these banners that they almost define Lamaist areas.* Handmade paper is not strong enough for the long banners, and even for the smaller prayer-flags cotton cloth is most common. These are often fastened to cords stretched across temples and chortens (plates 2 and 23). The same engraved wooden boards are used for both the prints on paper and on cloth.

Prayer flags on cords may also be suspended between the branches of trees in places of special importance. We found an example of this two days' march from Namche Bazar on a pass-like plateau called Poindala, where Sherpas travelling north catch a first glimpse of their main habitat, Khumbu.

Paper is generally used for prayer flags fastened to long sticks of wood or bamboo which are pushed down into chorten-like shrines or into heaps of stones. The shrines occur especially along roads in the vicinity of human habitations. The heaps of stones with sticks and prayer flags are found in passes, on smaller mountain peaks and in other lonely places.

The various kinds of shrines and prayer flags often appear together. An example of this is the big "Māṇi stone" above Namche Bazar (plate 160) with the inscription *"Oṃ māṇi padme hūṃ"* in multicoloured letters one metre high. The stone is surrounded by tall wooden sticks with narrow printed cotton strips and a small chorten in which sticks with small paper prayer flags have been stuck. A third type of woodcut on paper (plate 161) is suspended in great bunches on a rope stretched between two poles.

J. Kawakita, see KIHARA, 1955, pp. 164–166, distinguishes the following three types of prayer flags: *tarccho*, fixed to rods erected on or near houses, *tarbuche* which are bigger and found in front of temples or at meeting places, and the smaller *lungta* (lit. Tibetan *rLuṅ-rta* = wind-horse), which appear in places such as around town gates or far away from inhabited areas. It is remarkable that most prayer flags show a horse which, as far as the last-mentioned type is concerned, is also found in the name itself. (His words tarccho and tarbuche however do not, as Kawakita writes p. 166, contain the syllable *rta* = horse, but *dar (tar)* = a flag, a piece of cloth).

Examples of paper prayer flags are J. T. 7, 9, 10 and 23 (see table p. 233) and also the print p. 149 made in Bodhnath near Kathmandu. They are all of the third type, rLuṅ-rta. J. T. 23 is printed on a whiter paper and scooped on a finer mould than the other prints, which accords with its origin in Muktinath north of Baglung in West Nepal, where exactly this type of paper is produced.

In prayer wheels. A prayer wheel is a hollow metal or wooden cylinder, which can revolve on its own axis by manual power or some other external force. To be effective every prayer wheel must contain holy quotations. They are nearly always block-printed on paper and most often with the ubiquitous Lamaist code words "Oṃ māṇi padme hūṃ".

The prayer wheel exists in numerous versions. The most common type is the one shown in plate 37. A print from such a hand-turned prayer wheel is shown in plate 163 (paper analysis table p. 233). Somewhat larger prayer wheels but otherwise similar, are mounted in long rows around temples and turned round by the visitors (plate 2). Others are very large and contain several hundred or even thousands of prints. Even these are mostly manually turned, often by an old man or woman who makes a living in this way. The biggest hand-propelled praying wheel I have seen was in the village Tarkegyang at Yolmo, north-east of Kathmandu. It stood in a separate room, and it was about 3 metres high (plate 34), and was said to hold 6666 block-printed paper strips all bearing the above mentioned formula. The bigger prayer wheels may be worked by water power, as I observed near the Thyangboche monastery in Khumbu and in the Muktinath temple in West Nepal (plate 23). I have also seen prayer wheels placed on the roofs of houses and turned by the wind (plate 17), and even a type that was turned round simply by heat from a butter lamp.

Inside figures. Religious figures of many different kinds and sizes are sanctified by being filled with woodcuts. The Buddha figures of metal (or wood), which have found their way to the West from Central Asia and the Himalayan states in such great numbers, are nearly always without a bottom cover and empty. Leaving out of account figures made as tourist articles, this is however not the case in the countries from which the figures originate. There they are stuffed with a host of small objects including printed paper strips of various kinds. The filling needs a special ceremony. If the figure needs repairing and the things are taken out, another special ceremony is required.

Inside religious monuments. Larger fixed figures and chortens usually contain woodcuts, not infrequently mss. as well. FÜHRER-HAIMENDORF, 1956, p. 178, writes of this:

"Unlike the Sherpas, the Tamangs do not enclose bone relics within the structure of their chorten, but sheets of paper with the imprints of the iconographic representation of deities may be built into the masonry."

The commonest Lamaist woodcut, rLuṅ-rta, which is especially placed around town gates and in mountain passes. An explanation of the print is as follows:

The square above left, *Khyuṅ*, the mythical leader of the feathered race, symbol of resolution.

The square above right, *'Brug*, a dragon, symbol of fame. According to Tibetan legends it makes thunder which can be heard widely.

The first five lines are prayers in Sanskrit to:
Mañjuśrī ('Jam-dbyaṅs), *Avalokiteśvara (sPyan-ras-gzigs)*, *Vajrapāṇi (Phyag-na-rdo-rdje)*, *Padmasambhava*, den hvide Tara *(sGrol-dkar)* and *Amita Āyuṣa (rNam-rgyal-ma)*.

Horse, rLuṅ-rta, carrying a representation of Buddha, i. e. a symbol of the true path (his teaching) which will lead to the ultimate spiritual goal.

The square below left, *Seṅ(ge)*, a lion, symbol of courage.

The square below right, *sTag*, a tiger, symbol of beauty.

The last five lines begin with formulas for all the things wanted. Then follows something like:
The giver of this flag ... [name inserted] may his vitality, strength, good fortune, lifespan, wealth and power increase. Hail to the gods!

SNELLGROVE, 1961, p. 34, writes:

"The chorten, . . ., is the typical Buddhist monument, derived originally from Indian models. . . . Texts, representing perfect wisdom, and images as symbols of buddha-forms, often replace actual relics."

Indeed, what may Nepal's innumerable and often very old chortens not contain!

I attended the construction of a chorten in front of the Takśindu monastery (Taksindu of the map plate 52), half a day's march from Junbesi towards Namche Bazar. We arrived at the end of April 1964. It is marvellously situated just below a mountain crest, with a view of the Everest massif, and surrounded by a wood of rhododendron trees, then in flower. The head lama of the monastery had died a fortnight before, and his ashes were now going to be enclosed in the chorten together with a variety of things including enormous quantities of large paper prints (concerning the place and the lama mentioned, see SNELLGROVE, 1957, pp. 214–215). The head lama from Thyangboche monastery was on his way there to conduct the forthcoming ceremonies.

The chorten under construction and temporarily sheltered against rain by a canvas is shown in plate 158, together with one of the built-in prints, plate 159. In a loft of the monastery I saw two lay brothers printing them, their hands and faces black from soot. Great bunches of wet sheets were already hung to dry on cords stretched across the loft. Two prints, J. T. 9, which I brought home, but which were originally destined for the chorten, are made on whole sheets of the locally produced paper and measure 50 by 66 cm. and 49 by 61 cm. A wooden block similar to those used for making these prints is shown in plate 162; it derives from Namche Bazar. In Takśindu I also obtained J. T. 8, the oblong woodcut shown in plate 165, which is interesting because of being in Rāñjanā letters which Urgen called "Buddha writing" (for the analysis of the paper, see table p. 233)

In ceremonies. Woodcuts are also used in a number of ceremonies as in Tibet (see SCHLAGINWEIT, 1863, pp. 247–272, and MAC'DONALD, 1929, p. 153). An example of this is the print on p. 151 which is for use at a death-rite and derives from Bodnath, the Lamaist sanctuary in the Kathmandu Valley. SNELLGROVE, 1957, pp. 262–274, describes very closely this interesting ceremony which is intended to guide the consciousness of the deceased towards nirvana. The aim of the ceremony, however, seems to appear in very different lights to priest and layman just as with many other Lamaistic rites. Snellgrove thus writes p. 262:

"The whole tantric theory is based upon the doctrine of absolute non-substantiality and thus all its forms and symbols are quite unreal in themselves. The after-death rites are of this kind. At first they might appear to imply belief in a real transmigrating element, identified as consciousness. In fact the whole aim is to eradicate belief in anything substantial and to show the identity of samsāra and nirvāna."

The learned monk will be able to conceive of the ceremony in this way. To the family of the deceased the matter probably has quite another aspect. On p. 263 it is said:

"In practice this ceremony is always performed at the instigation of the deceased's relatives, who may well be thinking in terms of actually influencing the course of rebirth of one of their number. Often, however, their intentions are far less noble, being merely concerned that the spirit of the deceased (conceived of in no Buddhist sense) should cause them no trouble in the future."

Snellgrove is evidently not speaking of a woodcut but a drawn copy of the ritual print. Apart from this, text and motif are very much like that of the woodcut on page 151. This is seen from what he writes p. 265:

"His effigy should be drawn in a kneeling position with hands raised in supplication. . . . Over his head is drawn an umbrella . . ."

Snellgrove then describes the long ceremony during which, among other things, the deceased is requested to be present in the ritual picture, and an offering is made to the evil spirits who are claiming the deceased. His consciousness is then directed through the 6 spheres of existence from hell to nirvana, the print is consecrated and burnt, and finally the following is done, p. 274:

"With these ashes one makes little effigies, which are properly consecrated in due course. The certain effect of all this is that the deceased is released from existence,

Lamaist woodcut used in a death ceremony (for explanation see pp. 149 and 151).

especially evil rebirths, and is born in the purity of the buddha-field."

An approximate translation of the text of the woodcut p. 151 is: "He who has come from this world of suffering to the other side of the world of suffering; he who has reached beyond this life ... (name inserted) may the effects of all the dead man's bad and sinful actions be brought to an end."

The face is empty so that the features of the deceased may be filled in, or at least the coiffure, to indicate the sex. From the neck downwards 6 letters are to be seen, which are formulas for the 6 spheres of existence.

b. THE KATHMANDU VALLEY. What has previously been said about the uses of woodcuts in the Lamaist highlands also applies to the customs among the few Tibetans, Bhotias and Sherpas who live in the Middle Range, including the Kathmandu Valley. They make the woodcuts solely from Tibetan models. The prints on pp. 149 and 151 were executed in the colony of Tibetans in Bodhnath near Kathmandu.

The big ethnic groups in the Middle Range and in Terai partly use other woodcuts and to a much lesser extent. An interesting and strange intermediate position is held by the Newars, the original and even to-day the major part of the population of the Kathmandu Valley. They mainly make woodcuts for use at religious feasts and ceremonies unknown in the highlands, but they use in addition a few of the previously mentioned types such as the amulet prints and the strips imprinted "Oṃ māṇi padme huṃ" for prayer wheels (the rolled-up strip, plate 163).

Typical of most of the applications of woodcuts in the highlands is their ubiquitous and constant use; the Newars mainly use them on quite definite occasions and, unlike the people from the highlands, they mostly colour them. The motifs and texts are Buddhist or Hindu, but often contain elements of both religions. Many woodcuts have a distinctly local stamp and are known and used only by Newars (see e. g. the prints pp. 1, 153 and 155 and plate 176). In other words the mixed origin of the Newar culture, its rich and in many ways special development is reflected in the woodcuts.

Below are mentioned some of the most important types from the Kathmandu Valley. The material derives mainly from Werner Jacobsen of the *National Museum*, Copenhagen, see JACOBSEN, 1959, pp. 146–161 (summarised in English op. cit. pp. 161–165). The article was later extended and edited together with a collection of the original woodcuts, see JACOBSEN, 1966, pp. 1–95. Unless otherwise indicated passages below derive from the 1959-article:

Pp. 152 and 162:

"Every year on the fifth day in the lighter half of the month Srawan, a celebration is held in honour of the Nagas, the snakes. This celebration is called Naga Panchami and in 1958 occured on the 19th of August according to our calendar. The Buddhist scripture "Kriya Samuchchaya" records the saying of the Buddha: "Worship the Nagas, and also Varuna, on the fifth day in the lighter half of Srawan. This counteracts all devilry occasioned by snakes and promotes a plentiful rainfall!" The written authority of the Hindus is the "Garuda Tantra", in which Vishnu commands: "Paste with cow manure pictures of the Nagas over the entrance to the house and over the other doors of the house on the fifth day of the lighter half of the month of Srawan, and worship the snakes in accordance with the ritual prescribed." In agreement with these commands this "day of the snakes" is observed by Hindus and Buddhists alike, and coloured woodcuts, large and small, representing the Nagas, the snakes, are pasted up over the house entrance and the other doors."

Snakes, together with other reptiles and vermin, are believed to inhabit the underworld, oceans and lakes. When the valley was drained the Nagas were driven away. So here especially they must endeavour to mitigate the snake gods, who have so often revenged themselves by preventing rain from reaching the valley, which has caused famine in the over-populated area.

The two woodcuts on pp. 153 and 155, both on handmade paper and made in Kathmandu in 1959, show Kanyā Nāginī, the divine snake virgin, which is the motif mostly used for this occasion. The former is made in the old-fashioned manner, thus it is hand-printed, hand-decorated and handwritten, and executed on paper of 1 layer. The latter is made by mounting the wooden block on a printing machine and executed on paper of 2 layers, which is customary when using this printing technique. The text of the woodcut p. 155 has been explained in JACOBSEN, 1959, p. 162. Si-

Newar woodcut, used during Nāga Panchami, showing Kanyū Nāgini, the divine snake virgin (for explanation see opposite page). It is hand-printed and hand-coloured on a single layer of paper.

milar prints on modern machine-made paper are shown in plate 174 from Kathmandu, where they were hanging over the entrance to a dwelling house.

On pp. 162–163 it is said that only once a year are the dead supposed to have an opportunity of squeezing through the gate into the heaven of the Newars, Yama Dvār (in 1958 August 30th). But in order to succeed they must have the assistance of a cow, who alone is able to open the gate with her horns. That a cow should solve this difficult problem is certainly due to the affection with which the inhabitants of the valley as well as in India regard the cow. P. 163:

"It is to this end that the ceremony of Gaii Jatra (Sa-Paru in Newai) is observed on this day. Every family in which a death has taken place during the past year sends a cow, or one of the family decked out as a cow, to help the dead into heaven."

The ceremony varies from place to place, but usually consists of the making of a skeleton, most often merely a basket, which is adorned with a variety of things. On the front of the basket there is a woodcut representing a cow's head and on the back a print of Gaṇeśa (the elephant god or the god of wisdom). The decorated basket, symbolizing the cow, is then carried around the town with the appropriate ceremonial.

The event which is anticipated with the greatest excitement is the feast in honour of the goddess of wealth, Lakṣmī, which is celebrated to obtain her favours for the year to come (in 1958, November 11th). Jacobsen says on p. 163:

"The morning is sacred to the cow, which receives offerings and is adorned with flowers. Thereafter all windows and doors in the newly cleaned house are decorated, incense is burnt, and at nightfall innumerable lamps are lit inside and out. Surrounded by the entire family in its finest clothes, the head of the family carries out the various rituals of offering to Lakhsmi. Coloured woodcuts of the goddess of wealth (Fig. 5) are pasted on the cashbox, and before her picture are placed offerings of money, fruits and sweets."

The woodcut on p. 1 shows such a print, made in Kathmandu in 1968 from a carved wooden block in a small printing machine. The print is normally coloured. As Werner Jacobsen writes op. cit. p. 164 of the same woodcut, there are not only Nepalese but also Chinese, Indian and even European elements in the picture.

Still another religious celebration will be described here; it is the *bēl* fruit ceremony of which it is said, p. 158:

"At a very early age Newari girls are given away in marriage to a bēl fruit and by this attain immunity from the horrors of widowhood under the strict orthodox Hindu rules, because irrespective of how later contracted marriages may develop, this first symbolic marriage is regarded as permanently valid. During the ceremony a woodcut, Mo-ki, is tied to the little girl's head and she carries the print during the next 24 hours."

The ceremony, photographed by Ruth Christensen, is shown in plates 175 and 177 together with the woodcut itself, plate 176. The bēl fruit comes from the tree *Aegle marmelos* and it has a large number of practical uses.

For other feasts and ceremonies other woodcuts are used, just as there are old prints used once in ceremonies now forgotten. JACOBSEN, 1966, p. 92, adds:

"Some woodcuts are not connected with any definite ceremony but function as amulets for obtaining desired goods or for averting disasters or sorcery. For direct attacks on devilry and ghosts a print is used of the eight mother-goddesses; "Asta Matrika": Mahakali, Bhairavi, Brahmayani, Maheswari, Vaisnabi, Kumari, Indrayani and Mahalakhsmi. In the print reproduced here [p. 93] the eight mother goddesses are grouped round Bokhva, whose awe-inspiring portrait is employed to avert the imminent calamity of which a dead cat or snake in the house is thought to be a sure omen. When the situation calls for the use of this print it is placed like a flag on a bamboo stick, which is stuck into an earthen jar with offerings of food consisting of boiled rice, other sorts of cereal, and vegetables."

It should be added that such offerings are not only known in the Himalayan states and Tibet; I have seen very similar ones even in Northern Thailand.

Concerning the manufacture of the woodcuts Jacobsen says, pp. 164–165:

"The blocks are cut by specialists of the Urār caste, and the material is, with only one known exception, wood [which is an old block of sun-dried clay, shown in fig. 9 of Jacobsen's article] . . . The size of the block is 15.5 by 18.5 cm., its motif the goddess Lakhsmi. . . . From the wood carver the printing block goes to the artist, who belongs to the Pung caste. To preserve its strength and durability it is soaked in oil (of mustard seed) before printing commences. The printing ink is made from a mix-

Newar woodcut, used during Nāga Panchami, also showing Kanyā Nāginī, the divine snake virgin (for explanation see p. 152). It is printed on a double layer of paper using a simple printing machine.

ture of lamp-soot, gum arabic (sares in Nepali and Newari) and water, the correct consistency being obtained by a slight warming. The block is placed on the floor with the printing surface uppermost, and the ink brushed on. The paper is then laid over the block and smoothed over with the hand. The paints for colouring the print are prepared in the same way as the printing ink but are of a more fluid consistency to allow application with a brush. The pigments now used are all imported chemical colours, but originally natural vegetable and mineral pigments were employed. The colouring is carried out on the "assembly-line" principle, one colour at a time, and here the artist is often assisted by the children of the family."

Sometimes the pictures are not printed but drawn. Werner Jacobsen says that drawings are perhaps regarded as more correct and powerful, but that they may also have been used because the artist could not afford to have printing blocks made, which of course he does not carve himself.

"Some time before each festival or ceremony for which the woodcuts are used the artists begin to manufacture an appropriately large edition, never larger than they estimate can be sold in the course of the coming festival, for from then until the following year's festival there will be no possibility of further sale. The day before the festival, members of the artist's family station themselves in the street surrounded by bundles of the print. Each type of woodcut is normally offered for sale in a number of variations.

Not all woodcuts are sold in the street. Some prints are delivered directly to those who hold the ceremonies, such as priests and the so-called black magicians, as with the woodcuts for the *bēl* fruit ceremony.

The woodcuts are of very differing sizes. The following formats are mentioned: 55 by 45 cm. (the Nāga prints) i. e. almost a whole sheet, 46 by 30 cm. or a half sheet, 28 by 23 cm. or a quarter sheet, 21 by 17 cm. or 1/6 of a sheet and smaller, down to 5 by 4 cm. (the Lakṣmī prints).

Already for several years the prints have been executed chiefly on imported Indian machine-made paper, and with cheap factory-made dyes. This is presumably also due to the fact that in this way a more gaudy colour effect can be obtained, as preferred in India for religious pictures. Besides, prints are mainly machine-printed nowadays. The making of woodcuts has thus been subject to great changes during the last 20 years, and the prints are not far from entirely losing their original charm.

2. Paper Slips with Writing

Probably woodcuts had hand-written forerunners, but to-day these are quite rare. LEVI, 1905, I, p. 294, describes a complicated ritual, which was used on various legal occasions in the Kathmandu Valley by both Newars and Gurkhas. The names of two contending parties were each written on separate pieces of paper, which were rolled into balls and then worshipped (pūjā). After a complicated test after which only one of the balls remained, the paper ball was unrolled, and the name on it was that of the winning party.

J. Kawakita, see KIHARA, 1957, p. 194, describes a death ceremony from the Lamaist Tsumje northwest of Kathmandu, used if it becomes known that the deceased has been possessed by evil spirits:

"The lama makes an effigy called mik pi ten to represent the dead person's body. The effigy is made by attaching arms and legs to a khurma, a small bamboo basket used at planting time. Inside the khurma, rice, wheat or barley is placed, and the effigy is dressed in the dead man's clothes. A piece of paper on which is written a passage from the sutras is then placed within the khurma. After a prayer, the lama removes the paper, burns it, and mixes the ashes with some tsampa. This he hides himself in some secret place."

Purna Harsha Bajracharya, Kathmandu, tells me that he has heard that strips of thin paper inscribed with magic formulas have been used as a medicine, a practice which was wide-spread in Tibet.

3. Ritual Cards

J. Kawakita, see KIHARA, 1957, pp. 189–190, describes and depicts some ritual cards obviously on paper. They are called *Thyasing Nadung* and are used at the *Thuje Chhenbo* ceremony in Tsumje (northwest of Kathmandu). P. 190:

"Thuje Chhembo [67] is the name of a god with four hands in whose name services for the dead are performed in households where death has occurred or where a rich man wishes to have memorial prayers said for a dead relative.

. . .

[67] Following Waddell, T'ugs-rje-ch'en-po is a Tibetan name of Avalokita."

I bought some cards in the Lamaist Bodhnath very reminiscent of those described by J. Kawakita in both appearance and function. The cards are made from paper, except for a few executed on impregnated cotton cloth. Nearly all the cards are coloured and rather old and worn (plate 168). In Bodhnath I was told that they were used in a death ceremony during which a lama carried them one by one past the eyes of the deceased in order to help "the soul to heaven", or rather to guide the conscience through the 6 spheres of existence towards nirvana.

J. T. 48 a and b are 4-layered and coated with lime. The paper has been scooped on a fairly fine-meshed mould of fabric (see also the table p. 233). Yet another card has 6 layers and is not coated. The two outer layers consist of short-fibred paper, scooped on a fine mould of fabric (with 60 threads per 50 mm.), whereas the inner layers are of a long-fibred paper, scooped on a coarse-meshed mould. The two outer layers are short-fibred to make the surface smooth for drawing.

4. Horoscopes

In Nepal, as in India, astrology and the making of horoscopes and calendars are extremely old practices. As mentioned in chapter I, p. 25, the T'ang Annals say about the residents of the Kathmandu Valley (from LEVI, 1905, I, p. 164): "They know rather well how to calculate the future ... They are also clever at making calenders." Nothing much seems to have changed in these respects until our own times. WRIGHT, 1877, p. 44, thus writes:

> "Astrologers form another large class of the learned community. Some of them are also priests, but in general the professions are distinct. In Nepal astrology must be a profitable pursuit, as no great man thinks of setting out on a journey, or undertaking any business whatever, without having an auspicious moment selected. Indeed the time for everything, from the taking of a dose of physic to the declaration of a war, is determined by the astrologers."

The basis for making the calculations is a long and narrow horoscope roll, which is drawn up at one's birth and which can be consulted on important occasions later on in life (before travelling, marriage etc.). 3 different horoscope rolls, J. T. 42, 43 and 44 are described in the table p. 233 and J. T. 42 is shown in plates 169–170. The dimensions of the rolls show that whole paper sheets, measuring 640 by 480 mm. have been cut into 3 lengths of 640 by 160 mm. which are pasted together in 2 or 3 layers into one length. J. T. 42 consists of 3 such lengths and is 1740 mm. long. All 3 rolls are treated with orpiment on one side, which has evidently been necessitated by the mild climate of the valley in order to avoid attack from insects and other animals. Purna Harsha Bajracharya says that the horoscope rolls are of very differing size and appearance. One made for the famous king Pṛithī Nārāyaṇa Shah, who ruled Nepal 1768–1775, is said to measure 25 metres and is executed on cloth.

5. Fortune-Telling Cards

On my way to Bodhnath I met a pleasant elderly woman at a bridge, who asked if I wanted to have my palm read. Instead, I asked her to sell me the card she used for the interpretation of the lines of the hand (plate 171). In the sections between the lines of the card various figures are to be seen, including flags, scales, suns and flowers, which, she said, indicate happiness, harmony, a bright future, wealth etc. When I asked if there were no sinister things at all among them, she indignantly shook her head as if to say: "I certainly do not sell bad goods." The card measures 153 by 105 mm., it has 2 layers and is dyed yellow with orpiment on the front.

6. Paintings

Old Nepalese paintings, which practically always have religious motifs, seem generally to have been executed on canvas and are often made into scrolls (see e. g. LEVI, 1905, I, supplement). Furthermore the *thanka*, the Tibetan form of the Chinese scroll, has also been used in Nepal. But paintings on paper were common too. In *"Nepalese Art"*, 1966, several examples of these are shown and described. Two of them are from the 18th century (VIII/10 and VIII/12) and measure 81 by 60 cm. (almost twice a whole sheet of paper) and 61 by 57 cm.; two others are from the 19th century (VIII/19 and VIII/20) and measure 62 by 43 cm. and 56 by 41 cm. (nearly one whole sheet). The painting in plate 178 is from Patan and it measures 37½ by 29 cm. (half a sheet.)

7. Masks

The outer layer of a monkey mask brought home from Nepal is made of paper. The mask is made from burnt clay strengthened on the inside with a layer of canvas and on the outside with a layer of painted paper. Masks etc. of papier mâché are also known, especially in the Lamaist highlands (plate 19 from Northwest Nepal) and among Newars (plate 9 from Patan).

8. Decorations

Various paper objects are used at the many religious processions and ceremonies that take place in Nepal all the year round, including richly coloured flags, flowers, festoons and paper animals. In the Kathmandu Valley it is probably the painter caste, Chitra Kar, which makes these things and carves the woodcuts as well as the decorations of dancers' masks and the large umbrellas for processions.

D. Paper Used in a Plain and Undecorated State

1. Wrapping Paper

Stalls use quite a lot of the common quality for the customers' purchases of foodstuffs and various other items. Often the paper is on sale in grocers' shops, because there are only few shops that deal exclusively in paper. The handmade paper is particularly suitable for wrapping, because of its great pliancy and strength. On our tour in the mountains Urgen had prepared a number of bags of food, among them one of sugar. "Bag" is not really the word: two layers of the cloth-like paper were simply gathered round the sugar. Three times a day for three weeks the paper was twisted and untwisted without ever cracking. It is not difficult to understand the reluctance of the Nepalese to use the weak Indian or European paper.

2. String

The paper is so strong and flexible that it is sometimes twisted into string, e. g. for tying up big bundles of paper.

3. Windows

Until recently window-panes were rare and expensive in Nepal, not least in the highlands. To keep out the wind and cold, and yet admit a little light to the rooms, paper was used besides cotton cloth exactly as in Tibet, China and Japan. In Junbesi in Northeast Nepal there were glass windows in several places, but one of the windows in my room was covered with a sheet of paper. Of the same mountain tract SNELLGROVE, 1957, p. 217 writes:

> "Those who can afford it, import glass, but normally the windows consist of light removable frames covered with the tough paper."

Yet in 1964 paper windows were already becoming rare. According to P. H. Bajracharya it is not unusual in the Kathmandu Valley to paste paper on the back of the elaborately carved windows.

4. Ceiling Coverings

In Nepalese houses the division between the ground floor and the 1st floor mostly consists merely of simple boards upon cross-beams. Gravel, insects etc. often fall from the upper rooms, so paper is sometimes pasted onto the ceiling. G. B. Shah says that Nepalese cardboard was once used as wallpaper in the valley, but that it is out of fashion now.

5. Lining and Backing

BEATTY, 1962, p. 24, writes:

"Cheaper grades of paper are used in lining and backing in some hand-craft enterprises, and for making masks and cut-out images and shapes. . . . Paper is a source of warmth in the winter when used as padding under outer coats or capes."

However, this last mentioned usage must be rare in Nepal and Tibet, since none of my acquaintances from there knows of it.

6. As Dressings

P. H. Bajracharya says that in order to stop bleeding from a wound, it was once the custom to scratch the paper and place the fluffy fibres in the wound. Another description of the use of paper for medical purposes comes from Sikkim, but has surely been known in East Nepal too. HOOKER, 1855, Vol. II, p. 39 writes:

"My servant having severely sprained his wrist by a fall, the Lepchas wanted to apply a moxa, which they do by lighting a piece of puff ball, or of Nepal paper (that burns like tinder), lying it on the skin, and blowing it till a large open sore is produced."

7. As a Cure for Headaches

Among Bhotias and Sherpas I have often seen women with small squares of paper pasted to their faces. My Tibetan acquaintance tells me that in Tibet they are used against headaches (= evil spirits), that they contain a plant extract and that it is an old practice. These squares are equally used as a decoration to-day.

8. Wrapping Incense

To ignite incense it is often wrapped in handmade paper; other paper is less suitable for this purpose, as it burns with an acrid smell and leaves grey-black ashes. Plate 182 shows a bundle of such "incense sticks".

9. Cartridges

WALLICH, 1820, p. 387, quoting H. R. Murray, writes:

"The paper prepared of its bark is particularly calculated for cartridges, being strong, tough not liable to crack or break, however much bent or folded, . . ."

10. Fireworks and Toys

According to BEATTY, 1962, p. 24, paper is used for the production of fireworks. It is also used for making kites during the "Kite Festival" which takes place in September and October, when several hundred kites can be seen against the blue sky in the Kathmandu Valley (plate 5).

11. Miscellaneous

Beyond this, the handmade paper is used for albums, briefcases, boxes, blotting paper and serviettes in and around Kathmandu, where gradually all the general uses of paper elsewhere in the world have been introduced.

E. Decorated, Written or Printed Articles for Secular Use

1. Maps

LEVI, 1905, Vol I, pp. 72–74, mentions various locally produced maps of Nepal, and one on paper is shown on p. 72 in the same place. Another map, produced before 1785, is said to have been about 4 feet long by 2½ feet wide and on cardboard.

2. Playing Cards

The playing cards which we saw Sherpas using so industriously in many places were all of Western origin, but formerly hand-decorated playing cards on handmade paper were also used. The samples I brought home from Patan have 12 cards in each colour, 2 of which have pictures (the jack and the king, leaving out the queen of Western cards!). Two cards are shown in plates 172–173.

4. Postage Stamps

Nepal's philately is described by E. A. Smythies, L. E. Dawson and H. D. S. Haverbeck in *"The Postage Stamps of Nepal"* of about 1940. On p. 41 it is said:

"In 1886 the white wove imported paper was abandoned in favour of the local hand-made paper, which (with one rare exception) was used continuously for the next twenty years in the preparation and printing of these stamps."

The postage stamps on handmade paper are executed on various types of paper ranging from the rather brown to the whiter qualities. They all seem to be single-layered, and are often thin and on rather short-fibred paper. A block of 9 stamps is shown in plate 182 (see further the table p. 233 concerning J. T. 49 from the 1899 issue).

5. Newspapers

G. B. Shah says that until about 1941 the government paper *"Gorakhapatra"* was printed on Nepalese paper and also that until 1950 it was the only newspaper published. BEATTY, 1962, p. 24 moreover writes:

"The local newspapers are printed on a poor grade of imported sulphite pulp but from time to time, when the caravans don't arrive in time, "releases" and tabloid editions come out on local paper."

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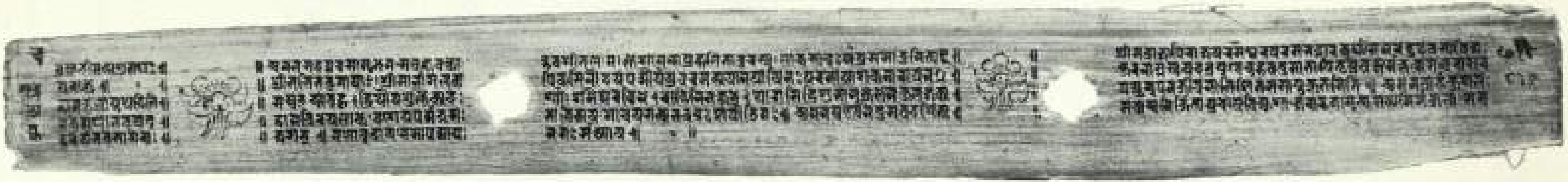

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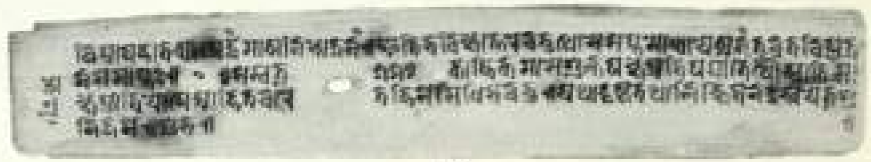

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Plate 110. n. 173, 11th or 12th century (executed in Bengal?). ½ size.
Plate 111. n. 175 a, N. S. (*Newari Samvat*) 200 + 60 + 5 (A. D. 1145). ½ size.
Plate 112. n. 168, N. S. 366 (A. D. 1246). *Mithila* writing. ½ size.
Plate 113. n. 91, N. S. 370 (A. D. 1250). ½ size.
Plate 114. n. 72, N. S. 446 (A. D. 1326). The date has later been adjusted to N. S. 447. ½ size.
Plate 115. n. 90, N. S. 552 (A. D. 1432). ½ size.
Plate 116. N. 169, N. S. 652 (A. D. 1532). ½ size.

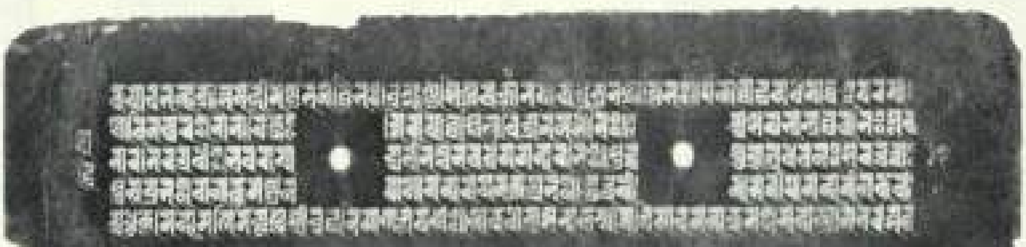
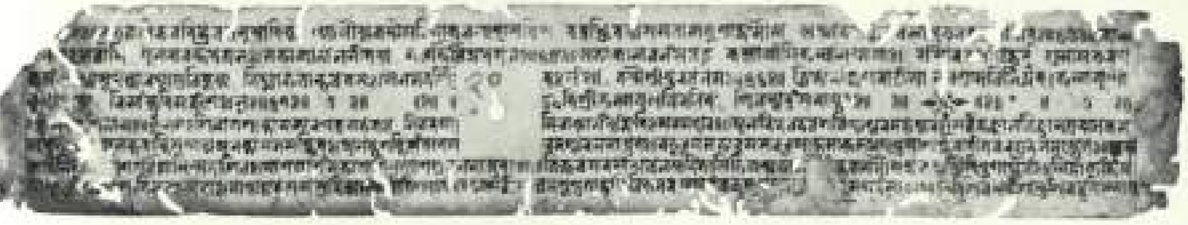


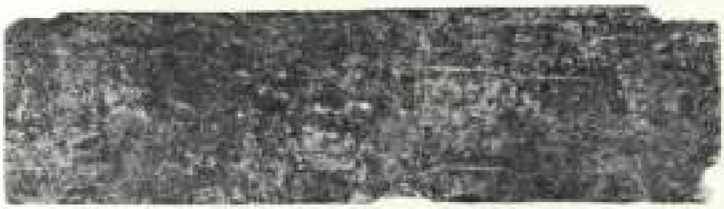
Plate 117. Probably the oldest paper ms. found in Nepal (10th century?), but possibly deriving from North-western India; now in the library of the *National Archives*, Kathmandu. The paper is made from Thymelaeaceae fibres probably from *Daphne bholua*, and it is neither dyed nor starched. About 1/3 size.

Plate 118. Ms., Bir Library, II. 51, N. S. 340 (A. D. 1220) on blue-black paper. Size 530 by 100 mm.

Plate 119. The double-layered paper from the preceding ms., Bir Library, II. 51, carefully separated before being photographed. Full size. Observe the imprint of the mould with 35 lines per 50 mm., probably a grass mat.

Plate 120. n. 176 f. 13th century. Colour and mould as the preceeding ms. but with 45 lines per 50 mm. 1/3 size.





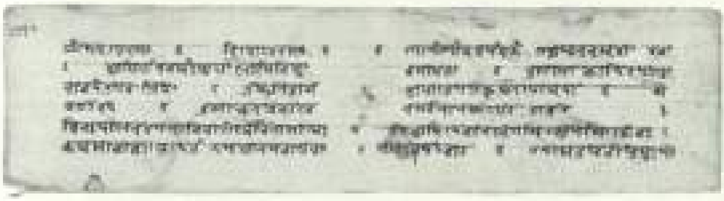


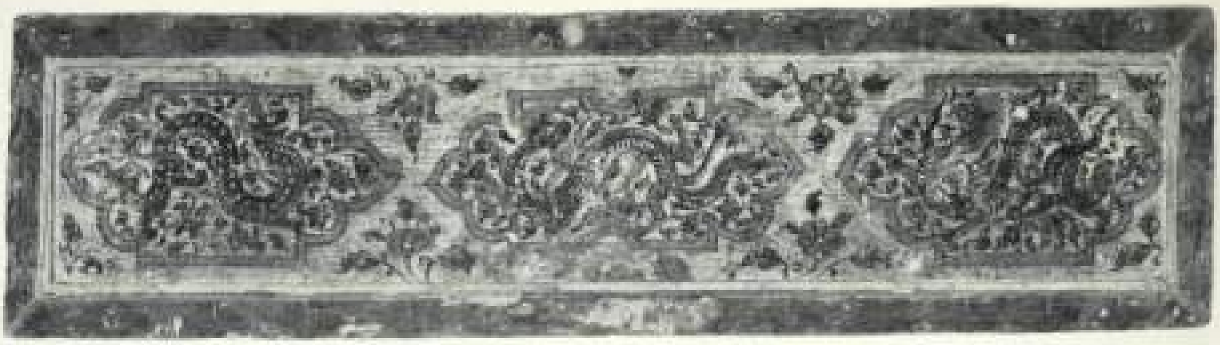
Plate 121. Ms. from the *Asutosh Museum*, Calcutta, N.S. 5 + 20 + 200 (A. D. 1105). Oldest known ms. on paper made in Nepal. Size 380 by 85 mm.

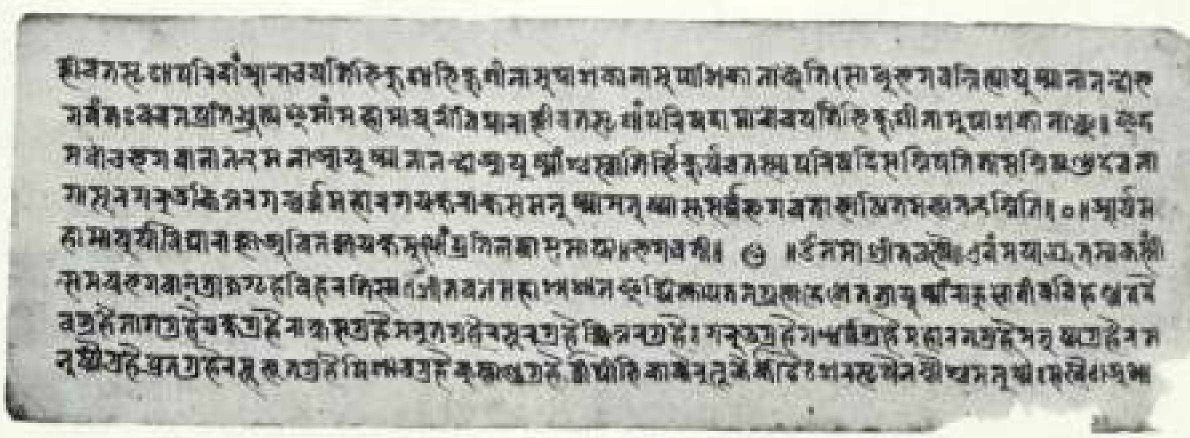
Plate 122. n. 117, late 15th century. Notice the palm leaf character of the ms. 1/2 size.

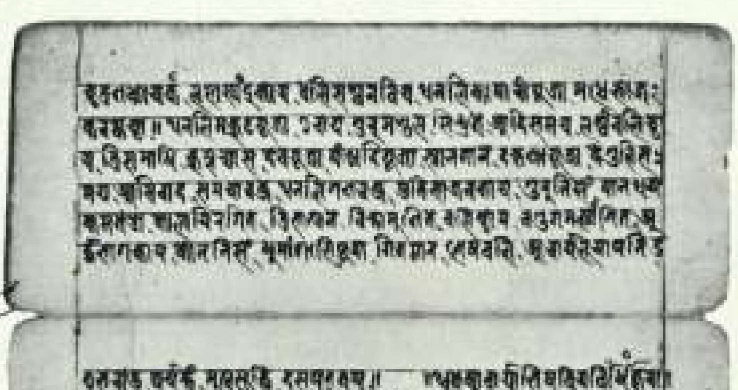
Plate 123–124. n. 123, 15th century, cover and ms. on *Aquilaria agallocha* bark. The pages are dyed yellow with orpiment, As_2S_3. 1/2 size.

Plate 125. n. 85, 15th or 16th century, a Jain ms. from Northern India but found in Kathmandu, 1/2 size.

Plate 126. A page of n. 85, photographed in transparency. The mould was a grass mat with 30–35 lines per 50 mm. Full size.



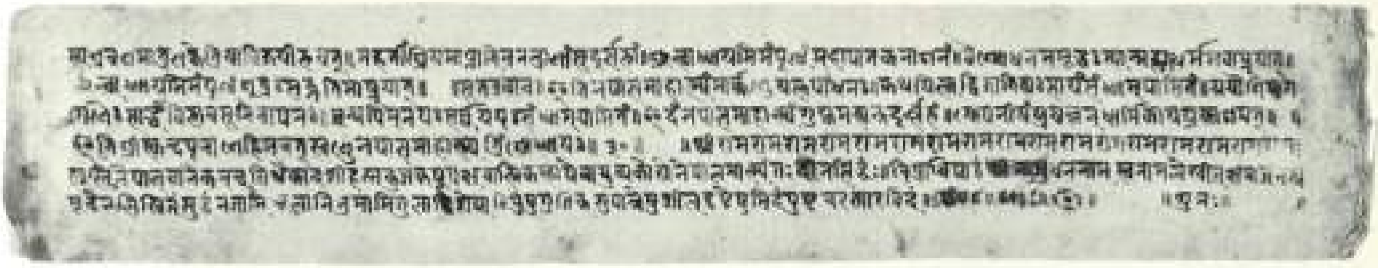




Plates 135–136. n. 100, N. S. 805 (A. D. 1685), one of the two wooden covers and the first leaf. The paper is dyed yellow with orpiment as the other yellow mss. mentioned below. 1/2 size.

Plate 137. n. 84, N. S. 856 (A. D. 1736). The paper is yellow and very soft, almost like blotting paper. 1/3 size.

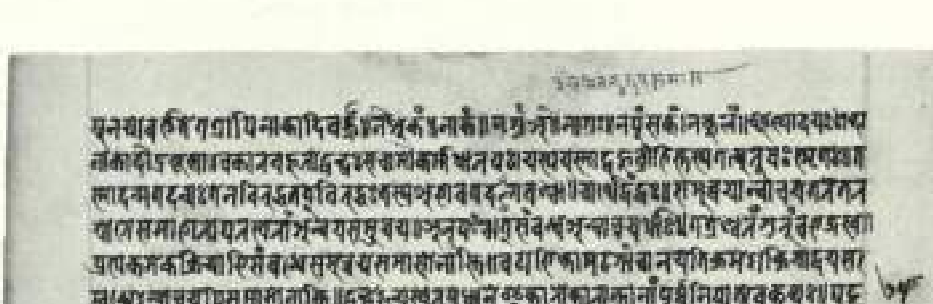
Plate 138. n. 70, N. S. 857 (A. D. 1737), concertina on yellow paper. 1/2 size.

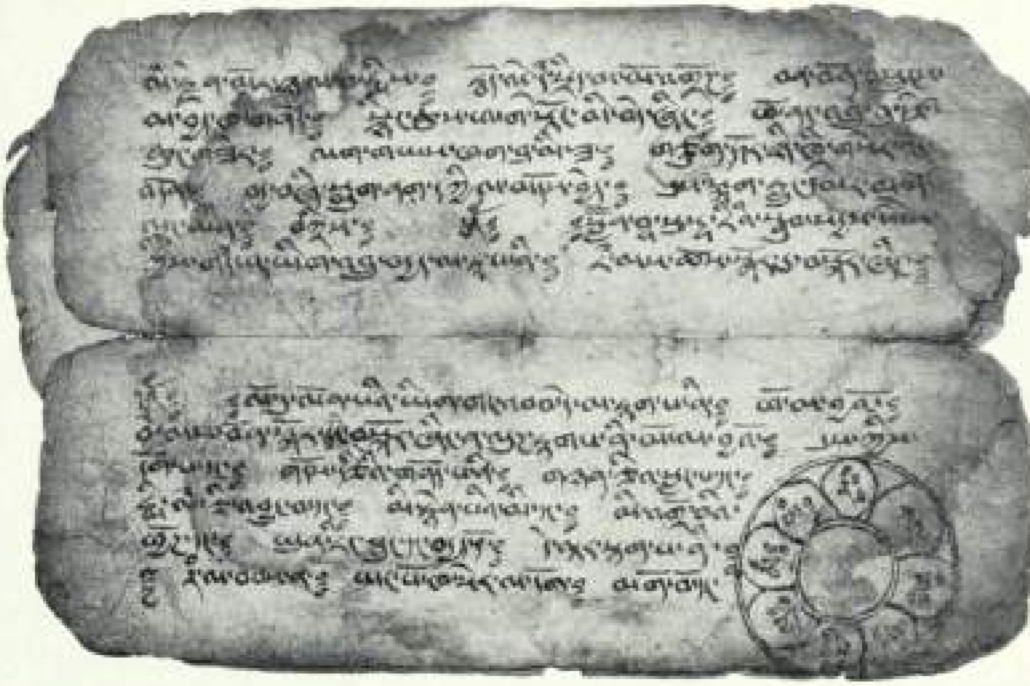


Plates 139–140. n. 162, N. S. 873 (A. D. 1753), one of the two wooden covers and the last leaf. The paper is yellow on one side. ¹/₂ size.

Plate 141. n. 67, N. S. 865 (A. D. 1745), concertina, two pages unfolded. The paper is yellow. Notice the fine cotton fabric on the right side of the plate which is the inner, strengthening layer of the leaf. ¹/₂ size.

Plate 142. n. 166, N. S. 939 (A. D. 1819). One side of the paper is yellow. ¹/₂ size.





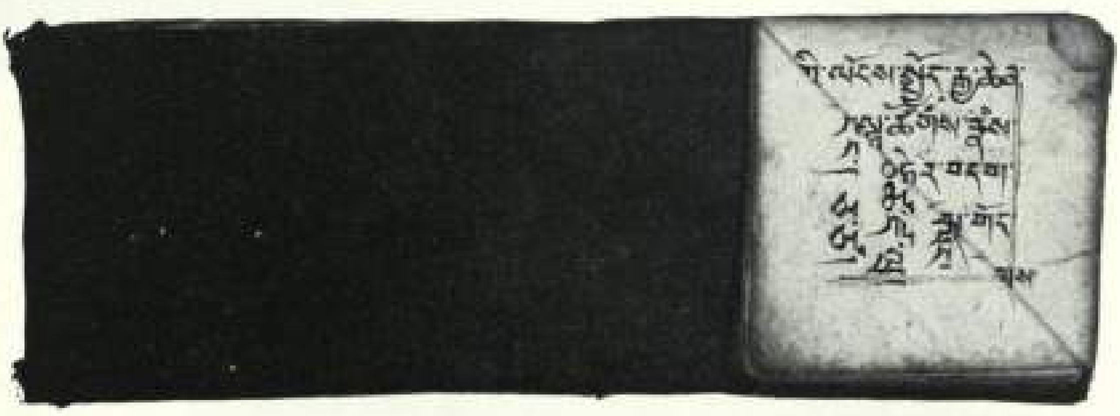


Plate 150. J. T. 16, ms. from the Sherpa village, Junbesi, East No. 3, like the mss. plates 151–156. Stitched binding. $^{1}/_{2}$ size.

Plate 151. J. T. 17, stitched binding, two pages shown. $^{1}/_{2}$ size.

Plate 152. J. T. 18, stitched binding made of black fabric; one corner is folded to show pages. $^{1}/_{2}$ size.

Plates 153–154. J. T. 12 c, coloured drawings with text on yoga. *Pōthi*, ½ size.

Plates 155–156. J. T. 20, block-printed *pōthi* leaves, front and second leaf. Notice the *Lañtsa*-writing at the top of the front leaf. ½ size.

Plate 157. J. T. 21, ms. found in Tukucha in West Nepal. Pōthī made on *Wikstroemia chamaejasme* paper. ½ size.

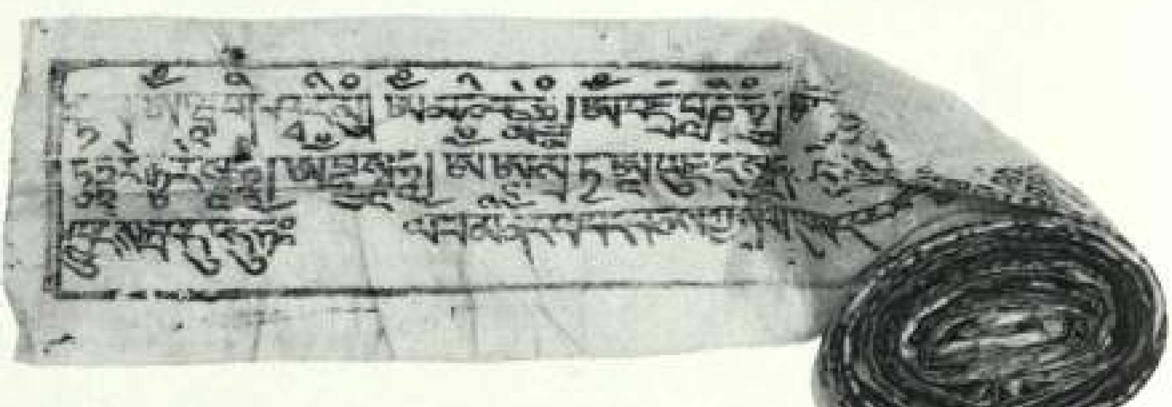


Plate 162. A printing slab made of hard close-grained wood acquired at Namche Bazar. It measures 50 by 32 cm. or exactly half of a paper sheet of the common size. Used for printing the long banners of cotton mounted on high poles seen outside almost all Lamaist houses, as well as for paper woodcuts like the one shown in plate 159.

Plate 163. J. T. 52, a paper strip about 10 meters long from a prayer wheel (cf. plate 35) on which is printed: *Oṃ māṇi padme hūṃ*. From Patan. $^1/_1$ size.

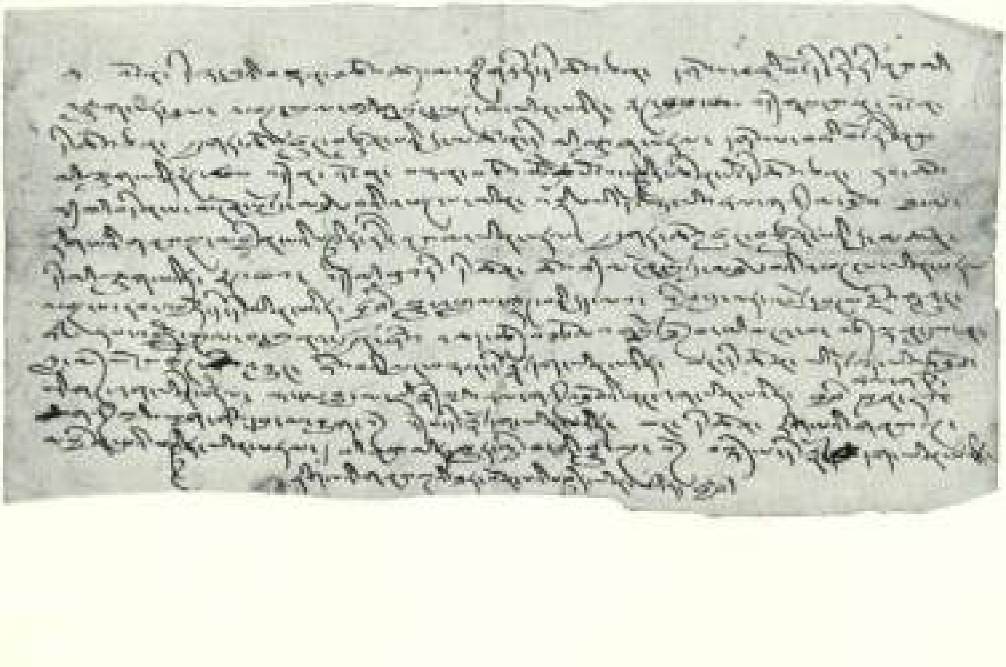


Plate 164. J. T. 2, woodcut, a *mandala* to protect the traveller. It is put in an amulet bag or box and hang round the neck. Dopu Bazar, Solu, East No. 3. 1/4 size.

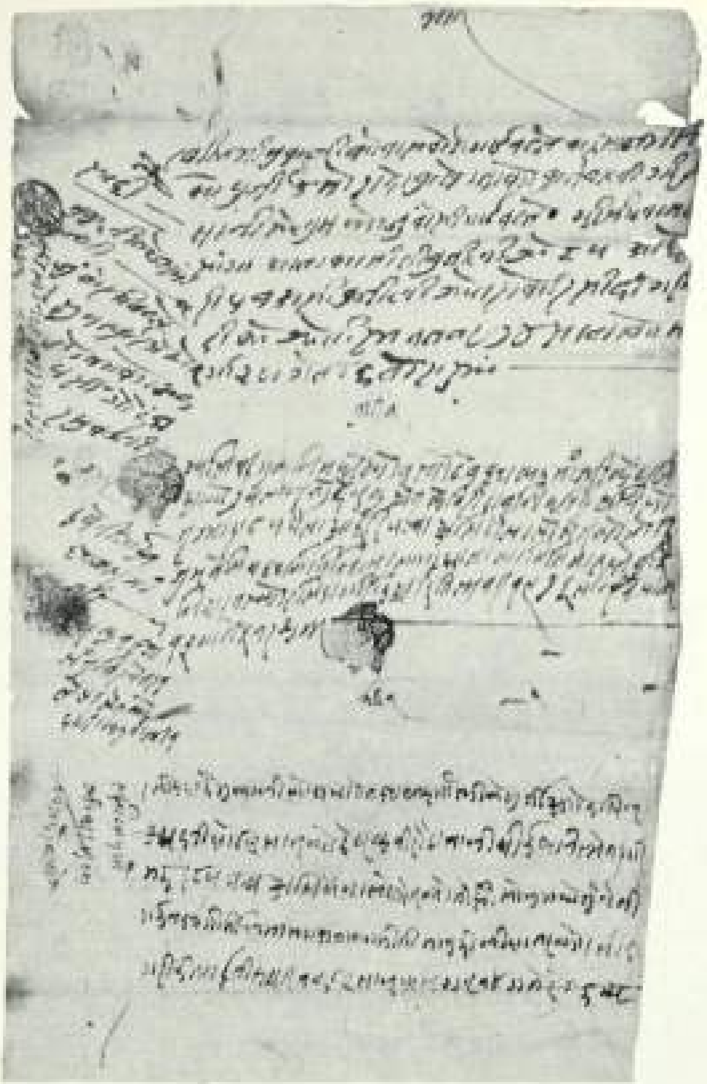
Plate 165. J. T. 8, *dhāraṇī* from the Takśindo monastery, Solu, with block-printed *Lañtsa* letters. 1/4 size.

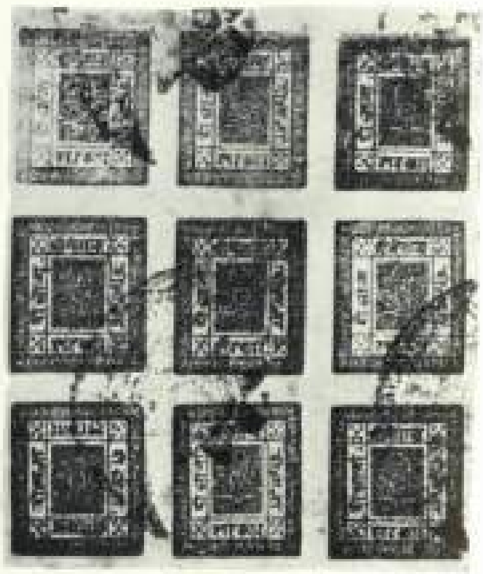
Plate 166. J. T. 46, letter in Tibetan found in Kathmandu but originating from Tibet. Written on *Wikstroemia chamaejasme* paper. 1/2 size.

Plate 174. Two Naga wood-cuts pasted with cow dung over the entrance of a Newar house in Kathmandu (see p. 152–154).

Plates 175–177. From the *bēl*-fruit ceremony, during which Newar girls holding a *bēl*-fruit (*Aegle marmelos*) in their hands marry this fruit so they may never suffer the restrictions of orthodox Hindu widowhood. Here 11 girls from the age of 6 to 12 years are married, the ceremony taking place in Kathmandu. Photographs by Ruth Christensen. Plate 176 shows the woodcut with the *bēl*-fruit fastened to the top of the girls' heads (plate 177) during the ceremony. 1/3 size.

Plate 178. Old painting on paper. Patan. ½ size.





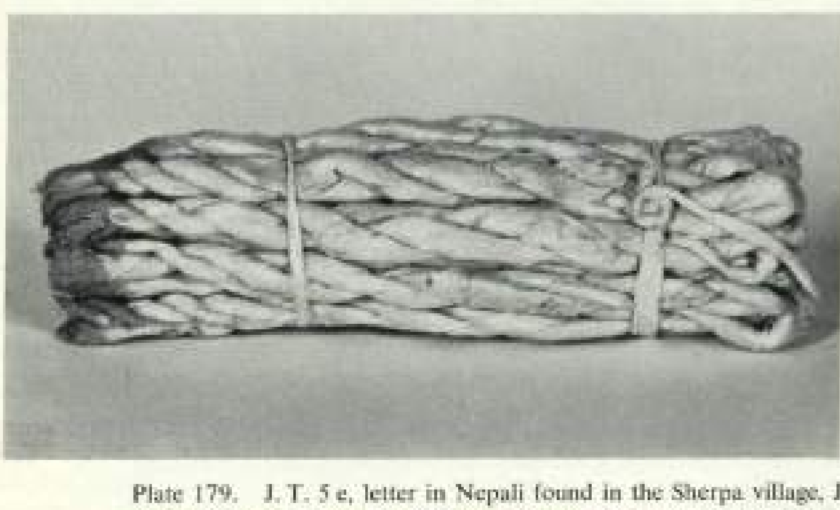


Plate 179. J. T. 5 e, letter in Nepali found in the Sherpa village, Junbesi (the official language all over Nepal is to-day Nepali). It is dated *Vikrama Samvat* 1983 (A. D. 1926). Notice stamps and fingerprints. ½ size.

Plate 180. J. T. 45, bill from a shop exclusively selling handmade paper in Kamalaksmi Road 11/907 (plate 10) in Kathmandu. ½ size.

Plate 181. J. T. 53, a bundle of incense sticks made from incense powder placed in rolls of handmade paper and then twisted. Full size.

Plate 182. J. T. 49, 9 postage stamps on handmade paper. Full size.

CHAPTER VI

Technical Investigations

This chapter contains a number of different technical investigations of bast fibres from plants and paper. Many of the results of these investigations have already been given above, but the measurements are more closely described and discussed in the following. The chapter is divided into three main sections. In section *A* measurements of the macroscopic properties of new, unused and untreated paper are referred to, i. e. shape, surface, density and strength; some of these measurements are also made on manuscripts and commented upon. In section *B* the microscopical analyses are closely described. Finally in section *C* a series of analyses are discussed of organic and inorganic elements and compounds in bast and in new and old paper.

A. Macroscopic Properties

1. New, Unused Paper

38 samples collected from different parts of Nepal together with two samples from Tibet, two from Bhutan and one from Dalhousie in Northwest India have been investigated (measurements see table pp. 226–227). The investigations cover the format, colour and brightness of the paper sheets, the imprint of the mould on the paper, as well as the thickness, density, various properties of strength, and also the fibrous texture of the paper as seen in transparency. The fibres of the samples are mentioned briefly here but dealt with more closely on p. 197. The various samples of Nepalese paper are divided into three groups in the table: In group *I* those made by the commonest method and originating from the mountains in East and Central Nepal i. e. almost as far west as Pokhara, in group *II* the samples from the Baglung area, and finally in group *III* the paper made in the Kathmandu Valley.

All the samples were made between 1958 and 1964 and measured in 1965 at the Central Laboratory, *The United Paper Mills Ltd.*, Copenhagen, and at a constant humidity of 65 % and temperature of 20 ° *C*. Even in the very same paper sheet there are often substantial differences in many of the properties mentioned. Each of the values indicated in the schedule is thus the mean value of a suitable number of measurements.

a. SHAPE. The *formats* of the sheets in group *I* deviate only a little from an average, measuring 48 by 64 cm. = *a* by *b* cm., where the proportion *a/b* is equal to 3/4. The Baglung format (group *II*) is much larger, about 60 by 135 cm. or about *b* by *3 a* cm. From the Kathmandu Valley (group *III*) we only have the format of three sheets. Two of them are only a little larger than the most common format, while the third almost corresponds to the large Baglung format. The two Tibetan paper sheets (see too p. 146) very nearly measure *a* by *2 b* cm. and *b* by *3 a* cm. respectively, one of the Bhutanese paper sheets *b* by *b* cm. and the other one a little more. The Dalhousie paper is somewhat less than *2 a* by *2 b* cm. The lengths *a* and *b*, which seem to reappear in so many formats, presumably derive from measures used in the bazaars. To the mountain people *b* almost equals the average length of the arm, and *a* equals *b* minus the length of the hand.

The *thickness* of the samples has been measured at a test load of 1 kg. per cm.², the test area being 2 cm.² For groups *I* and *II* the values are between 0.04 and 0.10 mm. (a single one, No. 27, being 0.165 mm.). Thin qualities below c. 0.06 mm. are specially used for wrapping paper.

b. SURFACE. The *colours* of the samples in groups *I* and *II* are all more or less brownish, only No. 19 from Baglung is whitish. This is due in the first place to the primitive method of production, by which the fibres are merely boiled in a lye of ashes. In group *III* the colours are far more varied. Here stronger chemicals are used for the cooking of the fibres and sometimes bleaching agents have also been added.

The *brightness* is a measure of the percentage of light reflected off the surface of the paper in bluish light. It has been measured by an apparatus of the make El-Rpo, Germany, with the use of a blue filter (wave length 427×10^{-9} m., R. 46 T, Tappi-standard). The values found follow the colour indications. For groups *I* and *II* a brightness below 31 % thus corresponds to red-brown, 31–42 % to brownish, 42–54 % to only light tanned, and above 54 % to almost white. In group *III* the values vary between 23 % and 64 %.

As previously demonstrated the *imprint of the mould* on the paper (a kind of watermark) may often disclose its origin. Not only the kind of mould (cloth, grass straw or bamboo mats as far as the older Nepalese manuscripts are concerned), but also its detailed structure may give important hints in that respect. The moulds of group *I* all seem to have been made of some fabric of linen with only 20 to 30 threads per 50 mm. (except No. 30, which was probably made very close to, if not in the Kathmandu Valley). The moulds of group *II* were made of cotton fabric, and there are 40 to 50 threads per 50 mm. The moulds of the sheets in group *III* from the Kathmandu Valley were also made of cotton fabric and the number of threads corresponds approximately to that of the samples from group *II*, which is presumably due to the fact that the papermakers were brought from Baglung to the Kathmandu Valley when production was started there.

The two Tibetan samples, Nos. 11 and 12, are easily recognisable, being soft, rather white and with small protruding fibre bundles on one side of the paper; properties that result from a different fibrous material and a slightly different method of production. No. 23 from Bhutan is very brown and thick with distinct streaks, because the paper has been scooped on a coarse-ribbed mould of grass straw. No. 44, also from Bhutan, is reminiscent in nearly all respects of Nepalese paper, but has been scooped on a very fine mould of cotton cloth. This is also the case with No. 46 made by Tibetan refugees in Dalhousie.

c. WEIGHT AND DENSITY. The *basis weight* or *square metre weight* is the weight in grams of 1 m.² of the sample. The *bulk or the relative thickness* is the thickness of the paper obtained by multiplying its real thickness by 100 grams/the basis weight. It is a term used to indicate volume or thickness in relation to weight and therefore partly a measure of the specific gravity of the particular fibres, partly of the density of the fibre network. For paper made in the mountains the bulk lies between 0.23 and 0.32 mm. and is greatest in the open qualities. For paper made in Tripureswar there are values down to 0.15 mm.

The *printing opacity* is not a well-defined quality and depends on a great number of the paper's characteristics, i. e. on the surface, the type of fibres and not least, with regard to the present samples, on the thickness. Measuring apparatus Bausch & Lomb, U. S. A.; filter yellow-green (wavelength 546×10^{-9} m).

The *porosity* was measured by a Gurley Densitometer, U. S. A., by which is determined the time it takes to force a fixed quantity of air (100 cc.) under a constant pressure (13.15 pond/cm.²) through a fixed area of the paper (6.45 cm.²). For samples in groups *I* and *II* the values are very small, between 0.1 and 1.8 sec. (for No. 18 which is 2-layered, 10 sec.). The porosity is highest in good qualities, such as Nos. 1, 2, 7 and 30 and smallest for typical wrapping paper. For single-layered samples produced in the Kathmandu Valley there are values up to 62 sec. The porosity of paper is mainly dependent on the sizing; it is normally unfit for writing purposes if the value of porosity falls below c. 0.5 sec.

d. PROPERTIES OF STRENGTH. The *breaking length* is defined as the length in metres at which a strip of the paper when suspended would break by its own weight. For the samples in group *I* and *II* the figures are seen to be high, between 2700 and 4200 m. Like the other properties of strength, the values depend on many properties such as species, length of fibres, amount of cooking and beating.

The *stretch* is here defined as the relative elongation of a paper strip at the moment of breaking, at the breaking point 20 ±5 sec. For samples in group *I* and *II* the values vary but little and are between 2.0 % and 3.4 %; in group *III*, on the other hand, they are between 1.0 % and 6.2 %.

Tearing is a measure of the resistance against tearing, measured in "gram force" (gf). This is the even force that is necessary in order to perform tearing in continuation of an initial cut in a single paper sheet, measured here by the Appita Elmendorf method. For groups *I* and *II* the values vary between 170 and 580 gf, for group *III* between 20 and 240 gf.

The *folding endurance* is measured by a specific method, which will not be described in detail. Let it merely be said that strips of paper, 1 cm. broad, are subjected to an initial load of 1 kg. and thereafter repeatedly folded along the same line until the break occurs, the number of double foldings being recorded. Apparatus: Schopper, Germany. The values vary a great deal and reveal essential properties of the paper. In groups *I* and *II* good qualities like Nos. 1, 7, 8, 18, 19, 24 and 30 have high folding endurance, while lesser qualities like Nos. 5, 6, 9, 10, 13, 17, 21, 25, 27, and 28 have low folding endurance or cannot even take the initial load. In group *III*, apart from No. 37, the tests show low folding endurance, mainly because the paper is short-fibred. Notice also the low values of the two *Wikstroemia chamaejasme* samples from Tibet.

The hardness of the paper or the so-called *rattle* is estimated simply by grasping the paper with both hands and making it rattle. The sharper the sound thus produced, the harder the paper, everything else being equal. The hardness depends on many factors but mainly on the degree of the partial gelatinisation or agglutination of the fibres under the prolonged action of beating.

e. MACROSCOPIC FIBROUS CHARACTER. As was to be expected, there is a close connection between the samples' fibrous character (cf. plates 183–198) and their properties of strength, see for example the samples from the Kathmandu Valley (group *III*) which are of very varying qualities.

2. The Uses of the Paper

Only a few of the measurements mentioned under section *I* may profitably be applied to the various uses of the paper such as mss. because these mostly consist of pasted and dyed paper that has, in addition, often been exposed to dirt and dust. As far as the old samples (the mss.) are concerned, one also has to take into account the considerable variations in the properties of the paper brought about by chemical changes of the fibres in the course of time. But the thickness of the separate layers, the imprint of the mould and the paper's macroscopic fibrous character will only have altered slightly.

Thickness. In the case of the manuscripts the thickness of the paper per layer amounts to 0.06–0.12 mm., with an average of about 0.09 mm. (see pp. 228–233). These are not the original thicknesses, as two or more layers have been pasted together and then smoothed. However, these two effects counterbalance each other pretty well with regard to thickness.

The moulds. The difficult and time-consuming measurements of the imprints of the moulds on the paper of old manuscripts show, a little suprisingly, that in the Kathmandu Valley the paper generally was scooped on finer moulds of fabric than those now in use in the mountains north of the valley.

Macroscopic fibrous character. Among the old mss. on paper there are some whose fibrous character is very different from modern qualities, but generally the *Daphne* paper of old manuscripts is not very different from the qualities that are produced in the mountains to-day.

B. Microscopical Analyses

The best method of studying a sample of paper, whose origin is either wholly or partly unknown, is still to examine the fibres under the microscope. In this way it is generally possible to determine the family to which the fibres belong, often the species too, and thus from which area and epoch the paper may originate. Furthermore, it is possible from the appearance of the fibres to say what treatment they have been subjected to, e. g. with regard to the cutting, cooking and beating. The presence of foreign particles may disclose the addition of various substances to the pulp, e. g. a coating of rice paste or wheat flour paste.

To determine the type and treatment of the fibres of a sample, it is of course important to know their appearance in their original state. Consequently the first investigations to be discussed are those of the microscopical properties of the raw Thymelaeaceae fibres, which have been used almost exclusively for making paper in Nepal up to our time. Then follows a description of the microscopical analyses of unused and untreated paper, and finally analyses of the paper of mss. etc.

Microscopical analyses of bast fibres from species other than the Thymelaeaceae family, which are found in a few mss. or in new Nepalese paper, will not be described separately as—with two insignificant exceptions—they are all thoroughly described in the literature. An important work on plant fibres and their identification is Julius Wiesner's *"Die Rohstoffe des Pflanzenreiches"*. The 1927 edition, Vol. I, pp. 290–705, contains an examination of the most important species of fibres and bast, e. g. of flax p. 541, hemp p. 554, jute p. 565, ramie p. 572, straw fibres including rice straw fibres p. 664, *Edgeworthia* p. 671, and bamboo p. 672. Reference may also be made to the three volumes by Alois Herzog published in 1955: *"Microphotographischer Atlas Der Technisch Wichtigen Pflanzenfasern"*.

The bast fibres of Thymelaeaceae are so much alike that it is rather difficult to differentiate between them. But as the trees and shrubs used by the paper-makers belong to such a heterogeneous area, an attempt has nevertheless been made to distinguish the species by their bast fibres.

VOGL, 1910, has carefully examined 10 different species of *Daphne* from Europe. This work is referred to in *"Just's Botanischer Bericht"*, 1910, p. 1590:

"Er ist aber der Überzeugung, dass die Bastfasern einen grossen Wert für die Systematik dieser Pflanzengruppe repräsentieren. Verf. konnte bei jeder der untersuchten Arten eine typische Form dieser Bastzellen konstatieren, und es gelang ihm auch aus diesen 'typischen Fasern' die Arten der Gattung zu erkennen."

DOMKE, 1934, pp. 23–27, does not specifically mention whether Thymelaeaceae bast fibres can be used for the classification of the species, but he emphasises the limited value of various plant-anatomical methods for this purpose with regard to these species.

Dr. M. Harders-Steinhäuser, see ROCK, 1963, p. 54, mentions some investigations of bast fibres from *Wikstroemia lichiangensis* W. W. Sm., *Wikstroemia aurantiaca* (Diels) Domke, *Daphne retusa* Hemsl., *Daphne calicicola* W. W. Sm., *Daphne acutiloba* Rehd., *Daphne odora* and *Daphne tangutica*. It is said:

"Die sorgfältige vergleichende mikroskopische Untersuchung der vorliegenden Pflanzenproben ergab keine eindeutigen Unterscheidungsmerkmale zwischen den verschiedenen Thymelaceen-Bastfasern; bei allen Einzelproben schwankten die Ausbildung von Zellenden, Wandstärken, Faserbreiten in derart weiten Grenzen, dass eine Unterscheidung zwischen den Mustern nicht möglich war."

Dr. Hans Huber, see TSCHUDIN, 1965, p. 316, reaches almost the same conclusion:

"Es ist nach wie vor fraglich, ob sich die Vertreter der Gattungen *Daphne*, *Edgeworthia* und *Wikstroemia* anhand mikroskopischer Kennzeichen der Fasern unterscheiden lassen."

On the basis of my own researches it seems evident that a comprehensive distinction between all the bast fibres of the Thymelaeaceae species used in paper-making in Asia (15–20 species) is very difficult, if only because many of the species are very closely related. However, I think it is possible to differentiate between important groups of these fibres, just as further investigations will no doubt enable small but characteristic differences between the fibres to be disclosed. It is a great advantage in this connection that the Thymelaeaceae fibres in paper from Himalaya are as a rule only lightly cooked and beaten, and are therefore not rendered unrecognisable.

If the problem is to distinguish only among those Thymelaeaceae species used in Nepal, then the task is more feasible. But because the identification of the fibres still remains difficult, some general properties of bast fibres and methods of investigating these will be mentioned before the single species are dealt with more closely.

1. Description and Analysis of Thymelaeaceae Fibres

a. THE STRUCTURE OF BAST FIBRES. The main object of the strengthening (mechanical) tissue is to impart stiffness and elasticity so as to make it possible for the plant to resist many kinds of loads. There are two main types viz. *collenchyma* and *sclerenchyma*. Collenchyma cells are live, whereas sclerenchyma cells do not as a rule possess living protoplasm when full-grown.

Among sclerenchyma cells a distinction is usually made between *sclereids* and *fibres*. Sclereids have many forms; the commonest are brachysclereids (stone cells), which are short, on the whole isodiametric cells, and fibre-like sclereids, which are longer and more slender. According to the position of the fibres they are divided into two groups, viz. *xylary* (wood fibres) and *extraxylary* fibres, often termed bast fibres, which are very long. (Concerning sclerenchyma cells see e. g. BÖCHER, 1948, pp. 43–48 and ESAU, 1965, pp. 203–223.)

The structure and chemistry of the cell wall of bast fibres, as of other cells, is complicated. A distinction is usually made between the following, not all equally well-defined layers (see e. g. TREIBER, 1957). On the outside the *middle lamella* consists chiefly of pectin and lignin compounds which are the cement substances that bind the fibres together. Then follows the *primary wall*. It consists of long, more or less orderly arranged cellulose microfibrils in an amorphous basic substance of hemicellulose, pectin etc. Every microfibril is built up of micells, which consist of cellulose molecules arranged in a 3-dimensional and regular (crystalline) network.

When plant cells are transformed into bast fibres, the fibres will be lignified by which, in particular, the matrix of the middle lamella and the primary wall is transformed (it dehydrates and partly dissolves). During this process lignin is deposited between the cellulose microfibrils, which adds considerably to the strength of the fibres but correspondingly reduces their flexibility. It is moreover the lignin content of the middle lamella which must be distintegrated in order to separate the fibres. It can be done by cooking in an alkaline liquid followed by maceration.

As far as bast fibres are concerned the *secondary wall* is many times thicker than the primary wall. Here the cellulose microfibrils are deposited more regularly and very densely, frequently in bundles, called macrofibrils (these may sometimes be seen with an ordinary microscope, see plate 239), and as a rule parallel-wise in helices round the longitudinal axis of the fibre. The secondary wall consists of many layers (often designated S_1, S_2 and S_3), the fibrils of which mostly have different orientations. This layer consists chiefly of cellulose or a mixture of cellulose and hemicellulose, for which reason it is highly refractive. In the sclereids, the secondary wall is distinctly lignified.

The border layer between the cell wall and the air-filled lumen has many designations. TREIBER, 1957, pp. 65–67, includes it under the secondary wall (S_3), while FREY-WYSSLING, 1959, pp. 33–35, calls it the tertiary wall; yet in both cases it is pointed out that it is mainly a question of definition. This border layer consists of cellulose-like microfibrils in a matrix of various still somewhat unknown compounds. Innermost we have the *lumen*, which sometimes contains traces of plasma.

The regular, concentric stratification of the bast fibres around the cell lumen has been described above. But in addition the cell wall contains other features. Fibres may, for example, have *pores* and *pits*, which are particularly conspicuous in the sclereids. Some interesting features are found at the *fibre ends* which, with many of the species of plants used in paper-making, are characteristic and therefore of considerable diagnostic value.

This is not least true of the Thymelaeaceae, of which several individual species or groups of species can be distinguished by their fibre ends (see drawings plates 199–200). They get their often knotty excrescences during the symplastic phase, probably from the pressure of surrounding swollen, juicy parenchyma cells (similar to what KUNDU, 1942, p. 120, describes for *Cannabis* and *Corchorus* fibres).

Finally some interesting cross lines, the so-called *dislocations*, displacement lines or slip planes, should be mentioned, which in many Thymelaeaceae bast fibres are very pronounced. (In German they are called: Querspalten, Querstreifen, Verschiebungen, Gleitflächen or Microstauchlinien.) They manifest themselves by zinc chloride iodine staining as many straight or slightly slanting, somewhat irregular lines. In raw fibres they appear as fine dark lines (see e. g. plates 201 and 207, but in fibres from paper they are more blurred and broader (plates 206, 225 and 239).

Dislocations were already observed in 1884 by Höhnel who assumed them to have been caused by internal pressures during growth. SCHWENDENER, 1894, however, writes that it is a question of an artificial product resulting from the isolation of the fibres. Fry-Wyssling has pointed out that it is not, as also proposed, a question of crystalline slip planes, because the cellulose molecules of the microfibrils have a structure entirely different from a simple crystal. Probably the dislocations arise during the isolation of the fibres in places where the microfibrils happen to be weakest. Here they undergo a double bending and are damaged. Thus the fibres are easier to stain just here. They also appear very distinctly in polarised light due to the changed orientations of opposite cell walls in the dislocations.

The reason why the dislocations look so different in the various species is due to the thickness of the cell wall and its composition (e. g. they are lignified to highly different extents). Even with most of the Thymelaeaceae species the dislocations differ in appearance, for which reason they can be used for purposes of identification. But in the first place they are a measure of the physical and chemical treatment which the fibres have undergone.

b. FIBRE DIMENSIONS. Proper measurements are necessary in order to make unambiguous distinctions between the various fibres. LEANDRI, 1930, p. 231, thus writes of the Thymelaeaceae species, that many of them can be classified by their dimensions. Let us see how these differences arise and also which ones are suitable for measuring.

The cell wall remains thin as long as the fibre is growing in length and thickness (symplastic phase). With the Thymelaeaceae fibres this phase seems to pass rather quickly, for even in a young plant the length and maximum thickness of the fibres are only a little less than in an older and bigger plant of the same species. Neither do these dimensions alter much from the innermost to the outermost layers of the bast.

As far as the species investigated are concerned, only rather slight differences from one species to another have been observed in the thickness of fibres. Furthermore, the fibres swell during the cooking and beating; therefore the *fibre thickness* is not a good means of identification. The thickness at the fibre end, however, is less susceptible to change so it has been measured systematically (size *b*, defined on p. 190). The natural *fibre length* changes hardly at all during the paper-making and it is quite typical in each species. However, measuring fibre lengths is time-consuming, especially when confronted with paper that has only a few intact fibres.

After the rather quick symplastic phase the cells undergo irreversible changes and lose the capacity for growing bigger. Then the secondary wall will thicken inwards, which is a slower process. The thickness of the secondary wall or of the greater part of the whole cell wall is therefore less in young shoots than in the older bast layers (those used for making paper). Here the wall thickness is quite distinctive in many of the Thymelaeaceae species. As I will show in section *B 2*, this thickness is smaller the greater the altitude of the upper limit of growth of the species.

The inward-facing thickening and stratification of the secondary wall appear most distinctly in the fibre ends. They are quite typical of many species – also in the various Thymelaeaceae species which are, incidentally, built up in the same way as described by FAHN, 1967, p. 88, regarding flax and ramie (notice the fine lines in the fibre ends plates 201, 207 and 232). If the arithmetrical mean value a_m of the wall thickness a at the fibre ends (see drawing p. 239) is measured and computed for many fibres picked out from different parts of bast from one individual plant or from other plants of the same species, it can be demonstrated that these mean values show only little variations. Even in cases where measurements were made on bast fibres of the same species gathered at very different altitudes or geographical localities, the size a_m was amazingly constant (e. g. with *Daphne bholua* it only varied from 8 to 10 μ). Furthermore, a_m is quite different as far as many of the species are concerned, and finally the more solid structure of the fibre ends makes them more resistent to chemical and physical influences so they can be identified even among much damaged fibres. *Therefore, the fibre ends are particularly suited for purposes of identification.* For the determination of a_m as well as of b_m at least 30 measurements ought to be made (preferably 40–50) for each plant or paper sample.

c. GUIDE ELEMENTS. Apart from the appearance of the bast fibres themselves, paper fibres can also be identified from other cells or particles from the plant found in the paper. These I call "*guide elements*" (adopted from German: Leiteelemente). Most important of these are the sclereids (see e. g. plate 207) which differ in the various species of Thymelaeaceae, thus their length, thickness, and the thickness of their cell wall, have all been systematically measured.

Thymelaeaceae paper also contains *parenchyma cells*, fragments of *starch grains*, *pith ray cells*, and *crystal druses*. The last are spherical crystal aggregates of calcium oxalate, which are usually broken so that they only can be seen as single crystals (highly refractive). Furthermore, particularly in less fine paper, there can be particles from other tissues of the plant e. g. cells from the epidermis. However, most of the guide elements are difficult to use for diagnostic purposes. This is partly due to the slight difference between the species, and partly because it depends on where the paper sample has been taken from (because the guide elements may not be represented in the sample at all).

d. METHODS OF ANALYSIS. Both apparatus and chemical reagents for fibre investigations are to-day available in an immense variety. The appearance of the bast fibres will only be described below as they appear under the light microscope and with the use of a few well-known colour and swelling reagents.

Apparatus. To observe the fibres a very wide-angled binocular attachment has been used at 250 magnification, which makes it possible to work uninterruptedly for a long time without getting tired and without constantly changing the magnification. For the black and white photographs an ordinary Zeiss-Leitz standard camera has been used at 240 magnification.

One of the difficulties of photographing the fibres lies in their round shape (diameter c. 10–50 μ). The best results are obtained by carefully distributing comparatively few fibres on the microscope slide and cautiously pressing the cover slip down over them, the liquid being absorbed by a piece of filter paper. The fibres can also be observed or photographed in cross-section but this involves quite a time-consuming process.

With a differential interference microscope it is possible to register particularly fine details of fibre walls; small differences in the thicknesses of cell walls appear as big changes of interference colours or, with another adjustment, as changes in the intensity of the light. Especially when dealing with several different fibres and guide elements from the same paper this microscope very much facilitates identification.

Reagents for the analysis. Bast fibres can be examined in *water*. This method has the advantage that the appearance of the fibres is not dependent on the age of the reagent. The colour reagents most frequently used in the investigation of paper fibres are some inorganic iodine compounds, primarily *zinc chloride iodine, abbreviated zichlo* in the following which on account of its very different colour reactions to the numerous paper fibres is a sort of universal indicator. It colours cellulose cell walls bluish to dark violet, but lignified or otherwise encrusted cell walls yellow to greenish (for explanation of colour effects, see e. g. FREY-WYSSLING, 1959, p. 118).

Thus raw Thymelaeaceae fibres are coloured slightly yellow in *zichio* ond only turn violet and finally brown-black after some hours, because the primary wall and the middle lamella layers are almost intact, the lignified walls probably preventing the zinc chloride from making the cell walls swell, so that the big iodine molecules cannot reach the cellulose-fibril network of the secondary layer and colour it.

The cooked and beaten (paper) fibres are at once coloured wholly or partly violet in *zichio*, because the primary wall is partly damaged, the secondary layer likewise, though to a lesser degree, so that the high cellulose content of this layer immediately makes itself visible in the violet colouring. But the sclereids remain green-yellow even in thoroughly treated paper, as the walls are very strongly lignified (plate 239).

It is interesting that, according to FREY-WYSSLING, 1959, p. 120, cellulose is transformed by strong bleaching or century-long oxidisation into oxycellulose ($((C_6H_{10}O_5)_nO)$), which can be detected with ruthenium-red or methylene-blue. With Thymelaeaceae paper that is more than 400 years old, I have observed that the fibres often turn a pale reddish-violet with *zichio*, obviously due to the formation of oxycellulose.

With regard to the use of *zichio* it should be noted that the appearance of the fibres depends to a great extent on the degree of concentration. Specially when comparing a large number of paper samples it is necessary to use a constant degree of dilution. It is also advisable when photographing to use a rather diluted *zichio*, as the film cannot register as big contrasts as the eye.

Besides the inorganic colour indicators, there is a long series of organic colour reagents for detecting the contents of more or less well-defined organic compounds in the cell walls. (List of frequently used reagents see e. g. HERZOG, 1955, pp. 29–55.)

An important method of investigation is that of allowing the fibres to swell vigorously in a liquid while observing the reaction of the different layers of the fibre. The fibres will already swell a little in water: 10–30 % in thickness, but less than 1 % in length; the process is reversible. The swelling in *cupric oxide ammonium, abbreviated cuoxam* is of special diagnostic value (concerning different methods of preparation see e. g. HERZOG, 1955, p. 32), or cupric ethylene diamine which is more stable in the atmosphere ($(Cu(NH_2CH_2CH_2NH_2)_2)(OH)_2$.

The globular swellings are very conspicuous and characteristic of many plant fibres (plates 203, 205, 208 and 213). They probably arise because the middle lamella and the primary wall are very thin in certain places, or pierced during the previous treatment of the fibres. Here *cuoxam* will penetrate and attack the very susceptible cellulose fibrils of the secondary layer, and this, owing to their parallel structure, produces a big transverse swelling and a small longitudinal swelling. On account of the swelling pressure, the primary wall and the middle lamella burst and the globules will appear at these parts of the fibres. With a sufficiently strong *cuoxam* the middle lamella and the primary wall dissolve entirely, and the whole fibre swells or completely dissolves.

The more cellulose available for the swelling process (i. e. the thicker the secondary layer or practically the whole cell wall is) the greater the globular formation will be. Large contents of lignin, however, have a restrictive influence on the swelling. The swelling will be most regular when the fibrils run parallel with the fibre itself. If they wind around the longitudinal axis, helices appear on the surface (plate 213), and the fibre is shortened. If the secondary wall is stratified the distances between the layers of the cell walls will increase, making them more easily visible (plates 203, 205 and 208). Sometimes even macro-fibrils become visible (plate 231). With swelling reagents it is possible to make visible the layer of the secondary wall bordering on the lumen (also called the tertiary wall or S_3). Often this layer is the last part to be dissolved. Also, stratification, fibrils etc. may frequently be observed where fibres have been flattened.

In those Thymelaeaceae species which develop globular formation with *cuoxam* (e. g. *Edgeworthia gardneri* and *Daphne bholua*) this reaction is less pronounced when the fibres have previously been carefully separated from each other in water. In this case, only an even swelling usually occurs. But the globular formation is very much pronounced on fibres from paper of the two above species. This formation certainly has a close relation to the dislocations already mentioned, which are specially numerous in much beaten fibres.

Fibres also swell in *zichio* because of its zinc chloride content. This has to be born in mind when measuring the thickness of fibres, and I have therefore used a rather diluted solution (*a*, the wall thickness at the fibre ends, hardly alters, but *b* increases rather much). The formation of globules may even take place in *zichio*, viz. at the edge of the cover slip where the liquid oxidises. In the following descriptions of the individual species, the reagent is *zichio*, unless otherwise indicated. This also applies to the diagrams on pp. 238 and 239, and to the drawings, plates 199 and 200.

2. Characteristics of the Bast Fibres of some Thymelaeaceae Species

a. *EDGEWORTHIA GARDNERI* (WALL.) MEISN. This species and *Edgeworthia chrysantha* Lindl. (synonym *Edgeworthia papyrifera* Sieb. et Zucc.) are so closely related that many botanists have made no distinction between them. But according to TSCHUDIN, 1964, p. 5, there are two species.

JENČIČ, 1902, p. 151, writes of *Edgeworthia papyrifera*, i.e. *Edgeworthia chrysantha:* The length of the fibres is 2.9–4.5 mm. (min. 0.75 mm.) and the thickness is 3.8–18.8 μ. The fibre ends are generally clavate, swollen, more rarely acuminate. The lumen is often big, but suddenly narrows and then again becomes big. The contour of the lumen does not follow the outer wall of the fibre; in places where the lumen is big the walls are thin. Fibres were only seldom found to have the lumen interrupted for stretches of more than 0.7 mm. The fibres are not lignified. In *Edgeworthia* paper, besides bast parenchyma and pith ray cells, beautiful crystal druses of calcium oxalate are found. The sole difference between *Edgeworthia papyrifera* and *Wikstroemia canescens* is that the former does contain these crystal druses, the latter does not. *Daphne papyrifera* [i.e. *Daphne bholua*] fibres, compared with *Wikstroemia canescens* and *Edgeworthia* fibres, are much more thin-walled and therefore easily distinguishable.

WIESNER, 1927, pp. 671–672, mentions Jenčič's observations concerning *Edgeworthia gardneri* Meisn. (he writes: = *Edgeworthia chrysantha* = *Edgeworthia papyrifera)* and adds: The frequently knotty form of the fibre ends, with undulations, usually only points towards one side, and the lumen is very irregular, disappearing entirely in places. This curiously shaped bast fibre is also found in *Wikstroemia* and other Thymelaeaceae species. By careful observation one can see that parts of the bast fibres are thin-walled and other parts are thick-walled. Only at the thick-walled parts does the lumen disappear in places. The former are younger and formed near the cambium, the latter are older, more peripherally placed bast fibres. In cross-section they are rounded off polygonally. The middle lamella and the primary wall are strongly developed and distinctly separated from the rest of the cell wall. Not infrequently the two layers are also separated from this. They are only faintly lignified and sometimes show cellulose reaction. *Cuoxam* partly dissolves the fibres which develop globular swellings (resembling a string of pearls) as with cotton fibres. The fibre wall is stratified. The stratification appears even more distinctly when chromic acid is added. Pores are rare.

No reference will be made to later sources as, on the whole, they repeat the observations already mentioned.

Bast fibres were taken from three rather small herbarium plants, all deriving from Nepal and, incidentally, collected by N. Wallich. Thus here there can be no question of *Edgeworthia chrysantha*. The result of my microscopical investigations of the fibres in diluted zinc chloride iodine (abbreviated *zichio*) is as follows.

The fibre lengths are between 1.5 and 5.0 mm. and only rarely bigger. The thickness of the fibres is 4–20 μ, sometimes as much as 25 μ. They are often very thin, particularly towards their ends. The contour of the fibres is only faintly undulating and mainly very straight. The lumen, on the other hand, is of greatly varying width and often disappears, especially near the fibre ends (plate 201).

The thin-walled fibres give a glossy effect, the cell wall is slightly yellow and appears clearly delineated. The thicker fibres are less transparent and more yellow. Undiluted *zichio* discloses thin, clearly delineated cross-lines in the thin-walled fibres, whereas broader, more diffuse lines appear in the thick-walled fibres (plate 201). The cell wall now takes on a more distinct yellow colour that can become slightly greenish. The fibres are rather sensitive to pressure, especially where the cell wall is thin. In places, where the fibres are flattened out, they are grey-violet like the dislocations.

The fibre ends are sometimes irregular and knotty, but mainly regular. Most of them are rounded off, but also clavate or acuminate forms occur (see drawings plate 199). Bifurcate ends of fibres (plate 202) are sometimes very long, up to about 1 mm.

As a rule the lumen ends rather more than one fibre thickness before the fibre end. Several plants were examined to verify this characteristic property, including a specimen from Sikkim and another one from Meitan in China (the latter is indicated as *Edgeworthia papyrifera* = *Edgeworthia gardneri*). The distance *a*, between the end of the lumen and the fibre end and also the fibre thickness *b*, where the lumen ends (see drawing p. 239) were measured in a great number of bast fibres. In all specimens *a* was 7–50 μ with an average of about 18 μ; *b* was 4–18 μ, with an average of 9½ μ. So the proportion a_m/b_m equals 1.9. (If the fibres are observed in a dry state, *a* is practically as given whereas *b* is now 4–14 μ.) With *Daphne bholua*, for example, the proportion a_m/b_m is a little below 1.0, thus substantially different from that of *Edgeworthia gardneri*.

With the addition of *cuoxam* the fibres swell to about twice their size, but even if different kinds of *cuoxam* in different concentrations are used, the proper string of pearls formation is only slightly pronounced when the raw fibres are cautiously divided, because the primary wall is then almost intact. The swelling of the fibre ends is interesting (plate 203) and, as might be expected, rather different from that of *Daphne bholua*. Notice the "cork" at the fibre ends, and also the accentuation of the border between the secondary layer and the lumen.

The fibres swell to double size in the course of a few hours if a not too strongly diluted *zichlo* is used and they become brown-black in colour. The lumen is still easily visible. Moreover it will be noticed that light passing through the fibres is now strongly polarised; two fibres overlapping each other at right angles are black at the point of intersection. This phenomenon is also found with the other Thymelaeaceae species.

The guide elements will not be mentioned further, apart from some fibre-like sclereids which are 0.7–1.6 mm. long and 10–20 μ thick. The fibre ends are pointed. The cell walls are slightly yellow, c. 3–6 μ thick, often irregular and very sharply delineated (plate 233). In contrast to the proper bast fibres they react only slowly to *zichlo* and preserve their yellow colour a long time after the bast fibres have turned brown-black.

From the Sherpa Urgen I received a long strip of bark 3 cm. broad from the neighbourhood of Kalimpong, where it is used in paper-making. The bark is rather red-brown and finely grooved (unlike *Daphne bholua* or *Daphne sureil*, which also grow in Sikkim). The bast fibres of this plant most resemble fibres from *Edgeworthia gardneri* even if the fibre lengths do not correspond to those from this shrub. (JENČIĆ, 1902, p. 151, thus gives the maximum fibre length of *Edgeworthia gardneri* as 4½ mm., LEANDRI, 1930, p. 146, mentions 5½ mm., and the small plants I have had at my disposal were 5 mm.)

The fibres are 3–7½ mm. long and 6–30 μ broad; only a few are thin and many are 15–25 μ broad. In diluted *zichlo* they are fairly yellow, but not so glossy as the fibres that are known with certainty to derive from *Edgeworthia gardneri*. In less diluted *zichlo* they become more yellow or green-yellow, but also turn violet in places. Flattened sections and ruptures then become black-violet. The lumen is negligible in many places and the cell walls appear to be very solid. The lumen can be either indistinct or sharply delineated. Dislocations are numerous; often they occur in broad bands, which makes the fibres look cross-striated.

Quite a few fibre ends are pointed; but mostly they are clavate and big (see drawings plate 199). Long ramifications are not unusual (plate 202). *a* was 8–35 μ with an average of 15 μ. As the mean value of *b* was c. 10 μ (6–22 μ) the proportion a_m/b_m is 1.5 (with dry fibres *b* is 3–12 μ with a mean value 6 μ).

The big green-yellow sclereids known from *Daphne bholua* have not been observed, but there were some thin-walled fibre-like sclereids, pointed at both ends, c. 0.8–1.5 mm. long and 20–35 μ thick. Cell walls are 3–6 μ thick and have some short longitudinal pits.

The bast fibres swell vigorously in *cuoxam*, in fact even in *zichlo*.

The bast sample has also been examined by Mr. C. R. Metcalfe at the *Jodrell Laboratory*, Kew, who reported that after microscopical analysis and comparison with some of the *Daphne* species from the area, the sample most closely resembles *Edgeworthia gardneri*.

b. *DAPHNE INVOLUCRATA* WALL. Bast has been taken from a plant collected in the Khasia hills in Northeast India, from a plant from East Nepal (East No. 2), and from two specimens marked H. Griffith 4370.

The fibres are 2–6½ mm., mostly 2½–4 mm. long, and 3–16 μ wide. Most of them are very thin, particularly just before the fibre end (plate 204). The fibres become dull yellow to green-yellow with *zichlo*. They are not as beautifully refractive as *Edgeworthia gardneri* fibres, because they contain less cellulose and more lignin, and hence, too, they become more greenish-yellow with aniline sulphate. The lumen varies but is mostly small and often indistinct, even near the fibre ends. Dislocations are more numerous than with *Edgeworthia gardneri*, but less sharply delineated. Flattened sections and ruptures are black-violet.

The fibre ends are mostly oblong clavate, often pointed and sometimes irregular and knotty and then small and finely formed. Long ramifications are not unusual. a is 9–50 µ with an average of 19 µ; b was measured at 7 ½ µ on the average (3–14 µ), i. e. the proportion a_m/b_m is 2.5. (In water the proportion was measured at 17 ½ µ/7 µ, also equalling 2.5. Finally, with dry fibres b was measured at 2–10 µ with an average of only 5 µ.)

With *cuoxam* the swelling is amazingly small considering the great thickness of the cell walls (plate 205) and this indicates that the fibres contain less cellulose. This is well in accordance with the fact that they are not considered good for making paper. Notice the division of the fibre walls into several layers.

Some fibre-like sclereids have been observed. They are 0.5–1.5 mm. long, 10–20 µ broad, partly thin-walled (3–10 µ), but occasionally more thick-walled. There are small pits in the cell walls. *Hexagonal starch grains also seem to be characteristic* (plate 204).

c. *DAPHNE BHOLUA* EX. D. DON AND *DAPHNE PAPYRACEA* WALL. EX. STEUD. EMEND. W. W. SMITH ET CAVE. As I have not been able to find much difference between the bast fibres of these closely related species they are dealt with together.

H. Huber, Basel, see TSCHUDIN, 1965, pp. 314–316, has examined bast fibres from specimens of plants of *Edgeworthia chrysantha* Lindl. and *Daphne papyracea*, the latter from Nepal, and has also drawn and photographed the fibre ends. I have examined the following samples:

1) In the herbarium of the *Botanical Museum* in Copenhagen there are 17 plants under the name of *Daphne papyracea* but none under *Daphne bholua*, though many of them, judging by the leaves and the dried flowers, are *Daphne bholua*. Possibly single specimens of *Daphne sureil* also occur in the collection. As there are hardly any exact indications of finding places and flowers, the fibre properties of the plant will not be mentioned here in detail, with two exceptions. One plant is labelled: "Sikkim, 5–9000 feet" and the other: "violet flowers", so that in these cases we must be dealing with *Daphne bholua*. (*Daphne papyracea* only occurs in West and Central Nepal and *Daphne sureil* only below 5000 feet.)

2) The sherpa Urgen has sent a pressed plant from the Baral pass in East Nepal, which is probably *Daphne bholua*.

3) Personally collected *Daphne bholua* from near Junbesi in East Nepal (East No. 3) at 3500 m. The bark is light brown and the bast itself very slightly yellow, almost white, like all the specimens mentioned below. The plant was about 1 m. high.

4) Broad bast strips used by the paper-makers near Junbesi, but deriving from a somewhat lower altitude. The plants were 1 ½–2 ½ m. high and were probably *Daphne bholua*.

5) *Daphne bholua* from an altitude of 2600–2700 m. from the forests around Tarke Gyang, Jolmo, East No. 1.

6) Three plants collected from the same area, a few kilometres north of the Kathmandu Valley at c. 200 m. One of them has been established with certainty to be *Daphne bholua*; according to G. B. Shah the others are of the same species.

7) *Daphne bholua* from the Baglung area, West Nepal.

8) *Daphne papyracea* from the Baglung area.

9) *Daphne papyracea* which we found in the jungle 1–1 ½ day's journey north-west of Pokhara at 2300–3000 m.

The fibres are 2–7 ½ mm. long, rarely more, 6–20 µ thick, smooth, very soft and flexible, transparent, faintly yellow and without any easily visible surface details. The contour is not as straight as in the case of *Edgeworthia gardneri*, but often wavy and irregular (plate 207). With only slightly diluted *zichio* many dislocations appear and the cell walls appear distinctly yellow, whereas the lumen becomes grey-violet on account of the dislocations. The cell walls thicken strongly in places and are then less easily visible. They are very sensitive to pressure and such places are grey-violet.

The fibre ends are very often knotty with all sorts of excrescences and ramifications, but chiefly lightly clavate and rounded off, and only seldom acuminate (see drawing plate 199). Ramifications above 0.5 mm. are rare. The dimensions a and b were measured for the samples from all of the plants and from different parts of the bast layers. a, the wall thickness at the fibre end, is 4–16 µ, averaging 8–10 µ. Since the fibre breadth at the fibre end was found to be slightly greater (9–11 μ), a_m/b_m is a little less than 1.0, average 0.9. (In a dry state b was 5–10 μ, average 7½ μ.)

The most conspicuous guide element consists of some frequently occurring thick-walled sclereids, 0.4–2.5 mm. long and 15–50 μ thick which take on a green-yellowish colour even with diluted *zichio*. The dimensions of these fibres were, for samples 1–9:

1. 0.7 mm. long, 22 μ thick.
2. 0.7–1.9 mm. long, 12–20 μ thick.
3. 2.5 mm. long, 15 μ thick.
4. 0.6–1.5 mm. long, 20–50 μ thick.
5. 0.3–1.5 mm. long, 15–20 μ thick.
6. 0.5–0.9 mm. long, 25–30 μ thick.
7. 0.7–1.0 mm. long, up to 30 μ thick.
8. 0.4–1.0 mm. long, 20–40 μ thick, both thick- and thin-walled (from 3 μ and up).
9. 1.1.–2.5. mm. long, 15–25 μ thick, both thick- and thin-walled (from 3 μ and up).

In samples 1–7, i. e. *Daphne bholua*, the heavy, thick-walled sclereids are by far the most common (plates 207 and 239). With samples 8 and 9, i. e. *Daphne papyracea*, the slender and thin-walled fibre-like sclereids are possibly the most common (plate 206), just as with the equally low-altitude Thymelaeaceae species, *Daphne involucrata* and *Edgeworthia gardneri*. However, as the sclereids may vary a good deal in both size and appearance in the selfsame plant, besides looking similar in other *Daphne* species and are, in any case, not always found in small paper samples, they are only partly suitable for purposes of identification.

In *cuoxam* the globular formation is common but not nearly as marked as with the paper fibres. It is characteristic that the cell walls in many fibres become almost invisible (plate 208). Notice how different the reaction is from that of *Edgeworthia gardneri* and *Daphne involucrata* bast fibres, with regard to size, stratification of walls and fibre ends. Furthermore, the swelling is different from that of the Thymelaeaceae species mentioned below.

d. *DAPHNE RETUSA* HEMSL. This plant is a shrublet; the specimen investigated comes from West China. According to DOMKE, 1934, p. 75, it occurs in the Himalayas between 3000 and 4500 m.

The fibres are 3–5½ mm. long and 6–20 μ broad with a few up to 25 μ. The fibre walls are far more sharply delineated than in *Daphne bholua* and considerably thinner, on average only 2¼ μ (plate 210). The lumen is completely continuous. The fibres have many small lateral branches, particularly at and near their ends (see drawings plate 200), which are often bifurcate. The forms are finer than those of *Daphne bholua*. The fibres are very sensitive to pressure and where they are flattened they turn a beautiful bright grey-violet. Dislocations are much rarer and finer than with *Daphne bholua*. a is 3–14 μ, b is 5–16 μ and a_m/b_m = 7/9 = 0.8.

The sclereids are pale yellow, 1–2 mm. long, 15–25 μ broad and rather thick-walled (more than 5 μ). The lumen often ends up to 40 μ before the fibre end.

In *cuoxam* the bast fibres curl up and have a pronounced pitted and undulating surface in which helical lines can be faintly discerned. In contrast to *Daphne bholua*, the fibre wall is still very prominent.

e. *DAPHNE TANGUTICA* MAXIM. Two specimens have been examined. One is from Northwest China (a shrublet c. ½ m. high), the other comes from the Kansu province, from an altitude of about 3000 m. (a shrublet c. ¼–½ m. high). According to DOMKE, 1934, p. 75, the plant occurs in West China from 600 to 3200 m., and also in East Tibet.

The fibres are 2¼–5½ mm. long, 6–20 μ thick and have very thin walls, 2¼ μ on the average. The walls are not quite as prominent as in *Daphne retusa*. The fibres are extremely sensitive to pressure and where they have been flattened become bright grey-violet. As with *Daphne retusa* fibres, from which they differ only slightly, the dislocations are quite delicate. The fibre ends have finer shapes and are often pointed (plate 200). a is 3–14 μ, b is 5–15 μ and a_m/b_m = 6–6½/7–8 = 0.8–0.9.

Sclereids are 0.7–1.5 mm. long, c. 20 μ broad and have walls more than 6 μ thick.

The bast fibres swell moderately in *cuoxam* and reveal an undulating surface. The walls continue to be very prominent.

f. *DAPHNE GIRALDII* NITSCHE. This is a shrub $^{1}/_{2}$–1 m. high, which, like *Daphne tangutica*, occurs in Northwest China up to c. 3000 m. The two specimens examined are from this region.

The fibres are 2–$4^{1}/_{2}$ mm. long, 5–15 up to 20 μ thick, with extremely thin walls, averaging only $1^{1}/_{2}$ μ thick. They are particularly sensitive to pressure and then turn bright grey-violet. The fibre ends have fine forms (plate 200). Only few ramifications were observed. a is 3–10 μ, b is 4–12 μ and $a_m/b_m = 5\text{–}5^{1}/_{2}/7^{1}/_{2}\text{–}8 = 0.7$.

Sclereids are 1.0–1.5 mm. long, 15–30 μ broad and rather thick-walled (more than 5 μ).

The *cuoxam* reaction is violent. The fibres curl up and become wavy and bulbous; on the surface faint helical lines can be seen. The cell walls are now indistinct in places.

g. *DAPHNE SERICEA* WAHL. Two specimens have been examined, one of which derives from Trans-Caucasia, presumably the farthest extension of the plant towards the East.

The fibres are $1^{1}/_{4}$–4 mm. long and 4–15 μ broad. The walls are on average $2^{1}/_{4}$ μ thick and not so prominent as in the last three *Daphne* species. The fibres are sensitive to pressure, and dislocations are few. The fibre ends have fine forms, many of them pointed, and ramifications are rare (plate 200). a is 2–11 μ, b is 3–12 μ and $a_m/b_m = 4^{1}/_{2}\text{–}7/5^{1}/_{2}\text{–}7^{1}/_{2} = 0.8$.

Sclereids are 1–$1^{1}/_{2}$ mm. long, c. 15 μ thick and the walls are more than 3 μ thick.

With *cuoxam* there is a violent swelling of the fibre walls in which helical lines are very distinct. Cell walls are now almost invisible in many places just as with *Daphne bholua*.

h. *DAPHNE ALPINA* L. Two specimens have been examined, from France and Switzerland respectively.

The fibres are $1^{1}/_{2}$–$4^{1}/_{2}$ mm. long, 6–15 up to 20 μ thick. They often have a wavy surface. Cell walls have varying thicknesses, on average 3 μ. The lumen often disappears near the fibre ends, upon which are many excrescences (plate 200). a is 2–10 μ, b is 3–13 μ and $a_m/b_m = 5^{1}/_{2}/7^{1}/_{2} = 0.7$.

Various sclereids have been observed. They are dull olive-green, 0.5–3.0 mm. long and 10–20 μ thick. The cell wall becomes strongly undulating, indistinct in places, but marked helical lines can be seen.

i. *DAPHNE MEZEREUM* L. A specimen from Switzerland has been examined. The fibres are 2–4 mm. long and 6–15 up to 20 μ broad. They are mostly thin-walled, on average c. 2 μ thick. The fibre walls are dull yellow-greenish. Dislocations are remarkably few, and the fibre ends are slightly clavate or pointed. a is 3–10 μ, b is 5–14 μ and $a_m/b_m = 6^{1}/_{2}\text{–}8/7^{1}/_{2}\text{–}8^{1}/_{2} = 0.9$.

Various sclereids have been observed. They are dull olive-green, 0.2–2.0 mm. long, 10–20 μ broad and with walls from 3 μ to very thick.

The bast fibres curl up in *cuoxam*, becoming intertwined, and the cell walls become strongly undulating. Cell walls are still easily visible.

j. *WIKSTROEMIA CANESCENS* (WALL.) MEISN.

HERZOG, 1955, p. 392, writes of these fibres, from which the so-called *Gampi* paper is produced: The bast fibres are delicate and the inner cohesion in fibre bundles is lacking. The fibres are either single or joined together in small groups. The peripherally situated bast fibres are, as with *Edgeworthia*, thicker than those near the cambium. The lumen is very irregularly developed. In the cell wall one may frequently observe a prominent longitudinal streaking. Knotty swellings [dislocations] are essentially more rare than with *Broussonetia* fibres. *Pores* are fairly common. The cell ends are rounded and only seldom divided. According to E. Müller the thickness of the fibres is 7–20 μ. The fibres are only faintly lignified and turn yellow in *zichio*. *Cuoxam* dissolves them without showing any striking swellings. Pith ray cells and bast parenchyma are present among the fibres in considerable quantities. Crystals on the other hand are totally absent.

Bast samples of a small plant from Nepal collected by N. Wallich were examined under the microscope.

The length of the fibres is $^{1}/_{2}$–4 mm., mostly 2–$3^{1}/_{2}$ mm., and the thickness 4–20 μ. Many of them are very thin. The fibres are massive and dull green-yellowish. Dislocations are fine and characteristically indistinct. The cell walls are slightly undulating. *Pores and pits* are quite distinct, especially in the thickest fibres. The lumen varies greatly but is usually not very big, which agrees with the fibres not being particularly sensitive to pressure. Flattened sections are black-violet. The fibre ends are often finely knotty, with all sorts of excrescences, and may be ramified; many of them are quite pointed (plate 200). a is 4–16 μ, b is 5–15 μ and $a_m/b_m = 7\text{–}9^1/_2/7\text{–}8^1/_2 = 1.0$.

During the swelling in *zichio* the fibres become grey-black as with the *Daphne* species. Cell walls are not very distinct.

The sclereids are thick-walled, 2–3 mm. long and 10–15 μ thick. Calcium oxalate crystals have not been observed.

In *cuoxam* the bast fibres curl up, while the cell walls remain indistinct.

k. *WIKSTROEMIA CHAMAEJASME* L. (SYNONYM *STELLERA CHAMAEJASME* L.)
After having met with this characteristic fibre so often in new paper sheets as well as in letters and manuscripts, I at last found a herbarium specimen at the *Botanical Museum* in Copenhagen with identical bast fibres. Interviews with Tibetans have later confirmed that this plant has been used for making paper in several places in Tibet. According to Corneille Jest, Musée de l'Homme, the plant has also been used for the purpose in the Dolpo area in Northwest Nepal.

The bast, most of which is found in the abnormally thick roots of the plant, is very soft and easily divided. The fibres are $^1/_2$–4 mm., mostly $^1/_2$–$3^1/_2$ mm. long and 5–20 μ, chiefly 10–15 μ broad. They have a characteristic wavy surface (plate 212) in which distinct helical lines can be seen. Lumen is never absent and the cell walls are very thin and sensitive to pressure. On an average they are c. $1^1/_2$ μ thick. In diluted *zichio* the cell walls are coloured slightly yellow, but bright-violet in only slightly stronger *zichio*, while the lumen then becomes a beautiful grey-violet. The fibres are very slightly lignified, and dislocations are few and almost negligible.

The fibres only narrow a little before the fibre end (plate 200), which does not adopt as many forms as with *Wikstroemia canescens*. Excrescences are mostly softly rounded off. In the two species examined, a is 1–6 μ averaging only 2 μ, whereas b averages 6 μ. Thus $a_m/b_m =$ is only c. 0.3. (For fibres in a dry state b was 3–9 μ, average $5^1/_2$ μ.) The fibres often appear twisted, single or in pairs or in great yarn-like bundles—far more marked than with the other Thymelaeaceae species.

The swelling of the fibres is already pronounced in rather diluted *zichio*, and the fibres turn grey-black after some time. The *cuoxam* reaction is very characteristic: whole fibres curl up in a violent torsional movement round the longitudinal axis and become more than twice their original size. In the swollen fibres helical lines in the cell walls are now visible (plate 213). The previously loosely twisted fibres turn into dense tight coils.

As guide elements there are many big black-violet, starchy parenchyma cells and small yellow strongly refractive calcium oxalate crystals, and also a few ruby-red, thick-walled fibres with greenish lumen c. 20 μ thick. Occasionally there are also some pointed, thick-walled dull-yellow sclereids c. 2 mm. long and 20 μ thick.

l. DISTINCTIONS AMONG THE THYMELAEACEAE FIBRES. The most important results of the investigations of the bast fibres, taken directly from plant specimens, are given in the table p. 236. The vertical distribution of the plants, indicated in metres, is mainly that stated in the literature (see pp. 50–56). The alleged fibre characteristics must be taken with reservations. They are often based on measurements of the fibres from small plants or from a rather modest number of plants, even if the number of individual measurements amounts to several thousand.

The properties which mark the chief distinctions among the fibres are italicised in the table. As mentioned, the quantity a_m shows only little variation in one and the same species. From the table it appears, however, that this quantity is the measurable property which varies most in the different species.

a_m and a_{max} are seen to be smaller, the higher the upper limit of distribution in the comparatively limited area which makes up Himalaya. (A similar reduction applies to fibre lengths and fibre wall thicknesses, but here the variation is less.) *The thickening of the secondary wall, in other words, is less, the higher the altitude at which the species is able to exist*, which must be due to the more difficult conditions of growth and adaptation to them.

In *Wikstroemia chamaejasme*, the species of Thymelaeaceae that is found in the highest altitudes (up to c. 4500 metres), the major part of the plant is below the soil. The thickness of the fibre wall, and especially a_m, is particularly small.

With regard to the task we have set ourselves, viz. to distinguish between the various fibres, it appears from the table p. 236 that this cannot be done on the basis of a single property or measurement. The best thing is to compare the properties of the unknown fibres with the values shown in the table and then compare the fibres with known plant fibres under the microscope. (It may be remarked incidentally, that bast fibres from *Daphne involucrata* differ greatly in several respects from the other species of *Daphne* examined. According to DOMKE, 1934, *Daphne involucrata* belongs in fact to the *Erisolena* subseries and not to the *Daphne* subseries, as HOU, 1969, p. 37 writes.)

A provisional key to distinguish the species of Thymelaeaceae examined is shown on p. 238. *Daphne sureil* is not included in the key. Owing to the close relationship between this plant and *Daphne bholua*, which it replaces below 1700 metres in Sikkim, it must be expected that the bast fibres of the two species are much alike. Presumably a_m will be a little over 9 μ and the sclereids more slender and thin-walled.

The differences between the fibres of *Daphne papyracea* and *Daphne bholua* are very small. Whether or not the sclereids differ has yet to be verified by the investigation of more plants.

The differences between the fibres of *Daphne retusa*, *Daphne tangutica* and *Daphne giraldii* are also small.

3. New or Unused Paper

After the cooking and beating of the Thymelaeaceae fibres their resistance against *zichio, cuoxam* etc. is changed. This causes their appearance to be rather varied. The fibres take on colours ranging from yellow through greenish and brownish to red and blue-violet. Flattened fibres, which are now numerous, are coloured deep blue-violet to grey-black. The fibres are often also broken or swollen, and the cell walls have become indistinct. *Only the fibre ends keep their original appearance fairly well, and in my opinion it is here that one can most easily identify the various Thymelaeaceae paper fibres.*

When investigating the fibres it pays to make several different preparations from the same sample. In one preparation the fibres are cleared of guide elements, added starch grains, colour particles, dust etc. by washing the fibres in water before, for example, *zichio* is added. In another test one may dye the fibres directly, so that the finer guide elements, starch etc. do not disappear. But it should be remembered that some of these cells and particles are dissolved by *zichio*.

It is important to notice that most handmade paper from the Himalayan area is so unhomogeneous, that a small sample taken from a sheet of paper, manuscript or the like, need not be at all representative of the paper as a whole with regard to the previous cooking and beating as well as to the shortening of the fibres. Many slides should preferably be made by taking fibres from 2–3 different parts of the sample and from all the layers.

a. PAPER FROM THE MOUNTAINS. Microscopical investigations of the modern paper sheets brought home, and made outside the Kathmandu Valley (see table p. 226) show—a little suprisingly —that these are all made from fibres of *Daphne bholua* or *Daphne papyracea*. As seen in chapter II, this does not mean that the other Thymelaeaceae species are not used at all to-day. Another important result of the investigations is that in none of the samples made in the mountains are the fibres intensely cooked, beaten or shortened, and none are sized or coloured.

b. PAPER FROM THE KATHMANDU VALLEY. Paper made in Sundarijal and Tripureswar is made of many different kinds of fibres. Besides *Daphne* fibres several kinds of straw fibres have been used, as well as imported wood pulp and waste paper from India, England etc. of highly differing character. In some paper one finds almost a dozen different fibres. It should be stressed that all Thymelaeaceae fibres occurring in modern handmade paper from the Kathmandu Valley are from either *Daphne bholua* or *Daphne papyracea*. Microscopical analyses of the samples in the table pp. 226–227 (see also pp. 90–91) show the following:

No. 15. Made from *Daphne* fibres. Quality and type (plate 191) are almost the same as the Baglung paper, No. 21.

No. 37. *Daphne* fibres which are somewhat shortened. The paper has 2 layers.

No. 31. *Daphne* fibres which have been rather strongly ground.

No. 34. *Daphne* fibres being much worn. The paper is made of waste paper (plate 196).

No. 32. Contains many different kinds of fibres and is probably mixed with waste paper. 1) c. ½ are *Daphne* fibres; sclereids up to 60 µ thick. 2) c. ⅓ are 1–3.5 mm. long, until 30 µ thick, red-brown, round, thick-walled fibres with pointed fibre ends and a shell visible everywhere. As we find vascular cells, angular parenchyma cells, big indented epidermis cells etc., the fibres are from a species of straw, possibly sabai grass. 3) The rest are conifer fibres (including mechanical pulp of fir), and there are even a few hardwood fibres. The paper is not sized (plate 195).

No. 36. The fibres (plate 237) are 0.4–2.3 mm. long, 3–15 µ broad (average 7 µ), mostly very thin, brown-yellow to faintly reddish and have many dislocations and pointed fibre ends. The guide elements are some few thin-walled, angular parenchyma cells and the characteristic indented epidermis cells, of somewhat varying size and shape. According to my informants the paper is made from sabai grass fibres, but they look more like rice straw fibres and those of another paper which was said to contain rice straw fibres (plate 236). The paper also contains some few *Daphne* fibres. It has been extensively coated with starch paste (plate 197).

No. 38. 1) This paper consists predominantly of conifer fibres (from spruce) and also a few hardwood fibres. 2) there are also small quantities of straw fibres up to 3 mm. long and 30 µ thick of the same kind as those described under No. 32 item 2. The paper is said to be mixed with waste paper and is extensively coated with starch paste (plate 198).

No. 39. 1) Contains predominantly c. 1 mm. long and 15–40 µ broad, flat, acuminate, mostly frayed light blue-violet fibres with badly defined, faintly undulating contours (plate 239). Fine lines are seen and some scarcely visible round or oblong holes. According to G. B. Shah these are *chiuli* fibres, which agrees with the fact that quite another paper, which was also said to be made from chiuli fibres, contains the very same fibre. 2) There are also *Daphne* fibres and 3) a few straw fibres like those described under No. 32 item 2. The paper is extremely short-fibred. It is not starched and looks very like parchment paper (plate 192).

No. 40. 1) This paper contains the same fibres as described under No. 32 item 2. Here they are 0.7–2.5 mm. long and 10–25 µ broad. 2) There are also many *Daphne* fibres which are a good deal shortened and worn. The paper is very much coated with starch paste (plate 193).

No. 41. Contains many different kinds of fibres and must be mixed with waste paper. The fibres described under No. 32 item 2 predominate. They are here up to 4.5 mm. long and 25 µ broad. Furthermore there are those under No. 36 item 1, finer fibres (rice straw fibres) as well as many kinds of round and angular parenchyma cells and also big vascular cells and various indented epidermis cells. Finally there are fibres of spruce and *chiuli* and also small amounts of *Daphne* and cotton fibres, conifer wood pulp etc (plate 194).

4. Manuscripts, Letters, Woodcuts Etc.

Used, printed, decorated paper or paper with writing has as a rule undergone various treatments (it can be starched, painted, lacquered etc.) and is often dirty, damaged by moisture, mould and so on. These factors alter the fibres' appearance in various ways so that they become more difficult to identify. The paper most often consists of several layers pasted together, which need by no means be alike. It already appears from this that a fairly complete description of the fibres, from for example a manuscript, is a complicated and circumstantial affair.

a. EARLIER INVESTIGATIONS. Before my own investigations are mentioned reference will be made to some earlier works concerning microscopical investigations of Asiatic paper.

WIESNER, 1902. An important work is J. Wiesner's book of 1902, which contains a series of analyses of old paper from East Turkestan and other parts of Asia. Among the samples investigated are two pōthī-mss. from the 4th–5th century in "Gupta Sanskrit" found in Kuchar, in Northern Sinkiang on the "Silk Road". In one ms. the paper is made of *Broussonetia papyrifera* fibres which are very long and have been exposed to an intense chemical treatment. The paper of the other ms. is made of Thymelaeaceae fibres which are somewhat shortened and to a great extent destroyed. In the first ms. the paper is covered with a layer of gypsum, in the second the paper is buff. Wiesner also mentions some analyses of North Indian paper from the 17th century, and further on a Nepalese ms. dated A. D. 1602, all of which are made of Thymelaeaceae fibres (species of *Daphne* unknown). In the last ms. the paper is buff, soft, long-fibred, only a little beaten and not treated with starch. Also to be noted is A. Stein's discovery of some very early Tibetan mss. in Tun-huang, Miran and Endere, of a different sort of paper than that of the other Tibetan and Chinese mss.

Such mss. from Endere were examined by Wiesner, who found that they too were written on *Daphne* paper, see STEIN, 1921, p. 462 and 816. According to Stein the paper seems to have come from Himalaya.

GEORG JAYME & M. HARDERS-STEINHÄUSER. With regard to modern investigations reference will only be made to a series of analyses undertaken at the *Institut für Cellulosechemie mit Holzforschungsstelle der Technischen Hochschule Darmstadt* by Georg Jayme and Marianne Harders-Steinhäuser. In the sources cited below exact descriptions of paper and fibres are given, all accompanied by fibre photographs. Some of the material has appeared in the following publications:

Papier Geschichte, June 1958. Analyses of 4 different Tibetan mss. from the 17th to 19th centuries. The paper is made respectively from fibres of: 1) *Daphne* species, 2) *Broussonetia papyrifera*, 3) bamboo species plus hemp or *Boehmeria* (ramie), and finally 4) ramie or hemp-like fibres.

MEIZEZAHL, 1961. Analyses of two Tibetan mss. One of them, presumably from the 15th or 16th century, consists of two inner layers of bamboo fibres and the two outer layers of *Broussonetia papyrifera* with a good many bamboo fibres. The other ms., presumably from the 16th or 17th century, is on paper made from *Daphne* fibres.

ROCK, 1963. Analyses of 8 partially very old Na-khi mss. made partly on *Broussonetia* paper, partly on *Wikstroemia* paper.

Papier Geschichte, April 1965. Analyses of various modern Nepalese paper.

Das Papier, April and May 1969. The results of M. Harders-Steinhäusers careful investigations of 21 paper samples from 13 Chinese mss. (C 1–C 13) and 8 Tibetan mss. (T 1–T 8), found in the famous bricked-up side-chapel in Tun-huang and now in the Bibliothèque Nationale in Paris. Probably none of the mss. is younger than c. A. D. 1000. It is of interest in the present context that many of the samples were made from hemp or ramie and on ribbed moulds, exactly the same as the paper mentioned on p. 109 found in Nepal (see also plates 118 and 119). In the English summary it is said:

> "Two of the papers were made according to the oldest paper making technique on the floating wire [the scooping-in technique] the other papers show a rib-like water mark which means that they are scooped on the movable bamboo wire [the dipping technique] which to our knowledge was not used in Tibet. That means that these papers come from China. In some cases the fibre material proved to be pure bast fibres from *Broussonetia*, in other cases it was a mixture of rags (may be hemp, ramie fibre) with bast fibres from *Broussonetia* or from Thymelaeacees. All papers show a more or less dense starch coating or starch flour that was dusted on. The two paper sides often varied in their coating."

The samples are of very mixed quality with regard to fibres and colour, thickness and hardness. Only one sample, C 13 is double-layered, the others being single-layered. C 1–C 13 and T 3, T 4, T 5, T 7 and T 8 are said to be scooped on bamboo moulds, whereas T 1 and T2 are scooped on cloth moulds (the mould of T 6 has not been identified). It is maintained that according to the literature, as well as the investigations of W. Sandermann (see bibliography), the ribbed paper cannot have been made in Tibet where the bamboo mould (or grass mould) has presumably not been used. It must be remembered, however, that Tibet covers an enormous area of very differing character, and that the history of the paper of that country is still only very little investigated. Incidentally, it should be mentioned that moulds of grass have been used in Bhutan and apparently in Kumaon as well (see pp. 61 and 143).

b. PRESENT INVESTIGATIONS. In the tables pp. 240–246 microscopical analyses are given of all the mss. described in the tables pp. 228–233 as well as of other examples of applied paper.

Fibres. The two first columns of the tables indicate the basic character of the paper fibres (maximum length, breadth, colour, fibre ends etc.). The fibres in Thymelaeaceae paper may be divided into two main groups. The largest one comprises the high-level fibres such as *Daphne bholua* and *Daphne papyracea*. In the tables they are indicated as T. h., i. e. Thymelaeaceae high-level species. For nearly all of these fibres a_m was between 8–10 μ (see table p. 236 and diagram p. 239, where *a* and *b* are defined). a_m and b_m have been obtained from at least 25 double measurements, in cases of doubt 50 or more. Sometimes a_m was found to be a little less than 8 μ, which may be due to the presence of fibres from *Daphne* species that grow at very great heights. Furthermore the two samples of *Wikstroemia chamaejasme* paper should be mentioned, where a_m was 4 μ.

In the other and smaller main group the fibres are broader, more thick-walled, a little longer and altogether of a different appearance. In this group a_m is greater than or equal to 15 μ (in a single case 14 μ). The fibres therefore derive from low-level plants, i. e. either from *Edgeworthia gardneri* or *Daphne involucrata*. In the tables they are indicated as T. l., i. e. Thymelaeaceae low-level species.

In contrast to *Daphne bholua* paper, nearly all the samples for which a_m is greater than 14 μ are remarkable in not containing bundles of fibres, in being softer, felted, clouded when held to the light and distinctly reddish. They are also easier to divide in water or zinc chloride iodine. Therefore in these cases they are probably made from *Edgeworthia gardneri* in spite of the great fibre lengths measured. (In the literature fibre lengths of at the most $5^1/_2$ mm. are given, presumably because only small plants have been investigated.) Fibres from the two main groups are in fact mixed in many of the samples.

The diagram p. 239 shows a_m and b_m of every single paper. Particularly with regard to a_m the values appear to be distributed in two sharply separated groups corresponding to the two above mentioned main groups of fibres. Thus $(a_m/b_m)_m$ of the two main groups was calculated to $9/10^1/_2$ and $16^1/_2/11^1/_2$ respectively. The reason why b_m is a little greater than that of the raw bast fibres is surely due to the swelling of the fibres after cooking. The diagram also shows that a_m can be used for dating manuscripts. *Thus it is seen that all the low-level fibres only occur in the period 1730–1880, when they are found in half of the mss.* This is possibly due to the fact that the consumption of paper increased greatly in the 18th and 19th centuries before the appearance of factory-made English and Indian paper, after which new fibres were taken into use.

State of the fibres. The values for the average lengths of fibres are estimated (long – quite long – medium long – quite short – short) and are a measure of to what extent the fibres are shortened through cutting and beating. The number of places where the fibres have been flattened is only a measure of the beating, and likewise depends on an estimate (a few – some – fairly many – many – very many). The swelling of the fibres due to cooking is only indicated when it is very pronounced.

The cuoxam reaction. For all dated manuscripts the swelling of the fibres in *cuoxam* has been investigated, which depends among other things on the fibres and the treatment to which they have been exposed as a result of cooking and beating. Also with reference to this reaction, the paper fibres of the two main groups of Thymelaeaceae species show a characteristic difference. The *Daphne bholua* or *Dahpne paryracea* fibres swell less but form many and more refractive spheres (plate 209). Since the *cuoxam* reaction is so different for most fibres, it is extremely suitable for disclosing the presence of even a few admixed fibres in a sample.

Guide elements. Only a few of the guide elements are noted; with Thymelaeaceae paper only the appearance of the sclereids. While paper made from the high-level species contains practically exclusively the thick, massive, green-yellowish sclereids (plates 207 and 239), the paper made of the low-level species contains chiefly the thin-walled sclereids (plate 206) in accordance with the results in the table p. 236. In the first group they averaged 1.2 mm. long (0.3–3.5 mm.), 42 μ thick (30–60 μ) and were thick-walled (over 10 μ), while in the second and smaller group they averaged 1.1 mm. long (0.5–3.0 mm.), 30 μ thick (25–35 μ) and were chiefly thin-walled (average 7 μ).

Starched paper. Many of the samples contain starch, either because several layers of paper have been pasted together or because they are coated to improve the surface or strength. These things have not been examined for all the samples, which would have been a rather vast and probably largely unprofitable task. The investigations seem to show that starch paste (colours blue-black in zinc chloride iodine) has been used almost exclusively for these two purposes. As well as being in accordance with the Nepalese aversion to using animal products especially for religious books, the use of starch paste also accords with what is commonly practised today. To judge from the kinds of starch grains which occur, they often seem to have used wheat flour paste and sometimes rice flour paste (concerning the identification of the different sorts of starch see e. g. WIESNER, 1928, pp. 1962–1965).

A distinction is made in the tables between two forms of starch: firstly some big, round or irregular, blue-black grains which are often placed on or directly envelope parts of the fibres (plate 229), and secondly finer, fluffy, brighter blue-violet particles resulting from the crushing and partial disintegration of the starch grains (plate 228). Both are indicated by three degrees of content (1 corresponding to a small and 3 to a large content). The figures given should not be taken too literally, as considerable variations may occur from one test to another with one and the same paper. The reason for this is that the layer or layers examined may contain an uncharacteristically great or small quantity of starch. The latter is the case when samples have been taken from edges of the manuscripts where the starch has dissolved or worn off. If the starch content is very great it is often due to a coating of the exterior sides of the leaves. Thus the starch content is very great in all the yellow-dyed manuscripts coated with orpiment plus starch paste.

In the following, attention will be called to the microscopical analyses of the oldest samples, but also to some representative examples among other specimens.

Asutosh-ms., A. D. 1105 (concerning this ms. and the paper see also p. 132 and plate 121). The fibres are up to 6 mm. long and 20 μ thick, but are nearly all much shortened, especially in the two outer layers (plates 215 and 216). The fibres most resemble *Daphne bholua* fibres, but a_m is only 7½ μ (b_m = 9 μ; in water a_m/b_m = 7 μ/9 μ = 0.8). Possibly this is a *Daphne* species from a greater height. There are many broad, olive-green, thick-walled sclereids, which are 0.5–1.6 mm. long and 25–40 μ broad. The proper bast fibres turn a pale red-violet colour, possible due to century-long oxidation. The fibres immediately dissolve in *cuoxam*, not just because they are rather heavily mechanically treated, but rather on account of withering (the sample has been taken from the edge of the ms.). Only a few big round starch grains have been found. The paper, which is 4-layered, has therefore presumably not been treated with starch to improve the surface.

Bir Library D. 161, A. D. 1182 (concerning this ms. and the paper see p. 133). The fibres are pale, violet or red-violet coloured and have knotty fibre ends. They resemble those of *Daphne bholua*, but also in this case a_m is only 7½ μ (b_m = 9 μ), for which reason it is possibly here, too, a question of a *Daphne* species from a great height. The thick-walled sclereids are about 1 mm. long and up to 40 μ broad. With *cuoxam* the bast fibres form typical strings of pearls which dissolve rather quickly and surely due to the manuscript's age, particularly as the fibres do not seem to have been much cooked or beaten. Many shortened fibre bundles occur. The paper, which is 4-layered, contains only a little starch and presumably has not been treated with starch to improve the surface.

Bir Library II, 51, A.D. 1220 (concerning ms. and paper see pp. 133–134 and plates 118 and 119). The natural fibre lengths are difficult to determine, as the fibres have been heavily treated mechanically and shortened (plate 218). They are flat and red-brown or violet. Already when studied under a magnifying-glass they are seen to appear in bundles in the paper. The thickness of the fibres is 20–40 μ, but sometimes up to 70 μ. The natural fibre ends are chiefly pointed, some single ones are rounded and not a few are bifurcate. They are mostly divided into many fibrils. The lumen is almost invisible and dimly demarcated. Cross-lines or dislocations only appear distinctly in polarised light (plate 220). Along with some indented epidermis cells, quite a few up to 1.5 mm. long and 10 μ thick, round fibres with pointed ends have been found. In addition single, big, round grains of starch occur. In spite of the application of several different methods of analysis it could not be decided with certainty whether the fibres derive from hemp or ramie, but the swelling in *cuoxam* (plate 219) points to hemp (see also HERZOG, 1955, pp. 332–337 on hemp, and pp. 347–349 on ramie). Furthermore, the helical fibrils, occasional traces of starch and often distinct lumen which characterise ramie (plate 223) have not been observed in the present sample.

n. 176 f., 13th century (ms. and paper see p. 134 and plate 120). The fibres are almost entirely of the same character as those of the previous manuscript. They are dirty yellow-brown, red-brown or violet, flat, and up to 70 μ broad, but mostly below 40 μ. The swelling in *cuoxam* is exactly as in the last mentioned test. Therefore the fibres probably also derive from hemp (or ramie). Here, too, thin pointed fibres have been observed and also single round grains of starch c. 50 μ in diameter.

As a comparison to the two previous samples, two early Indian mss. have been examined which also seem to be made of hemp (or ramie) fibres. One, *n. 85, c. 15th century*, is a Jain ms. but found in Nepal (ms. and paper see p. 134, plates 125 and 126). The fibres of this undyed paper are red-brown to greenish and violet (plate 221). They are flat and up to about 50 μ broad, but most of them are below 30 μ or even strongly divided into fibrils. Also some pink, round fibres up to 20 μ thick with a streak-like lumen were observed. Only a few big grains of starch were found. *I. 751, A.D. 1634* (of *The Royal Library* in Copenhagen) is also on undyed paper. The fibres are up to 60 μ broad (plate 222). The broad lumen is visible in isolated places, and the paper is not starched.

n. 117, 15th century (ms. and paper see p. 135 and plate 122). The fibres are from a high-level Thymelaeaceae resembling *Daphne bholua* (a_m/b_m = 9 μ/10 μ). The two inner layers are long-fibred, while the outer layers are short-fibred, which together with a dense coating of starch makes the paper stiff and suitable to write on.

n. 152, A.D. 1511 (ms. and paper see p. 136 and plates 127 and 128). The fibres are from a high-level Thymelaeaceae resembling *Daphne bholua* (plate 217. a_m/b_m = 9 μ/11 μ). In the two inner layers they are less shortened than in the outer layers. The layers are glued together with starch paste. As with all the other blue-black mss.

the colouring is pasted on the outside, only penetrating here and there to the inner layers.

n. 84 a, A.D. 1631. The fibres are of the same kind as those of the previous ms. ($a_m/b_m = 9\ \mu/11\mu$). The paper, which is long-fibred, contains only a few starch particles and is soft.

N. 29, A.D. 1675. The fibres are of the same kind as in the two previous mss. ($a_m/b_m = 9\ \mu/11\ \mu$), while some paper squares covering the miniatures are of later date and much less dirty than the book leaves. They are made from a low-level Thymelaeaceae ($a_m/b_m = 17\ \mu/11\ \mu$). The rather long-fibred paper has been stiffened and sized by means of a heavy coating of starch and subsequent polishing.

n. 176 g, 17th–18th century. The fibres are from a low-level Thymelaeaceae ($a_m/b_m = 16\frac{1}{2}\ \mu/11\ \mu$), as shown not only by the bast fibres themselves but also by the thin-walled sclereids and the *cuoxam* reaction. The soft, felt-like and slightly reddish character of the paper's undyed inner layers suggests that this is *Edgeworthia gardneri.* In the inner layers particles and grains of starch occur from the pasting together of the paper layers, while the many black irregular particles in the outer layers come from the black dyeing.

n. 84, A.D. 1736 (ms. see plate 137). The fibres are from a low-level Thymelaeaceae ($a_m/b_m = 16\ \mu/10\ \mu$, plate 224) and probably derive from *Edgeworthia gardneri.* The paper is long-fibred and very soft, almost like blotting paper and does not contain starch particles.

n. 70, A.D. 1737 (ms. see plate 138). The fibres entirely correspond to those of the previous ms. ($a_m/b_m = 17\ \mu/11\frac{1}{2}\ \mu$). The book leaves, however, are dense and stiff due to their having been coated with starch paste and then polished. Notice moreover the swelling of the fibres in *cuoxam* (plate 226) which is characteristic of *Edgeworthia gardneri.*

N. Gl. 1, A.D. 1802 (ms. and paper have been minutely dealt with on p. 139 and are shown in plates 132–134). Leaves 1–41 of the ms. are executed on bamboo paper (plate 230). The remainder of the leaves, 42–184, however, are made from fibres of a species of *Daphne* that seems to belong to a great altitude ($a_m/b_m = 7\frac{1}{2}\ \mu/10\ \mu$, plate 231). In these leaves the fibres have been rather strongly shortened, swollen and beaten. The starch content is fairly great, in spite of the paper being dyed blue-black and polished. The book leaves are consequently stiff and hard.

n. 10, A.D. 1820. The paper is made from a mixture of fibres from a high-level and a low-level Thymelaeaceae. This appears both from the differing appearances of the fibre ends, the presence of both thick and thin-walled sclereids, and the swelling in *cuoxam.* a_m of the whole paper is 12 μ and has resulted from the prevalence of the high-level species with a_m of 9 μ as against the fewer fibres with a_m of 19 μ (afterwards measured separately). The proportion between the two fibres by weight is about 1/1. The fibres have been heavily beaten and rather shortened which, in addition to a very heavy coating of starch, makes the book leaves parchment-like.

n. 164, A.D. 1824. The paper is made from a low-level Thymelaeaceae, presumably *Edgeworthia gardneri,* as shown not only by the paper and fibres (plates 228 and 229), but also by the swelling in *cuoxam.* The book leaves are hard on account of their high starch content, as the fibre photograph distinctly shows.

n. 155, A.D. 1848. The ms. contains two kinds of paper. In some leaves the fibres are from a high-level Thymelaeaceae, while other leaves consist of a mixture of this type and of one of the low-level species. The book leaves are parchment-like on account of their thick coating with starch paste.

n. 84 h, A.D. 1850. The fibres are from a high-level Thymelaeaceae ($a_m/b_m = 8\frac{1}{2}\ \mu/11\frac{1}{2}\ \mu$). The swelling in *cuoxam* (plate 227) is less than with *Edgeworthia gardneri* and there are a far greater number of refractive spheres. The fibres are rather shortened and the book leaves are coated with starch paste, and consequently dense and rather hard.

On the whole the same fibres appear as mentioned above with regard to the books, p. 141, in *Tibetan* (all found in Nepal and undated). It should, however, be emphasised once more that the investigation of books of this kind has not been particularly extensive, neither have all the existing types been dealt with. Many different types of fibre must be represented in the books brought to Nepal from Tibet.

As far as the specimens examined are concerned see tables pp. 245–246) most of the samples are made from high-level Thymelaeaceae like *Daphne bholua.* Fibres of the low-level species occur in other samples, presumably mostly *Edgeworthia gardneri,* and in a few the two fibres are mixed (see n. 138 b and J. T. 15). In n. 45 some of the leaves are made from one of the main types and some from the other. J. T. 21 is executed on *Wikstroemia chamaejasme* paper ($a_m/b_m = 4\ \mu/9\ \mu = 0.4$) and presumably imported from Tibet.

A heavy coating of the book leaves with starch is less common than with the mss. in Nepalese. In a few of the samples the starch content seems to be of a special kind, see for example n. 45.

Among the other applications such as letters, woodcuts, cards etc. only the kinds of paper already described occur, including the soft, felted and slightly reddish paper which is presumably made from *Edgeworthia gardneri* and which seems well suited to woodcuts (see J. T. 7, 8 and 10). An exception is the writing paper found in Kathmandu, J. T. 46, which also derives from Tibet. It consists chiefly of *Wikstroemia chamaejasme* fibres ($a_m/b_m = 4\ \mu/9\ \mu$) mixed with fibres from a low-level species, and also with small quantities of other fibres. The paper is made from waste paper, which was quite commonly used for making paper in Tibet.

C. Organic and Inorganic Substances in Bast, Pulp and Paper

Finally I will discuss a series of investigations of organic and inorganic substances in bast fibres, pulp, unused paper, mss. etc. Such analyses have several purposes. We can follow the chemical changes that take place in the fibres during the manufacture of the paper and thereby elucidate the process from a new angle. Of more significance in the present connection is the determination of colouring, protecting or surface-improving materials, as well as possible tracer elements which, on account of their special character or quantity, may be used to disclose the origin of the paper of mss. etc.

Unfortunately, the results of the measurements of the various elements and compounds in paper, new as well as old, can be very difficult to judge, because paper is an extremely complicated product. Its content of elements and compounds depends on the kind of fibres, place of growth, method of production, additions to the pulp etc., as well as the pasting together of layers, dyes, coatings and presence of dust and impurities. As long as only a few actual measurements are available it hardly pays to treat this subject in general. I shall therefore confine myself to recording and commenting on these measurements.

1. Organic Substances in Fibres, Pulp and Unused Paper

WATT, 1890, pp. 22–23:

"Chemistry of *Daphne*.—In the chemical analysis of the fibres of India, published by Messrs. Gross, Bevan, and King, *Daphne* . . . possesses . . . cellulose, namely, 22.3 per cent.

Edgeworthia:—Moisture 13.6 per cent., ash 3.9; loss by hydrolysis, for five minutes, in soda alkali 21.6, for one hour 34.7; amount of cellulose 58.5 per cent.; mercerising 16.5; increase of weight on nitration 126; loss by acid purification 8.3; amount of carbon 41.8 per cent."

WEHMER, 1929–31, p. 813:

"149. Fam. Thymelaeaceae. . . .
Als characterist. Stoff nur Glykosid Daphnin. . . .
2603. *Daphne Mezereum* L., Seidelbast, Kellerhals. . . .
Rinde: Glykosid Daphnin 1) (Diosycumarin, in Daphnetin u. Dextrose spaltbar), Aepfelsäure frei u. als K-, Ca- u. Mg -Salz, scharfes Harz, 'Schleimsucker', Wachs, gelf. Farbstoff u.a. nach früheren Angaben 2); fettes Oel, scharf. Harz ('Mezereinsaure') 3); [Umbelliferon oder Paraoxycumarin aus Harz der Rinde bei Destillation 4)].
. . .
2606. *Daphne alpina* L.
Rinde: Daphnin, scharfes Harz, Bitterstoff, Schleim u.a."

It should be noted concerning the measurements of cellulose content that the cellulose in bast and paper appears in several not very well-defined forms, for which reason the measured contents will depend to a certain extent on the method of measurement. The content given for *Daphne bholua* bast of only 22.3 % is remarkably low and does not agree with some measurements taken at the Central Laboratory of *The United Paper Mills*, Ltd. in Copenhagen. Here we found a cellulose content in *Daphne bholua* bast that was almost equal to that given above for bast from *Edgeworthia gardneri*.

Measurements

1) A bast strip of *Daphne bholua* from Tumbu in East No. 3 contained: 57 % holo-cellulose, determined by the chlorite-method; 46 % alpha-cellulose, determined by treatment with 17.5 % NaOH for 1 hour; ash 3.3 %.

2) Paper of the ordinary quality from Tumbu made

from the above mentioned bast strips contained: 83 % holo-cellulose and 72 % alpha-cellulose. Extract 0.23 % with alcohol-benzene.

3) Paper of the ordinary quality from Nanglibang in West Nepal contained: 85 % holo-cellulose and 77 % alpha-cellulose. Extract 0.20 % with alcohol-benzene.

The content of free water in the bast was 10 % and in the paper 8 %, both measured at a relative humidity of the atmosphere of 50 % at 20° C.

The paper-makers in Tumbu said that from 5 lbs. of bast or about 2250 g. they could make 200–250 sheets of paper of the ordinary quality with a square metre weight of c. 20 or 6–7 g. per sheet, i. e. in all 1400 g. of paper. This information, together with the above results, may help in following in outline the transformation of substances during the manufacture of the paper.

Out of the 2250 g. of bast strips, 57 % are cellulose, i. e. about 1300 g. The free water amounts to c. 250 g. and other substances constitute the remaining 700 g. Of the paper's 1400 g., 83 % is cellulose or c. 1150 g. The free water constitutes c. 100 g. and other substances the remaining 150 g.

	Total weight	Cellulose	Free water	Other substances
Bast	2250 g.	1300 g.	250 g.	700 g.
Paper	1400 g.	1150 g.	100 g.	150 g.
Loss	850 g.	150 g.	150 g.	550 g.

Thus during the manufacture altogether 850 g. has disappeared, consisting of 150 g. cellulose, 150 g. free water and 550 g. other substances. During the cooking of the fibres c. 350 g. (estimated) out of the 550 g. are lost to the cooking liquid (the cellulose content is hardly reduced at all during the cooking). The remaining 200 g. of the 550 g. and the 150 g. of cellulose are lost through impurities being sorted out throughout the process and through fibres escaping in the scooping basin.

2. Analyses of the Cooking Liquid, Pulp Etc.

The following measurements were taken at Tumbu, East No. 3, in huts I–V:

pH of the lye of ashes in the ash-basket was $9-10^{1}/_{2}$, of the cooking liquid $12^{1}/_{2}-13$ and of the pulp $8^{1}/_{2}-10^{1}/_{2}$. The temperature in the big cauldron during the cooking of the bast strips was only 88° C on account of the altitude. In the wooden conduits $9^{1}/_{2}$° C was measured and in the scooping basin $10^{1}/_{2}$° C in the middle of the day (20th April).

The measurements in the table below were taken at the Central Laboratory of *The United Paper Mills*, Ltd.

For comparison with the ion values given here, it should be mentioned that the cooking lye for making half-chemical pulp contains 25–75 g. NaOH/litre. The *pH*-values seem to agree fairly well with those measured on the spot.

The quantity of dry-matter in the cooking lye increases during the cooking owing to the liberation of salts, resin, wax etc. from the bast strips. This is apparent from its thick, oily, very dark brown character after the cooking is finished, even allowing for a certain amount of evaporation.

For the cooking of the bast strips the paper-makers used about 25 litres of cooking liquid of which about 15 litres were left afterwards. Based on these approximate values and on a somewhat simplified calculation the bast strips during the cooking have liberated: $5.5/100 \times 15$ kg. $- 2.2/100 \times 25$ kg. $=$ 825 g. $-$ 550 g. $=$ 275 g. of dry matter to the cooking lye. This figure seems to agree

	Dry matter	inorg.	org.	OH^-	CO^-	HCO_3^-	*pH*
Ash for cooking the bast	89 %	73%	23%	0%	4%	1.4%	10.3
Fresh cooking liquid	2.2%	46%	54%	1.2 g/l	4.5 g/l	0 g/l	12.0
Cooking liquid after use	5.5%	12%	88%	0 g/l	0 g/l	12.2 g/l	8.6
						(g/l is gram/litre)	

fairly well with the estimated value of 350 g. (see p. 202).

During the cooking the cooking lye has given off: $46/100 \times 550$ g. $- 12/100 \times 825$ g. $= 253$ g. $-$ 99 g. $= 154$ g. of inorganic materials to the bast strips.

On the other hand the bast strips have given off: $88/100 \times 825$ g. $- 54/100 \times 550$ g. $= 726$ g. $-$ 297 g. $= 429$ g. of organic material to the cooking lye.

3. Elements and Compounds in Bast and Paper

a. BAST AND RAW PAPER.

WEHMER, 1929–31, p. 813, writes:

"2603. *Daphne Mezereum* L., . . .
Rinde . . . -Asche (3% ungf.) mit (%) 40.8 CaO, 8.6 Na_2O, 12.4 MgO, 8.15 P_2O_5, 20 K_2O, 6.6 SO_3, 2.6 SiO_2, 0.2 Al_2O_3, 0.3 Cl . . ."

Converted into elements, the percentages in ash are: 29.1 Ca, 6.4 Na, 7.5 Mg, 3.6 P, 16.6 K, 2.6 S, 1.2 Si, 0.1 Al and 0.3 Cl.

At the *Mineralogical Institute* in Copenhagen a series of quantitative *optical spectrographic analyses* of *Daphne bholua* bast and of new, uncontaminated samples of paper have been undertaken, see table p. 247. Apparatus: Hilger Large Quartz/Glass Littrow Spectrograph. The analyses were undertaken by H. J. Bollingberg, M. Moritzen and I. Sørensen.

The quantities of elements are indicated in percentage of paper made into ash, each sample originally being c. 10 by 10 cm. The values can be converted into p. p. m. (parts per million) of the paper by multiplying by the ash content and the coefficient 100. With regard to the absolute values, the error is estimated to be rather big, because the standards of comparison are measurements executed on chemical silicates. On the other hand, the standard deviation with regard to the various samples' content of one particular element is only about -10 % and $+20$ % relative.

Some remarks are necessary on the character of the samples. The largest group of samples are all Thymelaeaceae paper of the *Daphne bholua* type. The figures given in brackets for some of the samples are those measured previously, see the table p. 226. The paper called *Dalhousie* is made by Tibetans near the town of this name in Northwest India. The bast was harvested in this area but the method of production is Tibetan (e. g. the format and the fine mould used for making the paper). The samples *PP 11*, *PP 70* and *Kanjur II 4* are from unprinted leaves of books in Tibetan and they do not seem to be contaminated. The books derive from Central Tibet north of Sikkim, but the paper may have originated in Himalaya. *PP 11* is slightly brownish, 0.10 mm. thick, scooped on a fine mould of fabric with c. 50 threads/50 mm. *PP 70* is rather bright, 0.12 mm. thick and has 32 threads/50 mm. *Kanjur II 4* is red-brown, 0.20 mm. thick, 2-layered and with 18 threads/50 mm.; the fibres are from a low-level Thymelaeaceae. The two Tibetan samples called *Shekar Dzong* and *Nyemo*, made near these localities, are both made from *Wikstroemia chamaejasme* fibres. The two last samples in the table are made from *Broussonetia papyrifera* fibres and they are from *Thailand* (fibres, see plate 211) and the *Shan* state in Burma respectively. The samples made outside Nepal and from other fibres are included to give an impression of the resultant changes in the content of elements. The maximum values in the table are italicised in order to underline the variations.

Results. It will be seen that in bast of *Daphne bholua* the elements Cr, Cu, Sr and Ba occur in about the same quantities as in the two samples of paper, bast and paper all originating from the same locality. Of the other elements found in the paper only traces were found in the bast, or nothing (Zr). Those elements which occur more abundantly in the paper than in the bast have been supplied during the manufacture of the paper, and mainly from the cooking lye.

The two sheets of paper made near Tumbu a few years apart and by different paper-makers, seem to contain almost the same quantities of the elements investigated. The *Yolmo* paper, in respect of Si, Ti, Cr, Fe and Cu only contains $^1/_2$–$^1/_3$ of the quantities of those elements found in the other Nepalese samples. This is assumed to be a casual deviation, the more so as the variations are one-sided. This assumption is supported by the analyses mentioned below. More remarkable is the high percentage of ash in the samples: *Bhutan*, *PP 11* and *PP 70*.

Paper from *Kanjur II 4* probably made of fibres from *Edgeworthia gardneri* contains a low ash percentage and relatively small quantities of Si, Ti Mn, Fe and Cu. For the cooking of the more easily divisible bast strips of this species smaller quantities of lye of ashes are certainly required.

The two samples of *Wikstroemia chamaejasme* paper from *Shekar Dzong* and *Nyemo*, not far from each other in Tibet, are distinguished by having small Mn and Ba contents and also by having the same small percentage of ash. Finally, the two samples made from *Broussonetia papyrifera* fibres contain rather divergent quantities of elements and ash, possibly because they are made in different regions.

In order to group the samples more clearly by their contents, the proportions between specific elements have been calculated as shown in the table.

Moreover one bast strip and two sheets of paper were subjected to *neutron activation analyses*, inter alia to control the above mentioned measurements. These analyses were made at the Isotope Division, *Danish Atomic Energy Commission, Research Establishment Risø*, by K. Heydorn. The results of the measurements are shown on p. 247. The three samples are from the same locality as three of the optically spectrum-analysed samples.

The method, which is very sensitive and accurate, is briefly as follows. The sample is irradiated with neutrons in a reactor and returned at once for analysis. Each of the isotopes formed emits γ-rays (photones) with quite definite energies which are characteristic of the isotopes and thus of the elements contained in the paper. The photones can be detected as faint flashes when they hit a sodium iodide crystal activated by 0.1% thallium-iodide. By means of a photo-multiplier the flashes are transformed into electric pulses, the number of which are proportional to the energy of the photones. The pulses are sorted according to their size in a multichannel analyser.

When the number of registered pulses is indicated as a function of the pulse height (the energy of the photones) we have the γ-spectrum. This consists of a series of maxima, the so-called photo-peaks, one or more for each radioactive element. The area below each photopeak determines the quantity of the isotope in question. Isotopes with the shortest half-life period have by far the greatest maxima at the beginning and are therefore measured first. If the measurements are repeated at suitable intervals, after hours, days and months, the content of other elements can be determined, as the γ-spectrum of isotopes with comparatively much shorter half-lifes has now decayed and handed over the stage to isotopes with a longer half-life period.

Results. The first measurements record some quantitative analyses of bast and paper from *Tumbu* and paper from *Yolmo*. At the bottom of p. 247 some further analyses of activation are given, but here the elements are measured in proportion to the content of the paper sample from *Tumbu*. It will be seen that the amount of each element in the bast sample is between 0.2 and 0.9 of those of the paper. It further appears that in the two samples of paper the quantities of K, Na, Mn, Ca, Fe, Cs and Au are almost equal, while the quantities of Cu, Al, Sc and Cr in the *Yolmo* paper are about twice those of the *Tumbu* paper. The two samples of paper, besides being produced by the same method, derive from areas very similar to each other. Finally it may be noted that there is a good agreement between the results obtained by the optical spectrographic analysis and those obtained by activation analysis, considering the heterogeneity of the paper.

The provisional results of the above analyses show that the elements in raw paper depend on the species of fibres used, from where the plant derives, the place of production, and particularly on the method of production, but that these factors each alter the composition in a specific way. The paper-making area in question is divided by the Himalayas, which with regard to height, climate and geology form such a sharp barrier that it should be possible to detect tracer elements in the paper, disclosing its origin. These are, however, difficult to determine, because there are so many factors influencing the composition. Moreover, the analyses are too few to afford a more precise distinction between the various effects, but they are of great value for the evaluation of small contents of inorganic dyeing and coating materials in the paper.

b. MANUSCRIPTS. Dyes and coatings are of special interest for the determination of the origin of the mss., because not only have they differed from one area to another, but they have also changed with time. In cases where organic dyes and coatings have been used it is extremely difficult to determine the character of materials, because they consist mainly of complicated high-molecular compounds. When inorganic compounds have been used they are mostly rather simple chemical compounds which are more easy to identify.

Below I shall mention some *X-ray fluorescence analyses* of paper from mss. which have been investigated because of their age or uncertainty as to the kind of colours etc. with which they have been treated. The analysed mss. have already been described above, see the tables pp. 228–234. The measurements were made by M. Grumløse and E. Leonardsen, at the *Mineralogical Institute* in Copenhagen. Results see p. 248.

Apparatus: Phillips X-ray, fluorescence-analyser, type 1540. With this method a sample is placed between two layers of Mylar-foil, which almost exclusively contains elements with low atomic numbers (at least below 20, i.e. Ca) whereupon it is irradiated with X-rays. (The effective area of the sample which can be measured is about 2 $cm.^2$. Control measurements showed that the X-rays passed almost unimpeded through two layers of the raw paper.) The intensity of the fluorescense radiation caused by the agitated atoms is registered as a function of the wavelength. From this a series of maxima results, the position of which in Ångström may be directly correlated with the elements in the sample. In principle the height of a maximum is proportional to the quantity of the element in question.

However, the height of a given maximum and thereby the value indicated in the table cannot be converted into an absolute quantity of the element, because among other things the height of the maxima is not only highly dependent on the element in question, but also to a certain extent on the amounts of other elements in the sample. In addition the sensitivity of the apparatus is dependent on the wavelength, and finally the samples are of different sizes and thicknesses. Therefore the figures are not even a measure of the relative quantitative contents of the samples element by element. Nevertheless by comparing the measured figures with the size of the samples we may discover possible added materials, where there are considerable relative differences, i.e. more than say 10 times the quantities in the untreated paper. According to the table p. 247 a new and untreated paper contains c. 200 p.p.m. Mn, 400 p.p.m. Fe and 20 p.p.m. Cu. According to the table p. 248, for the same paper and for the same three elements the relative amounts of these elements are respectively 5, 12 and 1 units. I.e. for these three elements 1 unit corresponds to about 20–40 p.p.m., which presumably also gives an idea of the order of magnitude of the contents of Ni, Zn and As in table 248.

The occurrence of definite, and comparatively large amounts of certain elements cannot in itself determine which inorganic dyes or coatings have been used. The measurements were therefore supplemented by some *X-ray diffractometer-analyses*, which may be used when the materials exist in a crystalline state and the crystals are bigger than c. 1 μ. The combination of these two methods is extremely well-suited for the determination of mineral dyes and coatings of manuscripts. Furthermore the measurements only require very small samples.

By the X-ray diffractometer method the distances in the lattice system of the crystal are determined by interference measurements. A well-defined X-ray is pointed at the sample during a continuous changing of the angle of incidence, at which a series of interference maxima, the position of which (in relation to the X-ray's angle of incidence) and size characterise the structure of the crystal, are registered in the reflected radiation (apparatus Phillips). Even small quantities are sufficient to obtain these interference maxima. The elements determined by the X-ray spectrographic method are checked in a table to find just that compound which has exactly the measured interference maxima determined by the diffractometer method.

Results (see also table p. 248).

Palm leaf mss. n. 173, 168, 109, 72, 90 and 94, 11th-15th century.

The measurements show that none of the palm leaves seem to have been treated with inorganic materials, as also indicated by the diffractometer analyses. It is especially remarked that none of the slightly yellowish palm mss. were treated with orpiment, as was first assumed. If we take the size of the samples into consideration, it appears that they contain approx. the same amounts of each element. However, the contents of K, Ti and Cr are rather high in n. 173, and the As-content in particular deviates from the other samples. This may be due to the fact that this ms. was probably not made in Nepal like the other palm leaf mss.

n. 123, 15th century. The slightly yellow *Aquilaria agallocha* bark sheets were also suspected of containing orpiment (As_2S_3), and the analysis confirmed this. In order to verify this result a deep yellow, modern paper, densely treated with orpiment, was analysed by means of X-ray fluorescence. It appeared to have exactly the same maxima.

Paper mss.

Anatosh, A.D. 1105. The sample is small and rather dirty. It will be seen that the content of Ca, Fe, Cu, Zn and Pb is about 10 times that of the untreated paper, yet still corresponds to a very small quantity. Neither did the diffractometer method disclose significant elements, therefore the paper has probably not been treated with inorganic materials.

Bir Library D. 161, A. D. 1182. What has just been said of the Asutosh-ms. also applies to the present ms. from the same century.

Bir Library II 51, A. D. 1220 (blue-black ms. on hemp or ramie paper). The content of Ca, Fe and As is considerably greater than with the untreated paper, but still no more than if the colour were of organic origin like the blue-black *niladuto* colour used up to our time. The black particles are very fine-grained even under the microscope and hard to dissolve in either petrol or boiling water. A diffractometer analysis indicates strongly that this is a case of an organic dye, which of course does not prevent inorganic materials from having been used in the preparation of the organic dye stuff.

n. 117, 15th century. This worn, slightly brownish and much worm-eaten ms. with dark, finely crystalline spots here and there, contains more than 10 times Ca and Fe than the raw paper and, it will be noticed, no arsenic. As the X-ray fluorescence analysis did not disclose the character of the coating, the finely crystalline spots were scraped off and subjected to a diffractometer analysis. Thus a series of maxima were found corresponding almost exactly to that which the tables indicated as γ-Iron (II, III) hydroxide phosphate hyd. q. ($FeFe_4(PO_4)_3$ $(OH)_5$, $3H_2O$ $_q$) and partly to γ-Iron oxide hydroxide ($-FeO(OH)$). The elements present and the brown colour of the paper, together with the diffractometer measurements, could suggest that the paper has been treated with the earth mineral ochre, which for unknown reasons has been transformed in places into the above phospates. However, it is more likely that the spots stem from blood-offerings so common on Nepalese mss.

Bir Library A 1671, A. D. 1505. The content of arsenic is about 100 times that of the raw paper. Consequently the paper has certainly been treated with orpiment.

Bir Library A 1593, A. D. 1535. The content of Ca and in particular of As is rather high. Possibly the paper has been lightly treated with orpiment.

n. 26, 17th or 18th century. The measurements show no remarkably high content of elements apart from As. Possibly the paper has been lightly treated with orpiment.

n. 84, A. D. 1736 and N. 34, A. D. 1764. With both these red-yellow coloured mss. the content of arsenic is about 500 times that of the untreated paper. The mss. have certainly been treated with orpiment.

N. GI. 1, A. D. 1802. The content of Ca, Fe, Cu and Pb is about 10 times, and the Zn-content more than 50 times, that of the raw paper. What was said concerning the blue-black colouring of the ms. II. 51 in Bir Library, from A. D. 1220 applies also to this ms.

J. T. 12b, 18th or 19th century. On account of the white dusty surface of the leaves of this book the paper's Ca-content was explored at once. As this was more than 10 times that of the untreated paper, the paper was investigated with the diffractometer. The measurements showed that the paper was covered with calcite ($CaCO_3$).

J. T. 21, 19th century (from Tibet). This whitish ms. was also expected to contain a chalky compound; this however, did not seem to be the case, the Ca-content being small and the diffractometer measurements giving no results. But the iron content is more than 10 times that of the untreated paper. Probably the whitish colour of the ms. is due to the fact that it is of greyish *Wikstroemia chamaejasme* paper heavily treated with starch paste.

Investigations into organic and inorganic materials in paper are still rather difficult to carry out, as well as time-consuming. The methods, however, are developing fast and becoming more sensitive and more easily executed. Soon it will be possible to make analyses of elements and compounds precisely and almost fully automatically, thus determining not only dyes and coatings, but also features of the technique of production, glues, sizing materials, various sorts of ink etc. *In this way these analyses will become just as important as the microscopical analyses which have until now been by far the most used method of examining antique paper from Asia.*

Summary (Chapter VI)

The technical analyses of bast, raw paper and paper made into mss. etc. give many kinds of information of technological and paper-historical interest. Chapter VI particularly deals with the identification of mss. fibres through the microscope, and the determination of elements and compounds in bast, raw paper and mss.

MACROSCOPIC PROPERTIES OF PAPER
Properties such as shape, surface, weight, density

and strength of raw paper as well as of paper in its various uses are investigated. Whereas these properties may give much useful information about new paper, only few of them such as surface properties can be studied in the case of old samples of paper.

MICROSCOPICAL ANALYSES

1. Fibres from herbarium plants. As nearly all Nepalese paper, new as well as old, is made of Thymelaeaceae bast fibres, the species of this family used for making paper are particularly dealt with. Special analyses have been made of the irreversible colour and swelling reactions in zinc chloride iodine and cupric oxide ammonium. It is shown that the fibre ends are of special diagnostic value, and that it is possible to distinguish between almost all the fibres used for making paper in Nepal.

2. Unused, new paper. Investigations of such paper show that all the samples from outside the Kathmandu Valley are made of either *Daphne bholua* or *Daphne papyracea*. In paper made in the valley in recent times we also find fibres of rice straw, sabai grass *(Pollinidum augustifolium* comb. nov.), chiuli (? *Sterculia coccinea* Roxb.) and various wood fibres, waste paper fibres of local or foreign origin, as well as mixtures of all the mentioned fibres. The mechanical and chemical treatment of these fibres used for making paper in the Kathmandu Valley is much more pronounced than is the case with the paper from the mountains.

3. Manuscripts, letters, woodcuts etc. A few early mss. are executed on hemp or ramie paper, probably not even manufactured in Nepal. Nearly all the other mss. are on Thymelaeaceae paper. Of these, the oldest mss. and most of the other mss., are executed on paper made from fibres of high-level species i. e. from plants found over c. 1800 metres. Another large group of mss. is on Thymelaeaceae paper made from a low-level species (below 2000 metres) with a remarkably soft, felted and slightly red-brown character. These fibres probably derive from *Edgeworthia gardneri* Wall., and it was found that mss. on this kind of paper are all from A. D. 1730 to 1880. The demand for paper in Nepal and Tibet increased so sharply during the 18th century, before the introduction of modern fibres, that the paper-makers had to introduce new fibres.

The earliest mss. do not seem to have been treated with starch paste, whereas from the 17th century onwards the great majority of mss. were treated with a starch paste containing orpiment – quite a necessity in the rather warm climate of the Kathmandu Valley. Mss. in Tibetan found in Nepal are not treated in this way, and are rather less often starched, but may sometimes have been dusted with chalk powder.

ORGANIC AND INORGANIC SUBSTANCES IN BAST, PULP, PAPER AND MSS.

1. Organic substances in fibres, pulp and paper. Here only measurements of the cellulose content in bast and paper are referred to:

Strip of bast, Tumbu, East Nepal:
(Daphne bholua) Hollo-cellulose 57%, Alpha-cellulose 46%

Paper, Tumbu, East Nepal:
(Daphne bholua) Hollo-cellulose 83%, Alpha-cellulose 72%

Paper, Nanglebang, West Nepal:
(Daphne papyracea) Hollo-cellulose 85%, Alpha-cellulose 77%

2. Analyses of ash lye (for cooking the bast), pulp etc. These measurements are primarily made in order to understand the chemical processes taking place when the bast is made into paper. About 60 % of the raw bast is made into paper. It is found that the loss is due to the removal of impurities and the sorting out and loss of fibres during the entire process (c. 50 %), and to the loss of various substances such as juices, wax, resin (c. 35 %) and water (15 %) during the cooking.

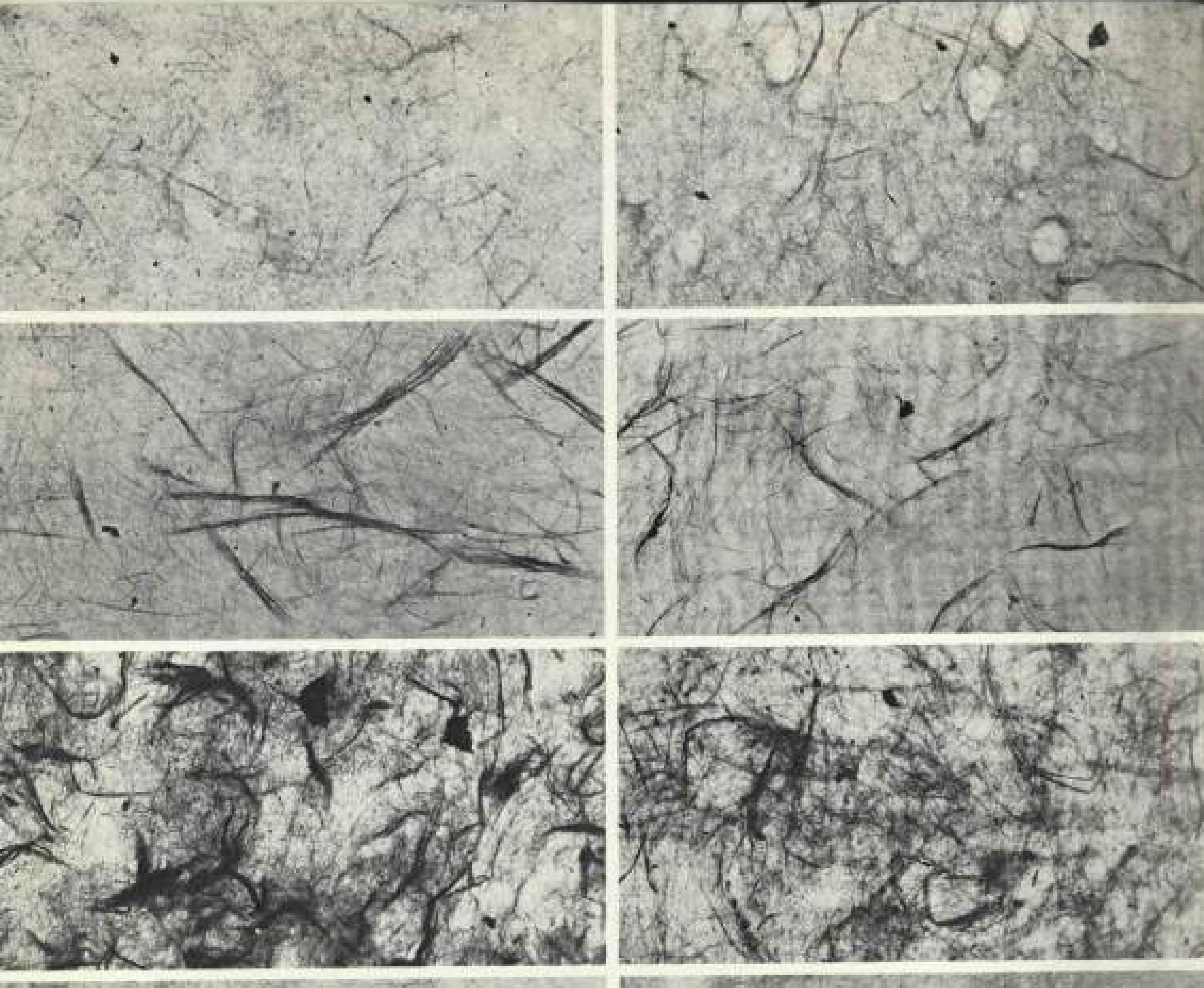
3. Analyses of elements in bast and paper. The *optical spectrographic analyses* and the *neutron activation analyses* demonstrate that during the manufacture the fibres absorb inter alia Al, Si, Ti, Mn, Fe, Ni, Cu, Zr and Cs, whereas the Sr content falls. When comparing new, raw Thymelaeaceae paper from various localities in and around Nepal, we see that the ratio between the amounts of one and the same element in two samples may be up to 7:1 (Si, Ti and Fe), but for other elements (Cr, Mn, Cu and Sr) there are ratios of over 20:1. Soil, climate, fibre and not least the method of manufacture each influence in a specific way the content of elements in a sample, but the measurements are still too few to distinguish between all these factors or to find tracer elements. The measurements are, however, of great value when determining the added inorganic dyes and coatings applied to the mss. because the treatment has changed from place to place and from period to period.

Through the *X-ray spectrographic analyses* it is found that palm leaf mss. were probably not treated with inorganic substances as was first anticipated. On the other hand a ms. made on bark sheets from *Aquilaria agallocha* was proved to have been treated with orpiment, As_2S_3. Analyses of the typical yellow mss. on paper, all from the 17th century and onwards, showed that they were also treated with this mineral.

X-ray diffractometer measurements enabled the determination of crystals in dyes and coatings, and thereby their exact chemical composition. In addition fine traces of dark crystals on a 15th century ms. were found to be of gamma-iron phosphates probably deriving from a blood-offering so common on later Nepalese mss. A Tibetan ms. from the 19th century was shown to have been treated with calcite, $CaCO_3$.

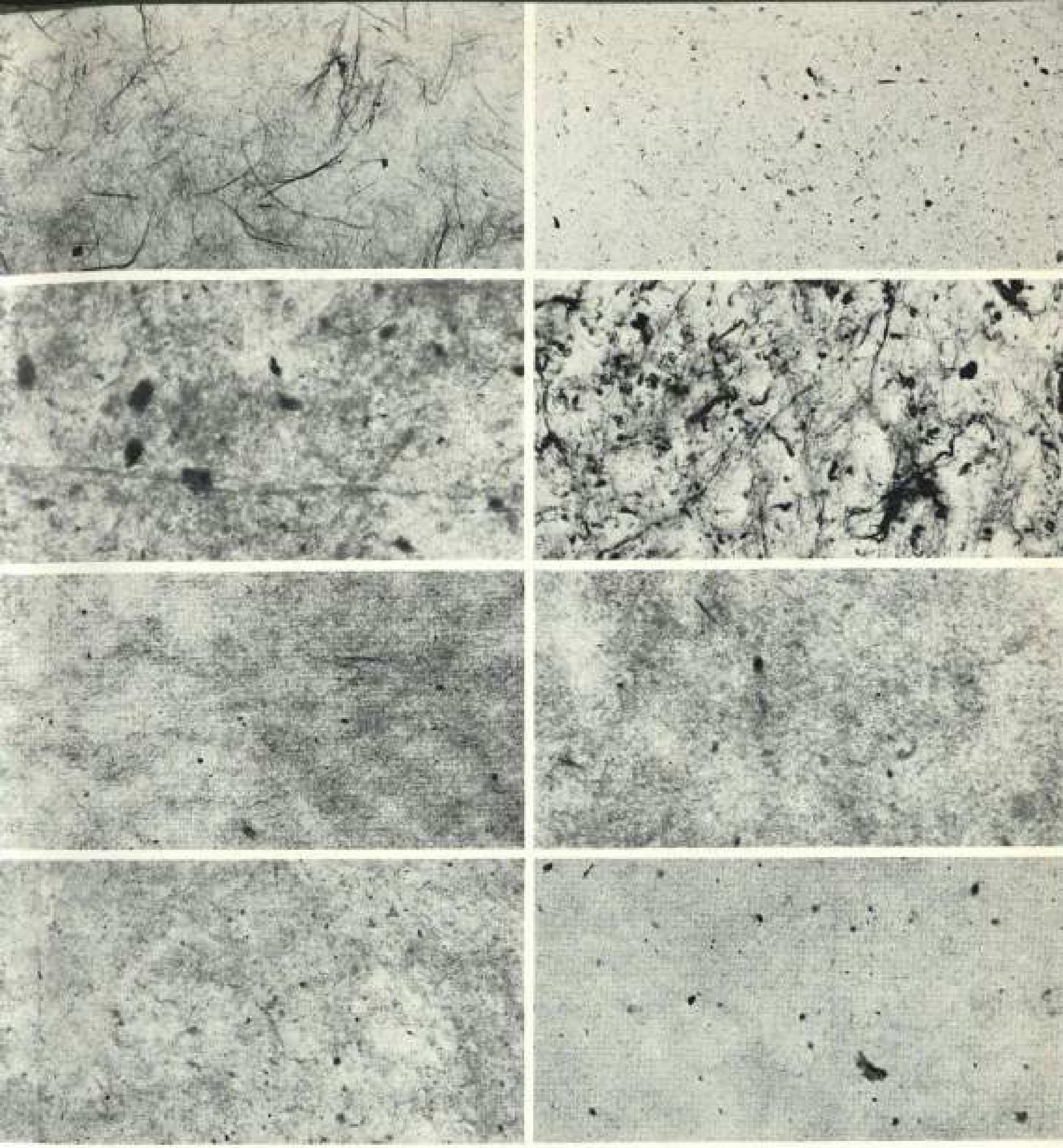
Even though the analyses of organic and inorganic substances in bast, pulp and paper are still somewhat complicated to make, it will soon be possible to carry them out far more quickly, with greater precision and less expensively. It will then not only be possible to determine dyes and coatings, but also characteristics of manufacture and of sizing, inks etc. Thereby these analyses will be able to compete with microscopical analyses which until now have been of major importance when investigating antique Asian paper.

Fibre Photographs



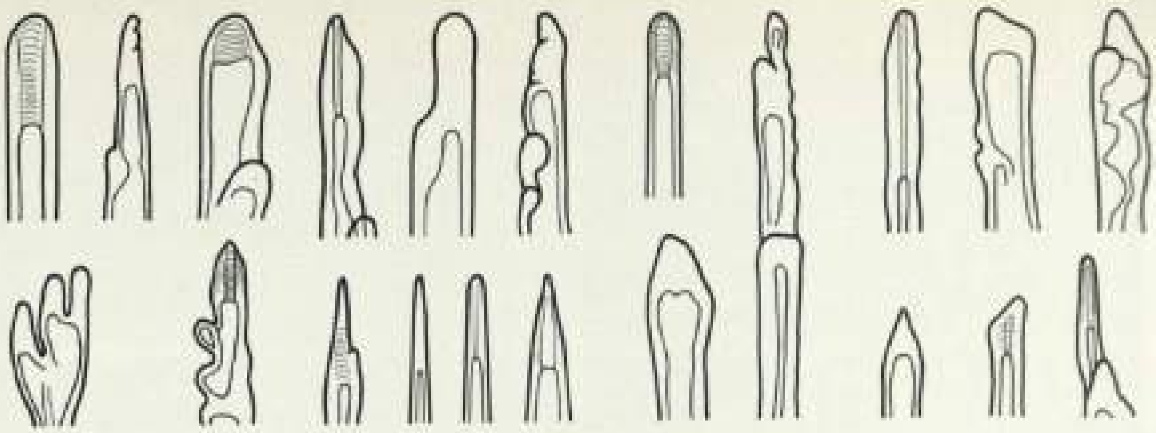
Plates 183–190. Paper photographed in transparency. Bundles of fibres appear darker. All fibres are from *Daphne bholua* or *Daphne papyracea*. For numbers and further properties see pp. 226–227. Scale 1 : 1.

Plate 183. Tumbu, no. 1, fine quality.
Plate 184. Tumbu, no. 5, with holes.
Plate 185. Tumbu, no. 6, ordinary quality.
Plate 186. East No. 1, no. 28, ordinary quality.
Plate 187. Yolmo, no 27, inferior quality.
Plate 188. Bhutan, no. 23, very coarse quality.
Plate 189. Baglung, no. 19, finest quality.
Plate 190. Baglung, no. 21, ordinary quality.



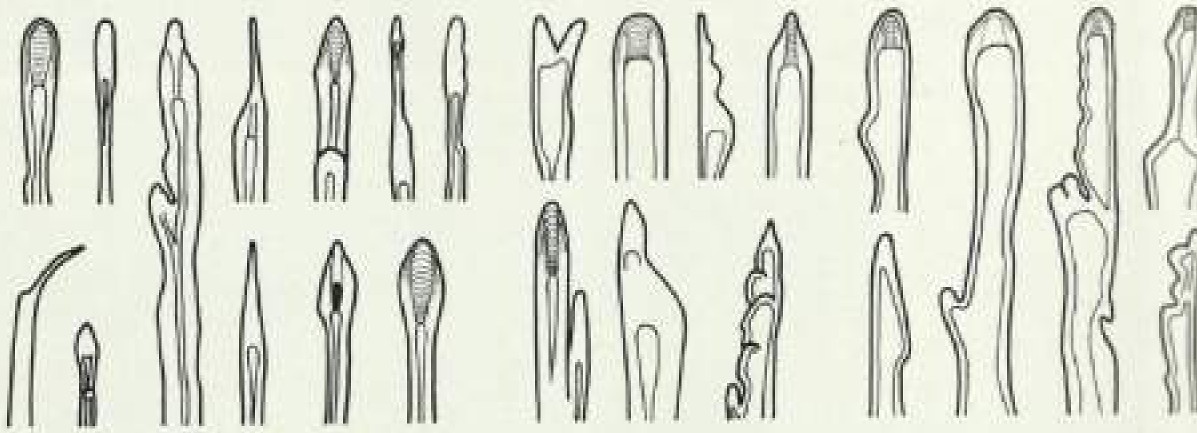
Plates 191–198. Paper photographed in transparency. Bundles of fibres appear darker. All samples except no. 15 (of *Daphne* fibres) contain various mixed fibres. For further properties see pp. 226–227. Scale 1 : 1.

Plate 191. Sundarijal, no. 15.
Plate 192. Sundarijal, no. 39.
Plate 193. Sundarijal, no. 40.
Plate 194. Sundarijal, no. 41.
Plate 195. Cottage Industry, no. 32.
Plate 196. Cottage Industry, no. 34.
Plate 197. Cottage Industry, no. 36.
Plate 198. Cottage Industry, no. 38.



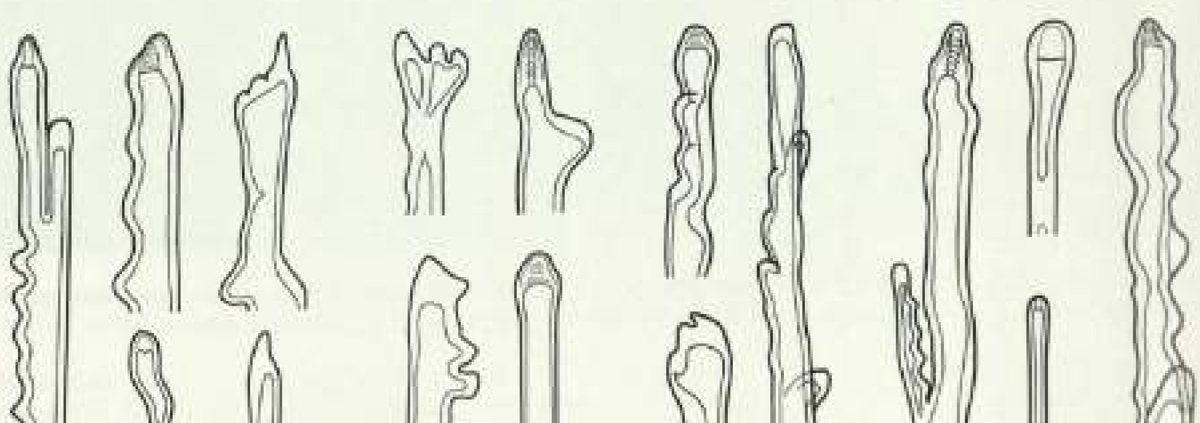
EDGEWORTHIA GARDNERI

Nepal | China (Meitan)



DAPHNE INVOLUCRATA | EDGEW. GARDNERI? | DAPHNE PAPYRACEA

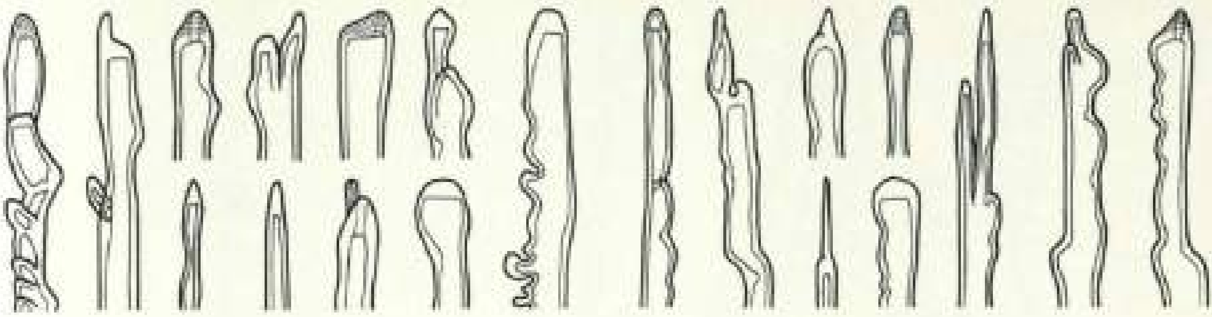
Nepal | Kalimpong | West Nepal



DAPHNE BHOLUA

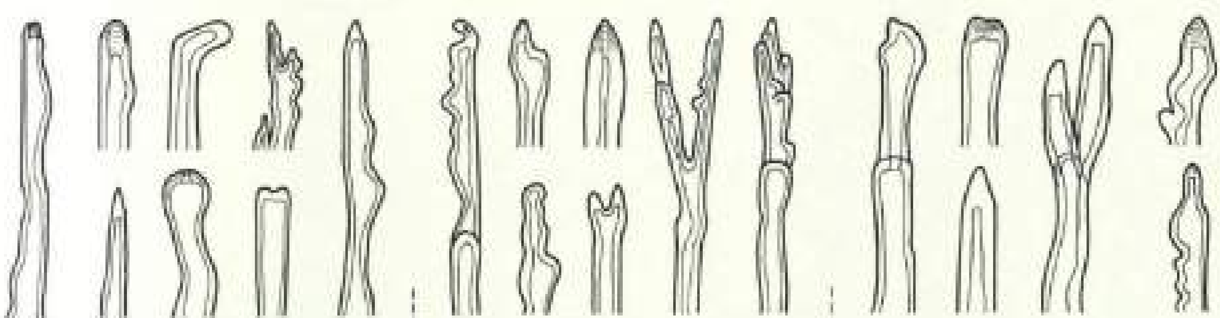
East Nepal | Central Nepal | West Nepal

Plate 199. Drawings of fibre ends of *Edgeworthia gardneri* (specimens from Nepal, Sikkim and China), *Daphne involucrata* (East Nepal), *Daphne papyracea* and *Daphne bholua* (two specimens from Nepal). Magnification × 500 (1 cm. = 20 μ).



DAPHNE RETUSA
West China

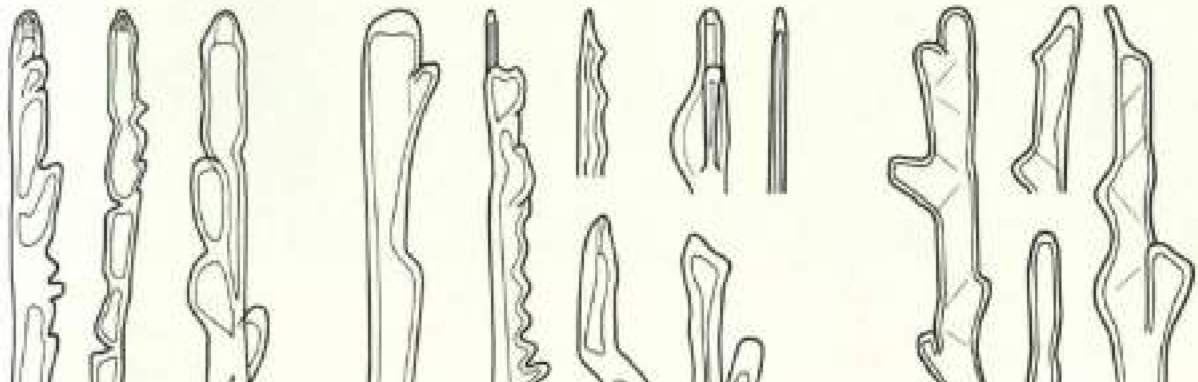
DAPHNE TANGUTICA
Northwest China



DAPHNE GIRALDII
West China

DAPHNE SERICEAE
Caucasus

DAPHNE MEZEREUM
Switzerland



DAPHNE ALPINA
France

WICHSTROEMIA CANESCENS
Nepal

WICHSTR. CHAMAEJASME
Siberia

Plate 200. Drawings of fibre ends of *Daphne retusa*, *Daphne tangutica*, *Daphne giraldii*, *Daphne sericeae*, *Daphne mezereum*, *Daphne alpina*, *Wikstroemia canascens* and *Wikstroemia chamaejasme*. Magnification × 500.

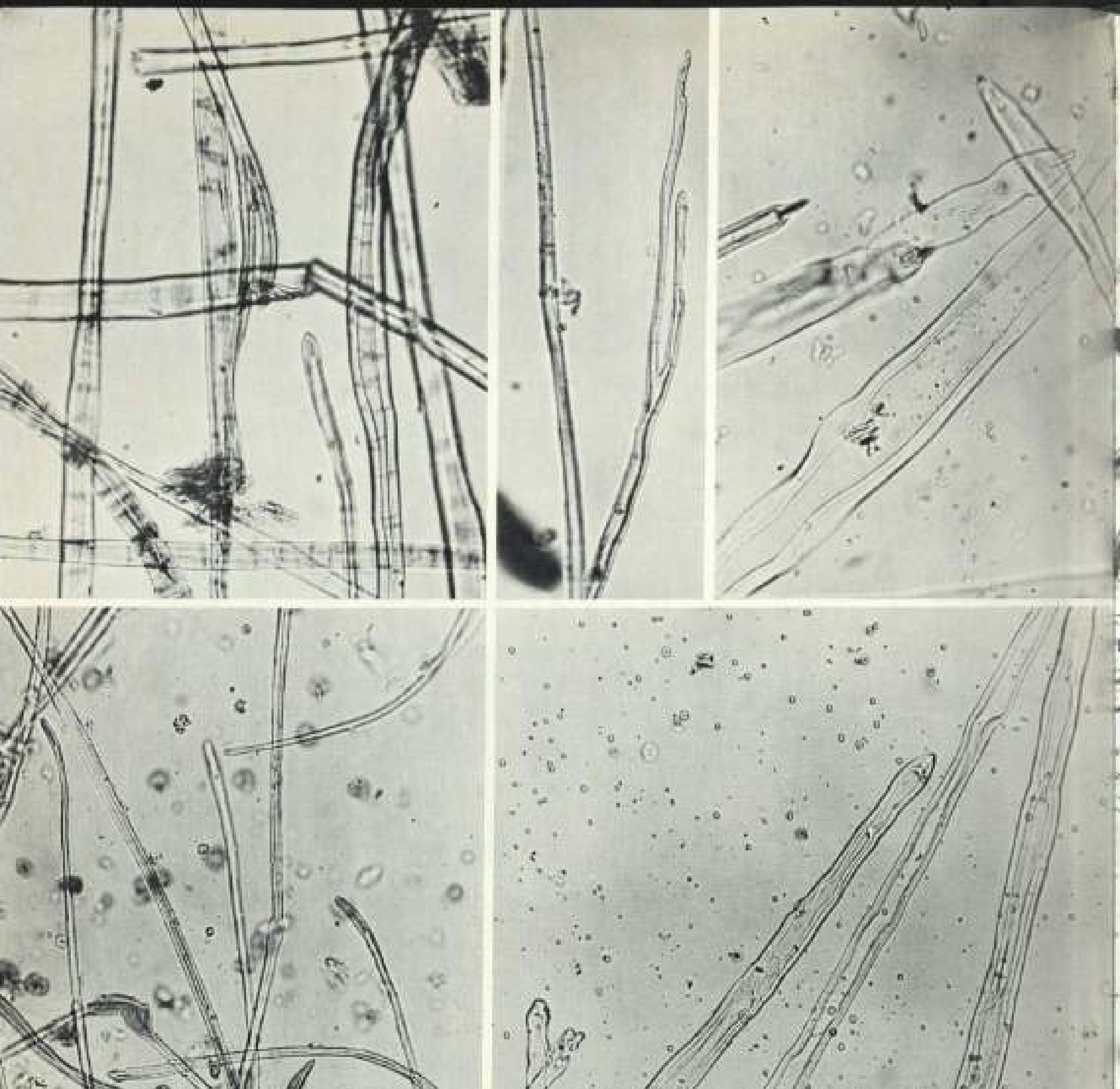


Plate 201–202. *Edgeworthia gardneri* fibres (from dried plants). Notice the comparatively great fibre thickness (up to 30 μ), the varying wall thickness and the fibre ends. Lumen often narrows or wholly disappears, especially near the fibre ends. Plate 202 shows a bifurcated fibre end. Magnification × 240 (1 cm. = 42 μ).

Plate 203. *Edgeworthia gardneri* fibres in cupric oxide ammonium *(cuoxam)*. Notice the big swellings, the now easily visible divisions of the fibre walls and also the long "corks". Magnification × 240.

Plate 204. *Daphne involucrata* fibres. The fibre walls are difficult to distinguish and often very thick. The thickening of the fibre ends with many long "corks", and presumably also the hexagonal grains of starch, are typical of this fibre. Magnification × 240.

Plate 205. *Daphne involucrata* fibres in *cuoxam*. The swelling is small and there is a very distinct stratification of the fibre walls. Magnification × 240.

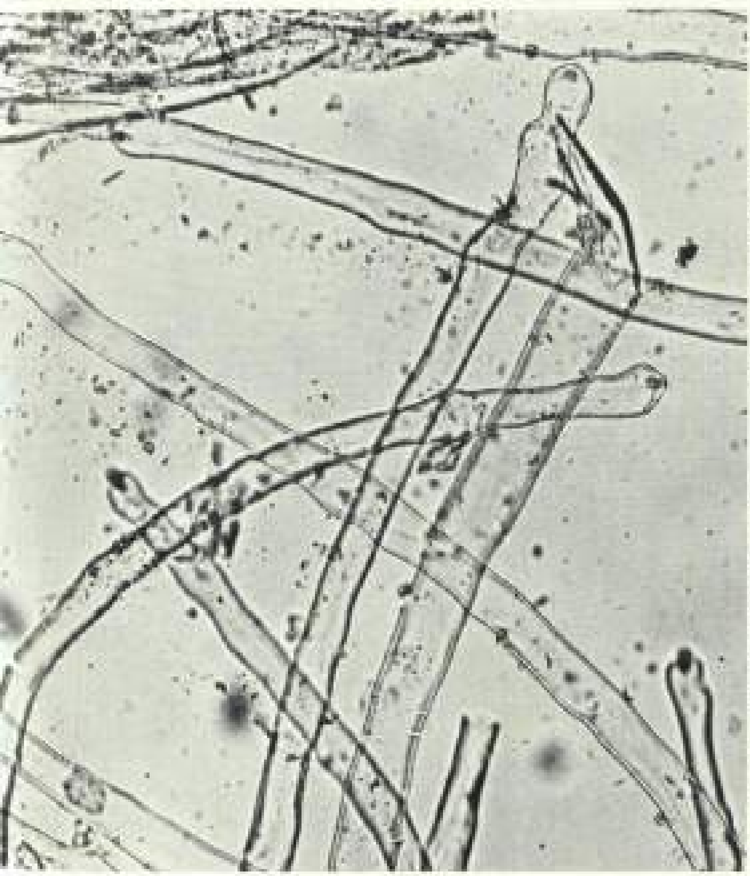
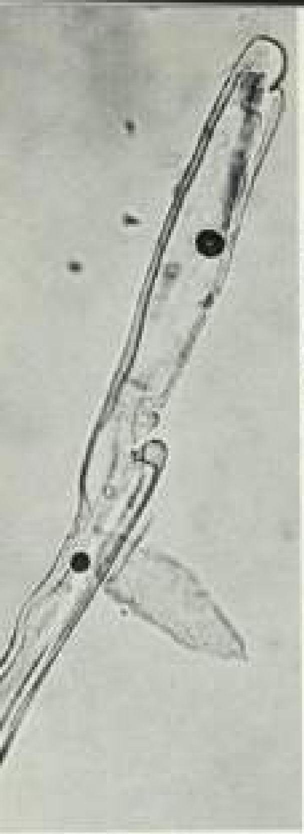


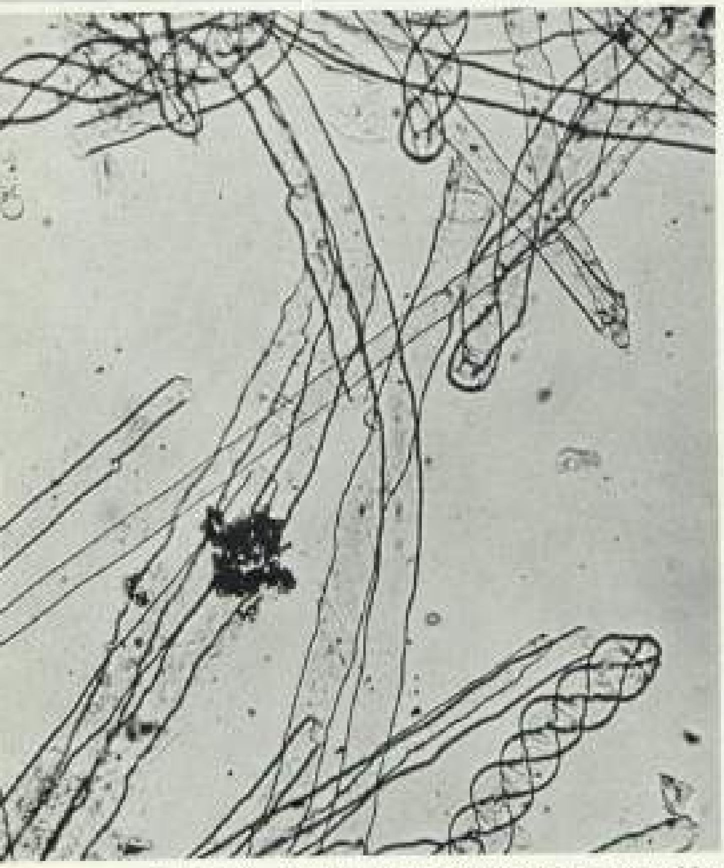
Plate 206. *Daphne papyracea* paper fibres. Notice the stronger staining of the paper fibres, the swelling, the indistinct fibre walls, the many flattened places and the dislocations, all due to the chemical and mechanical treatment of the paper fibres. To the left a long pointed sclereid fibre. Magnification × 240.

Plate 207. *Daphne bholua* fibres. Notice the knotty fibre ends with many excrescences, the thick-walled acuminate sclereids, the very thin-walled parenchyma cells and the big, round and almost black starch grain. Magnification × 240.

Plate 208. *Daphne bholua* fibres in *cuoxam*. Notice the great swelling, the indistinct fibre walls and the relatively small dark "corks" at the fibre ends. Only in a few places was a proper string-of-pearls formation observed. Magnification × 240.

Plate 209. *Daphne bholua* paper fibres in *cuoxam*. Here the globular formation is far more marked than in fibres taken directly from bast samples. Magnification × 240.





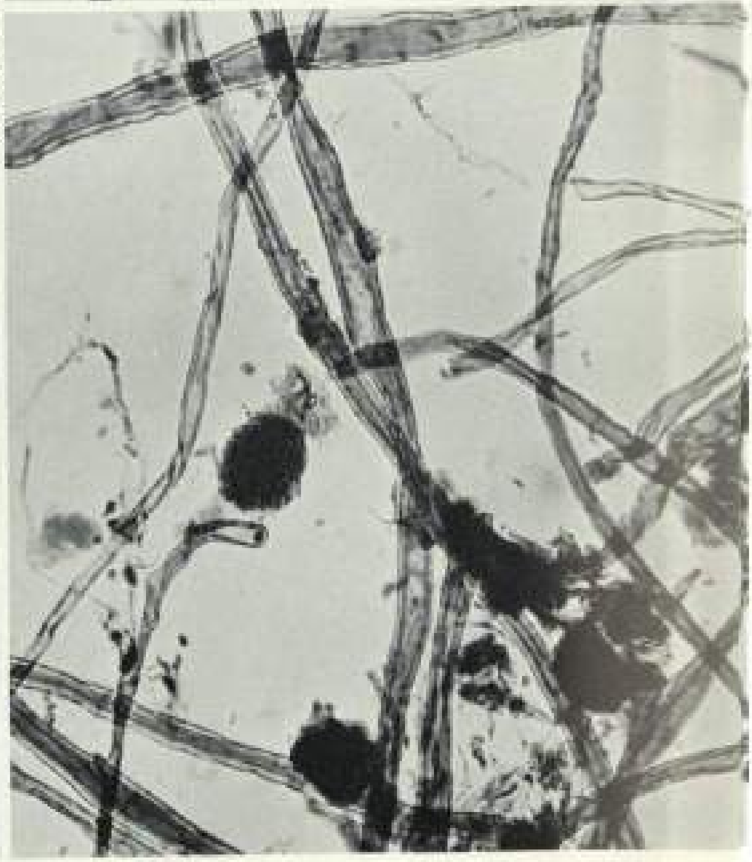


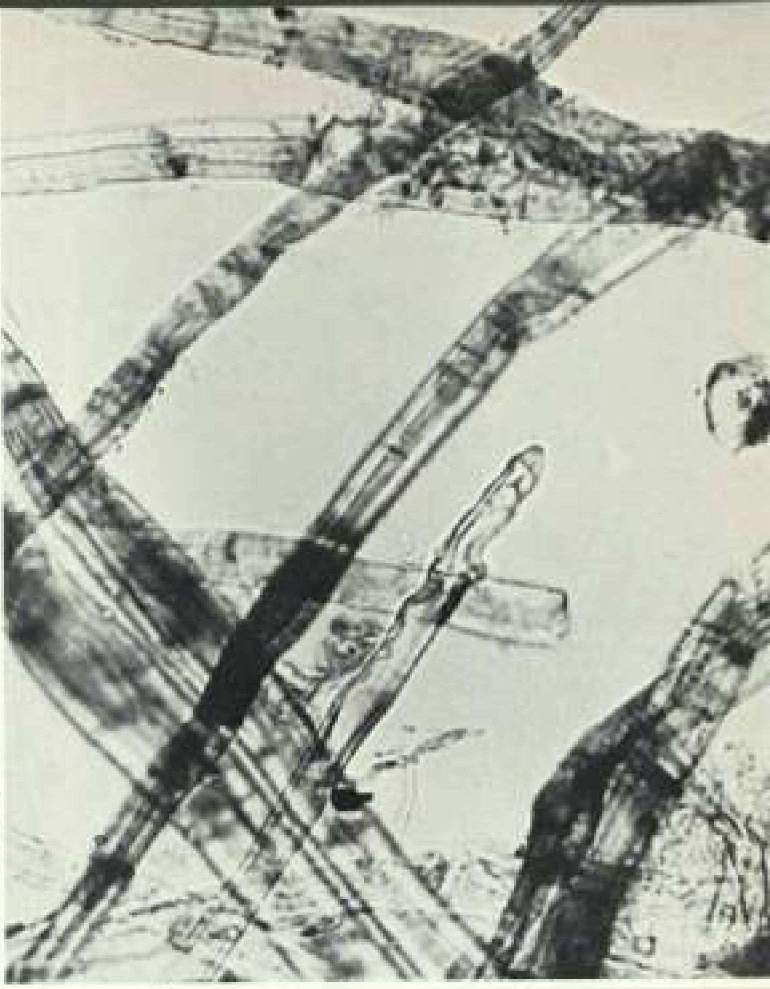
Plate 210. *Daphne retusa* fibres which are very thin-walled. Magnification × 700.

Plate 211. *Broussonetia papyrifera* paper fibres (from Northern Thailand). The fibres are reddish-brown; the fibre ends are bright violet and quite different from those of the *Edgeworthia* and *Daphne* species. Dislocations are very faint. Magnification × 240.

Plate 212. *Wikstroemia chamaejasme* fibres, flat with a slightly wavy contour and with very thin walls which almost lack dislocations. Notice also the typical twisted fibres and the many black, starchy parenchyma cells. Magnification × 240.

Plate 213. *Wikstroemia chamaejasme* fibres in *Cuoxam*. Notice the many tight twistings and the fine helices in the fibre walls. There is no globular formation here or in the paper fibres. Magnification × 240.

Plate 214. *Wikstroemia chamaejasme* paper fibres from a Tibetan paper (no. 11 see p. 226) bought in Dopu, East No. 3. Magnification × 240.



Plates 215–216. Fibres from ms. in the *Asutosh Museum* in Calcutta, A. D. 1105. *Daphne* fibres of a high-level species. To the left in plate 215 a sclereid. The fibres are covered with tiny particles, mostly dirt and dust. Magnification × 240. Plate 216 shows a very typical fibre end. Magnification × 550.

Plate 217. Fibres from ms. n. 152, A. D. 1511. Thymelaeaceae fibres of the *Daphne bholua* type. Magnification × 240.

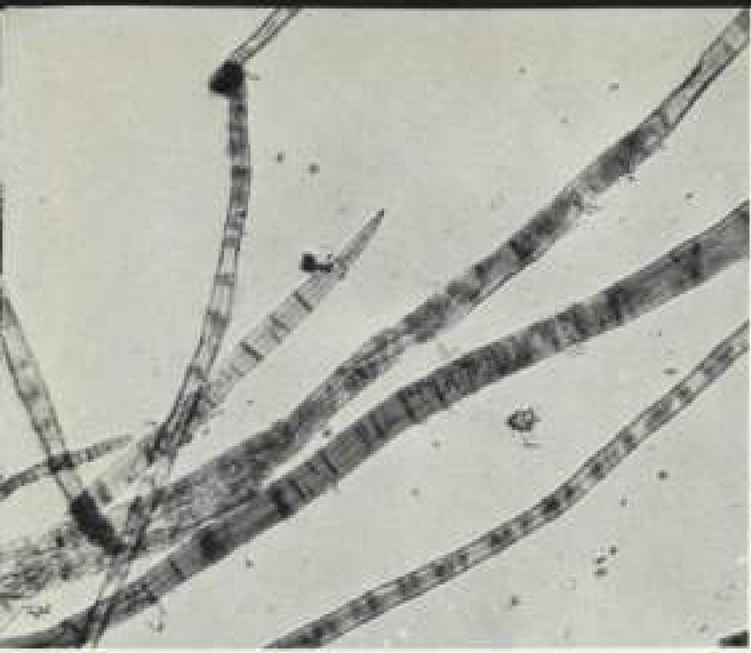
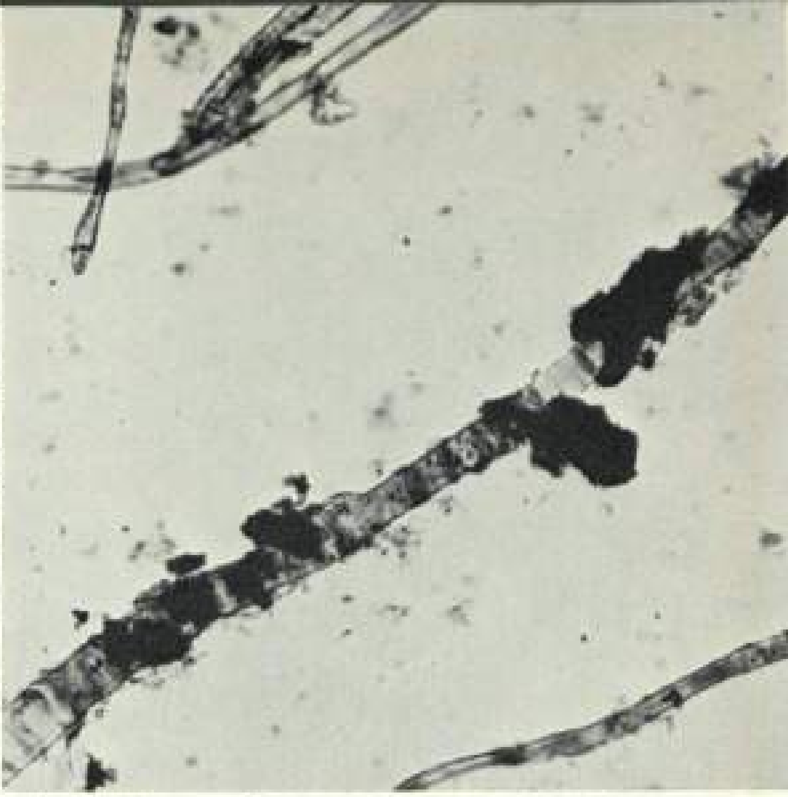


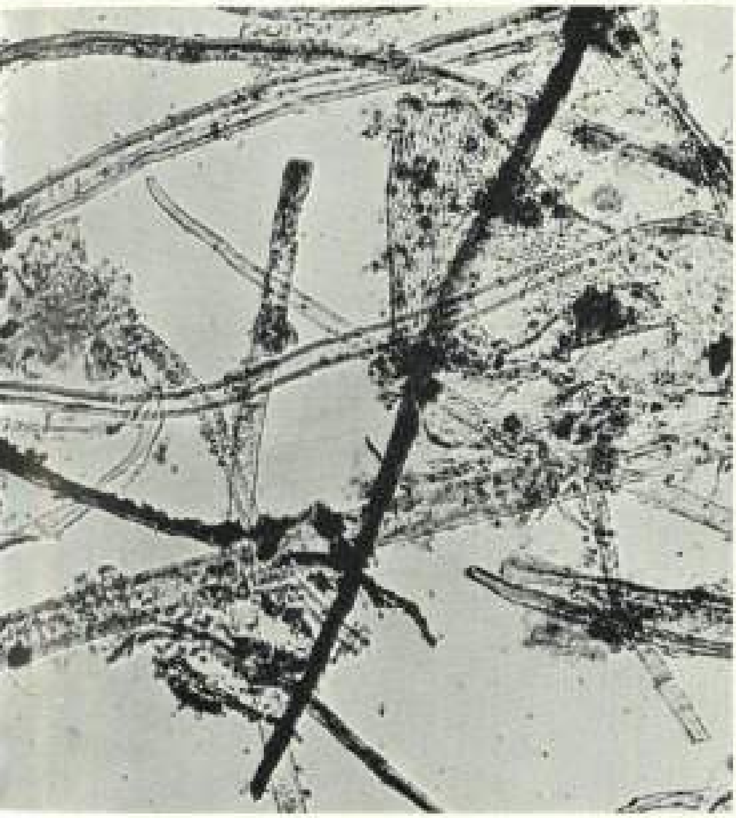
Plate 224. Fibres from ms. n. 84, A. D. 1736. Thymelaeaceae fibres, presumably from *Edgeworthia gardneri*. Notice the broad, thick-walled and often pointed fibres. Magnification × 240.

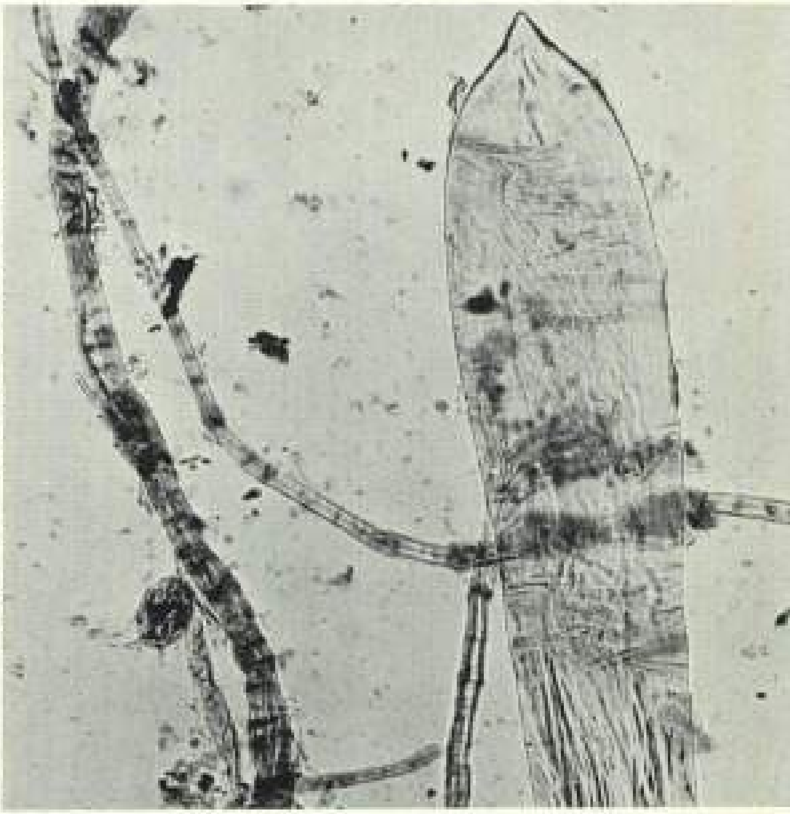
Plate 225. Fibres from ms. n. 34, A. D. 1764. Fibres as in plate 224. Notice the fibre end. Magnification × 240.

Plate 226. Fibres from ms. n. 70, A. D. 1737, in *cuoxam*. Probably *Edgeworthia gardneri*. Notice the very big globular swellings also observed in n. 84 and n. 34. Magnification × 240.

Plate 227. Fibres from ms. n. 84 h, A. D. 1850. *Daphne bholua*-like fibres in *cuoxam*. The globular swellings are smaller, thinner-walled and have less distinct wall-stratifications than *Edgeworthia gardneri* fibres. Magnification × 240.

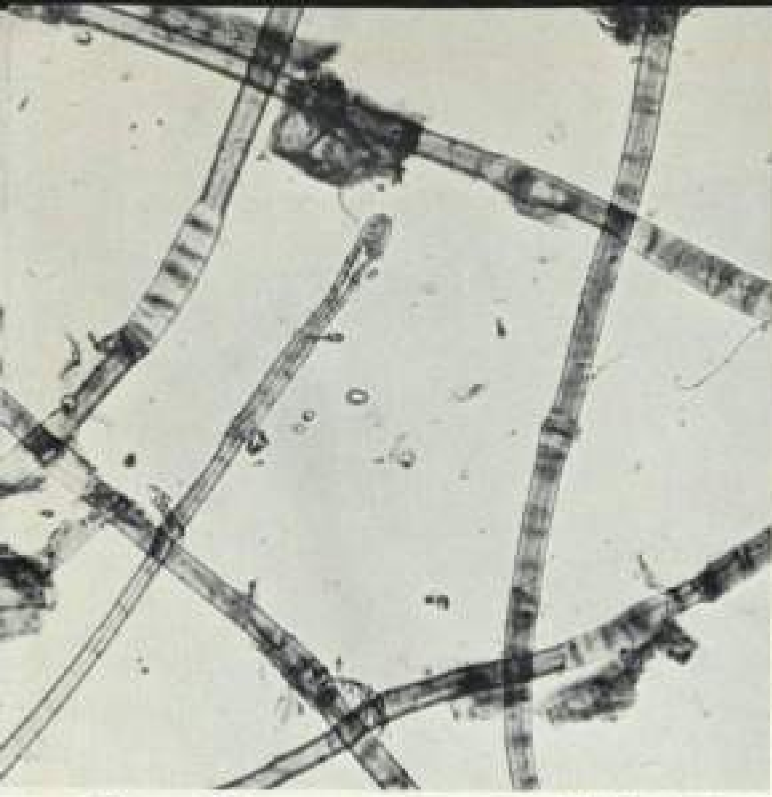






Plates 228–229. Fibres from ms. n. 164, A. D. 1824, probably *Edgeworthia gardneri*. The black particles and the many fine (blue-black) particles show that the paper is heavily sized with starch. Magnification × 240.

Plates 230–231. Fibres from ms. N. Gl. 1, A. D. 1802. The first 41 leaves of this ms. are made from bamboo paper. Notice the big vascular cell to the right in plate 230. The rest of the leaves of this ms. are made of Thymelaeaceae paper (plate 231), possibly from a high-level species of *Daphne*. To the right a swollen sclereid; notice the fine helices (macro-fibrils). Magnification × 240.




Plates 232–233. Fibres from a letter, J. T. 5 b, from Taplejung in East Nepal. Probably *Edgeworthia gardneri* fibres. Plate 232 indicates that the dislocations arise where the fibres have been affected by pressure. Notice the three thin and thin-walled sclereids in plate 233. Magnification × 240.

Plates 234–235. Fibres from a book, J. T. 40, published 1945; the sample was taken from the binding resembling blotting paper, that is made from different kinds of wastepaper containing mostly fibres of rice straw and *Daphne bholua*. Magnification × 240.

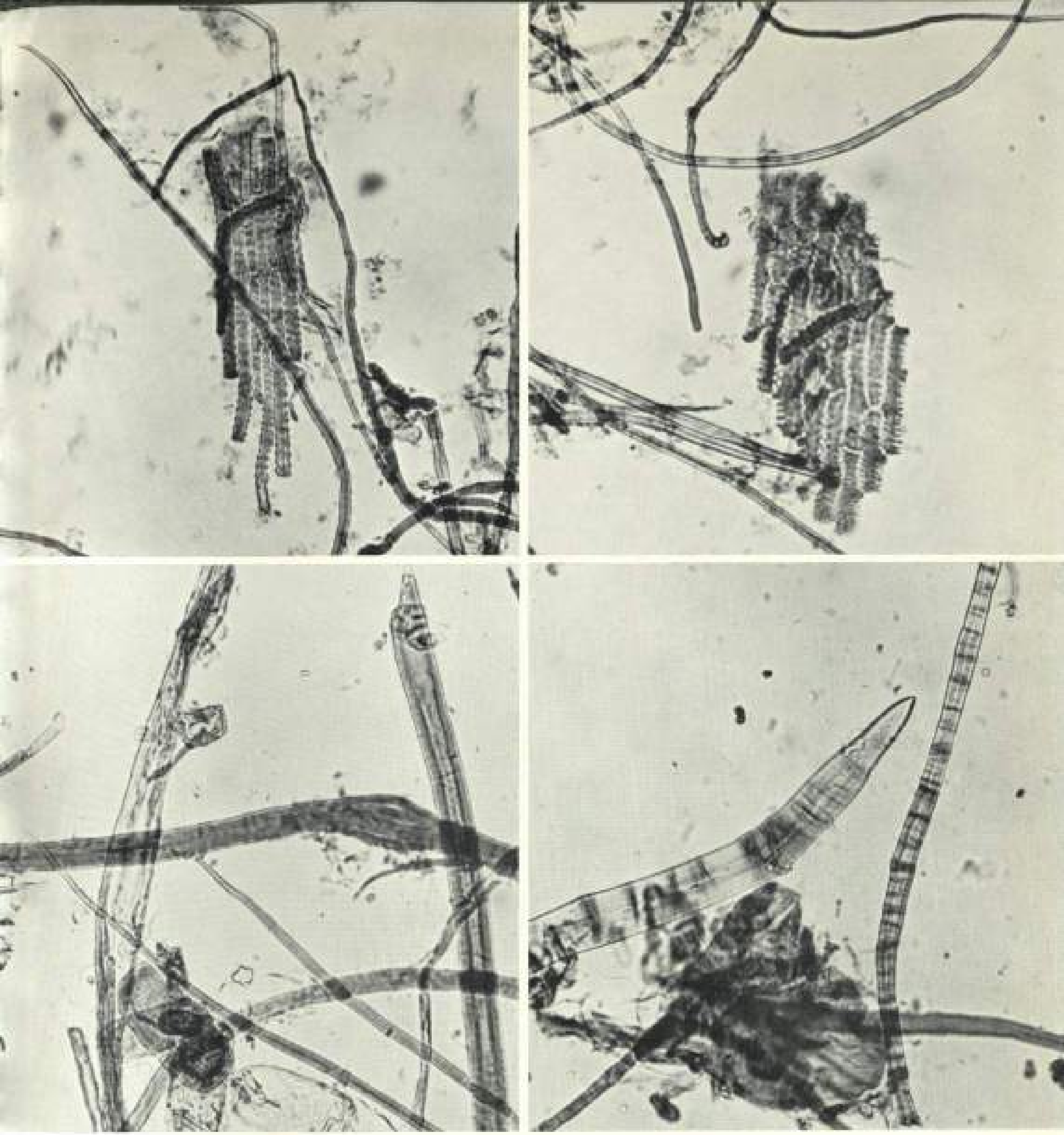


Plate 236. Fibres from handmade paper made of rice straw fibres at the small factory in Tripureswar, Kathmandu. Notice the long, thin, pointed fibres and also the indented epidermis cells. Magnification × 240.

Plate 237. According to the paper-makers at Tripureswar this sample, no. 36 (see table p. 226) contained fibres of sabai grass. But it seems to be rice straw mixed with small quantities of *Daphne* fibres. Magnification × 240.

Plate 238. Fibres of handmade paper made in Tripureswar from waste-paper containing fibres of wood, straw, *Daphne bholua* etc. Magnification × 240.

Plate 239. Fibres from paper made in Sundarijal of 50 % *Daphne bholua* and 50 % *chiuli* fibres. Notice the typical, thick-walled sclereid and some (bluish) fibres with indistinct contours. Magnification × 240.

Macroscopical Analyses

Analysis of New Paper Sheets

No.	Manufactured	Colour	Rattle	Character of fibre network	Species of fibre
1	Tumbu, East No. 3	tan	good	fine bdl. in dense paper	*Daphne bholua*
2	"	tan	good	bdl., some impurities	"
3	"	tan	rather good	bdl., some impurities	"
4	"	tan	rather good	long bdl., lumps & defects	"
5	"	tan	moderate	bdl., lumps & defects	"
6	"	tan	moderate	big bdl., lumps & defects	"
7	"	tan	good	few bdl., clouded	"
8	"	light tan	rather good	few bdl., clouded, dense	"
9	"	tan	rather good	few bdl., holes	"
10	"	light tan	rather good	many bdl., impurities	"
13	"	red tan	moderate	many bdl., lumps etc.	"
17	East No. 2	tan	rather good	bdl., no lumps	"
16	East No. 1	light tan	rather good	big bdl., lumps & impur.	"
24	Yolmo, East No. 1	tan	rather good	many bdl., few impurities	"
25	"	red tan	moderate	long bdl., lumps etc.	"
26	"	red tan	moderate	bdl., lumps etc.	"
27	"	tan	bad	big bdl. & lumps	"
28	East No. 1	red tan	bad	big bdl., lumps & impur.	*D. bholua or papyracea*
29	"	tan	good	small bdl., lumps, 2 layers	"
30	"	light tan	good	no bdl., dense	"
14	West No. 1	tan	good	big bdl., lumps & impur.	"
22	Lamjung, West No. 1	tan	rather good	few bdl., no lumps	"
18	Baglung, W-Nep.	light tan	good	no bdl., 2 layers	"
19	"	white	good	no bdl., clouded	"
20	"	light tan	good	no bdl., clouded	"
21	"	tan	rather good	some bdl., clouded, impur.	"
15	Sundarijal	tan	moderate	fine bdl., clouded	"
39	"	grey	very good	as parchment paper	chiuli, *D.* & straw
40	"	tan	bad	black particl., 2 layers	straw & *D.*
41	"	white	very bad	clouded	straw, wood, *D.* etc.
31	Cot. Ind., Kath.	light tan	rather good	fine bdl., dense	*D. bholua or papyracea*
32	"	white	bad	few bdl., black particl.	*D.*, straw & wood
34	"	tan	bad	many small lumps	*D.* (waste paper)
36	"	grey	bad	dense, black particles	straw (rice?) & *D.*
37	"	light tan	very good	dense, 2 layers	*D. bholua or papyracea*
38	"	white	bad	dense, black particles	wood & straw
11	Shekar, Tibet	grey	bad	short bdl., clouded	*Wikstr. chamaejasme*
12	Tibet	light tan	bad	many fine bdl.	*Wikstr. chamaejasme*
23	Bhutan	tan	good	coarse, big bdl. & lumps	*D. bholua or papyracea*
44	Bhutan	tan	rather good	few, short bdl., dense	"
46	Dalhousie, India	light tan	very good	fine bdl., dense	*D. bholua or papyracea*

bdl. = bundles   *D.* = *Daphne bholua* or *Daphne papyracea*

Format mm.	m^2 weight g.	Thick-ness mm.	Bulk mm.	Printing opacity %	Poro-sity (sec.)	Breaking length m.	Stretch %	Tearing 100/m^2g	Folding endurance	Bright-ness %	Mould, threads per 30 mm.
500 × 645	36	0.095	0.26	71	1.8	6900	3.3	280	1000	37.5	23
"	27	0.075	0.29	57	1.5	7200	2.8	370	500	39.5	23
"	22	0.055	0.27	55	0.3	5100	2.3	320	500	38.0	23
"	18	0.050	0.29	47	0.3	6900	3.0	330	550	39.5	23
"	23	0.065	0.28	48	0.2	4100	2.3	320	x	35.0	22
495 × 655	19	0.055	0.28	40	0.1	3400	2.2	350	x	36.5	20
500 × 655	33	0.090	0.27	72	0.8	6600	3.0	350	1200	39.0	21
"	16	0.040	0.27	37	0.1	4600	2.2	190	1050	42.5	23
515 × 645	15	0.045	0.30	39	0.1	4700	2.7	310	250	39.5	21
494 × 645	20	0.055	0.27	43	0.2	4600	2.6	330	x	44.0	20
500 × 645	24	0.060	0.25	58	0.6	5800	2.0	270	40	28.0	21
500 × 635	22	0.060	0.26	46	0.3	4200	2.0	350	250	39.5	30
450 × 630	23	0.065	0.28	47	0.2	4400	2.6	330	450	45.0	20
485 × 665	31	0.100	0.32	62	0.4	7200	3.0	300	1150	38.0	18
460 × 630	26	0.080	0.31	61	0.2	4500	2.3	580	200	26.5	20
460 × 640	22	0.070	0.32	52	0.5	3600	2.0	350	500	27.5	20
490 × ?	56	0.165	0.30	80	0.2	3400	2.7	290	20	33.0	19
500 × 645	14	0.045	0.32	33	0.1	2700	3.2	390	x	30.0	20
430 × 665	37	0.105	0.28	62	0.6	4500	2.5	170	550	34.0	30
540 × 635	27	0.075	0.28	64	0.7	4600	2.4	310	3250	42.0	62
400 × 605	37	0.095	0.26	68	0.9	5800	2.5	270	400	41.0	22
470 × 620	18	0.055	0.32	43	0.1	9100	2.1	330	900	41.5	29
585 × 1310	62	0.170	0.28	82	10	5200	2.9	270	1700	49.5	65
590 × 1380	25	0.075	0.30	55	0.5	5700	3.4	240	1150	52.0	59
570 × 1390	25	0.060	0.23	53	0.7	6900	2.5	210	650	51.5	59
590 × 1310	18	0.050	0.27	47	0.1	5400	2.3	200	70	41.0	44
650 × 1210	23	0.065	0.29	44	0.1	4200	2.2	240	350	34.0	49
xx	38	0.075	0.20	33	39	3500	1.0	20	550	23.0	56
530 × 685	189	0.280	0.15	99	520	1200	2.0	80	x	40.0	80
540 × 685	92	0.265	0.29	94	16	1800	3.0	70	x	58.0	43
xx	47	0.090	0.20	58	41	2800	6.2	80	450	45.5	62
xx	42	0.130	0.30	77	0.7	1200	3.0	180	xx	58.0	58
xx	59	0.185	0.32	88	0.4	1200	2.4	210	11	37.5	48
xx	95	0.185	0.20	98	62	2000	5.4	50	6	49.0	82
xx	52	0.085	0.16	73	32	4000	3.3	110	1750	42.5	35
xx	95	0.185	0.20	92	9	1900	4.5	60	xx	64.0	58
495 × 1270	36	0.115	0.32	70	0.6	3100	2.9	220	8	45.0	34
610 × 1460	26	0.075	0.30	58	1.2	1500	2.1	140	x	42.5	64
700 × 760	78	0.185	0.24	95	6	5500	2.9	230	650	22.0	16*
635 × 640	35	0.110	0.32	73	0.7	6600	1.6	220	650	35.0	70
830 × 1150	16	0.050	0.30	38	3.1	6700	1.4	119	613	38.0	64

x = does not take initial load   xx = too little paper for measurement   * = mould of grass straw

Analysis of Books and other items of Paper belonging to the Royal Library, Copenhagen
1. Manuscripts in Sanskrit, Newari, Nepali etc.

Catal. no.	Dated	Text	Type & language	Writing	Miniature		Mate-rial	Type
					binding	ms.		
n. 173	11.–12.c.	Aṣṭasāhasrikā-Prajñāpāramitā	B/S	Rāñjanā, excellent		f.	palm	pothi
n. 81	1143	Śatasāhasrikā-Prajñāpāramitā	B/S	rather good, big letters	g.	g.	palm	pothi
n. 175a	1145	"	B/S	rather good, big letters	g.		palm	pothi
n. 92	1147	mantra	H/S	good, ho. and tw.			palm	pothi
n. 168	1246	tantric texts	H/S	good, Mithila			palm	pothi
n. 91	1250	homonym word-book, Sanskrit	H/S	finical, ho., little tw.			palm	pothi
n. 109	1265	Amara's Nāmaliṅgānuśāsama	H/S	rather good, ho. and tw.			palm	pothi
n. 31	1284	Kavaca texts	H/S	good, ho. and tw. marked			palm	pothi
n. 176f	13.cen.	?	B/S	Rāñjanā, very fine, tw.			paper	pothi
n. 72	1326	Śabdalakṣaṇa	B/S	v. good, ho. and tw. marked	f.		palm	pothi
n. 176b	1371	various texts	H/N	good, ho. and tw. marked			palm	pothi
n. 90	1432	on rituals	B/N	good, tw. marked, ho.			palm	pothi
n. 123	15.cen.	?	?/S	Kūmo, small, very good, tw.			agal.	pothi
n. 117	late 15.c.	on medicine	B & H/N	good, tw.		g.	paper	pothi
n. 85	15.–16.c.	Jain	S/I	fast		r.g.	paper	pothi
n. 152	1511	Prajñāpāramitā	B/S	Rāñjanā, ornamental, indistinct	f.	g.	paper	pothi
n. 169	1532	stotras, mantras, dhāraṇis	B/S	fast, good, many st., tw.			palm	pothi
n. 176g	17.c. ?	?	B/N ?	Rāñjanā, tw., tk., in gold			paper	pothi
n. 52a	16.–17.c.	Prajñāpāramitāhṛdaya	B/S	Rāñjanā, indistinct, tw., silver		c.	paper	pothi
n. 26	16.cen.	on cakras	H/N	slovenly		r.g.	paper	pothi
n. 84a	1631	mantras	B/S	rather coarse, tk.		c.	paper	pothi
N. 29	1675	collection of dhāraṇis	B/S	good	f.	g.	paper	pothi
n. 133	1680	on astrology	B & H/S	rather good, some tw., tk.			paper	pothi
n. 100	1685	Samādhirāja-mahāyāna sūtra	B/S	ornamental, good, tw. marked	r.g.	r.g.	paper	pothi
n. 172	17.–18.c.	mantras	B/N	ornamental, indistinct, tk., gold	r.g.	r.g.	paper	pothi
J.T. 26	17.–18.c.	?	B/?	ornamental, indistinct, gold & silver		c.	paper	pothi
n. 184	1704	Mahāyāna sūtra	B/S	Rāñjanā, ornamental, gold		g.	paper	pothi
n. 27	1714	on medicine	B & H/N	moderate, tk.		c.	paper	conc.
n. 84	1736	mantras	H/S	coarse, big letters, tk.			paper	pothi
n. 70	1737	on initiation	B/S & N	rather good, tw., tk.			paper	conc.
n. 128	1743	strotras ("stava")	B/S	ornamental, good, tw., tk.			paper	pothi
n. 183	1744	dhāraṇi	B/S	Devanāgarī, rather good, tk.			paper	pothi
n. 87	1745	Kāraṇḍavyūha-mahāyāna sūtra	B/S	moderate, but readable	c.	c.	paper	pothi
n. 67	1745	on religious dances	B/S	coarse, indistinct, st., tk.		r.c.	paper	conc.

Abbreviations	ho = "books"	f = fine	palm = palm leaf
B = Buddhist	tw = "twists"	g = good	agal = *Aquilaria agallocha* bark
H = Hindu	tk = thick pen	r = rather	conc = concertina
S = Sanskrit	st = "straight-topped"	v = very	y = yellow coloured on one side
N = Newari	fr = fragment	w = worn	yy = yellow coloured on both sides
I = Indian		d = dirty	bb = blue coloured (both sides)
		c = coarse	va = varying
		k = complete	-fb = fibred

Format mm.	Thick-ness mm.	Folio no.	Lines no.	Lay-ers no.	Thick-ness of layer mm.	Mould. lines per 50 mm.	Colour-ed	Condi-tion	Character of paper	Fibre network
530×69	0.25	37	6	1						
555×53	0.21	741k	6	1						
552×54	0.27	800k	6	1						
306×46	0.20	9	5	1						
353×64	0.29	47k	5	1						
283×46	0.22	62	7	1						
304×45	0.29	22	4	1						
181×41	0.22	5	5	1						
276×75	0.25	3fr	5	2	0.12	45, straw	bb	v.w.	very soft, polished	short-fb.
290×48	0.23	46k	5	1						
220×48	0.23	60	4	1						
240×45	0.32	11	4	1						
220×53	0.33	15	5	1			yy	g.		
343×58	0.32	33	6–9	4	0.08	40, fabric		v.w.	as cardboard, hard	medium-fb.
263×111	0.12	184k	9	2	0.06	40, straw		f.	very soft, polished	very short-fb.
444×96	0.30	284 k	6	4	0.07	62, fabric	bb	g.	v. hard, good & stiff, polished	rather long-fb.
252×46	0.30	102	4–5	1						
215×65	0.36	4fr	5	4–5	0.08	40?, fabric	bb	r.w.	as cardboard, in layers soft	long-fb. c. clouded
405×96	va.	48	va.	va.	0.10	50?, fabric	bb	r.w.	polished	short-fb.
267×72	0.30	45	8–9	3	0.10	va. c. 50		w.d.	as soft cardboard, brown	long-fb.
327×109	0.30	95k	8	3	0.10	40, fabric	yy	v.w.	soft	medium-long-fb.
249×72	0.30	52k	5	4	0.07	55, fabric	yy	r.w.d.	good, as cardboard, polished	medium-fb., clouded
314×81	0.18	129k	6–7	2	0.09	53, fabric	y	r.w.	stiff, very hard, polished	long-fb.
320×88	0.21	240k	5	3	0.07	50, fabric	yy	g.	good hardness, v. polished	medium-fb. clouded
175×69	0.20	5k	5	2	0.10	20, straw	yy	g.	hard, polished, lacquered	dense
185×63	0.31	24	5	3	0.10	17, straw	yy	v.w.	rather hard, lacquered	medium-fb.
371×117	0.20	78k	5	4	0.07	21, straw	yy	r.g.	thick, but not stiff	rather long-fb.
194×85	0.25	14	5	3	0.08	36, fabric	yy	r.d.	good, hard	dense
330×108	0.23	17	8	3	0.08	23, fabric	yy	r.g.	very soft, as blotting paper	long-fb., clouded
195×76	va.	16k	6	va.	0.10	40, fabric	yy	r.g.	dense, polished, as n. 84	medium-fb., clouded
190×75	0.25	46k	5	2	0.12	75?, fabric	y	r.g.	hard, polished	dense
245×91	0.18	13k	5	2	0.09	60?, fabric	y	r.g.	not good, but hard	medium-fb.
304×91	0.24	87k	5–6	2	0.12	va, fabric	y	r.w.d.	bad, soft	short-fb., clouded
196×97	0.60	60	10–12	4+1	0.10	50, fabric	yy	v.w.	bad, mounted on 0.2 mm fabric	short-fb.

Survey of the Development of Books in Sanskrit, Newari, Nepali etc.

Period A.D.	Type of book	Format (mm) mean values	Material of leaves	Mould	Colour or/and impregnation
–1100	pothi	410×50	palm leaf		no inorg. impregn.
1100–1200	pothi	400×50	until A.D. 1550 by far the most mss. are on palm leaf		no inorg. impregn.
		(same length) broader	paper, Thymelaeaceae	fabric	not sized w. starch
1200–1300	pothi	340×50	palm leaf		no inorg. impregn.
		broader	paper, Thymelaeaceae	fabric	not sized w. starch
		broader	paper, hemp (or ramie)	grass straw	blue-black colour
1300–1550	pothi	300×50	palm leaf		no inorg. impregn.
		broader	paper, Thymelaeaceae	fabric	sized with starch
					blue-black colour
		(220×75)	*Aquilaria agallocha* bark		orpiment
1550–1700	pothi	285×75	only few on palm leaf		no inorg. impregn.
			paper, Thymelaeaceae; after about A.D. 1600 all mss. are on paper	fabric	mostly w. orpiment
					blue-black colour
	concertina	(few)	paper, Thymelaeaceae	fabric	mostly w. orpiment
1700–1800	pothi concertina	280×90 190×80	paper, Thymelaeaceae (some mounted on fine woven cotton cloth)	fabric	nearly all with orpiment or blue-black colour
				grass straw	
			Indian paper, hand-made	grass straw	none or orpiment
1800–1900	pothi	280×110	paper, Thymelaeaceae	fabric	mostly w. orpiment some blue-black
	concertina	190×80	Indian paper, hand-made	grass straw	none or orpiment
	stitched	short, high	European paper, hand-made or machine-made	metal wire	none or orpiment or synthetic colours
1900–	mostly stitched or paper bound	many different	paper, Thymelaeaceae straw, wood pulp, waste paper etc.	fabric	various
				metal wire	
			Indian and Western machine-made paper	metal wire	various

2. Books in Tibetan

Catal. no.	Text	Type and writing	Format mm.	Folio no.	Lines no.	Thickness mm.	Layers no.	Thickness of layer mm.	Mould lines /50 mm.	Colour	Character of paper
n.	*Kathmandu Valley:*										
44a	various	block-printed	480×120	35	5–6	0.16	2	0.08	c. 35	l. tan	soft, dense paper
45	Prajñāpāramitā	ms., old, modest	443×143	36	6	0.33	4	0.08	40–60	tan	r. hard, long-fb.
46	?	ms., modest	410×82	3	5	0.20	4	0.05	20	l. tan	r. hard, long-fb.
47	dPal rdo-rje sder-mo žes bya-bas gzuṅs	ms., old, bad	360×150	15	7	0.30	6	0.05	30	tan	r. soft, long-fb.
137a	rituals	ms., modest	406×82	2	4–5	0.23	3	0.08	c. 45	l. tan	r. hard, long-fb.
137b	rituals	ms., modest	425×81	3	4–5	0.18	3	0.06	c. 70	r. tan	long bundles, dense
138a	purification cerim.	ms., modest	392×83	6	4–5	0.17	2	0.08	c. 50	tan	soft, long-fb.
138b	purification cerim.	ms., modest	406×81	2	4–5	0.20	3	0.07	c. 50	tan	r. hard, long-fb.
156	Vajrācchedohā	block-printed	242×86	39	5	0.18	2	0.09	22	l. tan	soft, long-fb.
J.T.	*North Nepal:*										
12a	yoga, col. drawings	ms., old, good	380×76	2	–	0.20	2	0.10	24	tan	soft, medium-fb.
12b	yoga, col. drawings	ms., old, good	364×70	1	–	0.24	2	0.12	23	tan	soft, medium-fb.
12c	yoga, col. drawings	ms., new, r.good	365×70	3	–	0.35	4	0.09	24	white	rather long-fb.
12e	yoga, drawings	ms., new, r.good	375×78	1	–	0.18	2	0.09	25	white	rather long-fb.
13	rituals, drawings	ms., new, r.good	384×87	2	–	0.19	2	0.09	25	tan	soft, r. long-fb.
15	rituals, stitched	ms., old, modest	373×120	16	6–7	0.26	3	0.09	23	tan	long-fb.
16	divination, stitched	ms., old, modest	333×105	15	6	0.20	2	0.10	22	tan	long-fb.
17	divination, stitched	ms., old, modest	271×90	10	6	0.22	2	0.11	24	tan	rather long-fb.
18	rituals, stitched	ms., old, modest	290×95	22	5	0.27	3	0.09	23	tan	various qualities
19	cremation cerem.	ms., quite good	368×88	10	5	0.18	2	0.09	24	l. tan	medium-fb.
20	rituals	block-printed	260×85	7	6	0.20	2	0.10	22	tan	long-fb.
21	rituals	ms., good	315×78	18	6	0.19	3	0.06	45	white	short-fb.

3. Letters, Wood-Cuts, Cards, Rolls etc.

Catal. no. J.T.	Type and text	Collected (locality)	Format mm.	Thickness mm.	Layers no.	Thickness of layer mm.	Mould lines /50mm.	Colour	Character of paper
5a	letter, r. new	Junbesi	185×100	0.20	2	0.10	22	white	soft, long-fb.
5b	letter, from Taplejung, new	Junbesi	460×160	0.10	1	0.10	28	tan	very soft, long-fb.
46	letter from Tibet, r. new	Kathmandu	265×135	0.10	1	0.10	85	grey	very soft, short-fb.
45a	envelope, new	Kathmandu	135×93	0.10	2	0.05	23	tan	long-fb.
45b	bill, new	Kathmandu	158×114	0.04	1	0.04	26	tan	rather long-fb.
2	woodcut, mandala, new	Dopu Bazar	320×290	0.12	2	0.06	23	l. tan	long-fb.
8	woodcut, dhāraṇī, rather new	Takšindo	510×80	0.08	1	0.08	20	red tan	soft, long-fb.
7	woodcut, rLuṅ-rta, new	Takšindo	660×500	0.07	1	0.07	21	l. tan	soft, long-fb.
9	woodcut, rLuṅ-rta, new	Poijndala	150×140	0.07	1	0.07	23	grey	soft, long-fb.
10	woodcut, rLuṅ-rta, new	Namche Bazar	640×510	0.11	1	0.11	21	l. tan	soft, long-fb.
23	woodcut, rLuṅ-rta, new	West Nepal	160×160	0.16	2	0.08	41	white	clouded, r. long-fb.
52	roll from praying wheel, new	Kathmandu	10000×41	0.05	1	0.05	24	white	medium-fb.
48a	ceremonial card, rather old	Kathmandu	105×96	0.35	4	0.09	c. 40	tan	medium-fb.
48b	ceremonial card, rather old	Kathmandu	88×78	0.36	6	0.06	c. 40	tan	medium-fb.
42	horoscope roll, yellow	Kathmandu	1740×153	0.20	2	0.10	24	tan	r. long-fb.
44	horoscope roll, yellow	Kathmandu	636×160	0.18	3	0.06	7	tan	medium-fb.
49	postage stamp	Kathmandu	24×21	0.06	1	0.06	26	tan	medium-fb.

r = rather l = light -fb = fibred

SIZE & LINES ON PAGES OF MSS.

NEPAL, FROM C. BENDALL, CATALOGUE OF BUDDHIST SANSKRIT MSS., CAMBRIDGE

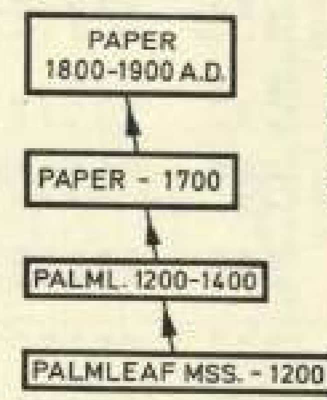
POTHI - MSS.			NUMBER OF LINES ON THE PAGE														
A.D.	TYPE		4	5	6	7	8	9	10	11	12	13	14	15	16	17	>17
-1200	PALM-LEAF	NUMBER OF MSS.	2	5	8	5	1										
1200 - 1400	PALM-LEAF	NUMBER OF MSS.		14	3	5	1										
1400 - 1600	PALM-LEAF	NUMBER OF MSS.	2	21	6	3	2										
1600 - 1700	PAPER	NUMBER OF MSS.		13	3	1			1			1					
1700 - 1800	PAPER	NUMBER OF MSS.		14	9	7	2										
1800 - 1900	PAPER	NUMBER OF MSS.		25	16	27	6	11	7	5	3	3	1	2	2	1	2

TIBET, FROM L. POUSSIN, CATALOGUE OF THE TIBETAN MSS. FROM TUN HUANG, INDIA OFFICE LIBRARY.

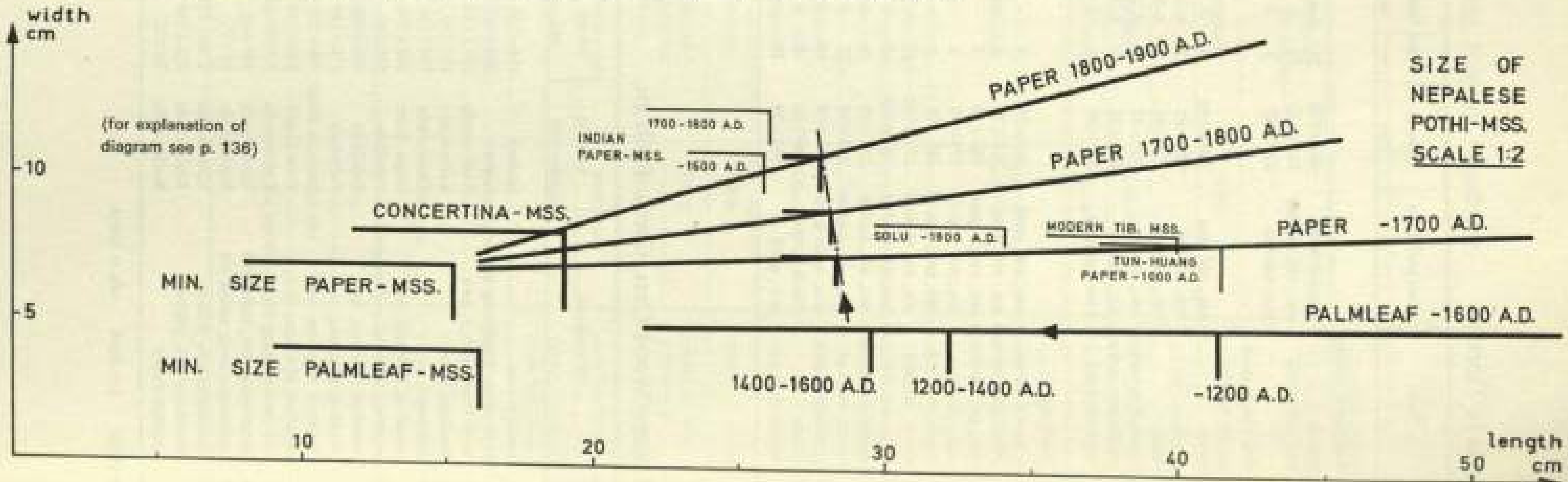
		4	5	6	7	8	9	10	11	12	13	14	15	16	17	>17
-1000	PAPER	74	146	95	45	17	8	3	4	6	1	1				

INDIA, FROM J. EGGELING, CATALOGUE OF THE SANSKRIT MSS. FROM INDIA OFFICE LIBRARY

		4	5	6	7	8	9	10	11	12	13	14	15	16	17	>17
-1600	PAPER			8	4	8	18	26	15	17	16	10	6	5	5	14



SIZE OF NEPALESE POTHI-MSS. SCALE 1:10



SIZE OF NEPALESE POTHI-MSS. SCALE 1:2

Microscopical Analyses

Thymelaeaceae Bast Fibres in Zinc Chloride Iodine and Cupric Oxide Ammonium

	Edgeworthia gardneri	*Daphne involucrata*	*Daphne bholua* & *Daphne papyracea*	*Daphne retusa*	*Daphne tangutica*
Vertical distribution in Nepal (m.)	1500–2400	1200–1800	1800–3600 1600–3000	3000–4000	(West China 600–3000)
Fibre length (mm.)	1½–5 (7½)	2–6½	2–7½	3–5½	2½–5½
Fibre breadth (μ)	4–20 (25)	3–20	6–20	6–20 (25)	6–20
Cell wall	very varying mostly distinct, soft	thick, often indistinct, only little soft	rather thin (3μ) mostly distinct, very soft	thin (2¼μ), distinct, very soft	thin (1¾μ), distinct, very soft
Colour after pressure	yellow to greenish black-violet	pale yellow to greenish black-violet	slightly yellow grey-violet	slightly yellow light grey-violet	slightly yellow light grey-violet
Dislocations (displacement lines)	many, fine or broad	many, mostly broad	many, sharply delineated	fine	fine
Fibre ends	rounded, but often pointed	oblong clavate, often pointed	irregular, often clavate	clavate, fine forms, irregular	fine forms
a (def. p. 239) a_m (μ)	7–50 18 (15–21)	9–50 19 (16½–23)	4–16 9 (8–10)	3–14 7	3–14 6¾
b (def. p. 239) b_m	4–20 9½ (7½–10)	3–14 7½ (6½–8)	6–16 10	5–16 9	5–15 7½
a_m/b_m	1.9 (1.5–2.1)	2.5 (2.1–2.8)	0.9 (0.8–1.0)	0.8	0.8
Cuoxam-reaction	fairly quick and big, walls indistinct	rather slow and small swelling	quick, many balls, walls indistinct	violent, walls battered, helical lines	quick, walls battered
Sclereids length (mm.) breadth (μ) wall thickn. (μ)	 0.7–1.6 10–20 2–6	 0.5–1.5 10–30 3–10	 0.4–2.5 15–50 see p. 192	 1.0–2.0 15–25 ≧5	 0.7–1.5 c. 20 ≧6

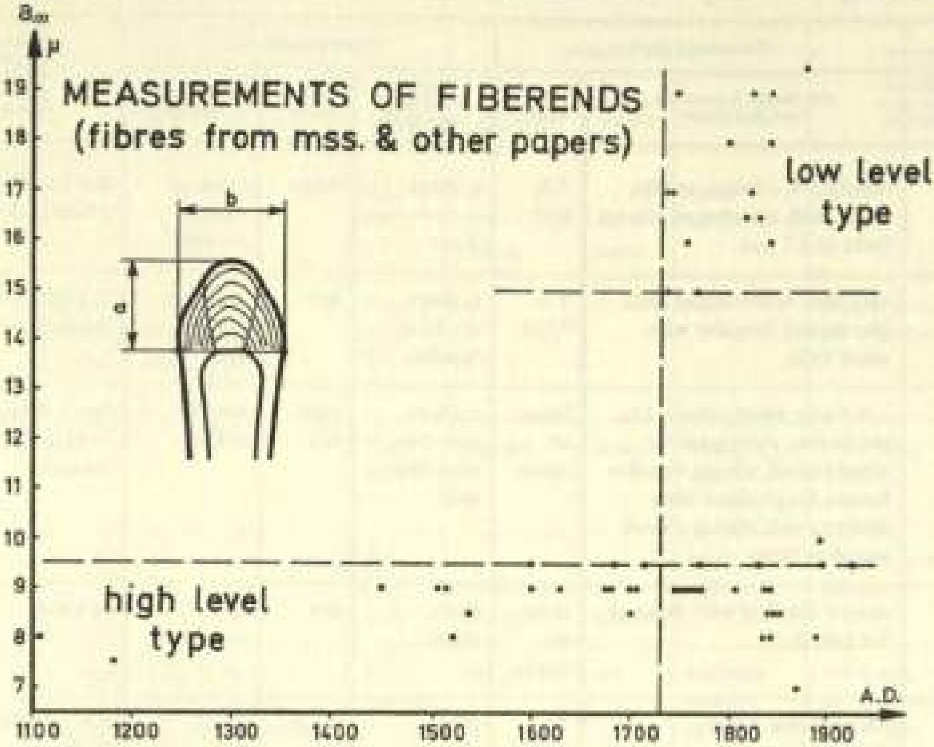
Daphne giraldii	*Daphne sericea*	*Daphne alpina*	*Daphne mezereum*	*Wikstroemia canescens*	*Wikstroemia chamaejasme*
(West China 1000 ?–3000)	(East Mediterranean)	(South and Central Europe)	(Eurasia)	1500–3000	2500–4500 (N.B. fibres from roots)
2–4½	1½–4	1½–4½	2–4	½–4	½–3½
5–15 (20)	4–15	6–15 (20)	6–15 (20)	4–20	4–20
thin (1½μ), distinct, extremely soft	thin (2½μ), distinct, very soft	rather thin (3μ), rather distinct and soft	thin (2μ), distinct, rather soft	varying, mostly thick and indistinct. Pits.	very thin (1½μ), irregular, extremely soft
slightly yellow light grey-violet	slightly yellow grey-violet	slightly yellow to greenish light grey-violet	slightly yellow to greenish light grey-violet	pale yellow-green black-violet	slightly yellow grey-violet
fine	fine	fine	fine	rather few, broad, indistinct	none, helical lines
fine forms	very fine forms, often pointed	fine forms, mostly rounded	lightly clavate, some pointed	fine forms, often pointed	mostly rounded, some pointed
3–10 5½	2–11 5½	2–10 5½	3–10 7	4–17 8	1–6 2
4–12 7½	3–12 7	3–13 7½	5–14 8	5–15 8	2–9 6
0.7	0.8	0.7	0.9	1.0	0.3
violent, walls battered and indistinct	violent, walls battered, helical lines	quick, walls battered, helical lines	quick, walls battered, fibres twisted	rather slow	violent, helical line, many intertwinings
1.0–1.5 15–30 ≧ 5	1.0–1.5 c. 15 ≧ 3	0.5–3.0 10–20 ≧ 6	0.2–2.0 10–20 ≧ 3	2.0–3.0 10–15 thick walls	c. 2.0 c. 20 thick walls

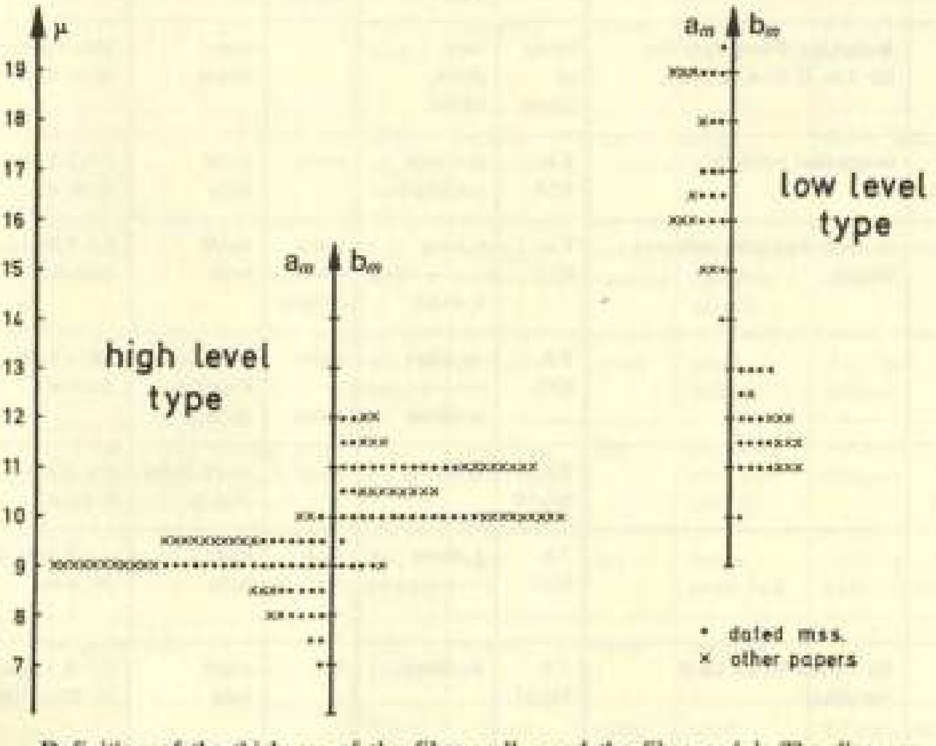
Preliminary Key for the Identification of Bast Fibres of Himalayan Thymelaeaceae

1. $a_m > 14\ \mu$:
    2. $a_m/b_m < 2.1$, *cuoxam*-swelling rather fast and big: — *Edgeworthia gardneri*
    2. $a_m/b_m > 2.1$, *cuoxam*-swelling rather slow and small, characteristic starch particles: — *Daphne involucrata*

1. $a_m < 14\ \mu$:
    3. $8 < a_m < 10\ \mu$: — *(Daphne sureil)*
        4. Mainly thin and thin-walled sclereids: — *Daphne papyracea*
        4. Mainly thick and thick-walled sclereids: — *Daphne bholua*
    3. $a_m < 8\ \mu$:
        5. Fibre length all > 1 mm:
            6. (Fibre walls)$_m > 2\ \mu$, $a_{max} > 12\ \mu$, at *cuoxam*-swelling: wall distinct:
                7. Fibres up to $25\ \mu$ broad, fibre ends mostly rounded: — *Daphne retusa*
                7. Fibres less than $20\ \mu$ broad, fibre ends mostly pointed: — *Daphne tangutica*
            6. (Fibre walls)$_m < 2\ \mu$, $a_{max} < 12\ \mu$, at *cuoxam*-swelling: wall indistinct: — *Daphne giraldii*
        5. Fibre length some < 1 mm:
            8. $a_m > 6\ \mu$ — *Wikstroemia canescens*
            8. $a_m < 4\ \mu$ — *Wikstroemia chamaejasme*

Abbreviations: a = definition see p. 239.
a_{max} = maximum value of a
a_m = mean value of a
fibre = bast fibre





Definition of the thickness of the fibre wall *a* and the fibre end *b*. The diagram below demonstrates that a_m (mean value of 25–50 measurements) is very different for high-level and low-level species of Thymelaeaceae for all the measured samples of raw paper and manuscripts paper. From the diagram above it is seen that paper from manuscripts before A. D. 1730 is made only of the high-level species.

1. Microscopical Analyses of Paper from Manuscripts in Sanskrit, Newari, Nepali etc.

Catalogue no.	Dated A.D.	Layers	Character of fibres: size (length & breadth) shape and colour	Character of fibres: type a_m/b_m	Condition of fibres: length: inner and outer layer	Condition of fibres: flattened sections	Condition of fibres: caoxam-reaction	Sclereids: length, breadth and wall thickness	Starch-particles: inner and outer layer: fine	Starch-particles: inner and outer layer: big
Asu-tosh	1105	4	mostly 3–4, –6 mm, to 20μ, claret, ends rounded or clavate forks to 0.7 mm	T.h. 8/10	r. short	many	quick & violent, no balls	0.5–1.6 mm, 25–40 μ, thick-w.	0	0
					short				0	0
Bir Lib. D. 161	1182	4?	very thin, brown-claret ends clavate and irregular with small forks	T.h. 7½/9	r. short, cut fibre bundles	few	dissolves quickly, balls	c. 1 mm, –40 μ, thick-w.	0	1
Bir Lib. II. 51	1220	2	– 6.5 mm, mostly 40μ, – 65μ, red-brown, some green or violet; broad, almost invisible lumen; longitudinal lines distinct; ends oblong clavate round or blunt	hemp or ramie	r. short very few with fibre ends	very few	waved contour	few 1–2 mm, – 10 μ, pointed, massive	0	1
n. 176f	13. cent.	2	almost identical with those of Bir Lib. II 51	hemp or ramie	short, fibrils	few	waved contour	as above	0	1
n. 117	15. cent.	4	- 8 mm, pale yellow, dislocations violet	T.h. 9/10	long	some	small balls	0.8–1.5 mm, – 40μ, thick-w.	1	2
					short	many			3	2
n. 85	15.–16. cent.	2	Indian ms. Fibres very like Bir Lib. II 51 & n. 176 f.	hemp or ramie	very short, fibrils		many forms	little admixture of other fibres	0	1
Bir Lib. A. 1671	1505	2 or more	(somewhat swollen)	T.h. 9/10	medium, cut bundles	many	small balls	0.5–2.2 mm, – 65μ, thick-w.	2	3
n. 152	1511	4	(2 outer layers are coloured black)	T.h. 9/11	r. long	some	small balls	0.4–1.0 mm, – 30μ, thick-w.	0	1
					r. short	r.many			2	?
Bir Lib. A. 1593	1518	3		T.h. 8/10	medium	some	small balls, dissolves quickly	1.0–1.5 mm, – 40μ, thick-w.	1	1
					medium	many			3	0
Bir Lib. A. 247	1535 (1400?)	2 or more		T.h. 8½/10	r. short	some	small balls, diss. q.	one 0.7 mm, 40μ, thick-w.	0	0
n. 52a	16.–17. cent.	various		T.h. 9/10	r. short	many	small balls	– 1.2 mm, to 40μ, thick-w.	2	2
					–	–			–	–
n. 26	16.–17. cent.	3	(in 2 outer layers black particles)	T.h. 9½/11	medium	few	small balls	0.3–1.5 mm, 20–40μ, thick-w.	1	1
									0	?
n. 84a	1631	3		T.h. 9/11	medium	few	small balls, dissolves	1.4–1.7 mm, 40–50μ, thick-w.	0	1
					–	–			–	–

Abbreviations: T.h. = Thymelaeaceae "high level" species (like *Daphne bholua*)
T.l. = Thymelaeaceae "low level" species (like *Edgeworthia gardneri*)
a_m/b_m = definition of a_m and b_m see p. 239.

– = up to or not measured
r = rather
thick-w. = thick-walled

0 = none
1 = few
2 = rather many
3 = many

Catalogue no.	Dated A.D.	Layers	Character of fibres: size (length & breadth) shape and colour	Character of fibres: type a_m/b_m	Condition of fibres: length: Inner and outer layer	Condition of fibres: flattened sections	Condition of fibres: cuoxam-reaction	Sclereids: length, breadth and wall thickness	Starch-particles: Inner and outer layer: fine	Starch-particles: Inner and outer layer: big
N. 29	1675	4		T.h. 9/11	– r. long	– some	small balls	–	– 3	– 3
	after 1700	1	paper covering miniature a) light yellow-violet & b) yellow-green, thick-w.	T.h. 9/11 T.l. 17/11	–	–	–	0.7–3.0 mm, 20–40μ, thick-w.	0	0
n. 133	1680	2		T.h. 9/11	medium	some	small balls	−1.2 mm, −55μ thick-w.	2 2	2 1
n. 100	1685	3		T.h. 9½/10½	– medium	– many	small balls	0.1 mm, −40μ thick-w.	– 2	– 1
n. 176g	17. cent.	4–5	−7 mm, −25μ, thick-w., yellow-green, bifurcations −0.8 mm, ends big, clavate, often pointed, a = 9–30μ, b = 5–23μ	T.l. 16½/11	very long	few	big balls which dissolve r. quickly	−0.8 mm, −40μ, walls −10μ, outer layer black particles	2 ?	1 ?
n. 172	17.–18. cent.	2		T.h. 9/11	medium	many	small balls	0.7–1.3 mm, −50μ, thick-w.	3	2
J.T. 26	17.–18. cent.	3		T.h. 8½/9½	r. long –	few –	small balls	0.6–1.7 mm, −45μ, thick-w.	0 –	1 –
n. 184	1704	4		T.h. 9/10	r. long –	many, swollen	small balls, dissolves quickly	0.7–2.3 mm, −45μ, thick-w.	3 –	1 –
n.27	1714	3		T.h. 9½/11	r. short	many	small balls	−1.7 mm, −40μ, thick-w.	3	1
n. 84	1736	3	−7 mm, −25μ, yellow-green, lumen small, indist., ends often pointed, a = 6–35μ, b = 10–22μ	T.l. 16/10	very long in all layers	few	big balls, dissolves quickly	−1.2 mm, −50μ, thick-w.	0	0
n. 70	1737	2 or more	as above n. 84	T.l. 17/11½	long	few	rather small balls	−0.8 mm, −35μ, walls 5–10μ	3	2
n. 128	1743	2	as above n. 70	T.l. 17/12	r. short	many	big balls	–	2	3
n. 183	1744	2		T.h. 9/11	r. short, swollen	many	small balls	0.7 mm, 20μ, thick-w.	3	2
n. 87	1745	2	as n. 70 (A.D. 1737)	T.l. 19/13	r. short, swollen	many	big balls	−0.8 mm, −30μ, walls c. 10μ	3	2

1. Microscopical Analyses of Paper from Manuscripts in Sanskrit, Newari, Nepali etc.

Catalogue no.	Dated A.D.	Layers	Character of fibres: size (length & breadth) shape and colour	Character of fibres: type a_m/b_m	Condition of fibres: length: inner and outer layer	Condition of fibres: flattened sections	Condition of fibres: cuoxam-reaction	Sclereids: length, breadth and wall thickness	Starch-particles: inner and outer layer: fine	Starch-particles: inner and outer layer: big
n. 176 1	18. cent.	3		T.h. 9/10	r. long	few	small balls	–0.8 mm, –40μ, thick-w.	0	2
					–	–			–	–
n. 162	1753	2	–7 mm, thick-w., yellow-green, long forks	T.l. 16/11	long	few	big balls	–0.9 mm, –30μ, walls c. 10μ	2	2
n. 157	1753	6		T.h. 9/10	r. long	few	small balls	–1.2 mm, –35μ, thick-w.	1	1
					–	–			1	2
n. 42a	1753	2	–6.5 mm, –30 μ, long bifurcations	T.h. 9/11	varying	many	small balls, dissolve fast	–1.3 mm, –45μ, thick-w.	2	3
N. 34	1764	2	mostly 3–4 mm, –35μ, many disloc., ends often pointed	T.l. 15/11	r. short	few	big balls, diss. fast	–1.3 mm, –40μ, thick-w.	1	2
n. 82	1768	4		T.h. 9/11	–	–	small balls	–1.0 mm, –40μ thick-w.	–	–
					medium	many			3	1
n. 151	1768	4		T.h. 9½/10½	–	–	small balls	0.7–1.5 mm, –40μ, thick-w.	–	–
					medium	few			3	2
n. 6	1799	3–4	(2 kinds of sclereids)	T.l. 18/12	–	–	big balls	a) –2 mm, –30μ, thick-w. b) c. 1 mm, 30μ, wall 5μ	–	–
					long	few			3	1
n. 174	late 18. cent.	2		T.h. 9/11	r. short	some	small balls	pieces of the thick-w. sclereids	3	3
N.Gl. 1	1802	4	pp. 1–41: a) 0.5–3.0 most 0.8–1.5 mm, 6–12μ, yellow-brown or green, round, pointed, fine, distinct lumen, pits. b) 0.5–2.0 (?) mm, 12–30μ, flat, violet, fine disloc. less pointed, wall 2–5μ	bamboo	v. short	some	small balls, like pearls	big vascular cells with many holes, few parenchyma. Outer layer coloured black	2	2
									–	–
		4	pp. 42 and on: T.l., very high altitude species	T.l. 7½/10	r. short	many	small balls, dissolve fast	0.6–1.2 mm, –40μ, thick-w.	3	2
n. 35	1803	3		T.h. 9/10	–	–	small balls	c. 1 mm, –30μ	–	–
					r. long	few			2	2

Abbreviations: T.h. = Thymelaeaceae "high level" species (like *Daphne bholua*)
T.l. = Thymelaeaceae "low level" species (like *Edgeworthia gardneri*)
a_m/b_m = definition of a_m and b_m see p. 239.

– = up to or not measured
r = rather
thick-w. = thick-walled

0 = none
1 = few
2 = rather many
3 = many

Catalogue no.	Dated A.D.	Layers	Character of fibres: size (length & breadth) shape and colour	Character of fibres: type a_m/b_m	Condition of fibres: length: Inner and outer layer	Condition of fibres: flattened sections	Condition of fibres: cuoxam-reaction	Sclereids: length, breadth and wall thickness	Starch-particles: Inner and outer layer: fine	Starch-particles: Inner and outer layer: big
n. 29	1817	va.	−6 mm, −30μ, thick-w.	T.l. 16½/11½	medium r. long	some	big balls		3	3
n. 166	1819	2	−7 mm, −30μ, thick-w. (2 kinds of sclereids)	T.l. 17/12	long	few	big balls	a) −3 mm, −45μ, thick-w. b) c. 1 mm, 25μ, walls 5–10μ	2	1
n. 10	1820	3	mixed fibres: a) mostly T.h. 9/10. b) yellow-green, big fibre ends, T.l. 17/12 (2 kinds of sclereids)	mixture 12/10	r. short	many	big and small balls	a) 0.5 mm, −50μ, thick-w. b) −1.5μ, −30μ, walls 5–10μ	3	3
n. 164	1824	2	−7 mm, −30μ, thick-w.	T.l. 19/13	long	few	big balls	0.8–1.5 mm, −30μ, walls 7μ	3	3
n. 84c	1829	2	−7 mm, −30μ, thick-w.	T.l. 16½/11½	r. long	rather few	big balls	0.7 mm, −35μ, walls 8μ	3	3
n. 125	1832	3	−7 mm (much beaten fibres)	T.h. 9½/11½	r. short	many	small balls	c. 1 mm, −55μ thick-w.	2	3
					–	–			–	–
N. 1	1834	3	fine and small fibre-ends	T.h. 8/9	r. short	few	small balls	c. 1 mm, −40μ, thick-w.	2	1
n. 153	1835	3	(very much beaten fibres, many cut bundles)	T.h. 9/10	–	–	small balls, dissolve fast	c. 1 mm, −40μ, thick-w.	–	–
					short	many			3	3
n. 106	1838	2		T.h. 8½/11	r. long	many	small balls	c. 1 mm, −30μ thick-w.	2	2
n. 149	1840	3	−7 mm, −30μ, thick-w., pointed long forks, big ends	T.l. 18/13	–	–	big balls, dissolve fast	0.7–1.8 mm, −30μ, walls 8μ	–	–
					long	many			2	3
n. 76	1841	3	fine, thin fibres	T.h. 8/9	–	–	small balls	0.5–1.7 mm, −45μ, thick-w.	–	–
					varying	some			3	2
n. 84 i	1841	2	−7 mm, −30μ, thick-w., pointed long forks, big ends	T.l. 16/11½	r. short	many	big balls	a) −1.3 mm, −30μ, thick-w. b) c. 1 mm, −30μ, walls 5–10μ	3	3
n. 155	1843	2–4	some leaves exclusively T.h.	T.h. 9/10	long	few	small balls	0.7–2.0 mm, 25–60μ, thick-w.	2	2
			other leaves a mixture: T.h. 9/10 and T.l. 19/13 (−7.5 mm, −30μ, thick-w.)	T.h. & T.l.			small and big balls		–	–

Catalogue no.	Dated A.D.	Layers	Character of fibres: size (length & breadth) shape and colour	Character of fibres: type a_m/b_m	Condition of fibres: length: Inner and outer layer	Condition of fibres: flattened sections	Condition of fibres: causam-reaction	Sclereids: length, breadth and wall thickness	Starch-particles: Inner and outer layer: fine	Starch-particles: Inner and outer layer: big
n. 165	1848	2	fine, thin (much beaten)	T.h. 8½/11	short	many	small balls	−1.4 mm, −40μ, thick-w.	3	2
n. 84h	1850	2		T.h. 8½/ 11½	medium	some	small balls	−1.2 mm, −35μ, thick-w.	2	0
n. 88	1870	?	thin, very fine fibre ends	T.h. 7/10	short	rather a few	small balls	−1.3 mm, −45μ, thick-w.	2	1
n. 84e	1876	3	very thick-w.	T.l. 19½/ 12½	long	some	big balls	a) 0.9 mm, −45μ, thick-w.	3	1
					–	–		b) −0.8 mm, 25μ, walls 5μ	–	–
n. 9e	1890	2		T.h. 8/10	short bundles	many	rather big balls	none found	2	2
n. 171	1894	2	(very beaten and swollen – *a* and *b* big)	T.h. 10/12	short bundles	many	small balls	−0.8 mm, − 40μ, thick-w.	2	3
n. 176c	1897	2	(very beaten and swollen – *a* and *b* big)	T.h. 9½/12	short	very many	small balls, dissolve fast	1.0–1.6 mm, −45 μ, thick-w.	3	3
n. 103	1926	2		T.h. 9½/11	varying	some	small balls	−1.3 mm, −55 μ, thick-w.	3	3

2. Microscopical Analyses of Paper from Books in Tibetan

a) Found in the Kathmandu Valley

Catalogue nb.	Layers	Character of fibres: size (length and breadth), shape and colour	Character of fibres: type a_m/b_m	Condition of fibres: length: inner and outer layer	Condition of fibres: flattened sections	Sclereids: length, breadth and wall thickness	Starch-particles: inner and outer layer: fine	Starch-particles: inner and outer layer: big
n. 44a	2	–6.5 mm	T.h. 9½/10½	medium	few	0.5–1.3 mm, –60 μ, thick-w.	1	1
n. 45	4	a) –35 μ, yellow-green, long forks, particles in lumen b) some few T.h. fibres	T.l.15/11½ and T.h.	long-fb.	few	0.5–1.6 mm, –30 μ, walls c. 5 μ	0	0
	4	another leaf: Not quite typical T.h. fibres (many, small, edged starch particles)	T.h. 9½/11½	medium	rather many	–1.0 mm, –50 μ, thick-w., many	(3) <10μ	0
n. 46	4		T.h. 10/12	long	few	–1.0 mm, –40 μ, thick-w.	0	0
				–	–		–	–
n. 47	6		T.h. 9/11	long	few	–2.5 mm, –45 μ, thick-w. many	0	0
				–	–	–	–	–
n. 137a		–7.5 mm, –30 μ, yellow-green, thick-w. Many ends big, quite a few pointed	T.l.16½/11	long	few	a) –0.5 mm, –30 μ, thick-w. b) –1.0 mm, –40 μ, walls 10 μ	1	2
				–	–		–	–
n. 137b	3		T.h. 8/10	medium	few	–0.6 mm, –30 μ, thick-w.	0	0
				–	–		–	–
n. 138a	2	–8.5 mm, –30 μ, as n. 137a	T.l. 19/11½	long	r.many		3	2
n. 138b	3	a) the main part as n. 137a b) c. 30% T.h. fibres	Mixt: 16/12: T.l. 19/11½ +T.h. 9½/11	long	r.many	a) 1–2 mm, –50 μ, walls 5–10 μ, b) –1 mm, –40 μ, thick-w.	3	2
				–	–		–	–
n. 15	2		T.h. 9/10	long	few	–0.6 mm, –45 μ, thick-w.	0	0

b) Found in North Nepal

Catalogue nb.	Layers	size (length and breadth), shape and colour	type a_m/b_m	length: inner and outer layer	flattened sections	Sclereids	fine	big
J.T. 12a	2	(very much beaten fibres)	T.h. 10/11	r. short	many	0.4–1.0 mm, –60 μ, thick-w.	0	0
12b	2		T.h. 9/10	medium	some	–1.3 mm, –40 μ, thick-w.	0	0
12c	4		T.h. 9/10	r. long	some		0	2
				–	–		–	–
12e	2		T.h. 9½/11	long	some	–1.5 mm, –50 μ, thick-w.	1	0
				–	–		–	–
13	2		T.h. 9½/11½	r. long	r. many	–0.8 mm, –45 μ, thick-w.	1	2
15	3	mixture: a) –6.5 mm, –30 μ, yellow-green, ends big, many pointed b) violet as *Daphne bholua*	14/11 = T.l. 18/11½ + T.h. 10/11	long	few	a) –0.8 mm, –30 μ, walls 6 μ, b) –1.5 mm, –60 μ, thick-w.	0	0
				long	r.many		0	0
16	2	(much beaten)	T.h. 9½/11½	r. long	many	–1.3 mm, –40 μ, thick-w.	2	2
17	2	(much beaten)	T.h. 9/11	medium	many		2	2

Abbreviations:
T.h. = Thymelaeaceae "high level" species (like *Daphne bholua*)
T.l. = Thymelaeaceae "low level" species (like *Edgeworthia gardneri*)
a_m/b_m = definition of a_m and b_m see p. 239.

– = up to or not measured
r = rather
thick-w. = thick-walled

0 = none
1 = few
2 = rather many
3 = many

Measurements of Content of Elements in Palm Leaf Mss. and Paper Mss.

Determined by X-ray Fluorescence, *Institute of Mineralogy*, Copenhagen

Catalogue no.	Dated A.D.	Material and quantity (cm^2)	Ca	Mn	Fe	Ni	Cu	Zn	As	Pb	Other elements	Coated with
n. 173	11. c.	palm leaf, 1.5	52	–	30	3	3	2	3	0	K, Ti, Cr	no inorg. comp.
n. 173	11. c.	palm leaf, 1.3	40	3	24	3	2	1	3	0	K, Ti, Cr	"
n. 168	1246	palm leaf, 1.4	34	2	25	3	1	2	0	0	K, Ti, Cr	"
n. 109	1265	palm leaf, 0.7	34	3	14	4	3	2	0	0	K, Ti, Cr	"
n. 72	1327	palm leaf, 1.5	30	3	21	2	2	2	0	7	–	"
n. 90	1432	palm leaf, 0.7	22	2	9	2	2	2	0	0	K, Ti, Cr	"
n. 123	15. c.	agallocha bark 3.0	–	–	–	–	–	–	200	–	–	orpiment
Asutosh	1105	paper, 1 layer 0.3	72	3	32	2	4	7	0	4	K, Ti	?
Bir D 161	1182	paper, 1 layer 0.7	68	4	32	2	4	–	0	1	–	?
Bir II 51	1220	paper, 2 layers 1.7	130	3	130	1	2	4	9	0	K, Ti, Sr, Cr	org. colour
n. 117	15. c.	paper, 1 layer 1.0	140	–	74	–	–	5	3	0	Zr	blood
Bir A 1671	1505	paper, 2 layers 0.3	30	–	–	–	–	–	34	0	–	orpiment
Bir A 1593	1535	paper, 1 layer 0.5	71	–	55	2	2	6	8	0	–	orpiment?
n. 26	17.–18. c.	paper, 1 layer 1.0	55	–	60	–	–	–	11	3	–	orpiment?
n. 84	1736	paper, 1 layer 2.0	23	–	–	–	(12)	2	170	0	–	orpiment
N. 34	1764	paper, 1 layer 5.0	26	–	–	–	(8)	–	200	0	–	orpiment
N. Gl. I	1802	paper, 2 layers 1.5	150	9	67	0	8	78	4	6	K, Ti, Cr	org. colour
J.T. 12b	18.–19. c.	paper, 1 layer 0.8	85	–	–	–	–	–	–	–	–	calcite
J.T. 21	18.–19. c.	paper, 1 layer 0.3	15	6	60	2	2	1	0	0	K, Ti, Cr	starch paste
orpiment p.	1964	paper, 1 layer 8.0	–	–	–	–	–	–	1000	–	–	orpiment
raw paper	1964	paper, 1 layer 10.0	16	5	12	1	1	1	0	0	–	none

The values are relative and can only be compared element by element taking into consideration the quantities of the samples. For the sample "raw paper" 1 unit corresponds to 20-40 p.p.m. (1 p.p.m. = $1/10^6$) which gives the magnitude of the quantities in the other samples.

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