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TO
THE MEMORY OF
PROFESSOR ALBERT A. MICHELSON
WORLD EMINENT PHYSICIST
THIS ISSUE IS
DEDICATED.



PROFESSOR ALBERT A. MICHELSON.

PROF. ALBERT A. MICHELSON AND HIS CONTRIBUTION TO SCIENCE.

THIS issue of our Journal is dedicated to Prof. Albert A. Michelson, as to the physicist, whose scientific genius in the field of Light research has given the world an enormous increase of most valuable knowledge. It is profoundly regrettable that this eminent scholar has departed from our midst during this year of review, and just at the very moment when he was at work on a new and most significant experiment, which was not destined to be completed by him.

With Prof. A. Michelson's death our Institute has further lost one of its most distinguished Honorary Advisors.

The following is a brief outline of Prof. Michelson's life and activities, as well as a short description of his most significant scientific achievements.

Albert Abraham Michelson was born in 1852 in Stelno near Posen. The family emigrated to the United States, where from 1873 to 1880 A. A. Michelson served in the U.S. Navy, then going to Europe to study at the Universities of Berlin, Heidelberg and Paris and returning to America, where he becomes first Professor at the Naval Academy of Annapolis and then at the Case School of Applied Science in Cleveland. Here in 1887 the now classical 'Michelson Experiment' took place. He then joins the Clark University, Worcester, Mass. and in 1893 the University of Chicago, where he becomes later Distinguished Service Professor and Head of the Department of Physics.

He has been honoured by all scientific organizations of the world, receiving the Nobel Prize for Physics in 1907 and holding the following distinctions: Doctor of Philosophy—Leipzig (1909), Goettingen (1911), Christiania (1911), Paris (1921); Doctor of Laws—Yale University (1901), Pennsylvania (1906), McGill University (1921); and Doctor of Science—Cambridge, Mass (1899), Princetown University (1927).

L'Académie des Sciences de Paris elects him in 1900 Correspondant pour la Section de Physique Générale and in 1920 their Associé Etranger.

His connection with the American Association for the Advancement of Science is also most significant. He joins the AAAS in 1877, is elected Fellow in 1879 and Emeritus Life Member in 1929. He was Vice-President of the

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Section of Physics in 1888, and heads this distinguished institution as President of the AAAS in 1910 (Second Minneapolis Meeting).

In 1928 the Meeting of the American Optical Society is called the 'Michelson Meeting' in honor of this 'Dean of American Optics'.

On May 10, 1931, he succumbed to cerebral hemorrhage. As a true scientist, he continued his research to the very last, trying his utmost to complete his new experiment. Reports state that he dictated scientific datae to the very last moment of consciousness.

Of all the phenomenae of nature, Light has since time immemorial fascinated the minds of those who devoted their lives to scientific research, even long before Roemer in the XVII Century measured the velocity of light by timing the eclipses of the satellites of Jupiter. Amongst the scientists of to-day Prof. Albert A. Michelson no doubt stands out as the most untiring, deep and successful research worker in this field.

It is true that science of to-day, despite whole centuries of persevering labour, cannot give a definite and indisputable reply to the question: 'What is light?' But it is also true that as far as comparative research of light, relative to known scientific datae, can go, Prof. Albert A. Michelson has added to the world's knowledge of light a colossal amount of most valuable material. He has no doubt also laid the foundation stone to what subsequently grew into Einstein's Preliminary Theory of Relativity in 1905, followed by Einstein's General Theory of Relativity in 1915. Prof. Albert A. Michelson is consequently to be regarded as the co-founder of the great discoveries of general physics, unifying the hitherto separate conceptions of electricity-magnetism-gravitation and time-space.

Prof. A. A. Michelson's first important scientific achievement in life was the famous 'Michelson-Morley experiment', which he performed in 1887, whilst at the Case School of Applied Science in Cleveland, in collaboration with his colleague Prof. E. W. Morley. The principle of this experiment, as is generally known, consists of his idea that if the earth moves in what physicists called ether, which was regarded the carrier of light, then a beam of light, moving in the same or opposite direction of motion of our earth, would travel either faster or slower, than light which travels at right angles to this direction.

This apparatus was built by Michelson and is called interferometer. It consists of a glass plate standing under an angle of 45° to a source of light

PROF. MICHELSON AND HIS CONTRIBUTION TO SCIENCE

and dividing the beam of light to travel in two directions perpendicular to each other. The whole device is mounted on a marble or steel base, floating and slowly rotating in a bath of mercury. The two beams of light, after division, are reflected by mirrors and then united, and if an 'ether-drift' exists, should have caused on combining dark bands on account of the interference of light waves. Michelson's interferometer proved that there is no drift from the motion of our planet in ether, and scientists, including Prof. A. Einstein, concluded from this that no such ether as carrier of light and filling space, as was assumed in the last century, exists.

The speed of light being 186,324 miles per second, the interferometer had to be very delicate to make any change visible, but as the earth's motion round the sun is almost 20 miles per second (and the supposed motion of our whole solar system is probably several hundred miles per second) Prof. Michelson succeeded in building an interferometer sufficiently sensitive to show a possible interference due to 'ether-drift' even at a far smaller velocity of our earth.

In 1925 Dr. Dayton C. Miller attacked the accuracy of this experiment, but Prof. Albert A. Michelson, despite serious illness, repeated it again in September, 1928, at the Mt. Wilson Observatory in Pasadena with a still better interferometer, which would have detected a motion fifty times less than that expected and his result was again in the negative, proving the absence of an 'ether-drift'.

Later an experiment was conducted on the same principle by Prof. G. Joos of Jena, Germany, in collaboration with the Zeiss Optical Works, with a most delicate instrument, known as the Joos-Zeiss interferometer, capable of detecting one-hundred-millionth of an inch deviations, and the result again proved Prof. Michelson's experiment to be fully correct.

Prof. Einstein has attended many of Prof. Michelson's experiments and after the results of his second experiment in 1928, Prof. Michelson is reported to have 'accepted all the consequences of Einstein's theory of relativity', yet maintaining his belief in the existence of ether, though he admitted that so far it cannot be proven.

Besides these experiments of 'ether-drift' and velocity of light, many more scientific achievements fall to Prof. A. A. Michelson's credit. He constructed an apparatus with the help of which the apparent diameters of several giant stars, like Alpha Orion, Alpha Bootes and Alpha Scorpion were measured and in general contributed much towards the knowledge of contemporary astrophysics.

His last experiment, so promising, was unfortunately interrupted by his death. At Santa Anna in South California, he had constructed a straight tube,

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about 3 feet in diameter and a mile long, in which the atmospheric pressure was reduced to a few mm., thus permitting light to travel in airless space, similarly to interplanetary conditions. By an arrangement of reflecting mirrors at the ends of the tube, the path of travelling of the ray of light was increased tenfold, giving a total length of about ten miles. Thus prepared to measure with most accurate up-to-date precision the velocity of light and to make further research in this field, he was carried away from us in the full glory and development of his activities by his fatal illness, but having earned forever humanity's gratitude through his enormous contribution to Science.

V. A. SHIBAYEV.

RECENT ARCHAEOLOGICAL DISCOVERIES IN INDIA.

BY COLONEL A. E. MAHON, D.S.O.

UNTIL a few years ago the earliest known monuments of India were roughly assignable to the 7th or 8th century B.C. The absence of structures of an earlier period was then supposed to be due to the fact that all previous architecture has been of wood and had completely perished. The recent excavations, however, at Mohenjo-daro, in Sind and at Harappa in the Punjab, have completely revolutionized ideas on this subject and proved that as far back as the third and fourth millennia B.C. and probably much earlier still, India was in possession of a highly developed civilization with large and populous cities, well built houses, temples and public buildings of brick, and many other amenities enjoyed at that period by the peoples of Mesopotamia and Egypt.

At Mohenjo-daro an area of some 17,000 square yards has now been cleared to a depth of about 18 feet below the surface. Here—as also at Taxila—the building construction improves as the lower levels are reached. The antiquities that have been recovered from the lower strata prove that the art of the seal cutter was of a very high order during the earlier periods of occupation. In the course of excavating one of the main arteries of the city five clearly defined periods of occupation were passed through, each with its own drainage system.

At Harappa one of the low-lying portions of the site has yielded abundant skeletal remains. Besides seemingly complete burials in open ground, 110 burial jars were recovered in another part of the site. So far, only 27 of these vessels have been examined and were found to contain skulls and human bones, and are apparently fractional burials. From the paintings on these jars, of flying peacocks alternating with stars, and with a human figure placed horizontally within the body of each bird, it is surmised that the peacock may have been believed to carry the ethereal body of the dead to the Abode of Bliss, and possibly accounts for the strong superstitious feeling for this bird which is still so marked in many parts of India.

Recent surveys of the prehistoric sites in India have yielded striking evidence of their widespread distribution and also of the fact that they are not all attributable to one civilization. Trial excavations in 1929-30 at Amri—near the station of that name on the Rohri-Kotri Section of the North-

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Western Railway—brought to light the remains of stone walls of two strata of occupation. The upper stratum yielded painted pottery and other relics similar to those from Mohenjo-daro, while from the lower stratum embedded in the silt of the Indus was recovered a peculiar type of thin painted ware of entirely different fabric and ornament and resembling pottery from Baluchistan and Seistan. This stratification brings out the remarkable fact that many of the sites in Baluchistan and Seistan must have been antecedent to the Indus valley culture, and that in the Indus valley itself the earliest civilization is not that represented at Mohenjo-daro and Harappa.

This Indus valley culture has now been traced as far as Rupar in the Ambala District, relatively close to the watershed of the Sutlej and Jumna and it is therefore highly improbable that this civilization was confined to the Indus valley.

Of the various discoveries made recently at Taxila, the most striking were several hordes of jewellery found by Sir John Marshall, consisting of bangles, bracelets, finger-rings, rosettes, a hair pin, and two interesting little reliefs of Eros and the winged Aphrodite. All these objects are gold and many are encrusted with coloured paste or gems. Along with them were a few articles of silver,—including two small dishes bearing brief inscription in Kharoshthi, and a dozen coins belonging to the close of the Parthian or beginning of the Kushan epoch. A few pieces from the Bhir Mound belong to the Mauryan period, but the bulk of it is referable to the beginning of the Kushan epoch,—that is, to about the first century A.D.

In the large Monastery of Paharpur, in the Rajshahi District of Bengal, over a hundred cells have been exposed and, except for the Southern and South-Eastern portions of the quadrangle, the whole *vihāra*, the largest ever discovered in India, is now open to view. The antiquities recently discovered were scanty, a few stone and bronze statuettes and an inscribed pillar with XII century epigraph being the most noteworthy.

In Bihar and Orissa some progress has been made in the exploration of the extensive and important Buddhist site at Nalanda. The most interesting finds were eight beautiful images of bronze and stone.

Further excavation of the Nagarjunikondi site in the Guntur District of the Madras Presidency resulted in the recovery of a number of beautiful and interesting bas-reliefs of the Amaravati style.

Excavations in Burma were undertaken at Halin in the Shwebo District, at Old Prome, and Pagan, but save for an inscription in Pyu and a carved

RECENT ARCHAEOLOGICAL DISCOVERIES IN INDIA

stone decorated with figures, presumably of Pyu date, very little of importance was recovered. A site in private ownership near Bassein yielded an inscription in Talaing and Pali of the XV-XVI century.

The remains recently brought to light at Mohenjo-daro tend to confirm earlier impressions that the amenities of life enjoyed by the average citizen of that city were far in advance of anything to be found at that time in Babylonia or on the banks of the Nile. Although there are proofs of a close cultural connection between Southern Mesopotamia and Sind, even at Ur the houses are by no means equal in point of construction to those of Mohenjo-daro, nor are they provided with a system of drainage at all comparable with that found in the latter site.

One of the most striking of the seals recovered at Harappa depicts a procession of seven men wearing kilts and helmets and marching in a line from right to left. A unique object found in this low stratum was a model in copper of a two-wheeled cart with a gabled roof and driver seated in front. Sir John Marshall states that this is, possibly, the oldest known example of a wheeled vehicle; older even than the stele fragment with the picture of a chariot recently found by Mr. Woolley at Ur, which in its turn antedates by a thousand years the use of the wheel in Egypt.

With the progress of exploration it has become evident that the connection of the Mohenjo-daro and Harappa civilizations with the Sumerian civilization of Mesopotamia was due, not to actual identity of culture, but to the intimate commercial or other intercourse between the two countries.

Among other interesting discoveries it has been established that cotton textiles were in use at Mohenjo-daro 3,000 years B.C.

At Harappa an interesting seal was recently recovered bearing a representation of the Earth Goddess. Among terracottas were human figures of men seated with legs drawn up in a devotional attitude, others squatting with their knees clasped in their arms, three nude figures, one of which is seated on a three-legged stool, pregnant women, others suckling babies, one kneading bread, and another with her hands placed sideways over her hips.

The most remarkable and most valuable find of small antiquities that has yet been made at Taxila was recently made in Sirkap, and consisted of a hoard of gold and silver ornaments and of silver vessels.

Several important results emerge from the recent excavations at Paharpur, in Bengal, namely: the discovery that a prosperous school of sculpture existed

in Bengal earlier than any so far known, and the recovery of images of orthodox Brahmanical deities in an undoubtedly Buddhist monument as well as of the earliest known sculptures in East India depicting the exploits of the boy Krishna, and the earliest images of Krishna and Radha. The Paharpur finds take back the beginnings of Krishna worship in Bengal to the sixth century B.C.

Within the last few years our knowledge of the old civilizations, and especially that of the Indus Culture, has been considerably enriched by the discoveries referred to above. It has been established that the specimens of wheat found in Mohenjo-daro resemble the common variety grown in the Punjab to-day. There are also strong reasons for inferring that the rainfall in Sind and the Western Punjab was then somewhat heavier than it is now; also that the Sind was watered by two large rivers instead of one. The food of the Indus people, in addition to bread and milk, consisted of beef, mutton and pork; the flesh of tortoises, turtles and gharial; also fresh fish from the Indus and dried fish imported from the sea coast. Among domesticated animals so far no trace has been found of the cat.

Male attire among the upper classes consisted of a skirt or kilt fastened round the waist, and a plain or patterned shawl, which was drawn over the left and under the right shoulder. Men wore short beards and whiskers, with the upper lip shaven. Their hair was taken back from the forehead and coiled in a knot at the back of the head with a fillet to support it. Among the lower classes, men went naked, and women with a narrow loin cloth only, though there is one statuette of a dancing girl without even this garment. From which it would appear that clothes were worn more for the sake of adornment than from any sense of shame. Ornaments were worn freely by all classes alike.

From the surprising paucity of weapons that have been recovered it would appear that the cities of Harappa and Mohenjo-daro were but little acquainted with warfare. Evidence shows that the people were familiar with the art of writing.

The main features of the Indus religion as revealed up to the present are:—the worship of a Mother Goddess, and, side by side with her, a male god, who is identifiable with Siva; the worship of animals both real and fabulous and of therio-anthropic creatures, as well as belief in Nagas; the worship of trees and baetylic and phallic stones, including the *linga* and *yonis*. 'There can be no question' says Sir John Marshall, 'that most of the elements found at Mohenjo-daro and Harappa are characteristically Indian and that they carry back the story of Hinduism to an age before the coming of the Aryans,

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thus disposing of the commonly accepted view that these elements represent a popular form of worship evolved by the Indo-Aryans themselves.'

It has been established that the Indus civilization extended over much of Baluchistan as well as over Sind and the Punjab; there is also evidence to show that it extended eastward over Cutch and Kathiawar towards the Dekhan. There is no question that it formed part and parcel of the wide flung Chalcolithic culture of Asia and Europe.

It is, perhaps, one of the most curious and unexpected results obtained that the Travels of Apollonius of Tyana in their accounts of Taxila contain several particulars which tally remarkably well with recent discoveries on the spot. Sir John Marshall concludes that Apollonius did in fact visit Taxila, probably in the year 44, A.D.

Among the numerous antiquities which the site of Sirkap has yielded, perhaps the most fascinating is a bronze statuette (height 5 inches) representing the Egyptian childgod Horus or, as the Greeks called him, Harpocrates, wearing on his head the double crown of Upper and Nether Egypt. His right hand is raised to his lips as if to impose silence.

Sir Aurel Stein's recent explorations in Baluchistan and Waziristan, on the North-West frontier of India have provided ample proof that the 'chalcolithic' civilization of prehistoric Sind once extended to those territories.

The explorations of Mr. Hargreaves at Nāl, in the Jhalawān Division of the Kalāt State, have demonstrated the existence in Baluchistan of a dolichocephalic people who used both stone and mud brick for building purposes, whose tools and weapons were of copper and who carefully buried their dead in different ways; a people acquainted with the art of melting ores and highly skilled in working refractory stones, capable of spinning if not weaving.

From the valuable knowledge we have gained from recent discoveries it is evident that further exploration will clear up other debatable points and add considerably to the knowledge already gained. There remains a vast and almost virgin field yet to be explored by the practical archæologist. It is no exaggeration to say that the archæological discoveries that have been made in India within the last few years have opened up an entirely new vista; have upset many of our former beliefs and theories, while confirming others; and have, owing to their stupendous importance, evoked a world-wide interest. We may confidently look forward to further explorations yielding more discoveries of supreme interest in the near future.

STUDIES IN THE KĀLACAKRA.

I.

BY GEORGES DE ROERICH.

THE importance of the Kālacakra system in the religious life of Tibet is apparent from the voluminous character of the literature dedicated to the system, and the powerful influence exercised by its teachings on the Buddhist world of Central Asia.

Most of the great monastic establishments of Tibet and Mongolia give instruction in this intricate system of mysticism. Many of these monastic establishments maintain special faculties dedicated to the study of the Kālacakra system / ex. the Kālacakra College or Dün-khor ḍā-tṣhañ (Dus-'khor-gyi grva-tṣhañ) of the Tashi-lhunpo Monastery at Shigatse, and the Dün-khor ḍā-tṣhañ, founded about 1825, at the Kumbum Monastery (sKu-'bum byams-pagliñ) in Kansu /. The programme of these Kālacakra Colleges is in general similar to that of the Tantric faculties or rGyud-kyi grva-tṣhañ, and consists of a 3-4 years' course, during which period the monk-student acquires a solid knowledge of the four principal Tantric systems. In addition to the study of the different Tantric systems, the monk-students of a Kālacakra College have to master all the intricacies of the Indian system of astronomy and astrology, and acquire a substantial knowledge of Sanskrit / monks with a good knowledge of Sanskrit are only rarely met with nowadays, but it would not be right to state that they have disappeared /. The Kālacakra system belongs to the Anuttara-yoga tantra / Tibetan: rnal-'byor bla-med rgyud /, the highest of the four Tantric systems. The other systems of the Anuttara tantra, each symbolized by the yi-dam or tutelary deity worshipped in it are: gSañ-'dus (Guhyasamāja); bDe-mḥog / Samvara /; Phyag-rdor / Vajrapāṇi /, and 'Jigs-byed / Yamāntaka /.

The monk-students of Tantric Colleges are distinguished by their ascetic life, and the severity of the novitiate. Before being admitted into a Tantric College, the student has to spend several years in a monastic establishment, often in another college of the same monastery, and then has to be specially recommended to the Superior of the Tantric College.

The extensive Kālacakra literature is written in a Tantric style, and is full of special Tantric terms, and allegorical expressions, the secret meaning of

which is known only to adepts. The abstruse character of the system, its deep symbolism, and the difficulty in obtaining Kālacakra texts and commentaries on them, have so far prevented scholars from penetrating the tenets of the system. This vast literature is of utmost importance for the study of Central Asian Buddhism, and Dr. Berthold Laufer rightly says: 'Better progress in the study of Central Asia would have been made if the suggestion made by me six years ago / Cf. T'oung Pao, 1907, p. 407 / had been carried out, for that literature contains the key to the understanding of many problems which now confront us in this new field' / Cf. Laufer, T'oung Pao, 1913, p. 590 /. For the proper understanding of this highly technical literature a knowledge of Tantric terminology of the Indian system of astronomy and astrology is essential. The whole question of the Kālacakra system is closely interwoven with the problem of the Realm of Çambhala, a mystical region from where the Kālacakra system has been brought to India in the second half of the Xth century A.D., and the problem of the origin of the Tibetan Sexagenary Cycle.

Besides the several Kālacakra works included in the Kāñjūr and Tāñjūr, there is said to have existed a number of commentaries and abbreviated versions of the Kālacakramūlatantra attributed to different Kings of Çambhala. These have been current in India in the first centuries of the spread of the doctrine in Central India and Tibet, and the later commentators on the Kālacakramūlatantra base their works on those commentaries, said to have originated in Çambhala. (There exists at least one text in the Kāñjūr said to have been translated into Tibetan from a manuscript from Çambhala. The text is entitled Bhagavān-Vajrapāṅiguhyābhideçatantrarāja, Cf. H. Beckh: Verzeichnis der Tibetischen Handschriften, p. 88).

The object of the present 'Studies' is to translate certain Tibetan historical texts on the Kālacakra doctrine and the Realm of Çambhala, and thus prepare the way for a translation and an exhaustive commentary of the Kālacakramūlatantra, and the other texts included in the Kāñjūr and Tāñjūr. Most of the Tibetan historical works of the čhos-'byuñ type contain chapters on the Kālacakra doctrine, giving a mass of information about its spread in India and Tibet. In the past great authorities in the Buddhist hierarchy of Tibet and Mongolia composed commentaries on the Kālacakratantrarāja, and these are of the utmost importance for the correct understanding of the doctrine. Many of those mentioned in the čhos-'byuñ or religious histories have no doubt disappeared, but a good many are still extant in Tibet. None of them are translated, and a laborious task awaits the scholar, who will venture to penetrate into this Sancta Sanctorum of Northern Buddhism.

The great Tibetan commentator and historian Bu-ston Rin-čhen-grub (1290-1364, the author of the well-known historical work the bDe-bar gçegs-

STUDIES IN THE KĀLACAKRA

pa'i bstan-pa'i gsal-byed čhos-kyi 'byuñ-gnas gsuñ-rab rin-po-čhe'i mdzod, composed in 1322; ed. of Tashi-lhunpo), is well-known as the author of a commentary on the Kālacakratantrarāja, and as a brilliant preacher of the doctrine. At the beginning of his activity as a writer, he followed in his numerous works the tradition of the Rva-lotsāba / pronounced Rā-lotsāwa; XIth century A.D. /, but later accepted the tradition left behind by 'Bro-lotsāba / XIth century A.D. /, a disciple and co-worker of Somanātha. A translation of the History of Buddhism by Bu-ston has now been published by Dr. E. Obermiller / Part I, Heidelberg-Leipzig, 1931 /.

The second great disciple of Tsoñ-kha-pa / 1357-1419 /, mKhas-grub dGe-legs dpal-bzañ / 1385-1438 / was a notable scholar and commentator of the Kālacakra doctrine, whose precepts he learned from Tsoñ-kha-pa himself. mKhas-grub is the author of a voluminous commentary on the Kālacakra or 'grel-čhen, composed in 1434 A.D., which occupies several volumes of his gSuñ-'bum or collection of works / Lhasa edition /. Most of the later works on the Kālacakra doctrine are based on the 'grel-čhen of mKhas-grub-rje. In the present article we shall translate some extracts from the 'grel-čhen dealing with the spread of the doctrine in India, and its introduction into Tibet. / vol. 𑎎 of mKhas-grub-rje's gSuñ-'bum /.

The next important source for the history of the Kālacakra doctrine, is the དེབ་ཐེར་སྟོན་པོ་, Deb-ther sñon-po or the 'Blue Annals', an historical work composed in 1478 A.D., by the 'Gos-lotsāba gŠon-nu dpal (1392-1481), contains a whole book (ཤ་, tha) dedicated to the history of the spread of the Kālacakra doctrine up to the XVth century. (There exist three editions of this important work. The old original edition was destroyed during the Nepāl-Tibetan War of 1791; a second edition was issued at the monastery of Kun-bde-gliñ in Lhasa; a third edition exists in Amdo at the Zorge-gompa near the great monastic establishment of Labrang). We shall use in these 'Studies' the edition of the Kun-bde-gliñ Monastery. A translation of the book ཤ་, tha, of the Deb-ther sñon-po will be given in the next issue of this Journal.

The རྗེ་མཆོག་འཇུག་བསྟན་པའི་བདུན་གྲུ་མཆོག་པའི་ཉིན་བྱེད་, Čhos-'byuñ bstan-pa'i padma rgyas-pa'i ñin-byed, by 'Brug Padma-dkar-po, a well-known author of the XVIth century, contains a chapter on the spread of the Kālacakra doctrine

in the Realm of Çambhala / čhos-'byuñ, ed. of Bhutan, pp. 64–70 / and another chapter on the spread of the doctrine in Tibet / *ibid.* p. 126 v,-130 / .¹

The great Tibetan scholar Tāranātha / Kun-dga' sñiñ-po; born in 1575 / author of the well-known History of Buddhism or rGya-gar čhos-'byuñ, composed in 1608 (translated by Schiefner, St. Petersburg, 1869), is equally well-known as the author of several works and 'guide-books' / khrid-yig / on the Kālacakra doctrine. We shall study his 'khrid-yig' in a future chapter of these 'Studies.'

An important source for the study of the Kālacakra, is the extensive commentary on the Kālacakra composed by the Pančhen bLo-bzañ čhos-kyi rgyal-mtšhan / 1571–1663 / . This Tashi-lama was the author of a gSuñ-'bum in four volumes, printed at Tashi-lhunpo.

Baidūrya dkar-po or 'The White Vaidūrya', composed in 1687 by the Tibetan Regent Sañs-rgyas rgya-mtšho, a treatise on chronology and astronomy, contains a brief account of the Kālacakra and a list of the Kings of Çambhala / pp. 5–10 of the Lhasa edition / .

dPag-bsam ljon-bzañ / S. C. Das' edition, Calcutta, 1908 / composed by Sum-pa mkhan-po (born in 1704).

kLoñ-rdol bla-ma Ņag-dbañ blo-bzañ (born in 1719) gives a brief account of the Realm of Çambhala and the spread of the Kālacakra doctrine in his gSuñ-'bum (there exists two editions of his 'Collection of Works' in two volumes printed in Lhasa and Peking).

Besides the large number of works and commentaries on the Kālacakra, there exists a special class of literature dedicated to the description of the road to the Realm of Çambhala. These treatises are usually known under the name of lam-yig or 'road description'. One of such lam-yig or 'road-description' is actually found in the Tānjūr and is entitled Kālapāvatāra / Tibetan: Ka-lā-par 'jug-pa / . It is the work of a certain Amoghāñkuça / Tibetan: Don-yod lčags-kyu / , and is translated into Tibétan from a manuscript of Nepāl (Cf. P. Cordier, Catalogue du Fonds Tibetain, vol. III, p. 515 / .

The best known description of the Realm of Çambhala is the Çambhala'i lam-yig, composed by the third Pan-čhen lama bLo-bzañ dPal-ldan ye-čes

¹ Alexander Csoma de Körös, J.A.S.B., vol. II, 1833, p. 57, translated a passage from the čhos-'byuñ of Padma-dkar-po. Padma-dkar-po is the author of a voluminous gSuñ-'bum, printed in Bhutan. The printing blocks have been destroyed by fire, and the edition is extremely rare.

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(1740–1780). The late Professor Albert Grünwedel has published a German translation of the text in the *Abhandlungen der Kon. Bayerischen Akad. der Wissenschaften*, vol, III, 3, München, 1915.

A Çambhala'i lam-yig is said to have been composed by the great Lama sTag-tshañ ras-chen (XVIIth century A.D.).

Dr. B. Laufer (T'oung Pao, 1907, p. 404) gives a translation of a curious passage from a Çambhala'i lam-yig, which he dates in the XIIIth century.¹

A description of the Sphere of Çambhala (Çambhala'i šiñ-bkod-pa) is found in the Tibetan Collection of the Library of the Himālayan Research Institute. It is an anonymous work, apparently composed somewhere in Western Tibet, and based on the 'grel-chen of mKhas-grub-rje and the Commentary of the Pan-chen bLama bLo-bzañ čhos-kyi rgyal-mtshan. This text will be edited in the present 'Studies'.

The above list of works on the Realm of Çambhala does not pretend to enumerate all the existing texts on the Realm of Çambhala. Several Byañ Çambhala'i lam-yig are said to exist in Khams, but they are extremely difficult to trace.

The search for the road to the Realm of Çambhala, and the spiritual communion with the King of Çambhala has always been a cherished subject among the ascetics and holy men of Tibet. For centuries legends and a vast oral tradition have accumulated round the problem hiding its true aspects.

The first mention of the Realm of Çambhala by a Western author is, I believe, made by two Jesuit fathers, Stephen Cacella and John Cabral, who during a visit to Bhutan with the purpose of finding out the route to Cathay, learned of the existence of the Realm of Çambhala, somewhere in the North, and in 1627 decided on a visit to Tibet with the object of finding out the road to Çambhala. Unfortunately their experiences are related only in two letters dated October 4th, 1627, and June 17th, 1628, respectively; the last letter is by Father John Cabral who gives a brief account of their experiences in Central Tibet.²

On arrival to Bhutan their inquiries about the route to Cathay had little success. 'But there does exist a country', remarks Stephen Cacella, 'very

¹ Laufer, *ibid.*, p. 406: the 'glos-sloñ maṇḍala (?)' of the translation should be read *blos-blañs* 'mind-created'. The expression is found in the 'grel-chen of mKhas-grub-rje, the Čhos-'byuñ of Padma dkar-po, and the Çambhala'i šiñ-bkod-pa.

² The two letters are reproduced in Appendix II and III in C. Wessels' *Early Jesuit Travellers in Central Asia, 1603–1721*, the Hague, Martinus Nijhoff, 1924, pp. 314 ff.

famous here, which is called Xembala / Çambhala / and which borders on another called Sopo / Sog-po /, but about its religion the king could give no information. I think this may be Cathay, because it is very large and its border-country Sopo is a Tartar kingdom, which answers the description of Cathay given in the maps. That the name of Cathay is unknown proves nothing, for neither China, nor Tartary, nor Tibet go by names here, China being called Guena / rGya-nag /, Tartary Sopo / Sog-po / and Tibet Potente' / Wessels, *ibid.*, p. 144 /.

Cecella decided to penetrate into Çambhala and took leave from the Dharma-rāja of Bhutan. He was able to travel only as far as the town of Gigaci / Shigatse /, and Father Cabral rejoined him there only in January of the next year. The two fathers must have noticed that Çambhala and Cathay were two different countries, for Cabral in his brief account of the kingdom of Uçangue / Ü-tsang / remarks: Xembala is in my opinion not Cathay but what in our maps is called Great Tartarea' (Wessels, *ibid.*, p. 155).

Since then Georgi in his *Alphabetum Tibetanum* (1762) reproduced some very inaccurate information about Tibetan chronology. Pallas in his remarkable *Sammlungen historischer Nachrichten über die mongolischen Völkerschaften*, St. Petersburg, 1801, gives the first accurate information about the Tibetan Sexagenary Cycle / pp. 218–227 / . The question of the Sexagenary Cycle and of the Realm of Çambhala was again taken up by Alexander Csoma de Körös in his *Grammar of the Tibetan Language*, Calcutta, 1834; by the Lazarist fathers Huc and Gabet in their *Travels in Tartary, Tibet and China* / 1844–1846 /, Routledge, London, 1928, vol. II, p. 268 ff; and by E. Schlagintweit in his *Buddhism in Tibet*, 1863. We shall deal with all the above mentioned and more recent works on the subject in a future issue of the present 'Studies'.

The story of the first preaching of the Kālacakra doctrine by Çākyamuni, the Buddha, is well-known. It has been reproduced by Csoma de Körös on p. 192 of his *Tibetan Grammar*, and need not to be repeated here. The 'grel-chen of mKhas-grub-rje gives several versions of the first preaching of the Kālacakra by the Buddha. No doubt these different versions represent different traditions current in India and Tibet. All of these traditions agree in locating the scene of the first preaching of the Kālacakra doctrine by the Buddha at the great stūpa of Çrī-Dhānyakaṭaka. The abridged commentary composed by Acalagarbha / 'grel-chen, fol. 17 / says that the doctrine originated from Çambhala, and that king Sucandra heard it at Çrī-Dhānyakaṭaka. The commentary composed by Ñi-ma-dpal ye-ces states that the Buddha preached the doctrine to an assembly desirous to receive instruction in the

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various Tantras / 'grel-chen, fol. 18 / . According to the tradition preserved in the writings of Rva-lotsāba and 'Bro-lotsāba, the Buddha preached the doctrine at Çrī-Dhānyakaṭaka in the year of his Passing Away. mKhas-grub-rje however states that this is incorrect and should not be retained. / 'grel-chen, fol. 18 / . According to mKhas-grub-rje / 'grel-chen, fol. 19 / the correct tradition is that which says that the Buddha preached the doctrine of the Wheel of Time at Çrī-Dhānyakaṭaka after His Supreme Enlightenment. Sucandra, the king of Çambhala, miraculously arrived there from Çambhala accompanied by the kings of the ninety six provinces of Çambhala and a multitude of bodhisattvas, devas and asuras. According to mKhas-grub-rje, the author of the first Kālacakramūlatantra was Sucandra / 'grel-chen, fol. 20 v / . He is said to have composed an abridged version of the Mūlatantra and a commentary of 60,000 çlokas. At the time of his death, Sucandra consecrated his son Lha'i dbaṅ-phyug as preacher of the doctrine, and since that time the doctrine has been expounded by the successive kings of Çambhala. We shall have occasion to return to the same subject while studying the different lists of kings of the Realm of Çambhala.

Such is the legendary account of the first preaching of the Kālacakra doctrine. It is as yet difficult to say whether the Kālacakra doctrine has any relation to the ancient Kālavāda system and its Iranian counterpart—the Zervanite system. The Kālavāda was at an early date absorbed by astronomical schools, and the allusions to the Kālavāda in Buddhist literature are too scant to permit the assertion that the system was wide spread in the time of Çākyamuni, the Buddha, or had any connection with primitive Buddhism. (the Aṅguttara-nikāya, ed. Morris, part II, 22, 2; 198, 8, mentions the Kālavādi in a list of different philosophical systems; the Buddhacarita, ed. Cowell, XVIII, 55, shows the Buddha pronouncing himself on the Kālavāda). Both the Kālacakra and the Kālavāda have an intimate connection with astrology and astronomy.¹ Kāla, the highest cosmic principle or the highest primordial being, and the system of time-periods of the Kālavāda, remind one of the Kālacakra doctrine with its Ādi-Buddha, the highest cosmic principle or primordial Buddha, and its system of time-periods. The whole question is intimately related to the problem of possible Manichean and other Near Eastern influences on the Kālacakra, many of whose adepts were natives of Kashmir, a region which always remained open to outside influences.

We shall now give a translation of the 'grel-chen by mKhas-grub-rje dealing with the spread of the Kālacakra doctrine in India and its introduction

¹ A very full account of the Kālavāda is found in Prof. Stcherbatsky's *La theorie de la Connaissance et la logique ches les Bouddhistes tardifs*. Paris, 1926, pp. 12 ff; Also Wesendonk, *J.R.A.S.*, 1931, pp. 52 ff.

to Tibet. According to mKhas-grub-rje there exist two main traditions: the tradition of Rva-lotsāba and that of 'Bro-lotsāba.

'grel-chen, fol. 36-39 (Lhasa edition):—

'The appearance of the commentary on the Tantra in Āryadeṣa, according to the tradition of Rva-lotsāba:—

The adepts of the Kālacakra doctrine, renowned in the science of bodhisattvas¹, lived in India in the time of the three kings: if one considers Vajrāsāna to be the centre, then in the East the king Ha-ba-la, Gajapati, the Protector of elephants; in the South King Dza'u-gaṅ-ga-pa, Narapati, the Protector of Men; in the West King Ka-na'u-ḍḍa (Kanauj), Aṣvapati, the Protector of horses.² At that time Ṭsilu paṇḍita, the great teacher, possessing profound knowledge of all the piṭakas, was born in Or-bi-sa (Orissa), one of the five countries of Eastern India. He studied all the works incorporated in the piṭakas at the Ratnagiri-vihāra, at Vikramaṣila, and Nālandā, but especially at the monastery of Ratnagiri, which was not destroyed by the Turukas / Turks / . Those who desire to attain buddhahood in one life should study the Mantrayāna, and especially the science of bodhisattvas. Ṭsilupa learned that this science was preserved in Ḃambhala, and following the instructions given to him by his tutelary deity, he made friends with some merchants trading in precious stones obtained in the Ocean. He agreed to meet these sea-going merchants after six month, in the meanwhile they proceeded along different routes. Ṭsilu paṇḍita, travelling slowly, ascended the summit of a mountain, and there met with a stranger. The man asked him: 'Where are you going?' Ṭsilupa answered: 'To Ḃambhala in search of the knowledge of bodhisattvas'. 'The road there is extremely difficult', said the stranger, 'if you are eager to learn, you can acquire this knowledge even here'. Ṭsilu paṇḍita then recognized in the stranger an incarnation of Mañjuṣrī, and prostrating himself, offered him a maṇḍala. The stranger bestowed upon him all the secret precepts of the commentaries of the Book of Power. After Ṭsilu had mastered them, the stranger placed a flower on the crown of his head, and blessing him said: 'May all the knowledge of bodhisattvas enter into you!' And all the knowledge of bodhisattvas having entered his mind, like water pouring from one vessel into another, Ṭsilu paṇḍita retraced his steps, and rejoined the merchants, and again proceeded towards Eastern India.

According to another tradition, Ṭsilu paṇḍita was the son of a yogin. Having been taken by his father to Ḃambhala, he met with a monk of an ex-

¹The science of bodhisattvas stands here for Kālacakra.

²This is evidently an allusion to the well-known theory of four great kings of the World. Cf. Pelliot, T'oung Pao, 1923, pp 97 ff, Ferrand: Les grands rois du monde in the Bull. of the School of Oriental Studies, vol. VI, 2, pp. 329 ff.

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tremely majestic appearance, an incarnation of the bodhisattva Avalokiteṣvara. The bodhisattva having blessed him, Ṭsilupa was able to memorize a thousand ḥlokas daily. He mastered all the commentaries on the Tantra. On his return to India, he obtained the religious name of Ṭsilupa. Later on he took up his residence in the country of the king Kaṭaka, and had three disciples. Having been requested by these to write down in book-form the Commentary on the Tantra, he wrote it. One of his disciples was a man of average faculties. Another called rGyal-ba'i 'byun-gnas sbas-pa obtained the siddhis. The third, born in Eastern Bengal, and known by the name of Biṭo ācārya¹ or Paṇḍitācārya, became a learned man. He obtained a profound knowledge of the science of bodhisattvas. At that time a foreign king carried war into Orissa, and all books containing the commentaries on the Tantra were buried in a pit, and Ṭsilupa fled. The war having passed, people searched for the books, and as they could not find the commentaries on the Samvara and Hevajra systems, Ṭsilupa was requested to write them down. This he declined, saying: 'The ḍākinīs having buried them, I am unable to write them down again'. After this Ṭsilupa² proceeded to Eastern India, and preached the Kālacakra doctrine to Paṇḍita ācāryadeva, born in Ba-ren-tā,³ the great adept of Kālacakra / Dus-šabs-pa čhen-pa / . Dus-šabs-pa čhen-po equalled his predecessors in learning, and had fully disciplined his mind. Some say, he had visions of the Tārā, and whatever he desired, was granted to him. Instructed by the Tārā, he proceeded to Čambhala. En route he was met by the bodhisattva Avalokiteṣvara who guided him to the 'Maṇḍala-house' / dkyil-'khor khaṅ-pa / of the Malaya grove, the 'cool grove'. Having consecrated him, the bodhisattva explained to him all the commentaries on the Tantra, and after presenting him with all the books, he let him go. On his return Dus-šabs-pa čhen-po took up his residence at Me-tog Khyem / Kusumagrha / in Eastern India, and had four excellent disciples. / This Me-tog khyem or Kusumagrha must be the Groṅ-khyer me-tog or Kusumapurī / nagara / , the capital of King Nanda and his son Mahāpadma. Cf. Sum-pa mkhan-po, ed. Das, p. 82 / . I / Dus-šabs-pa čhuṅ-ṅu; 2 / 'Dul-ba 'byuṅ-gnas blo-gros; 3 / Seṅge rgyal-mtshan / Simhadvaja / , and 4 / mTha'-yas-rnam. Dus-šabs-pa čhuṅ-ba was born in Eastern Mañjuhadeṣa, and was known by the name of Bodhipa. Some say his real name was Dharmākara, but this is incorrect. He was a disciple of Sādhuputra, and with him begins the 'later period'.

Rva-lotsāba says, that Dus-šabs-pa čhuṅ-ba preached the doctrine to

¹ The bKa'-babs bdun-ldan of Tāranātha, ed. A. Grünwedel, *Bibl. Buddhica*, XVIII, p. 109, mentions a Piṭo ācārya, who brought from Čambhala many texts on the Kālacakra.

² The bKa'-babs bdun-ldan of Tāranātha mentions a Ṭsilupa, a disciple of Praçāntamitra. Cf. ed. Grünwedel, *Bibl. Buddh.*, XVIII, p. 103.

³ Probably Ba-ren-dra / Vārendra / , name of the northern part of Bengal.

Ratnākara, who spread the doctrine in Nālandā. Former teachers have said: 'These two were friends. Dus-šabs-pa čhuñ-ñu went to Nālandā. He erected the temple of Kālacakra, and many paṇḍitas became his disciples. As this agrees with the other accounts of the lineage of the Kālacakra teachers, there is no need to bring in the name of Ratnākara'. Dus-šabs-pa čhen-po was of the opinion that if he could spread the doctrine in Magadha, it would spread everywhere. King Čin-stan-čan of Magadha was ruling at that time. Dus-šabs-pa čhuñ-ñu visited Nālandā during the abbotship of Sen-dha-ba¹ at the temple of Otantapurī. He wrote above the temple gates the rnam-bču dbañ-ldan formula, and inscribed under it the following words: 'He, that does not understand the primordial Buddha, knows not the true name of the deity. Having abandoned the path of Vajradhara, one is subject to transmigration!' ² Having written this down, about five hundred discontented paṇḍitas challenged him. Because of the profound character of the essence of the doctrine, he defeated most of them, and they became his disciples. Especially Mañjukīrti, Abhiyukta, Paṇḍita Ribe, Dā bodhisattva, Abhaya, Puṇya čhen-po / Mahāpuṇya /, Gambhīra the Kashmirian, Čāntagupta, Guṇarakṣita, Somanātha and Ťsami. All of them became very learned.

The members of the Royal family, the nobility, and followers of Brahmā, all paid homage to him. He wrote books and many entered into religion. The doctrine spread far and wide. After this the paṇḍita Samantabhadra born in Ye-rañ in Nepāl, studied with five learned men, and especially followed after Mañjukīrti.

According to the tradition of 'Bro-lotšāba:—

Dus-šabs-pa čhe-ba is said to have appeared, some say in the time of the preaching of the doctrine by Rigs-ldan dpal-skyoñ, others say in the time of Señ-ge; some say in the time of Ma dag-pa, again others say in the time of the preaching of the doctrine by Ńi-ma. Again according to others about the beginning of the 'added year' of the Byed-rtsis period of sixty years in the period of Me-mkha rgya-mtšho. The years of succession in the different accounts of the lineage of Kālacakra teachers seem to agree.

A son of a noble family, from the lineage of Yama, performed the 'rite of conception', and a son was born to him. When the boy grew up, he learned of the existence of the science of bodhisattvas in the North, and he proceeded there in search of knowledge. Rigs-ldan / Kulika, the King of the

¹ Sendhava.

² The čhos-'byuñ of Pad-ma dkar-po ascribes these words to Ťsilu-paṇḍita. Cf. čhos-'byuñ, fol. 68, of the Bhutanese edition. The account of the Pad-ma dkar-po'i čhos-'byuñ was translated by Csoma de Kőrös in J.A.S.B., vol. II (1833), p. 57.

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Realm of Çambhala / perceived by his magic power, the excellent thought of the boy, his craving for the secret knowledge, the difficulty of the four months journey to Çambhala across a waterless desert, and possible danger to his life, and appeared to him in his magic form and demanded: 'Where and for what purpose you are going?' The boy explained the purpose of his journey. 'The road there is extremely difficult', said Rigs-ldan 'if you are so eager to learn, could you not learn it here also?' The boy recognized in the stranger an incarnation of Rigs-ldan and paid homage to him. On being consecrated, he received for four months instructions in the whole of the piṭaka of the Anuttara-tantra, and especially in the three commentaries on the science of bodhisattvas. His mind became filled like a vase full of water. He then returned to India and became known as an incarnation of Mañjuçrī, and received the title of Dus-'khor šabs-pa čhen-po.

About the same time there lived in India a monk with a fully disciplined mind. He was desirous of increasing his knowledge, and prayed to the god of wishes. The god gave him advice in a dream. He made out of coral an image of Kurukullā equal to a finger's breadth, and having placed it on the mouth of a woman's corpse, he sat cross-legged behind it. He thus meditated for seven days. Then the corpse raising its head, uttered: 'What is your desire?' Instead of saying 'I desire to be able to memorize whatever I have seen', the monk said: 'I desire to be able to memorize the written characters only'. 'Be it so!', said the deity to his great satisfaction. After this exhibition of magic power, he became known as paṇḍita Naḡ-gi dbaṅ-phyug [Vāgīçvara]. Once, while in residence at the Khasarpaṇi temple, he asked the teacher Dus-'khor šabs-pa: 'What do you know in the Tantra?' The teacher answered him: 'I know this and that'. It is said, that the paṇḍita was unable to remember even the name of the Tantra! Dus-sabs čhen-po had many disciples and most of them became yogins. The follower of the doctrine, the Prince Nāleन्द्रa became also known as Dus-'khor šabs, the 2nd, and was equal in learning to the Kālacakra adepts of the past. According to some, Dus-šabs, the 2nd, and Nāleन्द्रa were father and son.

About this time, a boy of remarkable mental powers, named Somanātha was born to a Kashmiri Brahmin. At the age of 12, he acquired from his father a knowledge of heretical doctrines. His mother being buddhist, said to him: 'You should also learn my religion', and placed him with a Kashmiri paṇḍita called Šabs / the Deb-ther sñon-po, book 𑖦, tha, fol. 3 verso, states that the name of Somanātha's teacher was Šabs-bzaṅ-po or Sūryaketu. Sūryaketu had three disciples besides Somanātha /. Somanātha was very pleasing in appearance, and the daughter of the paṇḍita once said to him: 'Let us study

religion together!' Having agreed to this, they received many religious instructions. A disciple of Dus-šabs-pa čhen-po, 'Dul-ba'i blo-gros / Vinayamati/, once brought to the Brahmin Sūryaketu the book called dBañ-mdor bstan-pa / Çekoddeça; this treatise was translated by Somanātha and Çes-rab grags-pa of 'Bro / 'Bro-lotsāba / into Tibetan and is included in the Känjür. Cf. Beckh, *ibid.* p. 72 / , and the commentary on the dBañ-gi rab-byed / Çekaprakriyā/ translated by Samantaçrī and the lotsāba Čhos-rab. Cf. Beckh, *ibid.* p. 73 / .

Sūryaketu showed them to Somanātha, and he having read them, rejoiced greatly. After this, Somanātha journeyed to Magadha, and met with the two Dus-šabs-pas, from whom he learned the various commentaries on the science of bodhisattvas. During his stay there, he had a debate with the paṇḍita Rin-čhen rdo-rje / Ratnavajra / , and defeated him. Ratnavajra said to Somanātha : 'My disciples won't believe me now, you had better go to another place'. Somanātha agreed to this, and decided to proceed to Tibet to spread the doctrine.

Somanātha seems to have been the first preacher of the Kālacakra doctrine in Tibet, and is said to have been the introducer of the Sexagenary Cycle / 1027 A.D., / ¹ Assisted by Çes-rab grags-pa, better known as 'Bro-lotsāba, he translated several important treatises into Tibetan, and the different Tibetan authors give accounts of his stay and activity in the 'Land of Snows'. Atiça, who is usually credited with the introduction of the Kālacakra doctrine into Tibet,² arrived there some fifteen years later / about 1042 A.D., and died at sÑe-thañ in 1054 A.D. / , and his biographies contain no information about his preaching of the Kālacakra doctrine.³

¹The Candranātha mentioned by S. C. Das in his translation of Sum-pa mkhan-po's Re'u-mig, J.A.S.B., 1889, p. 40, foot-note, should be corrected to Somanātha / Zla-mgon / . In his Introduction to the Tibetan Grammar, p. XV, Das states, that 'the beginning of the first cycle from the year 1026 A.D. / read 1027 A.D. / when it was introduced in Tibet by one Chilu Pandita'. S. C. Das does not state the source of this information.

²Grünwedel, *Mythologie du Bouddhisme*, p. 60.

³Atiça is said to have written a work on Buddhist chronology in 1051 A.D. Cf. Das, J.A.S.B., 1889, p. 41.



RIGGS-LDAN GRAGS-PA, KING OF ÇAMBHALA.
/ COLLECTION OF 'URUSVATI' HIMĀLAYAN RESEARCH INSTITUTE OF
ROERICH MUSEUM / .

THE CEREMONY OF BREAKING THE STONE.

/ PHO-BAR RDO-GČOG /.

By GEORGES DE ROERICH.

AMONG the many popular plays of a religious character in Tibet, there exists one that enjoys special veneration, and whose performers are considered to possess supernatural powers that enable them to carry out the play. Such a ceremony is the 'breaking of stone' known under the Tibetan name of ཕོ་བར་རྫོག་ཚོག་, pho-bar rdo-gčog / pronounced p'o-war do-čok /.

Nowadays it is only seldom performed, and the ancient art of rdo-gčog or stone-breaking is rapidly vanishing. The purpose of the ceremony is to destroy an evil spirit which takes its abode in a stone. The ceremony of 'breaking the stone' is said to have been first performed by the great mahāsiddha Thañ-stoñ rgyal-po, a Tibetan wizard of the XIV-XVth centuries / born in 1385 /, and the famous builder of the Čhu-bo ri bridge on the Yaru tšang-po, some 32 miles South-West of Lhasa. During my stay in Lahul, North-West Himālayas, I was fortunate to witness twice this ceremony performed by a troupe of travelling lama-actors from Spiti. After the ceremony, the chief lama-actor or lo-čhen / lo-tšā-ba čhen-po /, who is usually the preceptor and trainer of the rest of the troupe, was good enough to recite the songs accompanying the ceremony, and to give me a brief historical outline on the origin of the ceremony. The Tibetan text of the story as told by the lama māñi-pa / actor / has been revised by Lama Lobzang Mingyur Dorje, and is here given in the original and in translation.

ཕོ་བར་རྫོག་ཚོག་གི་ལོ་རྒྱུས།

༡༡། །ཅུང་རི་བོ་ཆེའི་དགོན་པ་ལ། བ་གྲུབ་ཆེན་མང་སྟོང་རྒྱལ་པོས་དགོན་པ་བརྩིག་
པའི་དུས་སུ་ས་དབྱེ་ལངས་ནས། ཉིན་མོ་མིས་བརྩེར་ན་མཚན་མོ་འདྲིས་བཤེགས་པས།
རྫོང་དང་པོ་དེ་ཅུ་བཅགས་ཏེ་དགོན་པ་ཆགས་པ་ཡིན་ནོ། །ལྷགས་ཟམ་ཆུ་བོ་རི་བརྩིག་པའི་
སྐབས་སུ་འདྲེ་དབང་རྒྱལ་གྱིས་ཆུ་གཤེན་དོལ་གྱི་ཟམ་པ་ཚུགས་སུ་ས་བཅུག་པར་རྫོག་ཉིས་པ་དེ་
ཅུ་བཅགས་ཏེ་ཟམ་པ་ཆགས་པ་ཡིན་ནོ། །ལྷ་སར་བདུད་ཉ་ལ་དྲ་བརྒྱད་དང་གཟེར་བདུད་

ཀྱིས་ཀྱིན་བྱས་ཏེ། ལྷ་མོ་དང་ལྷ་མོ་ལ་སོགས་པ་ནད་རིགས་མི་འདྲ་བ་མང་པོ་བྱུང་ནས་
 ལྷ་མོ་ལྷ་མོ་ཀྱིས་སྐྱབས་བཏང་། དཔོན་པོ་ (སྐྱབས་པ་) ལྷ་མོ་ཀྱིས་དཔོན་བཅོས་བྱས་ཀྱང་
 མ་མཁུ། ལ་ལ་ནི་རི་ལ་ཤིང་འབྲུ་འཕྲོ་ལ་འཚི། ལ་ལ་ནི་ཟས་ཟ་འཕྲོ་ལ་འཚི། ལ་ལ་ནི་གོས་
 ཀྱིན་འཕྲོ་ལ་འཚི། ལ་ལ་ནི་གད་མོ་བཟད་འཕྲོ་ལ་འཚི་འགྲོ་ཡིན་འདུག་པས། ལྷ་མོ་
 རྗེ་རིན་པོ་ཆེའི་དགོངས་པ་ལ་ལྷ་མོ་མའི་མི་པལ་ཆེར་སྤོང་འགྲོ་ཡིན་འདུག་པས། ད་ནད་དེ་དག་
 ལྷ་མོ་འདུལ་སྐབས་དེ་ཅུང་རི་པོ་ཆེའི་དགོན་པ་ན་པ་གྲུབ་ཐོབ་ཐང་སྤོང་རྒྱལ་པོ་ཁོང་ལ་མིན་པ་
 བཞུགས་ལ་མིན་འདུག་པས། ཅུང་རི་པོ་ཆེའི་དགོན་པར་རྗེ་རིན་པོ་ཆེས་བང་ཆེན་པ་བཏང་ནས།
 དེའི་ལྷ་མོ་མའི་མི་པལ་ཆེར་སྤོང་འགྲོ་གི་འདུག་པས། དེའི་འདུལ་སྐབས་ཁྱོད་ལ་མིན་པ་བཞུགས་
 ལ་མིན་འདུག་པས། ད་ལྷ་མོ་མའི་མི་པལ་ཆེར་སྤོང་འགྲོ་གི་འདུག་ཏེ། དེ་ནས་པ་གྲུབ་ཐོབ་ཐང་སྤོང་རྒྱལ་པོ་འི་བྱམས་
 ཀྱི་དགོངས་པ་ལ། རྗེ་རིན་པོ་ཆེའི་བཀའ་ཡིན་པས་ང་འགྲོ་དགོས་བྱམས་ལ་དགོངས་ནས་ནས་
 མཁའ་ལ་སྤྱིགས་མཚུངས་མཚན་ནས་བཞུགས་པས། ལྷ་མོ་མའི་དགོངས་པ་ལྷ་མོ་མའི་མི་པལ་ཆེར་
 ལྷ་མོ་ལྷ་མོ་འཕྲུང་འགྲོ་གིན་འདུག་པས། པ་གྲུབ་ཆེན་ཐང་སྤོང་རྒྱལ་པོ་ནི་ལྷ་མོ་ཀྱི་ཨ་ཙ་ཙ་
 བཅོམ་དུ་སྐྱུལ་ནས་ལྷ་མོ་མའི་དགོངས་པ་ལྷ་མོ་མའི་མི་པལ་ཆེར་སྤོང་འགྲོ་གི་འདུག་པས། རྗེ་རིན་པོ་ཆེ་ལ་སྐྱོད་
 བ་བཏུན་ཡོད་པར་ “ ཁྱོད་ ལྷ་མོ་ཀྱིས་སང་ཉིན་ དེའི་མགོན་པོ་ཁག་ཆེན་ བཅོམ་ཡོང་གིན་ཡོད་
 པར་ཁྱོད་ ལྷ་མོ་ཀྱིས་སྐྱོད་པ་གཞག་པར་ཡང་གཏོང་ཅིག ” ཅེས་བཀའ་སྤྲོད་པོ། རྗེ་ནས་པ་གྲུབ་
 ཐོབ་ཐང་སྤོང་རྒྱལ་པོ་དེར་ཕེབས་པ་སྐྱོད་པ་ ལྷ་མོ་ཀྱིས་ ཏ་མ་གོ་བར་ཅུང་ཟད་བཀག་བཞག་
 འདུག་ཀྱང་རྗེ་རིན་པོ་ཆེའི་བྱམས་ཀྱིས་མཁྱེན་ནས་སྐྱོད་པ་ ལྷ་མོ་ལ་བཀའ་སྐྱུལ་པ། དེའི་
 མགོན་པོ་ད་ཅུང་ཡང་མ་བསྐྱེད་པས་བསྐྱེད་པས། སྐྱོད་པ་ ལྷ་མོ་ཀྱིས་ མགོན་པོ་བཞུགས་
 བེ་མིན་འདུག ། ལྷ་མོ་མའི་དགོངས་པ་ལྷ་མོ་མའི་མི་པལ་ཆེར་སྤོང་འགྲོ་གི་འདུག་པ་དེ་ཡིན་
 ལས་ལྷ་མོ་མའི་མི་པལ་ཆེར་སྤོང་འགྲོ་གི་འདུག་པས། རྗེ་རིན་པོ་ཆེའི་ཞལ་ནས། ད་ཅུང་རི་གཏོང་བ་བསྐྱེད་པས་ལྷ་མོ་ལྷ་མོ་
 དལ་གྱི་དགོན་པ་གྲུབ་ཐོབ་ཐང་སྤོང་འགྲོ་གི་འདུག་པས། སྐྱོད་པ་ ལྷ་མོ་ཀྱིས་སྐྱོད་པས་རྗེ་རིན་པོ་ཆེའི་དུང་

དུ་མེབས་པ་དང་། རྗེ་རིན་པོ་ཆེས་བཀའ་སྤྱུལ་པ། ད་ངའི་ལྷ་སའི་མི་པལ་ཆེར་སྟོང་འགྲོ་གི་
 འདུག་པས། དེ་ལ་ཁྱོད་ཀྱིས་མིན་པ་གཞན་གྱིས་འདུལ་སྐབས་མིན་འདུག་གསུངས། ས་
 བྱུང་ཕྱོད་ཐང་སྟོང་རྒྱལ་པོས་རྗེ་རིན་པོ་ཆེ་ལ་ཞུས་པ། ད་སང་གི་ནད་བདག་དེ་གང་ན་ཡོད་
 ཞུས་པས། རྗེ་རིན་པོ་ཆེ་འེམས། ད་སང་ངའི་སྐོར་ལྷོ་ལྷོ་མ་ཐེམ་གྱི་འོག་ན་པོ་བ་བཞེན་དུ་གསོལ་གྱིན་
 ཡོད་གསུངས་པས། དེ་ནས་བྱུང་ཕྱོད་ཐང་སྟོང་རྒྱལ་པོས་ནད་བདག་དེ་དོ་སྐྱེག་པོ་པོ་ཁར་
 གང་ལ་བསྐྱེམས་ནས་ལྷ་སའི་ཁྲོམ་དུ་གདན་དྲངས་ནས་བྱུང་ཕྱོད་ཀྱི་ཕྱག་མཚུབ་ལྷ་ལས་མེ་
 ལྷ་ཏུ་སྐྱེལ་ནས་གཅིག་སྐྱེན་ངས་གཅིག་གསུངས་ཀྱི་སྐྱེད་སྐྱེལ་ནས་བྱ་ཆེན་མཚན་ད། གཅིག་ཕྱག་དོར་
 སྐྱེལ་ནས་དཔོན་པོ་མཚན་ད། གཅིག་དབྱངས་འཕྲེན་པའི་ཕྱིར་ལྷ་མོར་སྐྱེལ་ནས་དོ་དེ་དྲངས་རང་
 གདན་དྲངས་ནས་ལྷ་སའི་མི་གན་ཕྱིར་ལྷ་མོར་འོངས་ནས་དེ་རིང་བྱུང་ཕྱོད་སྐྱོན་པའི་སྐྱོན་
 ཆས་བསྟན་འདུག་ཟེར་ནས་མི་གན་པོ་ཕྱིར་བེར་ཀ་ལ་བཞེན་ནས་ལྷ་མོ་ལ་ཚོད་འདུག་པའི་
 མདུན་དུ། དོ་དེ་ཆེ་ཡང་མི་ཆེ་པོ་སྐོར་ཅམ་ལ་ཡང་དོ་ཡང་དོ་རྗེ་སྐྱེད་པ་ལ་བྱས་ནས་བཅགས་
 མོང་། ད་ལྷ་བསྐལ་པ་སྐྱེད་དུ་སོང་བ་དང་འདྲི་མིན་གདུག་པ་ཅན་ནམས་ཁམས་གཞོན་པ་
 ལ་དོ་འདི་ཡང་ཆེ་བ་ཅམ་གྱིས་བཅགས་དགོས། ཡང་དོ་ཡང་དོ་ལ་བྱས་ནས་བཅག་གསུངས།
 དོ་འདི་གཅིག་པ་ལ་ (ཐང་དང་པོར) ཆག་ན་ཚོས་སྐྱེ། གཉིས་པ་ལ་ཆག་ན་ལོངས་སྐྱེ། གསུམ་
 པ་ལ་ཆག་ན་སྐྱེལ་སྐྱེ། བཞི་པ་ལ་ཆག་ན་རྒྱལ་ཆེན་སྡེ་བཞི། ལྷ་པ་ལ་ཆག་ན་རྒྱལ་བ་རིགས་
 ལ། དུག་པ་ལ་ཆག་ན་ཕྱབ་པ་རིད་དུག། བདུན་པ་ལ་ཆག་ན་སངས་རྒྱས་ཚན་བདུན།
 བརྒྱན་པ་ལ་ཆག་ན་བདེ་གཤེགས་བརྒྱན། དབྱུ་པ་ལ་ཆག་ན་ཐེག་པ་རིས་པ་དབྱུ། བཅུ་པ་ལ་
 ཆག་ན་སྟོན་པའི་མཚན་པ་བཅུ། བཅུ་གཅིག་པ་ལ་ཆག་ན་འཕགས་པ་བཅུ་གཅིག་ཞེས། བཅུ་
 གཉིས་པ་ལ་ཆག་ན་སའི་ལྷ་མོ་བསྟན་མ་བཅུ་གཉིས། བཅུ་གསུམ་པ་ལ་ཆག་ན་དོ་རྗེ་འཕྲིན་
 པའི་ས་ཡིན། མ་ཆག་པ་མི་ཡོང་ངོ་། །མ་ཆག་པ་བྱང་ན་རྒྱབ་ཡང་མི་ཏུང་ངོ་། །དེ་ལྷ་ས་
 ངན་ཡིན་པས་དགོན་ཆེན་གྱི་མ་ཐེམ་ལ་བཅགས་ནས་ལྷ་ས་ཆེན་པོས་མཚན་དགོས། ཡང་ན་

མཁའ་ཆེན་པོ་འི་ས་ཤེས་ལ་བརྟུགས་ནས་རྒྱལ་པོ་ཆེན་པོས་མནན་དགོས། མཁའ་དང་དགོན་
 བ་མིད་སར་མ་ཆག་བ་བྱང་ན་རྒྱ་ལམ་གྱི་གསུམ་མདོར་བྱིར་ནས་མགར་བ་བརྒྱས་ཐོ་རུབ་དང་
 ཡང་ན་བྱིས་བ་བརྒྱས་ཏུར་རུབ་དང་། འབྲོག་མཐོང་བརྒྱད་ཀྱིས་ཉ་དམར་རྒྱབ་ནས་བཙག་
 དགོས་བ་ཡིན་ནོ།།

Translation :—

‘At the time when Pha-grub-chen Thaṅ-stoṅ rgyal-po (Pha-grub-chen is an honorary title given to a great seer; the word “pha” is used here in the sense of our “father, elder, reverend”) was erecting the monastery of Čuṅ Ri-bo-če, evil omens made their appearance. Whatever was built by men during the day, was destroyed by demons during the night. After performing the ceremony of breaking the stone for the first time, they were able to resume work on the monastery. At the time of building the iron bridge of Čhu-bo-ri, the demon dBaṅ-rgyal caused the water to rise, and thus hindered the construction of the bridge. After performing the ceremony of breaking the stone there for the second time, the iron bridge was built.

In Lhasa the demon Hala rta-brgyad and a “planetary demon” / gza’-bdud often stands for Rāhula / caused a great many diseases, especially the disease of the bowels and pains in the intestines. Doctors administered their medicines, magicians their charms, but these were of no avail. Some died while collecting wood in the mountains, others while partaking of food. Some died while dressing, others while enjoying themselves. The Precious Lord of Lhasa / rġe-rin-po-če Tsoṅ-kha-pa, 1357–1419 / pondered over the matter, and said: “The people of Lhasa are mostly dying out! If the great mahāsiddha Thaṅ-stoṅ rgyal-po of the Čuṅ Ri-bo-če Monastery possesses no means to control the disease, no one else can do anything.” The Precious Lord despatched messengers to the Čuṅ Ri-bo-če Monastery with the message: “My people of Lhasa are mostly dying out! You are the only one who can subdue this disease, others can do nothing. Come at once!”

The great mahāsiddha Thaṅ-stoṅ rgyal-po after reflecting on the matters said: “This being a command of the Precious Lord, I must go!” Pointing his fore-finger to heaven, he perceived a mighty white-tailed eagle flying high in the sky. The great mahāsiddha Thaṅ-stoṅ rgyal-po having assumed the form of an “iron Atsara” / none was able to explain to me the meaning of the word lčags “iron” in this sentence. It may mean “iron-coloured”, or according to others it may mean “well-protected”, that is, Thaṅ-stoṅ rgyal-po going to fight the spirit of the epidemic, assumed a well-protected magic form / mounted the mighty white-tailed eagle, and proceeded to Lhasa.

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The Precious Lord ordered to his seven door-keepers: "I am expecting to-morrow an important guest to arrive. Let him come upstairs without hindrance!"

The great mahāsiddha Thaṅ-stoṅ rgyal-po having arrived, the door-keepers did not recognize him, and detained him for a while. The Precious Lord perceived this in his mind, and said to the door-keepers: "My guest did not arrive as yet?" The door-keepers replied: "There is no other guest, except one Aṭsara who came riding on a mighty white-tailed eagle. Is this the one?" The Precious Lord exclaimed: "Why did you not let him in at once?", and having pulled out a sword from beneath his leg, he was ready to strike the door-keepers. The door-keepers opened the gate and led the guest into the presence of the Precious Lord. The Precious Lord said: "Nowadays my people of Lhasa are mostly dying out! If you are unable to help in this, no one else can do anything."

The mahāsiddha Thaṅ-stoṅ rgyal-po then requested the Precious Lord: "Where resides the spirit of the present epidemic?" To this the Precious Lord answered: "At present he is found under the threshold of my door, and has the shape of a stomach." Then the mahāsiddha Thaṅ-stoṅ rgyal-po having caused the spirit of the epidemic to enter inside this brownish stone, which had the shape of a stomach, invited the stone to the market place of Lhasa. From the five fingers of the mahāsiddha five flames sprang up. One assumed the form of Avalokiteṣvara, and acted as preacher of the Doctrine; another assumed the form of Vajrapāṇi, and acted as his assistant; a third one assumed the form of a goddess possessing a melodious voice.

Having placed the stone in a yard, all the elderly people of Lhasa gathered to see the ceremony, saying: "To-day a mad mahāsiddha will perform some crazy things!" And there in the presence of the assembled elderly people of Lhasa, who came to the ceremony riding on sticks, he / Thaṅ-stoṅ rgyal-po / broke this stone, which was just the size of a stomach, with another stone similar to a magic dagger.

In the present evil kalpa, one has to use a bigger stone to break it, for the purpose of subduing demons, ogresses and evil spirits. If one breaks the stone with the first stroke it signifies dharmakāya. If one breaks the stone with the second stroke it signifies saṃbhogakāya. If one breaks it with the third stroke it signifies nirmāṇakāya. If one breaks it with the fourth stroke it signifies the Lords of the Four Quarters. If one breaks it with the fifth stroke it signifies the five dhyāni-buddhas. If one breaks it with the sixth stroke it signifies the manifestation of Buddha in the six state of existence. If one breaks it with the seventh stroke it signifies the seven groups of Buddhas.

If one breaks it with the eighth stroke it signifies the eight Sugatas. If one breaks the stone with the ninth stroke it signifies the nine stages of the Vehicle / Doctrine /. If one breaks it with the tenth stroke it signifies the ten forms of the Teacher. If one breaks it with the eleventh stroke it signifies the eleven headed Avalokiteçvara. If one breaks the stone with the twelfth stroke it signifies the twelve manifestations of the Earth-goddess. If one breaks it with the thirteenth stroke it signifies the sphere of Vajradhara. If one is unable to break the stone, one should not proceed with the ceremony, this being an evil omen. If the stone is found under the threshold of a monastery, a great lama should subdue it; again if it is found under the threshold of a castle, a great king should subdue it. If one is unable to break it in a region where there are no castles or monasteries, one should place it at the meeting place of three highways, and there it should be broken either by a hundred blacksmiths' striking it with their hammers, or by a hundred boys' attacking it with loud cries, or by eight strong young men smashing it'.

Such is the story of the origin of this ceremony. It will be noticed from the above story that each stroke with which the stone is broken corresponds to a divine manifestation. At the beginning of the ceremony the lama-actors or lama-māṇi-pas arrange a travelling altar or mēhod-bçams with the image of Thaṅ-stoṅ rgyal-po placed on it. Thaṅ-stoṅ rgyal-po is usually represented as an old man, sitting naked and cross-legged, his white hair arranged in a kind of knot on the crown of his head. In his hands, which are placed on his lap, the sage holds the tshe-bum or amṛta vase. Behind the image of Thaṅ-stoṅ rgyal-po two painted images or thaṅ-sku are placed: one representing the four-armed manifestation of the Bodhisattva Avalokiteçvara, and the other representing the life-story or rnam-thar of Dri-med kun-ldan. The head lama-actor or lo-chen wears the usual monastic attire. On his head he wears the five-coloured hat of an actor / Tibetan: phod-ka / adorned with multicoloured ribbons. During the initial prayer before the ceremony, the lo-chen or chief lama-actor holds in his left hand the rosary / 'phreṅ-ba /, and in his right hand the prayer wheel / māṇi 'khor-lo /.

He opens the ceremony by blowing the conch and reciting the following prayer:—

གསུང་དང་ལྷ་མ་རྣམས་ལ་ཕྱག་འཚལ་ལོ།།

ཇི་འགྲོ་བ་མགོན་པོ་འཇིགས་ལ་འདུད།།

ལྷ་མ་མི་འགྲུང་ཚོས་ཀྱི་ངང་ལ་བཞུགས།།

སྐྱོན་རས་གཟིགས་ཀྱང་ཚོས་ཀྱི་ངང་ལ་བཞུང།།

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ལྷན་ཆེན་པོ་ཚོས་ཀྱི་ངང་ལ་བཞུགས། །

གང་སྟོང་གྲུལ་པོ་ཚོས་ཀྱི་ངང་ལ་བཞུགས། །

ལོ་ཆེན་གོང་མ་ཚོས་ཀྱི་ངང་ལ་བཞུགས། །

གྲུ་སྒྲིམ་བ་ཡིག་དྲུག་མ་ཁི་དྲོངས། །

ཨོཾ་མ་ཁི་བ་དྲེ་ཏྲེ།

Translation :—

Let us salute the Teachers!

Bow to the feet of the Venerable Lord of Living Beings!

Abide in the spiritual essence of the Eternal Teacher!

Abide in the spiritual essence of Avalokiteçvara!

Abide in the spiritual essence of the All-Merciful One!

Abide in the spiritual essence of Thañ-stoñ rgyal-po!

Abide in the spiritual essence of the sublime Paṇḍita!

You, country-folk, recite the six-lettered māṇi!

Om māṇi padme hūñ!

A large stone, which is obtained from the neighbourhood by the lo-chen and his assistants, is placed in front of the travelling altar. Frequently these stones are extremely heavy and can hardly be lifted by one man. After placing the stone in front of the altar, one of the lama-actors draws on its surface a human figure, representing the nad-bdag or spirit of the epidemic who is to be destroyed through the ceremony. The initial prayer and burning of incenses over the stone is followed by a dance. The head lama-dancer leads the dance, and rhythmically strikes the cymbals. Two of his assistants follow him in a frantic dance. With each ringing sound of the cymbals the dance doubles its pace, and at the end of the dance the performers whirl past the onlookers, their dancing skirts tracing large circles in the air.

When the dance is over, the performers rest, while the lo-chen turns his prayer-wheel in a silent prayer. The silence is interrupted by shrill sounds similar to those used by Tibetan herdsmen in driving yaks. There appears one of the performers attired as a shepherd in a grey homespun coat, and wearing a black sheep-skin cap. His face is smeared with tsam-pa or parched barley flour. He is holding a sling / Tibetan 'ur-rdo / and a bag with tsam-pa. He makes the round of the place on which the ceremony is held, and jeers at the crowd of onlookers, swinging his sling. During this part of the dance the lo-chen or head lama-actor represents the dharmarāja Nor-bzañ, the destroyer of evil ones / the dharmarāja Nor-bzañ and Thañ-stoñ rgyal-po are both considered

to be destroyers of evil forces; there seems to be no inner connection between the Čhos-rgyal Nor-bzañ-gi rnam-thar, and the ceremony of 'breaking the stone' /. The lo-čhen representing the king Nor-bzañ questions the shepherd, and notwithstanding the latter's evasive answers, discovers in the shepherd the Wild King of the North / byañ mi-rgod rgyal-po /, his deadly enemy. 'Who are you, and what is the purpose of your coming here?'—is the question put by the king Nor-bzañ to the shepherd, who sits down before the altar and plays with a tsam-pa ball. King Nor-bzañ then challenges the disguised Wild King of the North. A fight takes place during which the Wild King of the North rolls several times on the floor. Mortally wounded by king Nor-bzañ, the Wild King of the North sings the following song:—

- (१) བཀའ་ཐོས་པ་མཚོག་གི་རྣམས་གསུམ་ཡོད །
 རྒྱལ་དབང་ཐོད་མཁུན་པ་དང་གཅིག །
 པཎ་ཚེན་ཐོད་མཁུན་པ་དང་གཉིས །
 ཉུ་སེར་དབྱེ་ལ་བརྣམས་པའི་ལྷ་མ་དང་གསུམ །
 བཀའ་མཐོ་བ་རྣམ་གསུམ་དེ་ལ་ཉུ །
- (२) ལྷ་བདེ་བ་མཚོག་སེ་རྣམ་གསུམ་ཡོད །
 མ་ཞིང་ལོ་དོག་ལེགས་པ་དང་གཅིག །
 རྒྱལ་བང་འབྱུ་ཡིས་ཁེངས་པ་དང་གཉིས །
 རྒྱལ་བོའི་མཁའ་མའི་སྤང་ལ་བྱ་མོར་འཛོམས་པ་དང་གསུམ །
 ལྷ་བདེ་བ་མཚོག་སེ་རྣམ་གསུམ་དེ་ལ་ཉུ །
- (३) ལྷ་སྦྱིད་པ་མཚོག་སེ་རྣམ་གསུམ་ཡོད །
 རྒྱ་དར་ཅེ་མདོ་ནས་རྒྱ་རྩ་ཐོན །
 ཁམས་ཕྱོད་སེ་ཕྱོགས་ནས་འབྲི་མར་ཐོན །
 དགོན་རྣམས་ལྷང་གཉིས་ལ་མང་རྩ་སྤུལ །
 རྒྱ་རྩ་འབྱུང་བའི་སི་ཕོ་དེ །
 རྒྱ་ཡི་བསྐྱལ་བཟང་རྒྱ་མཚོ་མིན་ལགས་སམ །

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(ཡ) ངའི་ཉིན་མོ་འཁྲུང་བའི་བོ་རྗེར་འདི།

ཉིན་མོ་འགོ་དུས་གྲུབ་ལ་འཁྲུང།

མཚན་མོ་ཉལ་དུས་ངས་སུ་བཅུག།

I.

There are three manifestations of the most excellent Doctrine :
The first is the All-knowing Lord,¹
The second is the All-knowing Paṇḍita,²
The third is the Teacher wearing the yellow hat.³
I say, these are the three manifestations of the lofty Doctrine!

II.

There are three forms of happy songs :
The first is the good harvest in the field.
The second is the well-filled royal granary.
The third is a son and wealth on the lap of a wealthy bride.
I say, these are the three forms of happy songs!

III.

There are three forms of pleasant songs :
From Tatsienlu comes China tea,
From Khams comes yak butter,
To the two monasteries of sTag-luñ we offer tea!
This man drinking China tea,
Is he not bsKal-bzañ rgya-mtsho of rGya ?⁴

IV.

This bag contains my daily food,
While walking at day, I carry it on my back.
While sleeping at night, I place it as a cushion.

This brings the second part of the ceremony to an end. While one of the lama-actors recites the māṇi-prayer over the stone, the lo čhen prepares himself for the sword-dance. The upper part of his body is stripped naked, and a light shawl is fixed to his naked shoulders with two long pins. A large pin is introduced through his left cheek. These gruesome preparations take a

¹ The Dalai Lama.

² The Tashi Lama.

³ Tsoñ-kha-pa.

⁴ The VIIth Dalai Lama | 1719-1757 | .

considerable time, and cause great excitement among the crowd of onlookers. Then the lo-chen takes two swords and begins a slow dance, with each step swinging the swords in front of himself. Several times during the dance, he points the two swords towards his belly, and jumps on them resting his body on the swords' points. Then pointing the swords towards his armpits he makes several similar jumps resting his body on the sword-points. A tense moment during which the onlookers draw nearer to the dancing man; one false step on his part and the sharp points of the two swords would pierce his body, causing fatal injury. The sword-dance is accompanied by the following song which is here given in the Tibetan text and translation:—

སྤྱི་གཙུག་ཡོད་དོ་ཉི་ཟླའི་གདན་མྱེང་ན།།
 བཀྲིན་བཞུང་ཡོད་མཚན་ལྷན་སྐྱ་མ་མཁྱེན།།
 བོད་པ་ཡོད་དོ་དུང་ཁང་ཞལ་ཡས་སུ།།
 བྲག་འབྲུང་ལྔ་བཅུའི་ལྷ་ཚོགས་ལ་གསོལ་བ་འདེབས།།
 མགྲིན་པ་ཡོད་དོ་ངག་གི་འབྲུབས་དབྱེང་སུ།།
 བསྐྱེང་མཚོག་ཡི་གོ་དུག་མ་ལ་གསོལ་བ་འདེབས།།
 སྤྱིང་ག་ཡོད་དོ་ཚེས་ཀྱི་འཁོར་ལོ་རུ།།
 ཡི་དམ་གྱུར་ཇི་ཆེན་པོ་ལ་གསོལ་བ་འདེབས།།
 ལྷེ་བ་ཡོད་དོ་བདེ་ཆེན་འཁོར་ལོ་རུ།།
 མ་གཅིག་མཁའ་གོ་སྤེལ་ལ་གསོལ་བ་འདེབས།།
 བསྐྱེང་གནས་ཡོད་དོ་ལོངས་སྤྱོད་གཟུང་སྐྱུ་རུ།།
 དོ་ཇི་གཞོན་ཀུའི་ལྷ་ཚོར་ལ་གསོལ་བ་འདེབས།།
 རང་ལུས་ཡོད་དོ་འདོམ་གང་གུ་བཞི་ལ།།
 ཞི་བོ་དམ་པའི་ལྷ་ཚོགས་ལ་གསོལ་བ་འདེབས།།
 བཀའ་ཚོགས་ཡོད་དོ་ཉི་ཤུ་ཅ་བརྒྱད་ལ།།
 དབང་ཕུག་ཉེར་བརྒྱད་ལྷ་ཚོགས་ལ་གསོལ་བ་འདེབས།།

THE CEREMONY OF BREAKING THE STONE

བཀའ་ལུང་ཡོད་དོ་བཀའ་ལུང་ཡོད། །
 མཚན་ལྡན་གླ་མས་གསུངས་པའི་བཀའ་ལུང་ཡོད། །
 བྱ་ཁྱོད་མདའ་ཅིང་གི་ཅིང་གཏོང་ཤོག་གསུངས་པའི་བཀའ་ལུང་ཡོད། །
 བཀའ་ལུང་ཡོད་དོ་བཀའ་ལུང་ཡོད། །
 ལྷོབ་པ་མ་གཉིས་ཀྱི་བཀའ་ལུང་ཡོད། །
 བྱ་ཁྱོད་མདའ་ཅིང་མདུང་ཅིང་མ་གཏོང་གསུངས་པའི་བཀའ་ལུང་ཡོད། །
 ལྷོབ་པ་མའི་བཀའ་ལུང་རྒྱབ་དུ་བསྐྱུང། །
 མཚན་ལྡན་གླ་མའི་བཀའ་ལུང་དང་དུ་གླངས། །
 བྱ་ང་མདའ་ཅིང་གི་ཅིང་བདང་རྒྱ་ཡིན། །
 རྒྱ་སྤེ་ཁྲིམ་པ་ཡིག་དུག་མ་ཁི་དྲོངས། །
 ཨོཾ་མ་ཁི་བ་རྗེ་ཏུ།

Translation :—

‘On the throne of the sun and moon, which is the crown of our head,
 O Merciful and Virtuous Teacher, Thou knowest all!
 In the incomparable conch-house, which is our skull,
 We pray to the divine assembly of the fifty khrag-’thuñ!
 In the melodious speech produced by our throat,
 We pray to the most excellent six-lettered prayer!
 In the Wheel of Law, which is our chest,
 We pray to the Protecting Deity, the Great Merciful One!
 In the Wheel of Felicity, which is our navel,
 We pray to the five kinds of ḍākinīs!
 In the Saṃbhogakāya, which is the hidden organ of our body,
 We pray to the divine assembly of the rDo-rje gšon-nu!
 In the fathom square, which is our body,
 We pray to the divine assembly of the Holy Peaceful and Wrathful
 Ones!
 In the twenty-eight joints which form our spine,
 We pray to the divine assembly of the twenty-eight Lords!
 There are precepts and precepts!

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The Virtuous Teacher gave us the precept:
“Son, practise archery and lance drill!”
There are precepts and precepts!
Our father and mother gave us the precept:
“Son, do not practise archery and lance drill!”
We disobeyed the parents’ order,
We carried out the Virtuous Teacher’s order!
I shall practise archery and sword drill!
You, country-folk, recite the six-lettered māṅi!
Om māṅi padme hūṅ!’

It will be observed from the above that each part of the human body is mentioned as corresponding to the seat of a divine manifestation. On finishing the sword-dance, the head lama-actor attires himself in his monastic garment, and begins the preparations of the final and culminating part of the ceremony—the breaking of the stone and the driving away of the evil spirit. The mantle belonging to one of the lama-actors, on whose body the stone is to be broken, is held over the stone, and the head lama-actor passes his sword over it, reciting the māṅi-prayer and sounding his bell. The dancer, on whose body the stone is to be broken, then lies down in front of the stone, covers his head with the mantle, and for some time remains in this posture, inhaling some burning incense which he is holding in his clasped hands in front of him. The rest of the lama-actors continue to recite prayers over him. The blue smoke of the incense envelops the body of the lying man. His fellow dancers with a grave and concentrated look continue to murmur prayers. The cadence of the prayer becomes quicker and quicker, and then suddenly comes to a stop, as if interrupted. The actor is then declared to be ready for the final ceremony. He lies down on his back, a piece of thin cloth is placed on his stomach, and the heavy stone is lifted by two dancers and slowly placed on his body. The head lama-actor then lifts the second stone and drops it twice on the stone which is on the dancer’s body. With the second stroke, a crash is heard and the huge stone breaks asunder. The dancer gets up, a bit pale, but none the worse for his experience. Immunity from fatal injury while performing the ceremony is attained by long years of special training. The dancer who underwent the ceremony in my presence had an unusually developed chest and powerful build.

The breaking of the stone is followed by a dance accompanied by music on a string instrument or pi-wang, played during the dance by the lo-chen or head lama-actor. The dance is accompanied by the following song which is a variant of a well-known Tibetan dance song:—

སྤྱི་ཉི་ལུང་པའི་ཞབས་བྱོའི་གྲུ།

I.

གུང་སྤོན་མཐོལ་ཅུ།	(ཡང་བྱུང་།)	ཉི་ལྷ་བཞུགས་མཉམ་དུ་བྱོ་བྱུང་།
གངས་སྤོན་མཐོལ་ཅུ།	”	དར་*སང་བཞུགས་མཉམ་དུ་དགའ་བྱུང་།
བྲག་སྤོན་མཐོལ་ཅུ།	”	བྱ་རྒྱལ་བཞུགས་མཉམ་དུ་དགའ་བྱུང་།
དགོན་རྒྱུང་མཐོལ་ཅུ།	”	ཡར་འདྲིན་བཞུགས་མཉམ་དུ་དགའ་བྱུང་།
སྐུ་མཁའ་མཐོལ་ཅུ།	”	མི་ཚེན་བཞུགས་མཉམ་དུ་དགའ་བྱུང་།
དཔལ་ཁང་མཐོལ་ཅུ།	”	ཡབ་ཡུམ་བཞུགས་མཉམ་དུ་དགའ་བྱུང་།

II.

(1) བྱིད་ནམ་པ་དགུང་སྤོན་མཐོན་པོ།	(གསུང་ཡ་ལ།)	ངེད་ནམ་པ་ཉི་ལྷ་གཉིས་པོ།
དགུང་དང་ཉི་ལྷ་གཉིས་པོ།	”	འཛོམས་བསམ་པ་ཡིད་ལ་མིན་ འདུག།
དེ་རིང་འདི་ཅུ་འཛོམས་པ།	”	བག་ཆགས་མཉམ་དུ་བཟང་བྱུང་།
(2) བྱིད་ནམ་པ་གངས་སྤོན་མཐོན་པོ།	”	ངེད་ནམ་པ་དར་སང་དགའ་མོ།
གངས་དང་དར་སང་གཉིས་པོ།	”	འཛོམས་བསམ་པ་ཡིད་ལ་མིན་ འདུག།
དེ་རིང་འདི་ཅུ་འཛོམས་པ།	”	བག་ཆགས་མཉམ་དུ་བཟང་བྱུང་།
(3) བྱིད་ནམ་པ་བྲག་སྤོན་མཐོན་པོ།	”	ངེད་ནམ་པ་བྱ་རྒྱལ་མོད་པོ།
བྲག་དང་བྱ་རྒྱལ་གཉིས་པོ།	”	འཛོམས་བསམ་པ་ཡིད་ལ་མིན་ འདུག།
དེ་རིང་འདི་ཅུ་འཛོམས་པ།	”	བག་ཆགས་མཉམ་དུ་བཟང་བྱུང་།

* གངས།

III.

གར་ཤོན།*

- (༡) དང་པོ་མེ་དོག་གངས་ལྷུལ་དུ་འབྱུངས། །
 དང་པོ་སེར་ཆེན་གངས་ལྷུལ་དུ་འབྱུངས། །
 དང་པོ་མེ་དོག་ལྷ་ལྷུལ་དུ་འབྱུངས། །
 དང་པོ་སེར་ཆེན་ལྷ་ལྷུལ་དུ་འབྱུངས། །
- (༢) བར་དུ་མེ་དོག་གངས་ལྷུལ་དུ་འབྱུངས། །
 བར་དུ་སེར་ཆེན་གངས་ལྷུལ་དུ་འབྱུངས། །
 བར་དུ་མེ་དོག་བཙན་ལྷུལ་དུ་འབྱུངས། །
 བར་དུ་སེར་ཆེན་བཙན་ལྷུལ་དུ་འབྱུངས། །
- (༣) མཐའ་མར་མེ་དོག་གངས་ལྷུལ་དུ་འབྱུངས། །
 མཐའ་མར་སེར་ཆེན་གངས་ལྷུལ་དུ་འབྱུངས། །
 མཐའ་མར་མེ་དོག་ལྷ་ལྷུལ་དུ་འབྱུངས། །
 མཐའ་མར་སེར་ཆེན་ལྷ་ལྷུལ་དུ་འབྱུངས། །
- (༤) ད་ནི་མེ་དོག་མི་ལྷུལ་དུ་འབྱུངས། །
 ད་ནི་སེར་ཆེན་མི་ལྷུལ་དུ་འབྱུངས། །
 མེ་དོག་མཚོད་དང་མེ་དོག་མཚོད། །
 མེ་དོག་ཕྱིང་གི་ལྷ་ལྷུལ་མཚོད། །
- (༥) མེ་དོག་མཚོད་དང་མེ་དོག་མཚོད། །
 མེ་དོག་བར་གྱི་བཙན་ལ་མཚོད། །

* གཤོན།

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མེ་ཉེག་མཚོད་དང་མེ་ཉེག་མཚོད ॥

མེ་ཉེག་འོག་གི་གླུ་ལ་མཚོད ॥

(༩) མེ་ཉེག་མཚོད་དང་མེ་ཉེག་མཚོད ॥

མེ་ཉེག་མི་མཚོག་གྲུལ་པོ་མཚོད ॥

Translation :—

I.

In the lofty blue sky,
We are happy with the sun and moon!
In the lofty high snowy abode,
We rejoice with the snow lion!
On the high lofty cliff,
We rejoice with the eagle!
In the lofty hermitage,
We rejoice with the Uplifter!
In the lofty castle,
We rejoice with the Chief!
In the lofty blessed home,
We rejoice with Father and Mother!

II.

You are the lofty blue sky,
We are both the sun and moon!
Heaven and sun and moon,
Had no thought of coming together!
To-day we gathered here,
Our habits have become virtuous!
You are the high snowy abode,
We are the white snow lion!
Snow and snow lion,
Had no thought of coming together!
To-day we gathered here,
Our habits have become virtuous!
You are the lofty high cliff,
We the fierce eagles!
Cliff and eagle, both,
Had no thought of coming together!
To-day we gathered here,
Our habits have become virtuous!

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III.

At first a flower was born in the snowy country,
At first the flower ser-čhen was born in the snowy country.
At first a flower was born in the realm of the gods,
At first the flower ser-čhen was born in the realm of the gods.
Then a flower was born in the snowy country,
Then the flower ser-čhen was born in the snowy country.
Then a flower was born in the demons' realm,
Then the flower ser-čhen was born in the demons' realm.
At last a flower was born in the snowy country,
At last the flower ser-čhen was born in the snowy country.
At last a flower was born in the nāga realm,
At last the flower ser-čhen was born in the nāga realm.
Now a flower is born in the realm of men,
Now the flower ser-čhen is born in the realm of men.
Accept the flower! Accept the flower!
I offer the flower to the gods of heaven!
Accept the flower! Accept the flower!
I offer the flower to the denizens of the middle space!
Accept the flower! Accept the flower!
I offer the flower to the nāgas of the lower region!
Accept the flower! Accept the flower!
I offer the flower to the King of Men!

The singers improvise their own tunes, and vary them according to their desire. If you ask them to repeat the same song several times, the tunes will be different each time.

The different parts of the ceremony have apparently no inner connection between themselves, and serve merely to draw away the attention of the onlookers from the secret part of the ceremony which precedes the 'breaking of the stone', and is performed by the lo-čhen or head of the troupe.

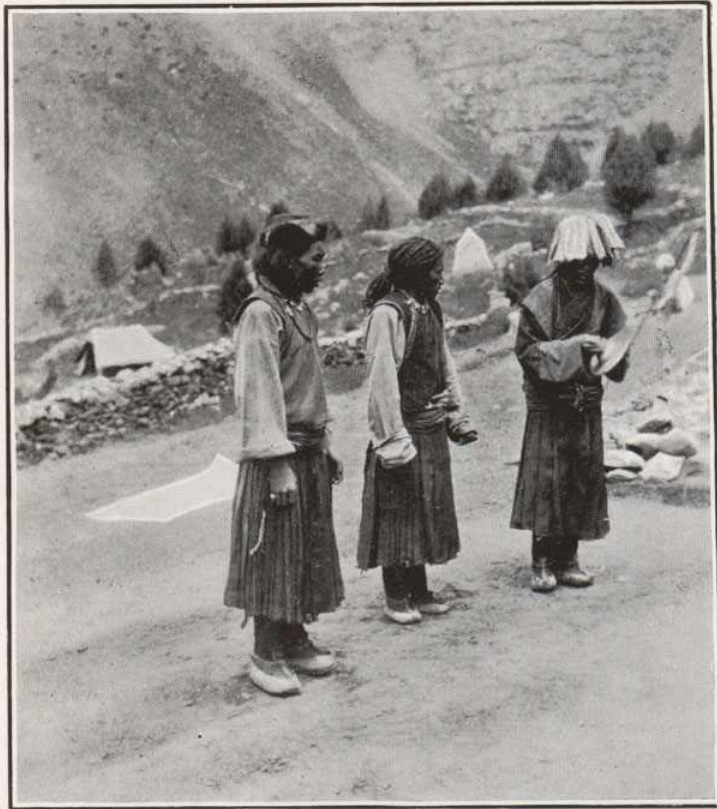
These ceremonies represent a vanishing art, closely inter-woven with religious beliefs and magic practices. A few decades more, and the Land of Snows will see the last of its religious actors.



THE BLA-MA LO-CHEN-PA RECITES PRAYERS IN
FRONT OF A TRAVELLING ALTAR, ON WHICH
IS PLACED THE IMAGE OF THAN-STON
RGYAL-PO.



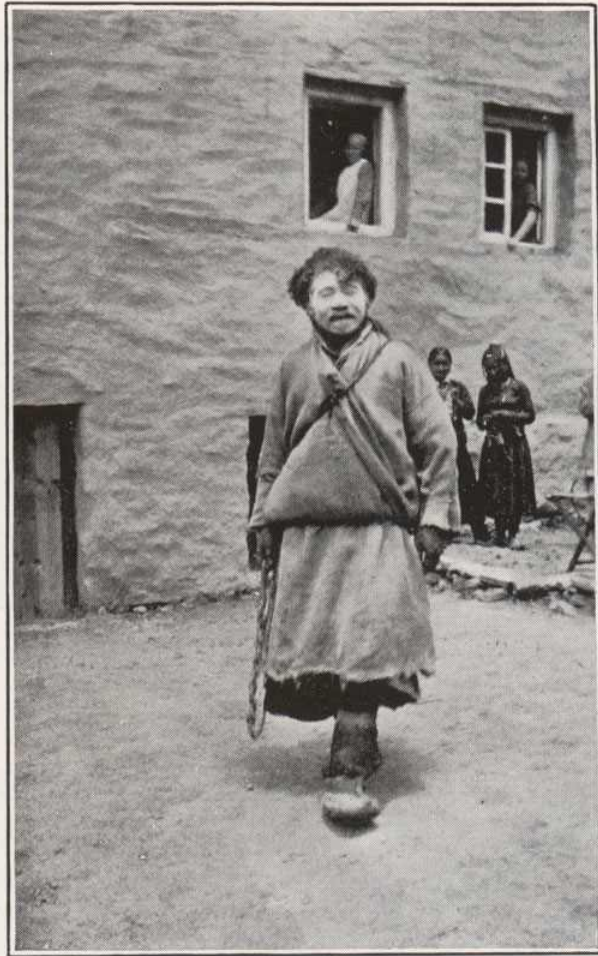
AN ASSISTANT DRAWS A HUMAN
FIGURE ON THE SURFACE
OF THE STONE.



BEGINNING OF THE DANCE.



THE DANCE IN PROGRESS.



THE WILD KING OF THE NORTH
DISGUISED AS A SHEPHERD.



ČHOS-RGYAL NOR-BZAN^o QUESTIONS THE SHEPHERD.



READING PRAYERS OVER THE STONE PRECEDING THE CEREMONY OF
BREAKING IT.



THE SWORD DANCE. FIRST MOVEMENT.



THE SWORD DANCE. SECOND MOVEMENT.



PREPARATIONS FOR THE FINAL PART OF THE CEREMONY. TO THE LEFT STANDS THE DANCER ON WHOSE BODY THE STONE IS TO BE BROKEN.



THE BREAKING OF THE STONE.

PANJABI PHONETICS.

EXPERIMENTAL STUDY OF AMRITSAR DIALECT.

BY E. ŠRÁMEK.

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THE materials of the present work, the palatograms of Panjabi sounds, were gathered during the months of June and July a.c. in the Laboratory of Experimental Phonetics at Collège de France in PARIS, with the purpose to continue my previous studies on the nature of so-called retroflex sounds¹ in Indian dialects.²

As I met a good subject of experience whose patient amiability doubled by scientific interest and love for his mother-tongue permitted me to extend the sphere of my experiments to all Panjabi sounds, I was able to study them by all methods, direct and experimental. In this preliminary sketch I shall treat only the lingual consonants as to the contact of the tongue and palate to have a sure basis for the classification of Panjabi sounds as to the point of articulation and the mode of their formation.

The palatographic method gives really the best test about the point of articulation and a simple print of the tongue contact conveys generally more than a long description to anyone able to read it and to make conclusion on the correspondent position and physiological movements of the tongue. The palatographic method keeps always, at least in the beginning, its individual character and avoids large generalizations about the articulations of all the idiom; but its objectivity, if carefully executed, prevents many mistakes, gives

¹The term RETROFLEX has been adopted to design the group of sounds called often CACUMINAL, SUPRADENTAL or INVERTED sounds. The ancient Indian phoneticians called them MŪRDHANYA (sound of the head, i.e., of the summit of the palate) which denomination was probably translated by European grammarians as CEREBRAL consonants. If the term 'retroflex' has been adopted in this study, it was done only as a fact of scientific discipline to be in accord with the propositions of the International conference at Copenhagen (in April 1925), but the aim of this work can be put, on the contrary, to search if at all and how far this denomination is applicable for Panjabi Phonetics. 'Retroflex' is here employed as generic term for a class of phonemes, ancient mūrdhanya sounds, meanwhile without physiological meaning as to the formation of these sounds.

²S. '*Les consonnes rétroflexes du Bengali et leurs correspondantes non rétroflexes.*' (Revue de Phonétique, Fasc. 2 et 3, PARIS 1928.)

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the best basis for phonetic exploration of a dialect and indicates useful hints for scientific investigations with other methods.

The palatograms presented here have been executed with two artificial palates, one made of thin metal (0,4 mm.) and the other of thin celluloid (0,2 mm.) prepared in Paris. Though both permitted a good work, I have preferred the second one to be sure that the subject is not hindered by the thickness of the palate. This precaution was especially necessary for some retroflex sounds whose tongue contact is very slight and was originally the real aim of this palatographic study. After a few experiments, the subject felt quite easy and the presence of the artificial palate in the mouth did not disturb his pronunciation. The exercise and practice of more than two months of our common work, made my subject quite accustomed to the artificial palate, which proved, moreover, also the constancy of the traces, for all articulations of typical words chosen as examples, have been repeated several times and at different periods.

The proceeding was as usual: the contacts of the tongue on the artificial palate were designed on its horizontal projection, obtained by its photography (in natural size); some little holes, symmetrically disposed on it, permitted easier control, and served as guiding points for the design of the lines of contact. The contour of this projection was prepared in the form of india-rubber stamp, to work easier and more surely.

For the ordinary consonants, it is sufficient to content one's self with the contact on the palate, because in their normal articulations, the opposite part of the tongue takes part in their articulation. But for the retroflex sounds, it seemed necessary to put at the same time the trace of the contact on the tongue too. For this purpose the colored method of ancient physiologists was chosen. The (natural or artificial) palate was painted with black colour and the contact on the tip and on the blade of the tongue was measured with compasses and drawn like the palatograms. That is why the original designs of the projection of the palate and of the tongue were made in natural size so as to permit easier measures and direct comparison.

The subject of the following experiments was *SIR UMRAOSING SHERGIL* of *MAJITHA*; from Amritsar district, 60 years old, who speaks Panjabi as his mother-tongue, and both his parents spoke the same dialect of Amritsar. He spent all his youth in Amritsar District, spoke at home and in his neighbourhood this Panjabi dialect. In the primary school, he learnt Hindoustani too and in secondary school English and Persian. But the English though fluently spoken, seems not to have apparently influenced his Panjabi articula-

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tions, on the contrary his English consonants to the ear, present Indian character, i.e., without aspirations. His voyages and dwelling abroad in Europe took place in advanced age, so that he did not notice any particular influence on the pronunciation of his mother-tongue, because he was not personally interested in imitation of the foreign sounds.

So, his Panjabi pronunciation can be regarded as very near to the normal common Panjabi.

THE LIST OF WORDS.

The list of words, the palatograms of which are studied in this work, presents:

- in the 1st column, phonetic transcription;
- in the 2nd column, transliteration of Panjabi orthography;
- in the 3rd column, their significance.

For the *phonetic transcription* on principle, the phonetic alphabet of the International Phonetic Association has been adopted.¹

The *transliteration* has been made on the basis of Gurmukhi alphabet as it is usual in the sect of Sikhs and which is current to our subject from his youth in his ordinary writing. All words spoken with the artificial palate or with the kymograph, were written down by the subject himself, to avoid the psychological influence of any other, even phonetical transcription. I have transliterated these typical words with regard to the usual transcription of Sanscrit alphabet. That is why I left the guttural ñ and palatal ñ nasals, the retroflex ṭ ḍ ṇ, affricate c (=č, tʃ), ch (čh, tʃh), j=dž (dž), jh=džh (džh), but to indicate that in Gurmukhi alphabet there is only a *single* sign the aspiration or subsequent fricative element is marked as little index ()^h. For m, n, (anusvāra et anunāsika) in Gurmukhi a point over the precedent *sign* is written, I write it too over the precedent *vowel*. The point over ś indicates the š [ʃ] that is in Gurmukhi marked by a dot *in* the sign of s, especially in Persian words, or simply by s. For a double consonant also is let the original sign (̄) over its simple (Latin) letter. The long vowels ā, ī, ū, are transliterated as usual in Sanscritic transcriptions, the horizontal dash indicating very well the vertical (for a, i) or horizontal (for u) dash added to the original Gurmukhi letters.

¹ By underlined letters in the phonetic transcription I mark in this work some sounds the aspiration of which was lost or weakened, as t, tʃ, d, etc., and the character of which will be studied later. The sign ə at the end of the words, does not indicate only the quality of e, but an indistinct vowel-sound in general.

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LIST OF TYPICAL WORDS :

ta	ta	letter t
ta·pə	tāpa	fever
ma·ta·	mātā	mother
patə	pata	honorer
matto	maṭa	understanding
pattə	paṭa	lief
tha	t ^h a	letter th
thammə	t ^h ama	pillar
mattha·	mat ^h a	forehead
pha·tha·	p ^h at ^h a	caught (in trap)
da	da	letter d
dabbə	daḅa	you press
da·d	dāda	eruption
bada·mə	badāma	almond
pa·də	pāda (pād ^h a)	journey
pā·da·	pādā	teacher
ta	t ^h a (instead of d ^h a)	letter dh [t]
ta·	t ^h ā (d ^h ā)	running
ta·p	t ^h āpa	„
ma·do	māt ^h o (d ^h)	Name of Krishna
na	na	letter n
nā· (or nā·m)	nā	name
ma·nə	māna	pride
la	la	letter l
la·lə	lāḷa	ruby
la·la·	lālā	Mister
ra·	ra	letter r
ra·	rāha	way
ṭa	ṭa	letter ṭ
ṭa·pa	ṭāpā	basket, cover
ṭappə	ṭaṭpa	jump
ṭo·pi·	ṭōpī	head

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a·ṭa·	āṭā	flour
maṭṭə	maṭa	big jar
ṭha	ṭ ^h a	letter ṭh
ṭhappə	ṭ ^h aṭpa	shut (a book)
pa·ṭhə	pāṭ ^h a	reading
maṭṭhā	maṭ ^h ā	cake
aṭṭ(h)ə	aṭ ^h a	eight
ḍa	ḍa	letter ḍ
ḍabbā	ḍaḅā	small box
aḍḍa·	aḍḍā	stall, stand
paṇḍə	pāḍa	packet
p ^h a·ṇḍa·	b ^h āḍā	vessel
ṭa	ḍ ^h a	letter dh [ṭ]
ṭa	ḍ ^h a	throw down
buddā	buḍā (Hindi buḍḍ ^h a)	Buddha
ka·ḍa	kāḍ ^h ā	take out
muḍə	muḍa	root of the tree
pa·ṇə	pāṇa	temper of the steel
ba·ṇə	bāṇa	arrow
pa·ṇi·	pāṇi	water
ṛa	ra	letter r
ma·ṛa·	mārā	bad
pa·ṛə	pāṛa	tear
la·lə	lāla	saliva
maḷa	mala	rosary
va·ḷa·	vālā	earring
pa·ḷa	pāla	cold
puṣpa	puṣpa(ss.)	flower
ja·	yā	consonant y[j]
a·ja·	āyā	came
ma·ja·	māyā	starch ; illusion
para·ja·	parāyā	alien
sappə	saṭpa	snake

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ʃa·m[tʃha:m]	śāma	evening
ʃuka	śūkā	dandy
ʃappə	śaṣṭa	quick (adv.)
ba·ʃa	bāsā	falcon
ana·ṇa	añāṇa	ignorant
a·ja·ṇa	„	„
tʃammə	caṃa	leather
batʃə	baca	avoid, escape
matʃa·	macā	make noise
battʃa·	bačā	child
tʃha·pə	c ^h āpa	seal, ring
tʃhaba	c ^h ābā	basket
vatʃḥa·	vac ^h ā	spread
patʃhā·	pac ^h ā	backward
vattʃha·	vač ^h ā	calf
mattʃhə	mač ^h a	big fish
ɖamə	d ^ž ama	death
ɖapə	d ^ž apa	mutter
aɖa·	ad ^ž ā	come !
adɖə	ad ^ž a	to-day
kimbə	kība	sour orange
kambə	kāba	tremble
kubə	kuba	haunch
kuppə	kuṣa	leather jar
khubṇa·	k ^h ubṇā	pierce
a·kho	āk ^h o	say (ind. 2p.)
a·khə	āk ^h a	say (2sg. imper.)
gappə	gaṣa	fib
ba·gə	bāga	garden
ba·gi·	bāgī	(rhythmic) gesture
va·ga·	vāgā	vaga (geogr. name)
va·gə	vāga	rein (of the horse)
paggə	paḡa	turban

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ka	gha	letter gh[k]
kappə	ghaṣa	gulp(down)
ŋa	nga	letter ng[ŋ]
paŋə	b ^h āga	hashish
maŋə	māga	beg
tʃa·ru·	d ^{žh} ārū	broom
ma·dʒa·	mād ^{žh} ā or mād ^ž ā	middle country
sā·dʒə	sād ^{žh} a (sād ^ž a)	co-operation

PART I.

PALATOGRAMS.

In this preliminary study of Panjabi sounds, we shall present the palatograms of dental, palatal, guttural and of so called retroflex consonants that permit to take the traces of contact on the ordinary artificial palate. Generally, we shall take some words presenting the respective articulation in three typical positions: initial, final and intervocalic. The influence of the vocalic neighbourhood has been observed but is known as a fact of general phonetics and in this first sketch has not been farther developed; it would be easily completed by adding some more examples of all consonants with neighbouring vowels both of the front and back series. We have used it only for the velar consonants to approach their point of articulation more forward.

In the second part, we intend to study the breath current with the usual dispositives on the kymograph. From both these studies, we shall try to make some conclusions on the pronunciation of our subject and to give the classification of his Panjabi sounds.

DENTAL.

t

The voiceless dental t is formed by the contact of the upper part of the ridge of the tongue blade pressed on the limit of the gums and on the upper teeth. It is useful to prepare such a palate that shows all the upper teeth and permits to control how far reaches the contact on them. In the pronunciation of our subject t always marks the contact upon the upper incisive teeth in all positions. That seems to distinguish the Panjabi t from the French one that is formed generally at the limit of the incisives and of the gums and from the English t that is less advanced than the French one. The Panjabi t is real *dental* and not only alveolar as it occurs in many Indo-European languages. The point of greatest pressure (marked in the design by small crosses) is on the ridge of the upper teeth. The initial t presents greater pressure (Plate I, n. 1) not only forward, but also by sides; this is proved by a

large contact on the palate for [ta·pə, Pl. I, n. 2]. The intervocalic *t* in [ma·ta· Pl. I, 3] has less contact. There is very little difference between the final and intervocalic position. This is rather comprehensible because in Panjabi there are very rare final consonants in single words. The off glides of the final consonants are always accompanied by a voiced (or at least voiceless) sound. In the pronunciation of our subject, I heard always the tendency to pronounce at the end of all words especially of those ending in a plosive consonant a little vowel sound (in the phonetical transcription it is sometimes indicated by a little vowel-like index or ə). That is why the final trace of *t* and other plosives often present the form of intervocalic articulation; the intervocalic position of *t* after a short vowel ex., pattə (Pl. I, n. 5) seems to favour the region of canine teeth and relaxation on the sides as is shown by the shape of the trace. The greater pression of the intervocalic consonant after a short vowel is due to a sort of doubled consonant (this phenomenon is otherwise known as common already in Prakritic phonetics). In any case the muscular tension of the point of the tongue is much nearer to the initial position than before a single consonant, after a long vowel; ex. ma·ta· (Pl. I, n. 3).

th

The aspirated voiceless dental plosive has the same contact as the *t* in all positions and the same articulation, but the general pression is lesser and the muscular tension of the tongue is weaker than for *t*. The intervocalic *th* is less pressed than the initial one when it follows the main accent. After a short accentuated vowel ex. [maṭtha·] (Pl. I, n. 9) the consonant is doubled and present the same energy in articulation as in the initial position, the width of the contact in *thammə* (Pl. I, n. 7) is the same as in *mattha·* (Pl. I, n. 9).

d

The voiced dental plosive is articulated in the same way as *t*, but the pression of the tongue contact seems to be replaced. As we said, the place of the greatest pression in *t* was the edge of the tongue against the teeth and the limit of the upper gums; in the voiced dental *d* the larynx is a little lowered and retired backwards and the pression is reported on the inner side of the contact (S. the crossed portion of the trace (n. 10, Pl. I).

For initial *t*, the muscular tension of the tongue is greater than for *d* and the shape of the blade is more pointed, the contact narrower: for *d* the blade of the tongue is more pressed on the inner side and the contact is enlarged backwards. The comparison is evident if both articulations *t* and *d* are pronounced one after the other; the trace of *d* on the inner side covers that of *t* (Pl. I, n. 1 and n. 10).

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In the intervocalic position (pā·da·, Pl. I, n. 12) the contact is relatively narrower and the pression is less, and in the final position (pa·də Pl. II, n. 13) yet less.

dh [t̪,d̪]

The contact and all characters of the *initial* aspirated voiced dental plosive dh, i.e., orthographed as such a one, are much nearer in the real pronunciation to a t than to a d. Auditively, it is a voiceless consonant, and its aspiration is scarcely heard, but it does not entirely disappear, it seems to modify the quality of the following vowel. These particularities will be examined in the second part of this study as they regard the breath, the outglide of the [t̪] and the onglide of the following vowel and its melody. If we compare the real dh as pronounced, for instance, in Sanscrit alphabet [dha] (Pl. II, 18) by our subject and his Panjabi dha [t̪a] (Pl. II, n. 15) in his usual pronunciation of modern words, we see that the contact in [t̪a] is larger and the pression greater than in [dha] (II, 18).

The intervocalic aspirated voiced dental plosive (orthographed dh) does not exist either, but is replaced by the corresponding unaspirated d̪ (voiced dental plosive). In the example ma·d̪o (Pl. II, n. 17) orthographed matho, the tongue touches a smaller part of the gums than for an unaspirated d in pā·da· (L. 12). In this case, the relaxed pression of the whole articulation of d̪ < dh seems to show that muscular tension is relaxed in d̪ < dh in the same degree as we have seen in th in comparison with t. If it is so, then d̪ < dh has lost only its aspiration in the intervocalic position but has maintained the original relaxed muscular tension, and does not seem to be confused with ordinary dental d in the pronunciation of our subject. The analysis of the breathline and larynxline, and examination of other examples will give some more indications. The final position of dh does not occur.

n

The voiced dental nasal has the same articulation as d, but the pression is not so great. The tongue touches the upper incisive teeth as for d. The comparison of both articulations n and d [as shown in Ex. na (Pl. II, n. 19) nā·m (Pl. II, n. 20) and Pl. I, n. 10, ii for d] indicate the relaxed tension and larger contact along the molar teeth for d than for n, the blade of the tongue is much more hollow with strengthened edges for d; for n the blade is flatter and the contact softer. The final position is the weakest as in (ma·nə. Pl. II, n. 21).

LIQUID.

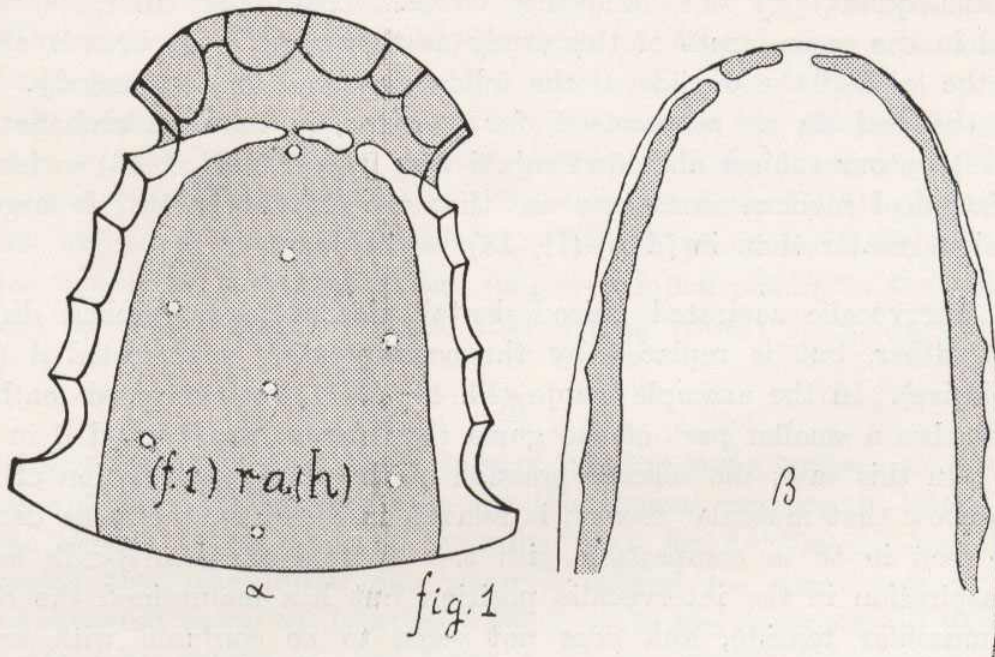
1

In the voiced lateral dental the tip of the tongue touches the incisives. Sometimes, the contact reaches only the edge of the teeth. The contact is

quite small and goes along the upper teeth, from incisives to the first molars; the back part of the tongue is lowered so that the air escapes by sides over and through the last molars. (Ex. Pl. II, 22, 23.)

r

The voiced alveolar vibrant is formed by the tongue concave raised to the alveoles and touching on the sides the molars and the palate. The tip of the relaxed tongue beats some flaps against the alveoles (Ex. ra(h) Pl. II, 24).



The trace on the tongue (Fig. 1, β) does not apport anything new, but completes the precedent indication. The upper edge of the lightly concave tongue beats against the alveoles; the contact is larger on the sides than in the middle at the tip of the tongue. The trace has no continuous contact, but shows little traces of some flaps that are executed with the upper marginal part of the tongue. Ex. ra(h) fig. 1, α (trace on the palate), β (corresponding trace on the tongue).

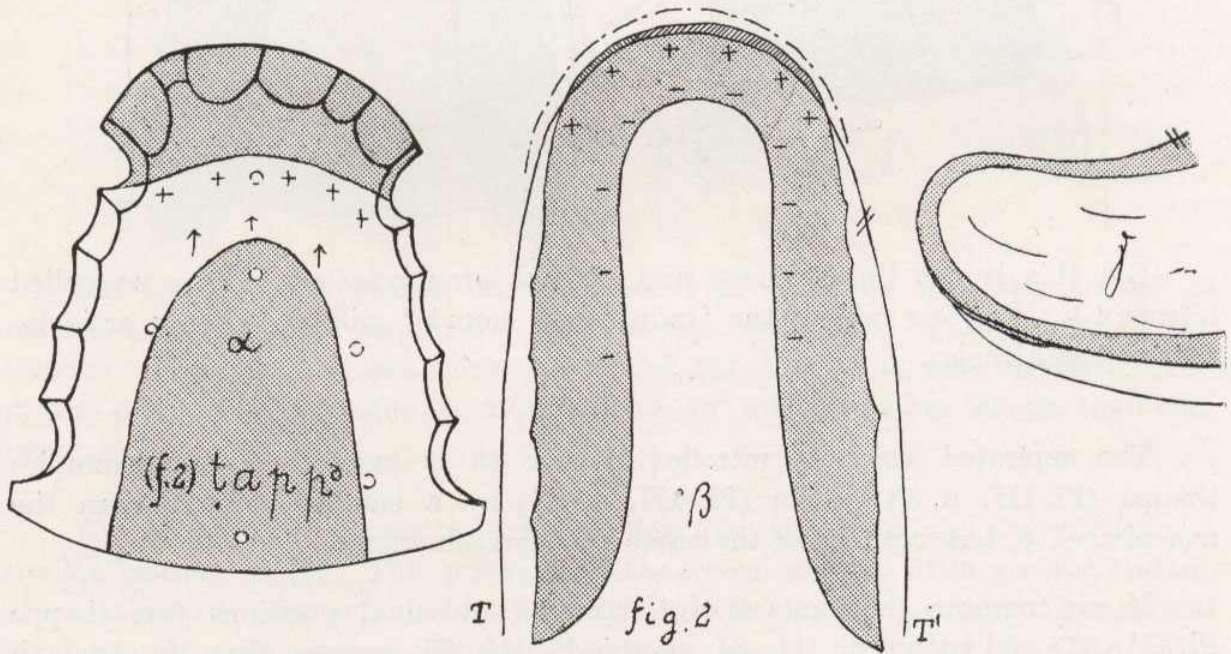
RETROFLEX.

‡

The retroflex voiceless dental plosive [t] is articulated on the alveoles much more backwards than the ordinary not retroflex dental t. The concave blade of the tongue is raised and touches the palate opposite the canine or first molar teeth. The contact is executed by the ridge of the tongue that is laid slightly by a movement from back to the front, so that the edge of the tongue sweeps a rather wide portion of the palate, glides a little, as is shown by arrows in Pl. III, 25, stops for executing the closure and then jumps down

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with explosion towards the lower teeth (Ex. P1. III, n. 25-31). In reality, in Panjabi—in the pronunciation of our subject—there is no ‘retroflex’ t , i.e., during the production of the articulation the tip of the tongue is not curled up, but only slightly hollow in the form of a spoon and applied against the palate with the edge sweeping the alveoles and jumping down and keeping always this curved position during the articulation of $[\text{t}]$. This position of the tongue causes that the articulation is accompanied by a slight projection of the lower jaw. To have a more persuasive proof of the real articulation, I took both traces on the palate and on the tongue at the same time. For this purpose, I employed the colouring method. To obtain an hygienic and inoffensive mixture I prepared a paste of condensed milk with the powder of carbonised wood (pastils) by adding some drops of boiled water to obtain the required density. With a little brush, the colour is put on the palate and after the articulation the tongue is shown and the figure of the contact on the

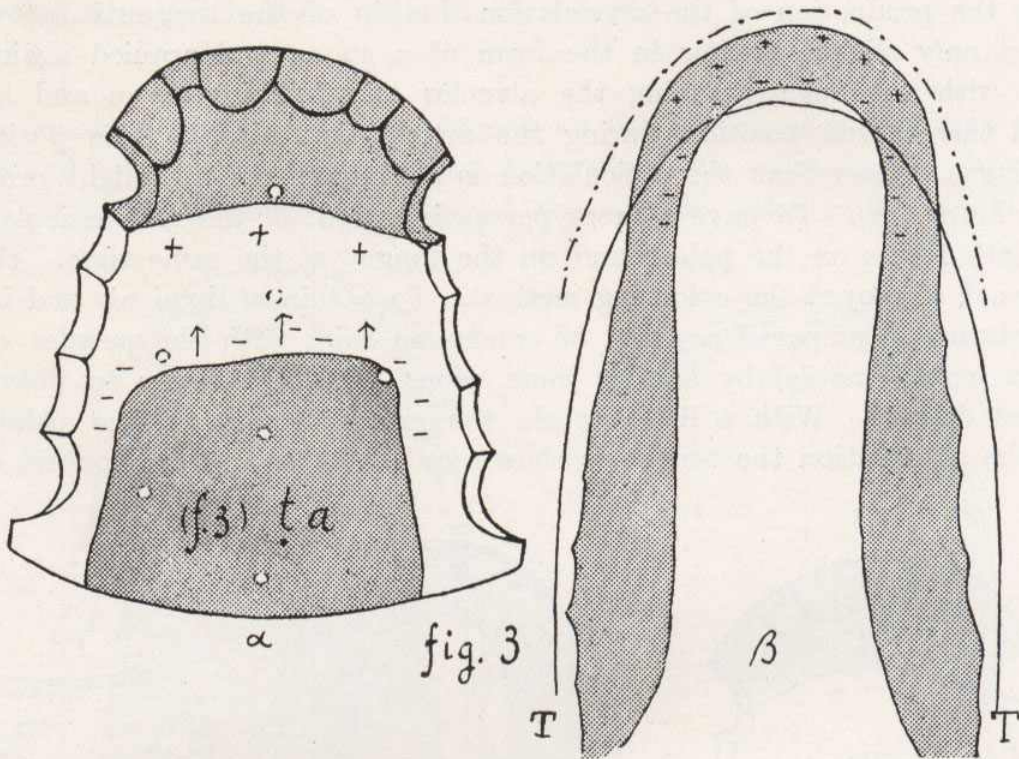


dry tongue can be measured and designed on a projection of the tongue prepared in advance (as in Fig. 2, 3, β). The curve T T' represents the projection of the edge of the tongue. The design over this curve is the trace on the lower inverted side of the tongue, within is the upper part of the blade.

So was obtained the figure 2, β and γ , which proves that the contact is executed just by the edge, the apex of the tongue, and not with its inverted lower side. Ex. tappe , Fig. 2, β and γ .

The real retroflex, i.e., inverted position of the tongue tip occurs only when the point of the tongue is stretched, in an exaggerated pronunciation,

and curled up while the articulation is executed far back and high in the middle part on the roof of the palate as can be seen in the Ex. *ṭa* in Fig. 3; β .



But this is not the ordinary and normal pronunciation of the so called retroflex *ṭ*. For our subject the 'mūrdhanya sounds' will say simply articulated on the alveoles.

ṭh

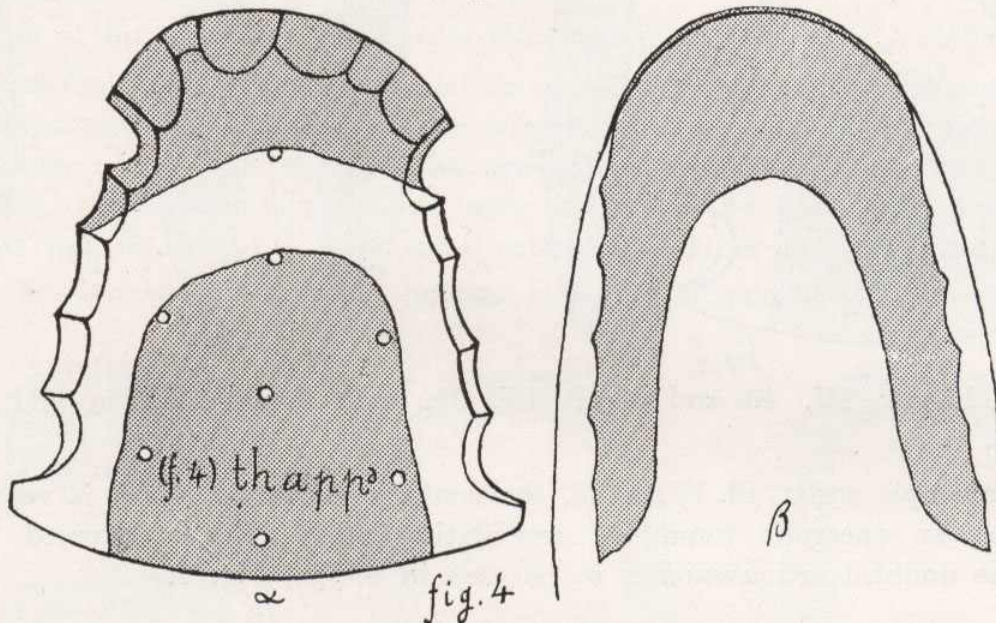
The aspirated voiceless retroflex plosive *ṭh* is marked in our examples *ṭhappə* (Pl. III, n. 33; *aṭṭhə* (Pl. III, n. 34) by a smaller contact than the unaspirated *ṭ*, but both have the same retroflex character.

If we compare the contact of the initial and final positions (ex. *ṭhappə* Pl. III, 33) and *aṭṭhə* Pl. III, 34, *paṭṭhə* Pl. III, 35, we see that the final *ṭh* in Pl. III, N. 34 and 35 presents as large a contact as the initial one in III, 33; in any case, not less.

This phenomenon has been stated in a very constant way and strikes the attention because it presents a character that is quite opposite to the treatment of dental *t*. In dental series the initial *t* is more pressed than the intervocalic and the final *t* is the weakest; this phenomenon is a general work of all dental phonemes pronounced in words. If we see here just the contrary, it must have a special reason and tell us that there is a change in the articulation. The palatograms of *aṭṭhə* and *paṭṭhə* show that the final articulation is more advanced, approaches the incisives without touching them and its trace

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becomes more alike to the dental: this can indicate the partial or total loss of the aspiration in the final position. The analysis of the breathline of the same words will prove if the aspiration of *ṭh* disappears or not. Then the initial *ṭh* has a small contact because the tongue is more stretched and thinner, the ridges are thinner when the tongue rests concave. A thinner contact is not here a sign of weaker pression.



The trace of the tongue (Ex. *ṭhappə*—Fig. 4) shows that the contact is mostly performed by the upper part of the blade and by the ridge of the tongue. It is easy to see that the tip of the tongue is not inverted. The upper part of the tongue is more active in the formation of *ṭh* than the lower one.

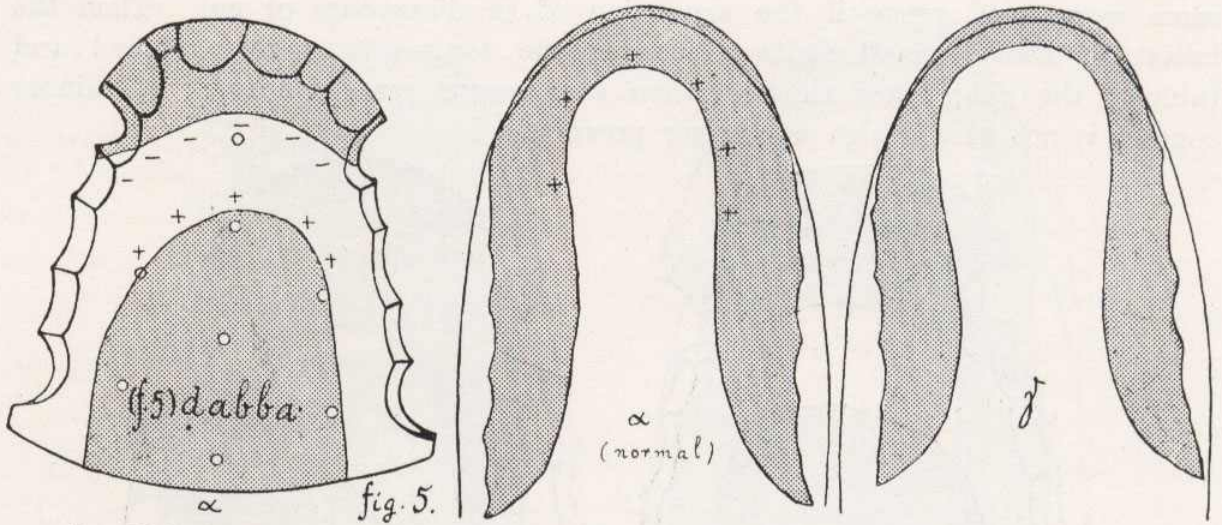
ḍ

The articulation of the voiced retroflex plosive [ḍ] is the executed in a similar manner as [ṭ]. The pression of the voiceless is a little greater and its articulation is more advanced especially in the initial position. As several palatograms were taken in different positions, it can be stated, that the point of articulation for [ḍ] reaches neither farther than to the canine teeth nor more backwards than the first molars.

The contact and total pression is greater for the retroflex [ḍ] than for dental [ḍ] (which is articulated on the incisives and on the limit of the upper gums). The retroflex [ḍ] is retired back on the alveoles and articulated with the ridge of the hollowed tongue. Ex. Pl. III, 36 and Pl. IV, n. 37-40.

The colored method indicates the real contact of the tongue in Fig. 5, ex. *ḍabba* and proves that for [ḍ] as for [ṭ], the active part of the tongue is just the middle of the ridge that touches the post-alveolar region of the palate. The anterior part of the tongue is slightly concave on the upper side and the

tension is less for ḍ than for ṭ as it shows the shape of the inner side of the contact. [ḍabba] Fig. 5.

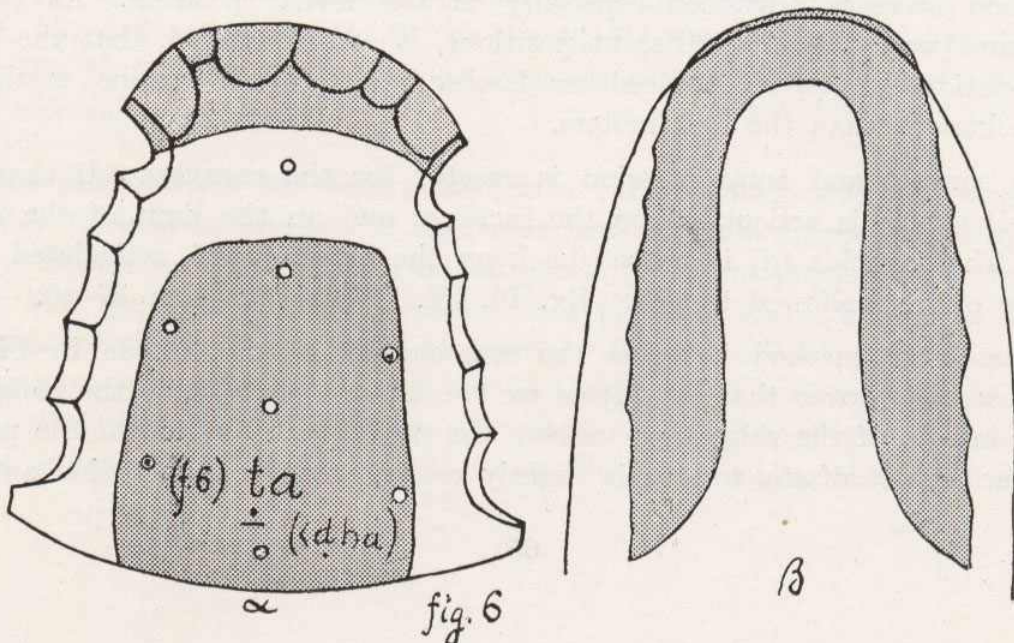


In bhaṇḍa IV, 40 and paṇḍa IV, 39, both articulations ṇ and ḍ are retroflex.

In example aḍḍa , Pl. IV, n. 38, the contact of intervocalic ḍ is very large indicating an energetic (doubled) articulation after a short stressed vowel. The same doubled articulation is to be seen in buḍḍa , Fig. 7.

(ḍh) > [ṭ ḍ]

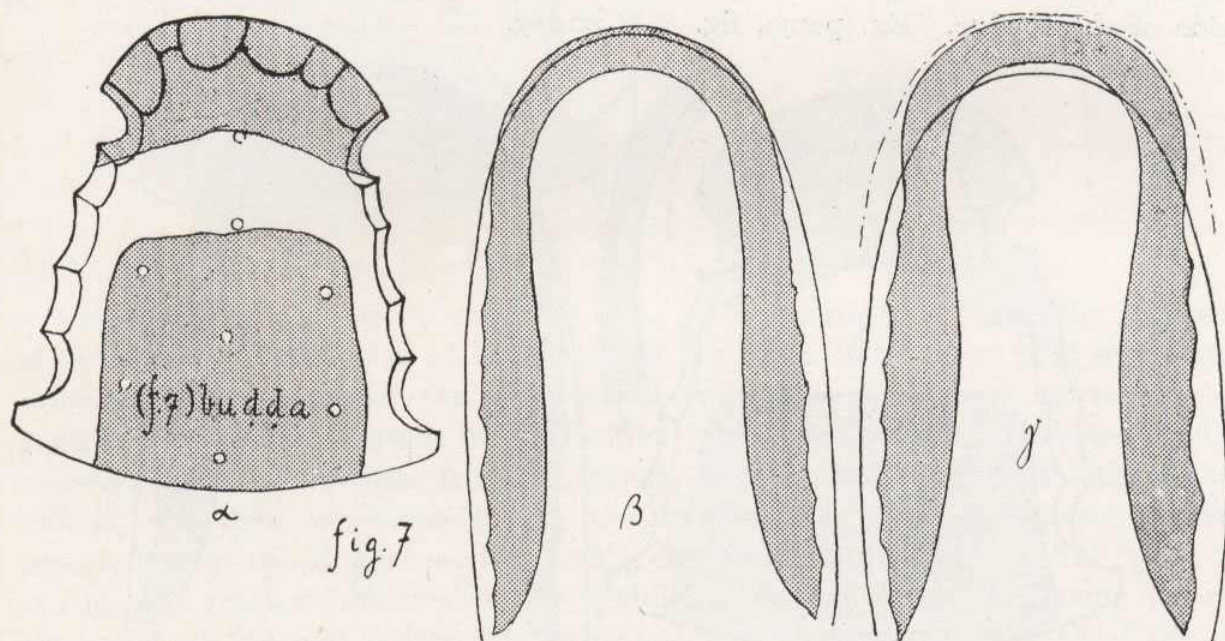
NOTE:—The orthographed aspirated voiced alveolar plosive ḍh does not exist in the pronunciation of our subject in the aspirated form: the aspiration and the sonority of the initial ḍh is lost so that we have to do with an alveolar voiceless plosive ṭ whose aspiration has left a certain influence on the mode of intonation of the neighbouring vowel. The articulation is much more executed by the upper part of the tongue and by its tip slightly bent but not particularly inverted as it is shown in Ex. ṭa Pl. III, n. 26 and in Fig. 6.



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The intervocalic $\underline{ḍ}$, in Ex. $\underline{k}a\cdot\underline{ḍ}a$, Pl. IV, 41, has a large contact and indicates an energetic pronunciation caused probably by a greater tension of the preceding vowel [a] that presents a special melody under the stress, for this $\underline{ḍ}$ is in reality a $\underline{ḍh}$ in [$\underline{k}a\cdot\underline{ḍ}a$] < [$\underline{k}a\cdot\underline{ḍ}ha$] (written to-day $kāḍha$, $kāḍa$ or $kāḍhā$, $kāḍā$).

After a short vowel a gemination takes place, ex. [$\underline{b}uḍḍa$] < $\underline{b}uḍḍhā$, fig. 7, that presents in β the normal and in γ a more stressed articulation. In this exaggerated pronunciation, the tongue is stretched, raised higher, and more bent, i.e., curled up and the articulation in these conditions becomes 'retroflex,' the contact in the front being performed by the lower part of the inversed tip (fig. 7, γ). The same articulation is in final $\underline{ḍ}$, Ex. [$\underline{m}uḍ$]ə, Pl. IV, 42, but weaker than in [$\underline{b}uḍḍa$] and a little more advanced.



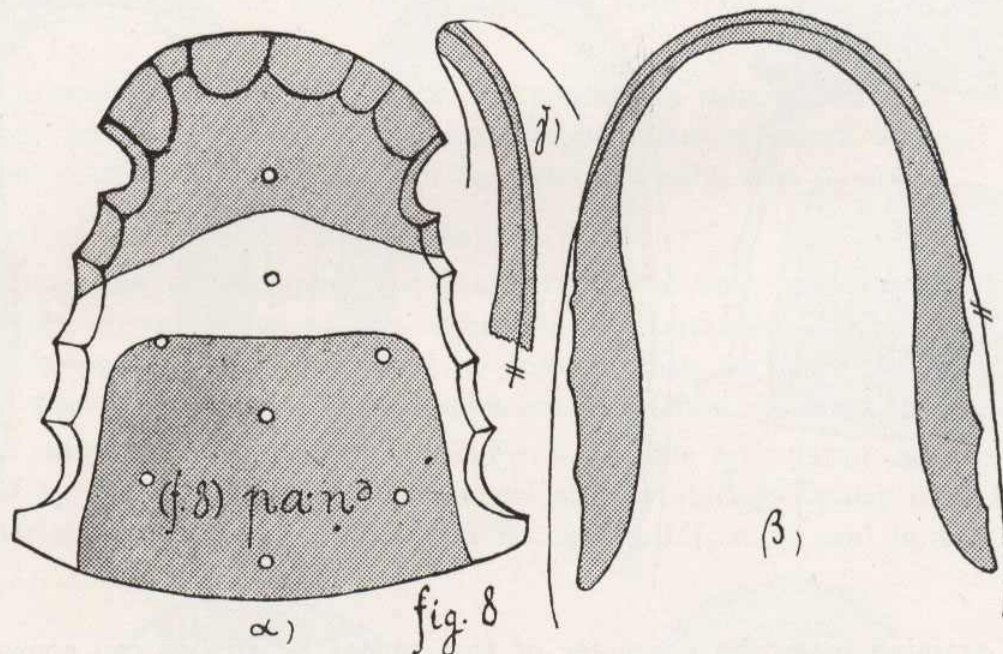
To examine more the character of this initial $\underline{ḍ}$ < $\underline{ḍh}$, we can consult the trace on the dry tongue, ex. $\underline{ṭ}a$, Fig. 6, but always the articulation is performed with the tip of the tongue and the upper part of the blade as it was stated for the ordinary $\underline{ṭ}$ (fig. 3) or $\underline{ṭh}$ (fig. 4). If we try to distinguish by their palatograms the $\underline{ṭ}$ from original $\underline{ṭ}$ and the $\underline{ṭ}$ < $\underline{ṭh}$ < $\underline{ḍh}$, we can hardly recognize a great difference: the $\underline{ṭ}$ < $\underline{ḍh}$ seems to be a little weaker. And because our subject does not mix up them, as it seems, the reason could be, not in the point of articulation, but in the mode of breath, which we shall examine later, and there will be stated, if the initial $\underline{ṭ}$ < $\underline{ḍh}$ is to be ranged to $\underline{ṭ}$ and intervocalic $\underline{ḍ}$ < $\underline{ḍh}$ to $\underline{ḍ}$ (Ex. [$\underline{k}aḍa$] IV, 41 and [$\underline{b}uḍḍa$] fig. 7 and [$\underline{m}uḍ$] IV, 42).

r

The retroflex voiced alveolar nasal occurs only in medial intervocalic position (or in combination with other retroflex consonant). The examples Pl. IV, n. 43-46 show that the contact is made opposite the first molar teeth with the upper part of the tongue slightly concave in a spoonform. The contact with the gums on both sides of the molars is very small and smooth (sometimes is marked only one side on the palate, the other being stopped on molar teeth, which is evidently personal particularity of the subject as in *ba·nə*, Pl. IV, n. 44; *pa·nə*, Pl. IV, 45; *ṛa*, IV, 43.)

The point of articulation is advanced as usually before anterior vowels, ex. [*pa·ni*] (Pl. IV, n. 46).

The trace on the tongue indicates that it is just the margin of the tongue that touches and surely there is more pression on the upper than on the lower side of the tongue. Ex. *pa·nə*, fig. 8, β and γ .

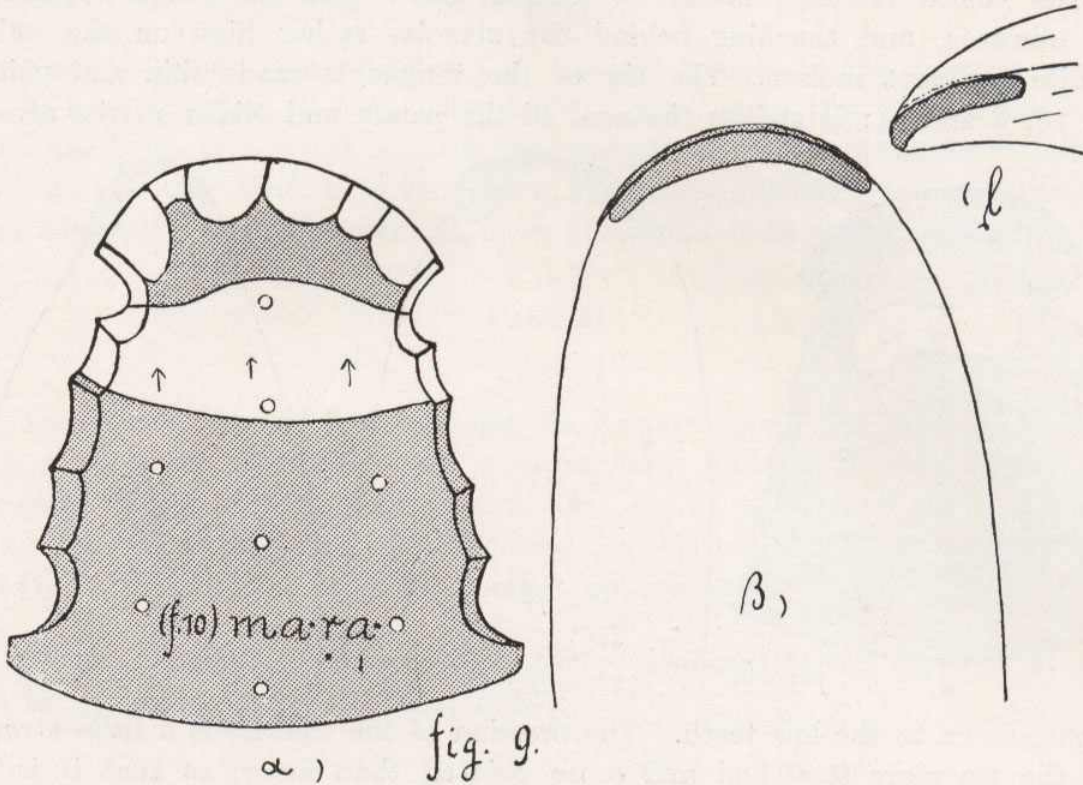


r

All palatograms of the vibrant voiced retroflex *r* indicate the Panjabi retroflex character, i.e., the contact is executed in the pre-palatal and alveolar region IV, 47-48, fig. 9. The tongue, slightly concave at its front part, raises towards the palate, opposite the first molars, being retired a little back and is projected to the palate but without stopping. The tongue continues the movement sliding lightly over the alveoles and jumping down towards the edge of the low teeth, the over incisives are not touched. The muscles of the tongue tip are relaxed and its edge has a circle like form, as in fig. 9 β , not pointed

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as in fig. 10 γ , so that the gliding contact sweeps the palate in a large line from one side of the teeth to the other.

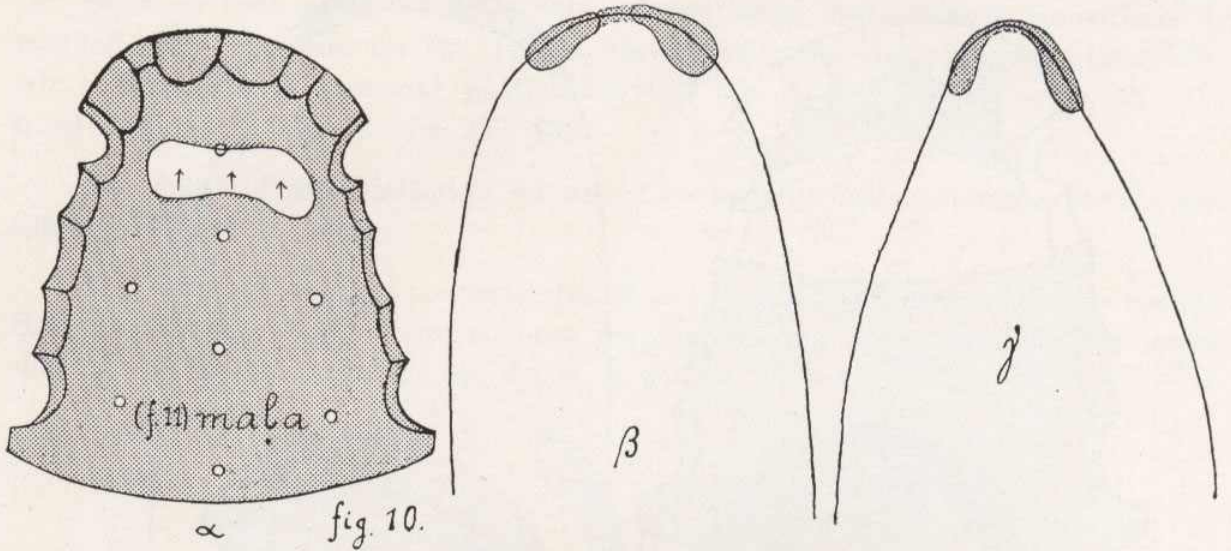


Sometimes, the tip is narrower, i.e., more pointed, so that the contact does not reach the ridge of the teeth on the sides, but I have seen this form only in the beginning of the alphabetical syllable *ra* V, 50, and never in the normal intervocalic position in real words. The characteristic vibrations of this retroflex glide sound come from the glotte, from the contracted isthmus of the throat, and their interference with the tone of the resonance cavity of the mouth like in the English and especially American intervocalic *r*. The contact reaches its greatest pressure in the middle, is weaker in the beginning (inner side) and at the end (outer side) which is indicated not only by the form of the trace, but also by the circumstance, that its edges dry more quickly (Pl. IV, 48). The raised tongue does not touch the palate on the sides, but only grazes by its edges the upper molars. The contact on the sides is rather exceptional (Pl. IV, n. 47), and occurs only in the beginning, like alphabetical sound *ra*. I suppose, that is the cause why this sound has been sometimes approached to *ḍ*, when the articulation is executed, starting from the slowly prepared position, when the tongue is not in continuous movement through all three phases of this consonant.

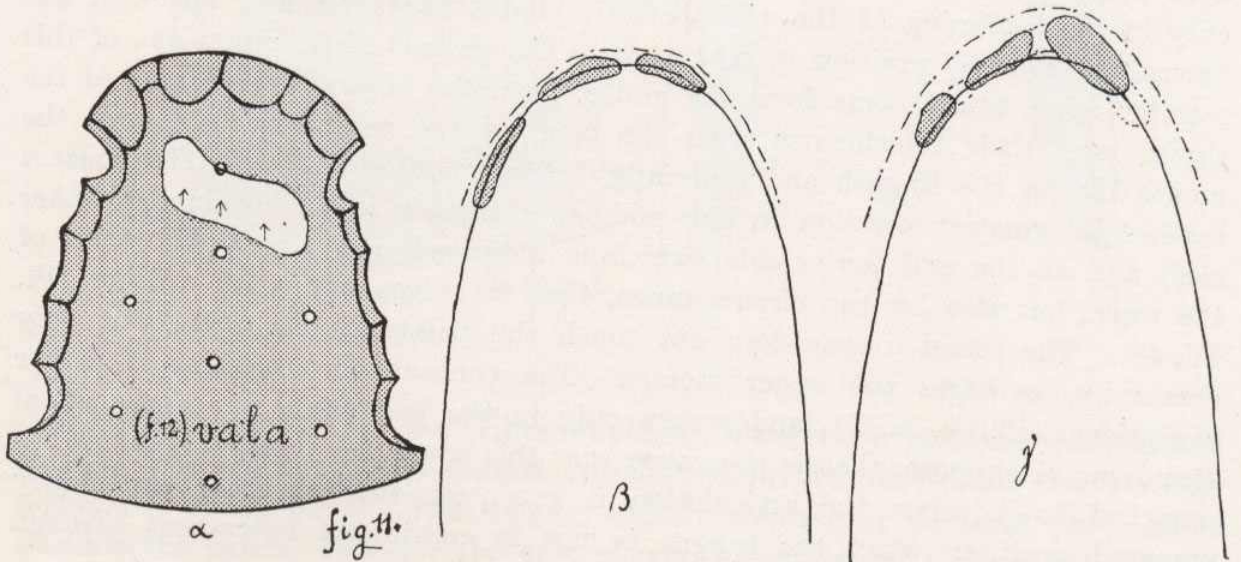
The trace on the tongue proves that even here—ex. *ma·ra·*—fig. 9 β , γ —it is the edge of the tongue and more the upper part of the tongue that sweeps the alveoles and executes the gliding contact.

!

The voiced retroflex lateral is formed like *r* with the tongue, spoon-like bent upwards, and touching behind the alveoles rather high on the palate, opposite the first molars. The tip of the tongue is made thin and pointed (Fig. 10, β and γ); it strikes the roof of the palate and glides on the alveoles



jumping down to the low teeth. The pression of the contact is a little stronger with the tip more stretched and more pointed than for *r*, so that it is performed only with the middle part; the sides are not at all touched, neither on the palate, nor on the molars.



The trace on the tongue shows that the contact is performed just by the edge of the tip (Fig. 10 and 11). Only by the energetic initial articulation sometimes the lower part touches more and seems to be really 'retroflex', i.e., inverted as in *vaḷa*, Fig. 11, γ , but this is not to be regarded as the most fre-

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quent case. Ex. la·lə (Pl. V, n. 55-56) permit to compare both articulations dental l and retroflex ɭ.

ɟ (š)

NOTE:—There is no retroflex ɟ in Panjabi words; in the Sanscrit words ɟa (Pl. V, n. 57) puɟpa (V, 58), the subject pronounces the ɟ with the tongue spoon-like bent, and raised towards the roof of the palate rather back and high, this could advise that it differs from the other retroflex sounds which are more advanced, more alveolar. I have not found it in real Panjabi words.

PALATAL.

[j=y]

The palatal voiced fricative has its contact along the sides of the molar teeth so that the frictional space is rather large and the friction is very weak, especially in the medial position (ex. aya, Pl. VI, n. 62, and maya, Pl. VI, n. 63); in the beginning, it is more pressed (ex. [ja·] V, 59-60) and chiefly before [i·] ([ji·] Pl. VI, 61) so that the contact approaches to ʒ (ž).

NOTE:—In relaxed pronunciation the j nasalised [j̃] can serve as a substitute for ɲ (Ex. [aʃa·na] Pl. VIII, n. 87).

s

The voiceless alveolar sibilant [s] occurs rather rarely, only in some words, in the pronunciation of our subject. In the marked example [sappə] (Pl. VI, n. 64) that he pronounces also [ša·pə] the contact is very narrow along the upper teeth to the incisives and the friction space in front is wide.

[ʃ, š]

The voiceless chuintante [ʃ] is articulated like the French [ʃ], with the tip of the tongue behind the low teeth, the jaws are very near to each other, the lips not rounded. The blade touches the gums only by the sides, along the molars up to the incisors VI, 65; VI, 66. In the medial position the articulation is a little retired (reaches only the eye-teeth) under the influence of neighbouring vowels, ex. [ba·ʃa] (Pl. VI, n. 67). The example [ʃuka] (VI, 66) is pronounced with both syllables, the trace of k does not recover the trace of ʃ.

[ʒ, ž]

NOTE:—The voiced pre-palatal fricative ʒ occurs in the pronunciation of our subject, but not in real Panjabi words; it is a Persian sound which is heard in the language of town citizens, the corresponding Panjabi sound is ɟʒ, Ex. ʒa, Pl. VI, n. 68.

[tʃ, č]

The voiceless pre-palatal affricate tʃ is formed by a large contract along the teeth like for t and ʃ together. The explosion of t is executed only by the tip while the side contact rests as for ʃ, so that the explosion is made in the position of ʃ. The detachment of the tongue is executed by the same movement so that the acoustic impression is that of a single explosive. The greatest pressure is in front of the contact and during the articulation, is replaced to the sides by retiring slightly the tongue from the position of dental t, or better alveolar, to the position of ʃ, for the contact reaches the upper incisors only in the initial [tʃ] (tʃa(ru) VI, 69) or in a stressed syllable as in matʃa· (VI, 71). In final position the occlusion is very narrow and retired backwards. (Ex. batʃ VI, 72.)

[tʃh, čh]

The aspirated voiceless pre-palatal affricate is articulated in the same manner as tʃ, č, but generally the contact does not reach the incisive teeth, not even in the initial position (tʃhapə, Pl. VII, 73 or tʃhaba, Pl. VII, n. 74).

In the intervocalic position the contact is thinner than in the final, though the [tʃh] is placed in [vatʃha·] Pl. VII, 75 and in [patʃhā·] VII, 76 in a stressed syllable. In the final mattʃhə (VII, 77), the greater contact must have a reason in a stronger articulation after the short accentuated vowel that doubles the following consonant as we have already seen in the Panjabi pronunciation, moreover, the final aspiration is lost.

[dʒ, dž]

The voiced pre-palatal affricate dz, has a similar articulation as [tʃ] but it is accompanied by the vibrations of vocal chords, and the contacts are less extended, the tongue pressure being weaker.

The initial position (dʒapə VII, 78, dʒamə VII, 79) is more energetic with a larger contact than the intervocalic a·dʒa· VII, 80, or final sā·dʒə VII, 81.

The final position, in which the articulation is relatively weaker in most Indo-European languages, in the example [addʒə] Pl. VII, n. 82, is much more energetic with a larger contact than in a·dʒa· VII, 80, or sā·dʒə VII, 81. It is due to the mentioned phenomenon of doubled consonant after a stressed short vowel and we shall study it later with the kymograph.

[dʒh, džh > tʃ, č]

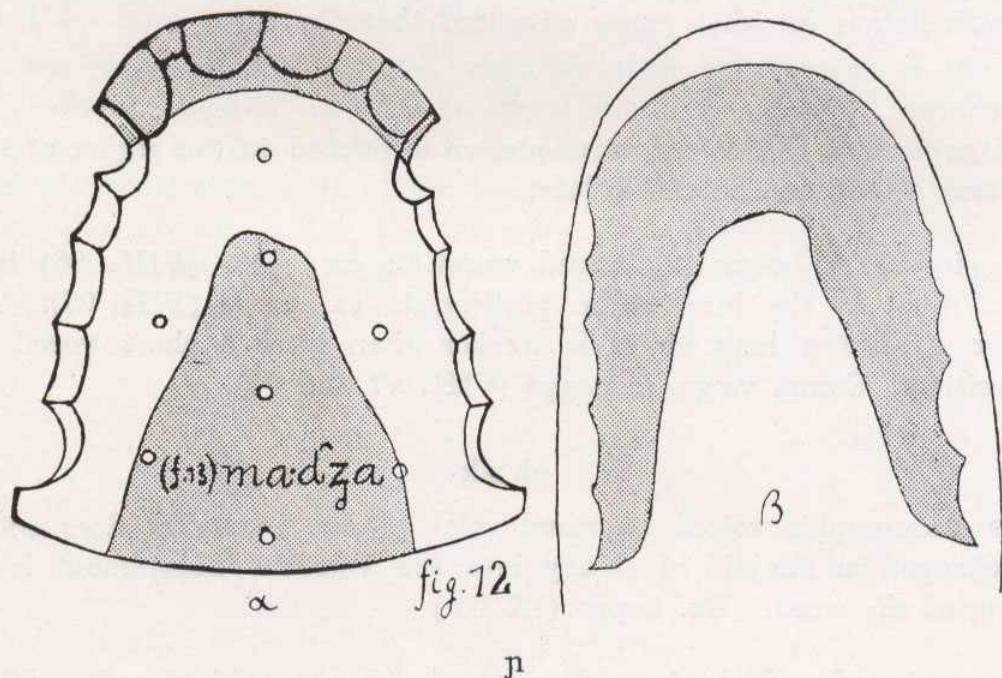
The orthographic voiced aspirated pre-palatal affricate does not exist in modern Panjabi in initial position, but is changed in voiceless pre-palatal affri-

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cate whose aspiration is lost and seems only to be marked by a special timbre of the neighbouring vowel. The palatogram indicates by its form a greater pressure and a greater palatalisation than an ordinary [tʃ, č] but auditivey the consonant tʃ, č and č, tʃ resulting from dʒh > čh are rather difficult to distinguish. Meanwhile, we distinguish both articulations by underlining tʃ, č < dʒh to distinguish it from the ordinary [tʃ, č]. The ordinary [tʃ, č] in the articulation of our subject is less pressed on the sides along the molars than the [č, tʃ]. Compare f. inst. VI, 70 and VII, 74.

If we compare Hindi or Sanscrit dʒh (Pl. VII, 83) with tʃ (VII, 84), we see that the muscular action in the surd tʃ is stronger than in the sonant dʒh.

In the medial position the dʒh has only lost its aspiration and is pronounced [dʒ], and shows a great palatalisation of d. Ex. ma·dʒa, fig. 12.



The palatalized (mouillé) n = n̄ is articulated as n̄, removed a little back and accompanied by a large contact of the tongue on the hard palate, Pl. VIII, 85 and 86. The muscles of the tongue are much looser in n̄ than in n. The contact never reaches the upper incisive teeth as in the ordinary dental n. This Panjabi sound is formed in the same way as in the Slavic languages, the n̄ mouillé (ň) or as the anterior French n̄ mouillé (gn). The separation of the tongue from the palate is executed on the whole contact at the same time, so that there is no complex sound n + j (n + y), but a single n̄ sound. In Panjabi, as in French, it does not occur in the beginning nor at the end of the words. When the occlusion and the tension are relaxed in careless pronunciation, the sound n̄ can be changed into nasalized j: ex. aṅa·(ṅa), Pl. VIII, n. 87.

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VELAR.

k

The voiceless velar plosive has its contact in the region of the last molars at the limit between the hard and the soft palate. Ex. Kambə VIII, 90. The articulation is advanced by the influence of the front vowels, ex. kimbə VIII, 89, and retired before back vowels, Ex. kuppā (VIII, 91).

kh

The aspirated voiceless velar plosive has the initial articulation more pressed than the intervocalic one. Comp. khubṇa VIII, 93; akhə; VIII, 94; a·kho VIII, 95. If we compare the unaspirated **k** with the aspirated **kh**, we see that the aspirated has a larger contact kub: khub (VIII, 92-93). The place of the articulation for **kh** is more advanced than for **k**.

g

The contact of the voiced velar plosive is formed in the region of the last molars and chiefly on the soft palate.

The initial **g** before a stressed vowel in ex. gapə (VIII, 96) is more advanced than in the intervocalic position in ex. va'gə (VIII, 97). The intervocalic **g** after a long vowel is weaker than after a short vowel in the same position. Comp. va'go :: paggə (VIII, 97 and 98).

gh > k

The orthographic voiced aspirated velar plosive in reality does not exist, but is changed in Panjabi of to-day into the voiceless unaspirated **k** in the beginning of the word. Ex. kappə (IX-99.)

The aspirated voiced **gh** is pronounced by our subject quite differently (IX, 103).

In the intervocalic position **gh** has no more kept its aspiration and is pronounced as **g**; the palatogram of $g < gh$, in va'ga' (waga-IX, 100), ba'gə (garden-IX, 101) is the same as in va'gə (rein-VIII, 97). In ba'gə (IX, 102) the influence of *i* has advanced the articulation. The loss of aspiration is expressed in a special articulation of the preceding vowel, whose melody we shall examine in the breath-line of the kymograph, our palatograms not being able to give some more indications about the possible difference.

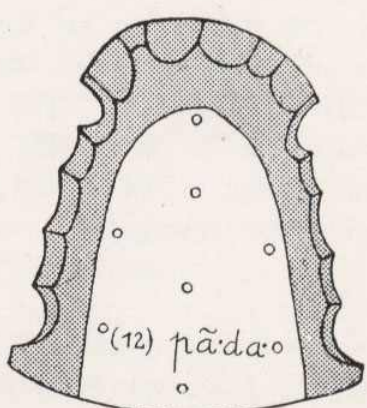
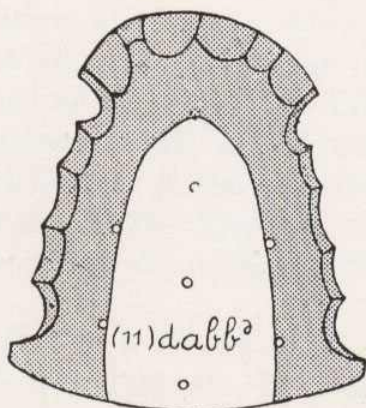
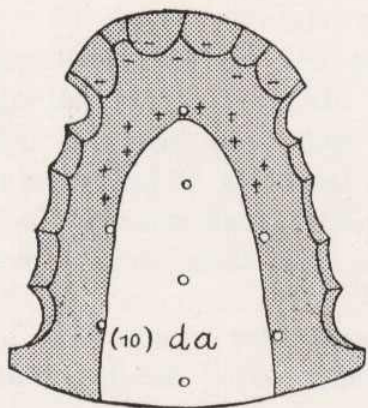
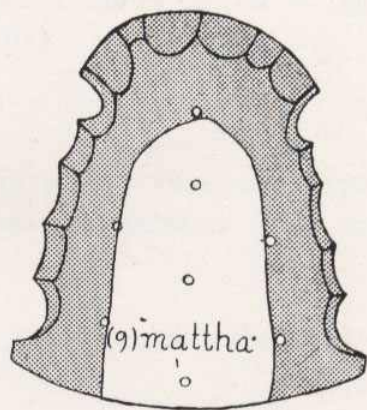
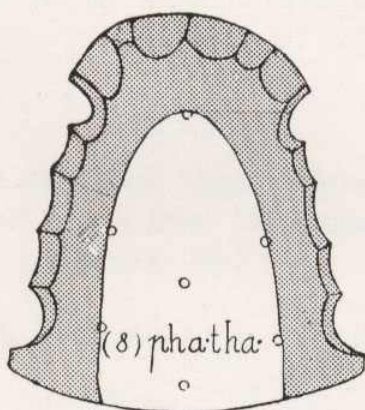
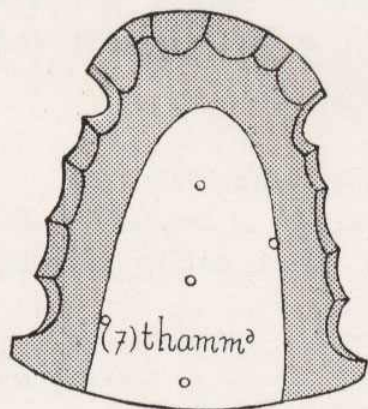
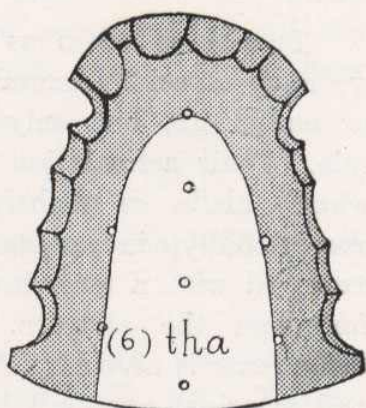
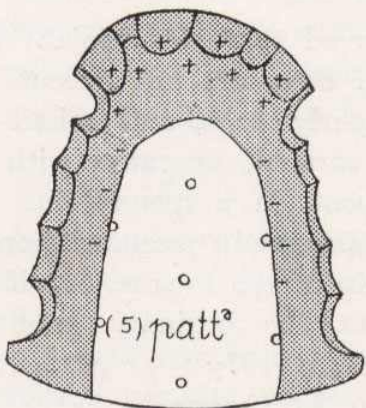
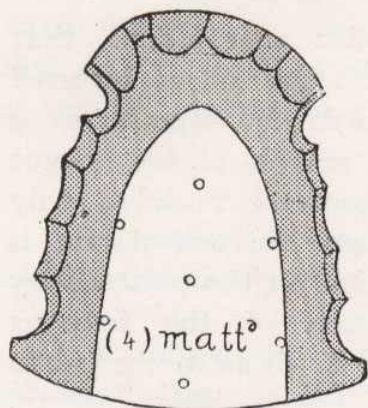
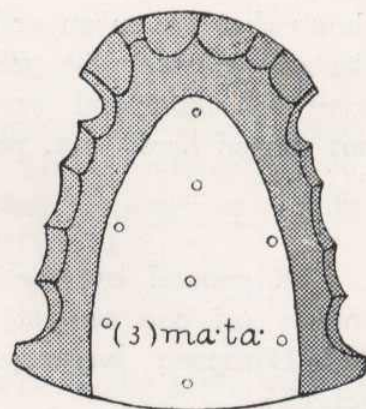
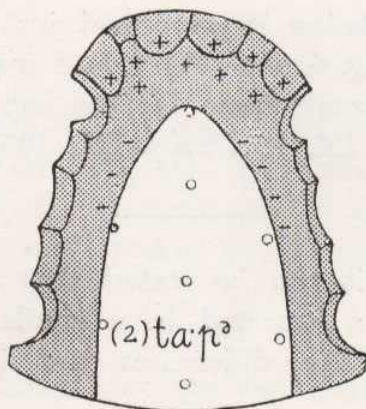
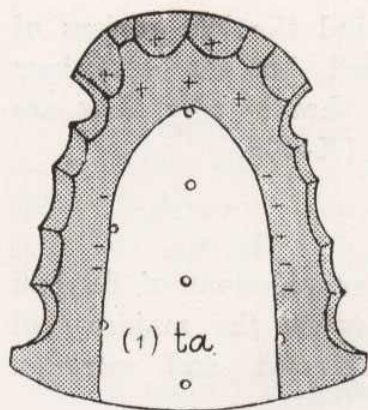
The voiced velar nasal plosive does not occur in the beginning of words. Our artificial palate, though cut just at the beginning of the soft palate,

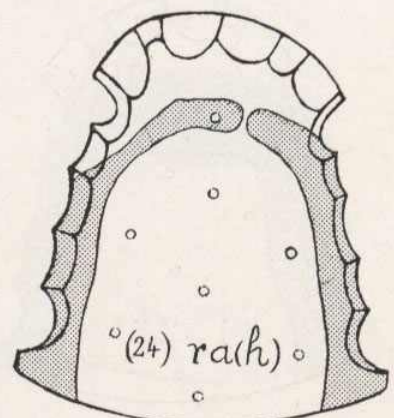
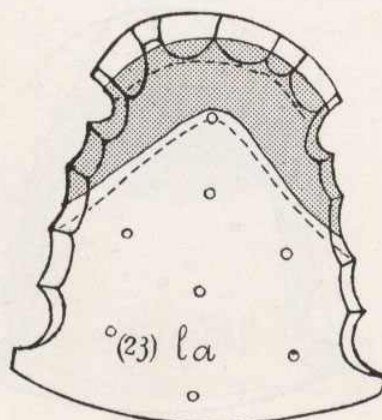
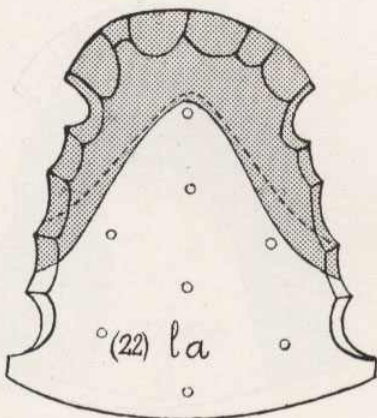
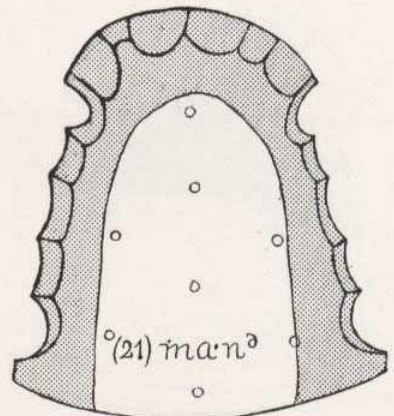
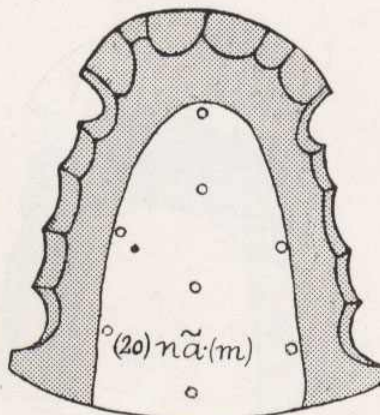
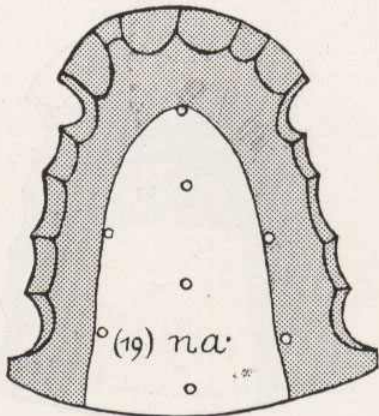
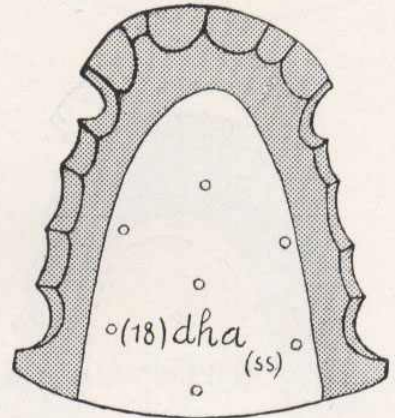
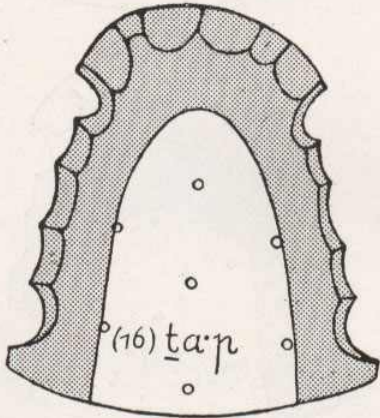
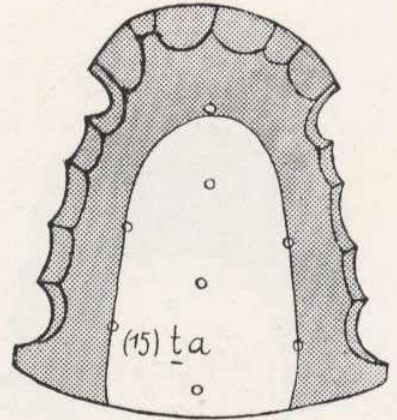
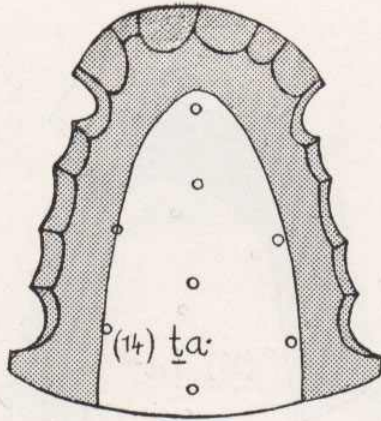
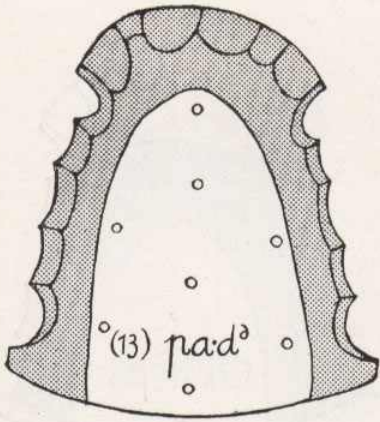
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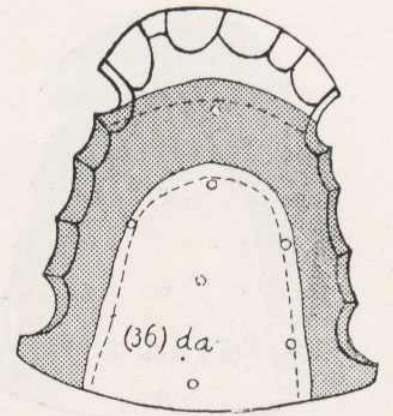
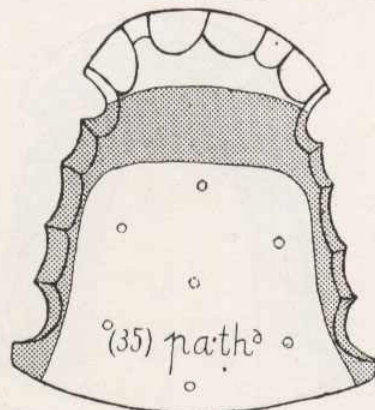
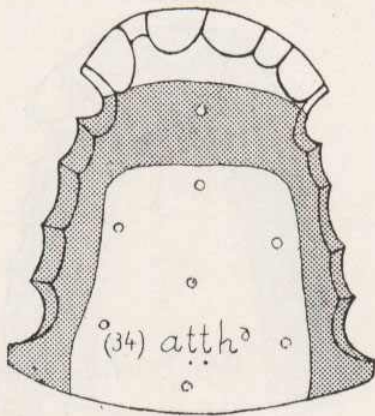
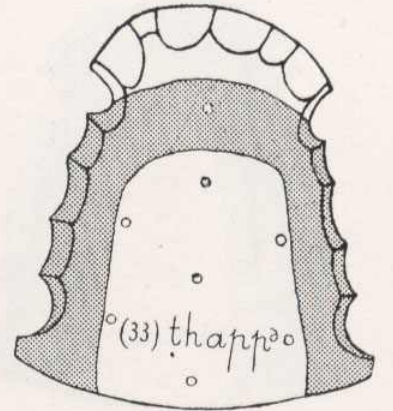
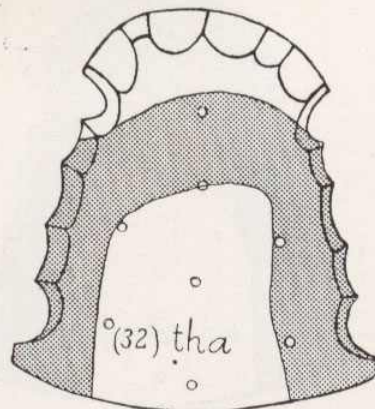
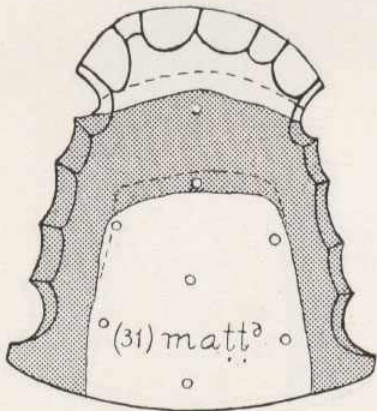
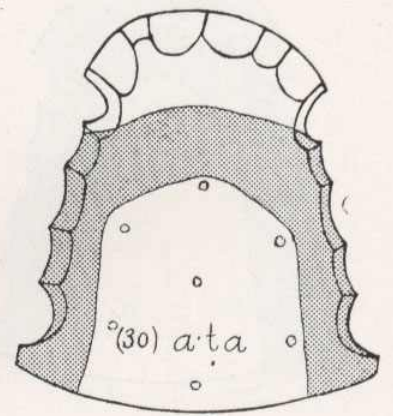
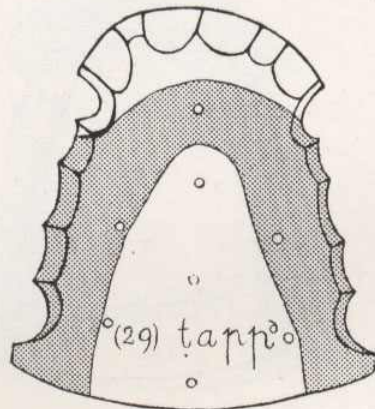
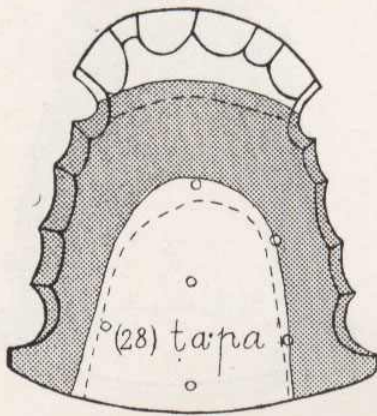
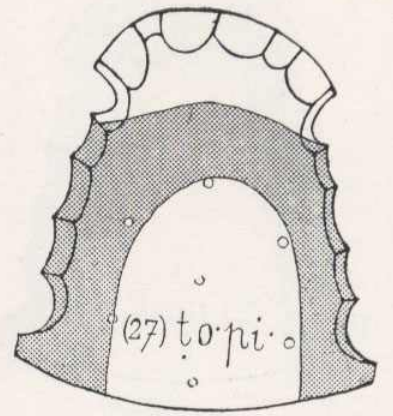
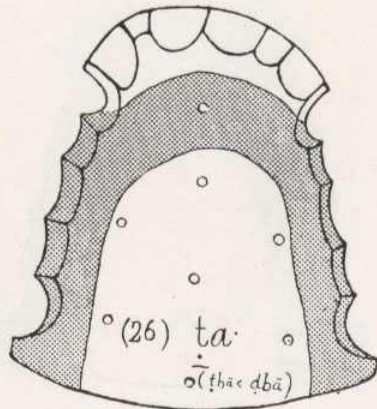
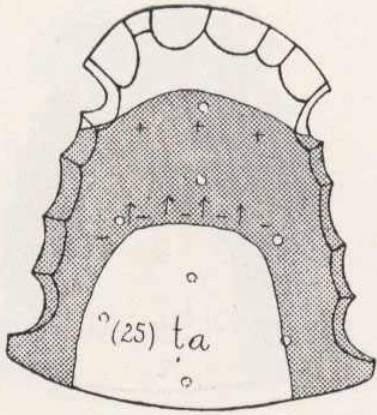
shows that the mean articulation is performed just behind the last molars of the soft palate. The prolongation of the palate was tried, but its indications were not surer and were troublesome for the subject, that is why they are not ranged here. Ex. paŋə IX, 104, maŋə IX, 105, ɳa IX-106.

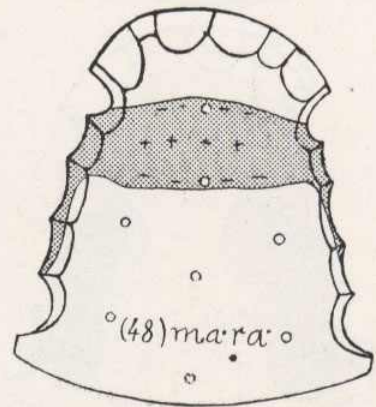
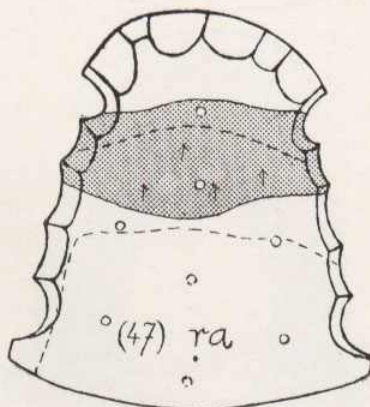
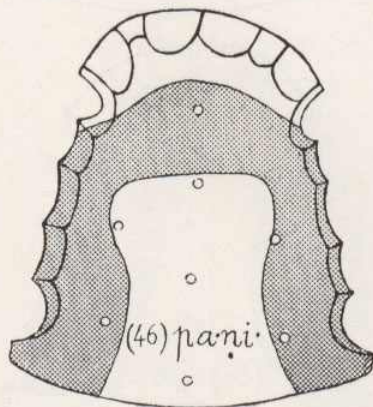
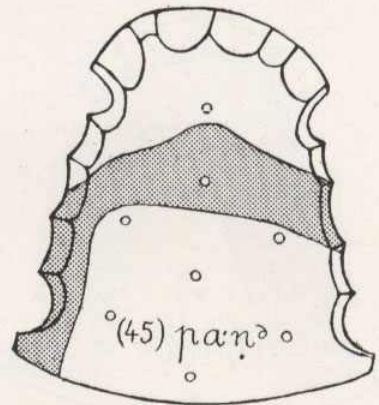
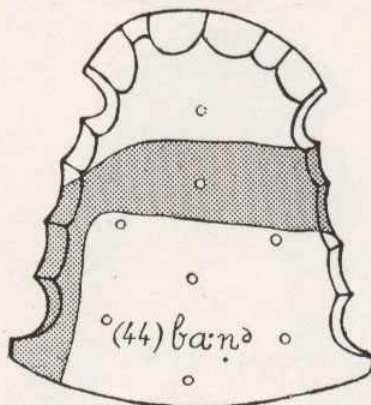
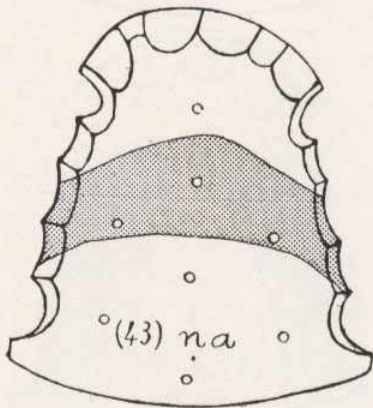
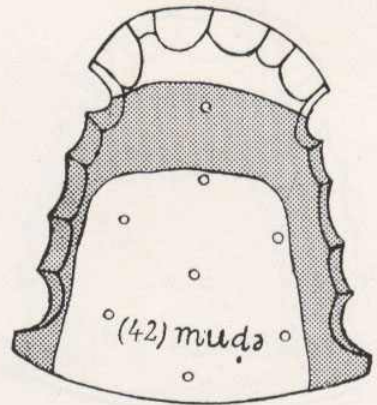
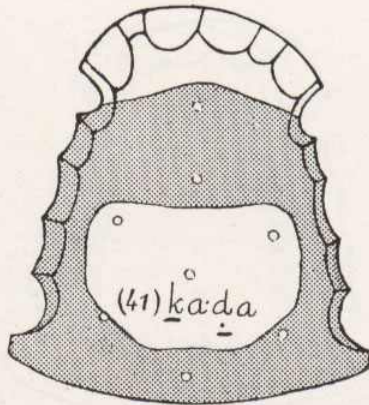
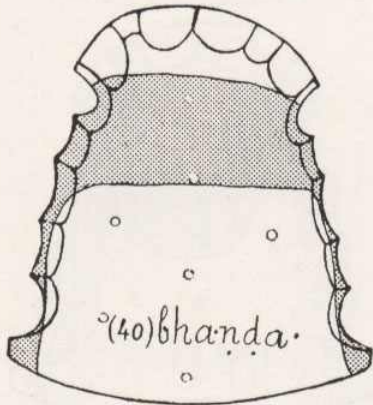
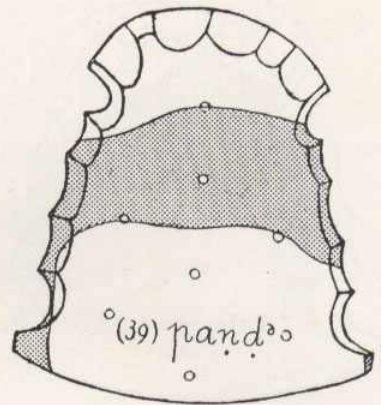
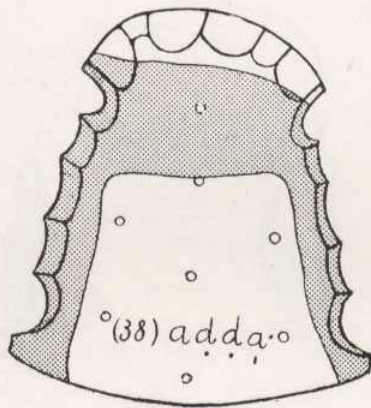
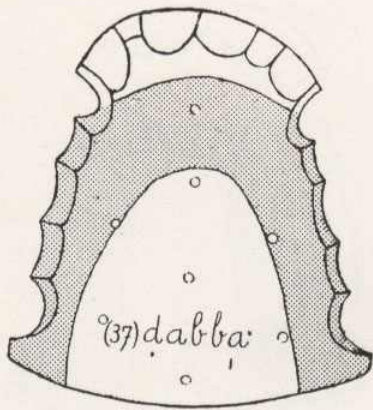
In general conclusion, it can be stated that the articulations of Panjabi sounds (of our subject) are executed in a similar way as the majority of Indo-European languages. The differences are in aspirated and retroflex sounds.

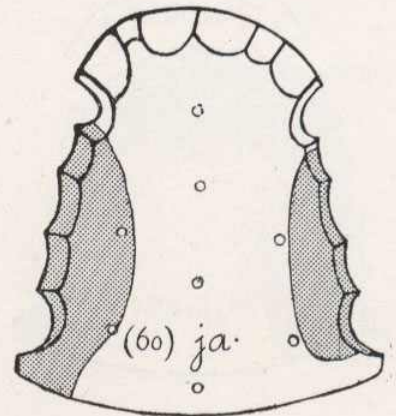
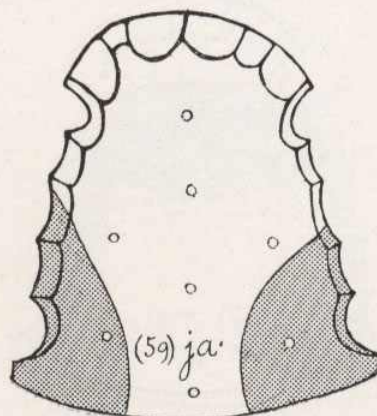
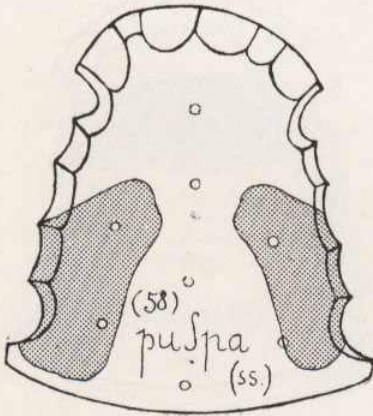
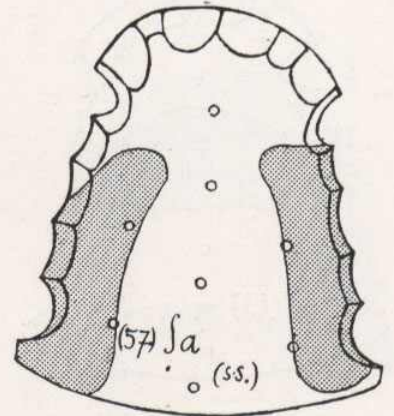
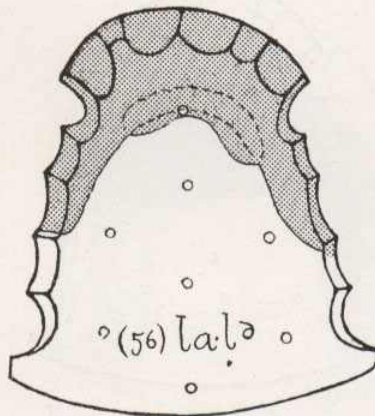
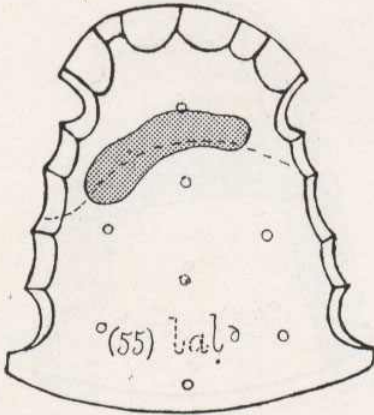
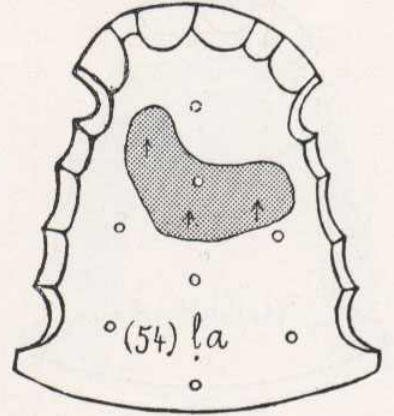
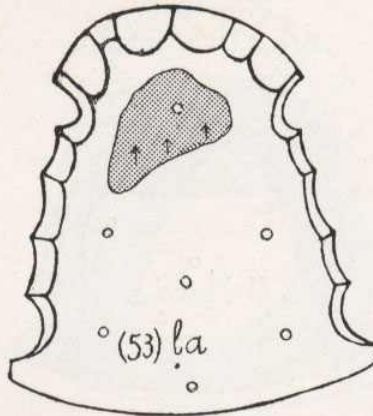
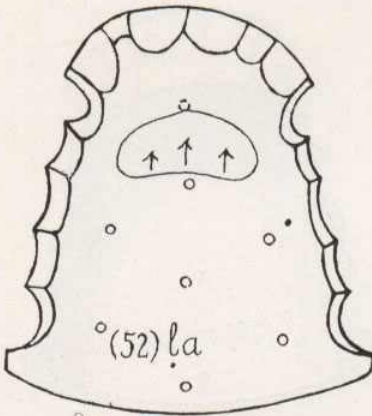
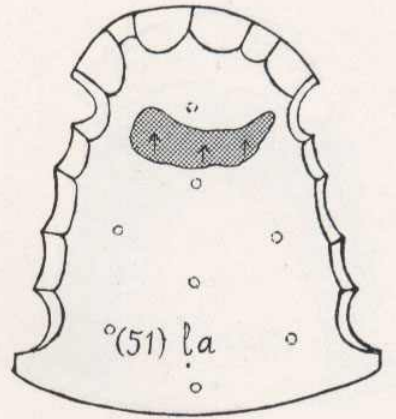
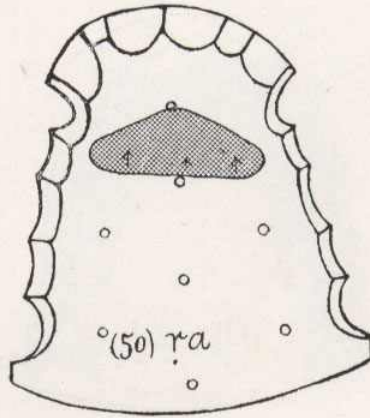
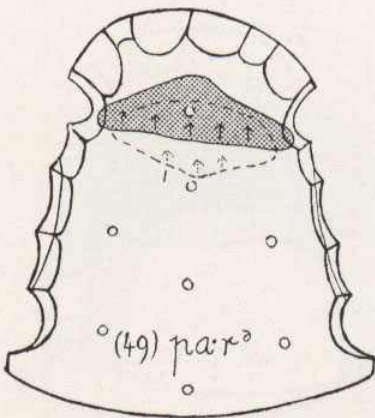
It can be taken as proved that the Panjabi retroflex articulations, that we have especially examined here, are not executed with the tongue inverted or curled up, but only slightly bent, and raised towards the alveoles as a rule. Their articulation is coronal, executed with the margin of the tongue whose blade is slightly bent in a spoon-form. It becomes retroflex only exceptionally, in emphatic (stressed) pronunciation, when the articulation is executed with a stretched tip of the tongue, touching high on the palate, very far from the alveoles. But the ordinary pronunciation of the retroflex consonants is alveolar (Pl. IX, n. 107γ-δ) or post-alveolar (α - β) as to the palate and marginal (coronal) as to the tongue.

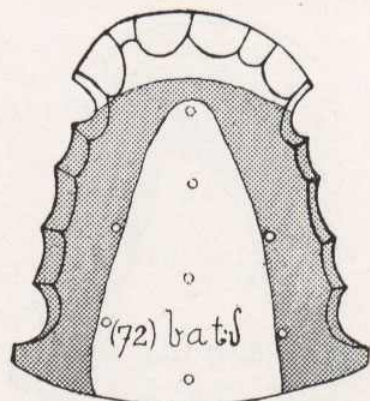
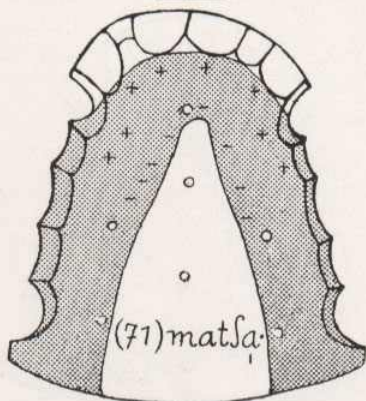
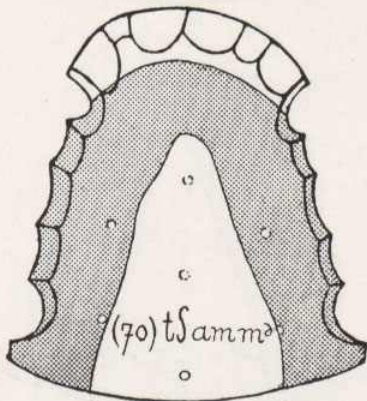
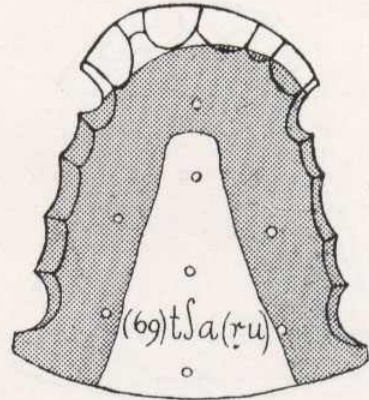
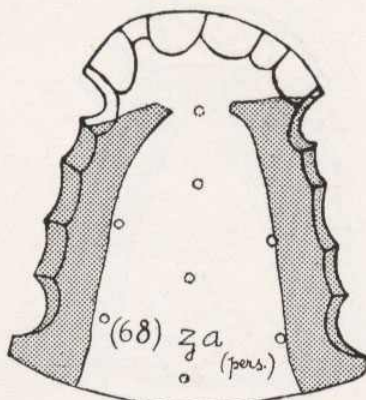
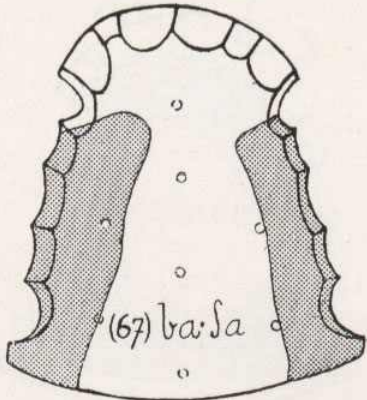
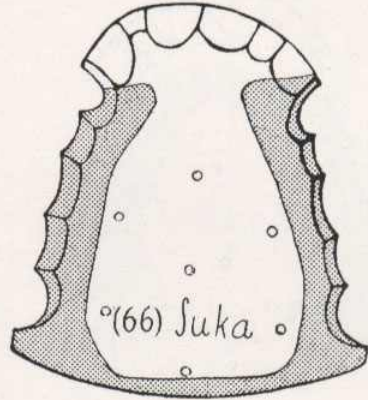
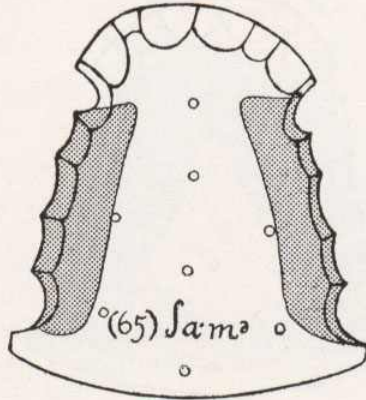
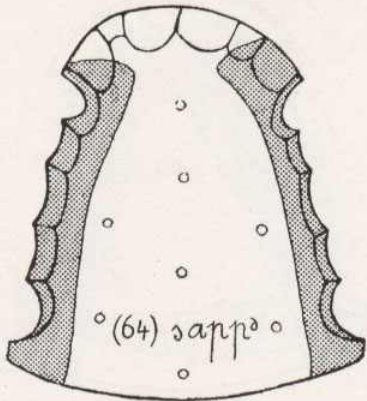
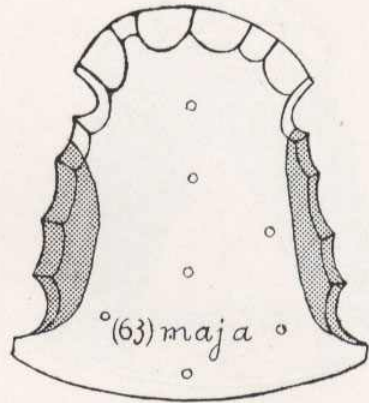
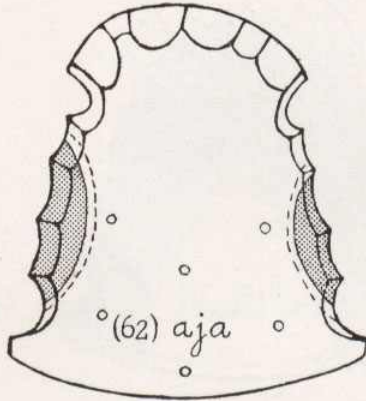
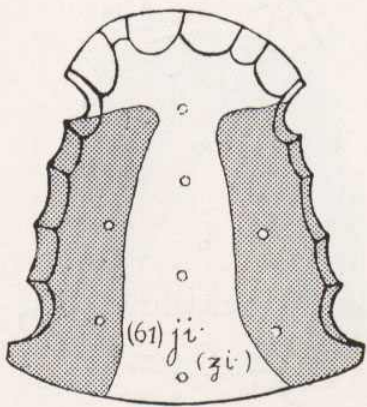


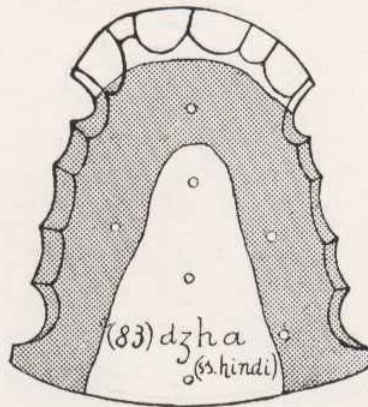
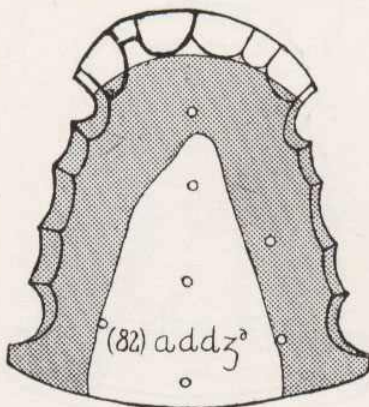
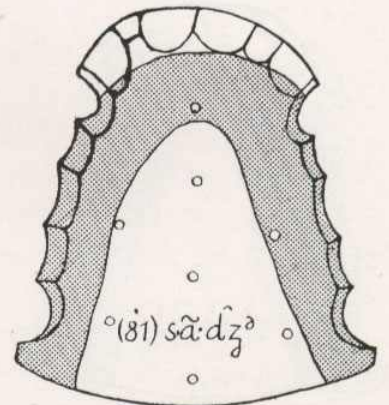
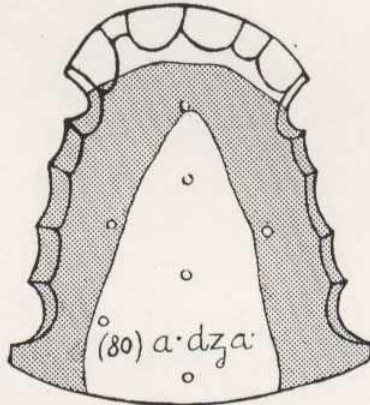
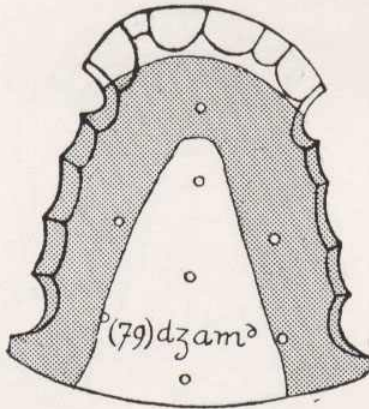
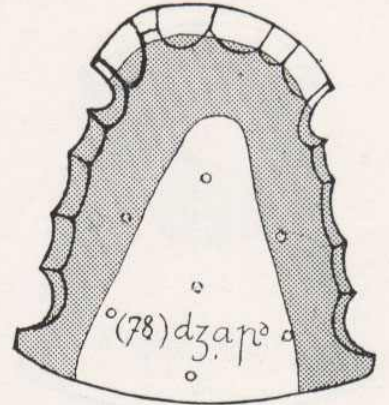
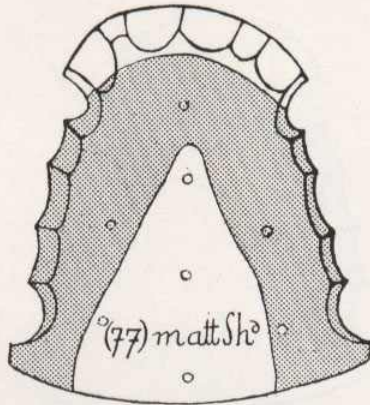
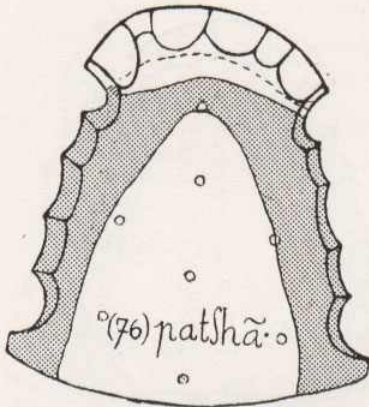
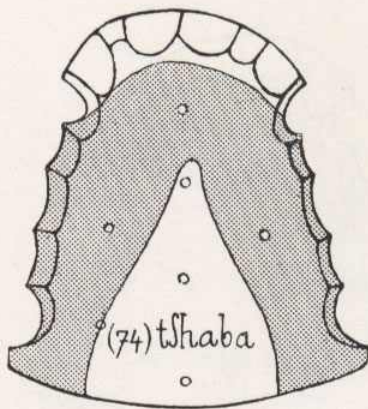
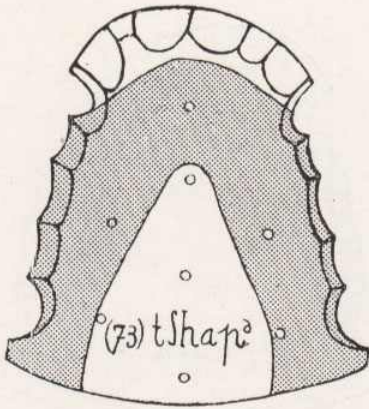


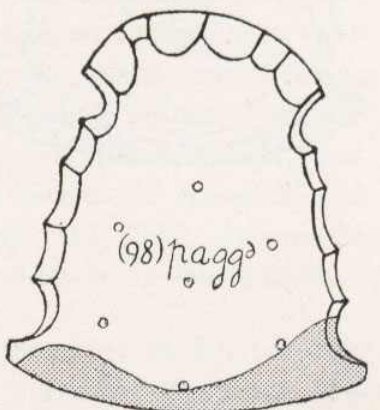
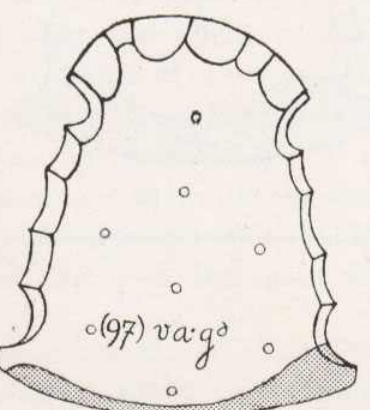
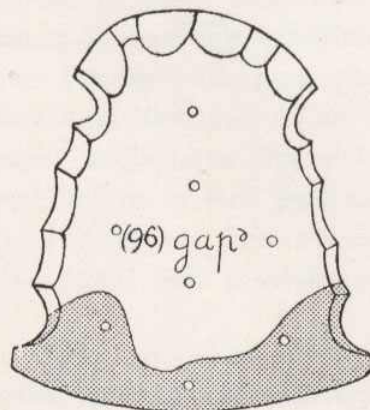
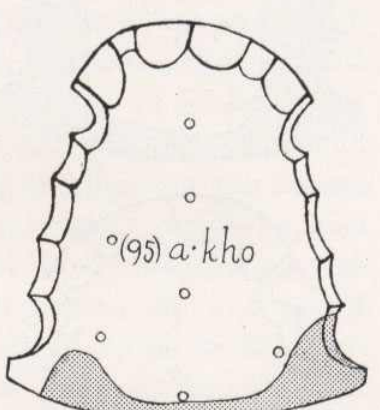
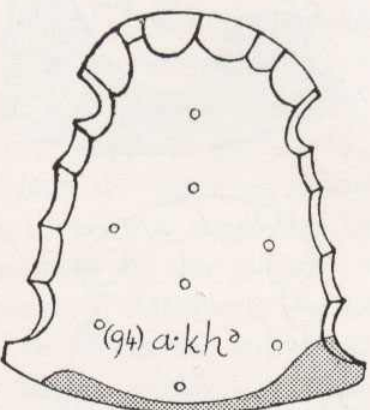
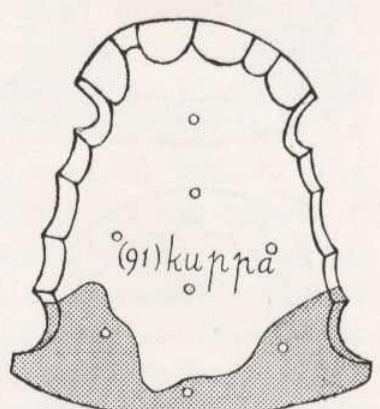
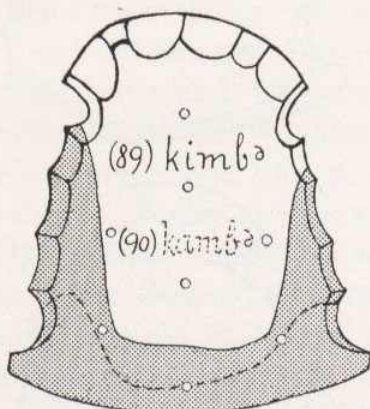
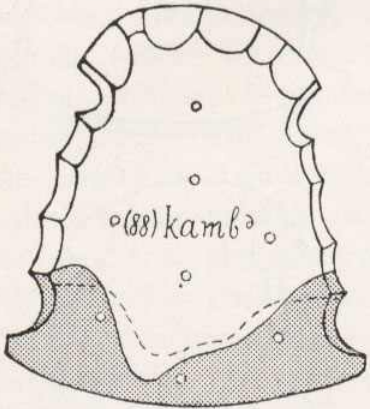
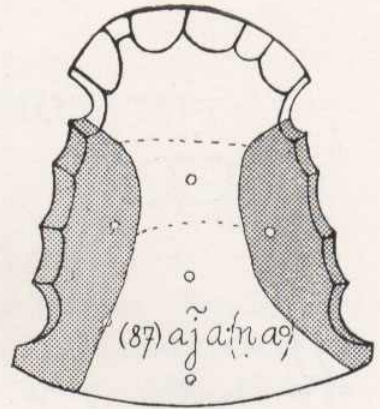
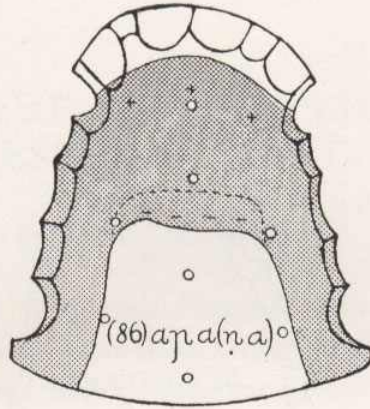
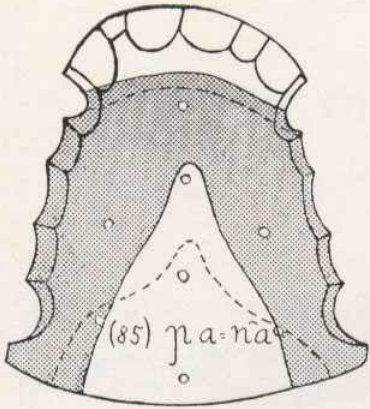


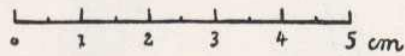
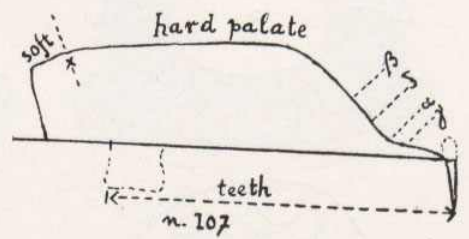
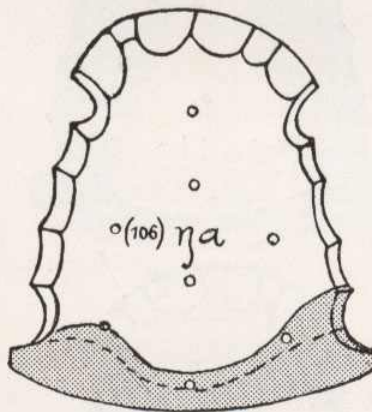
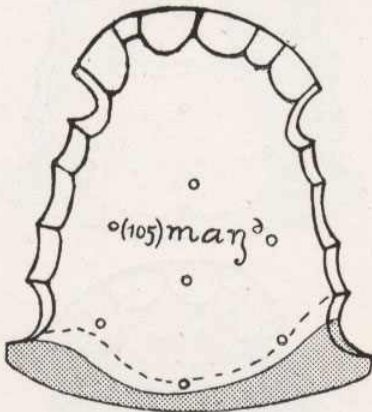
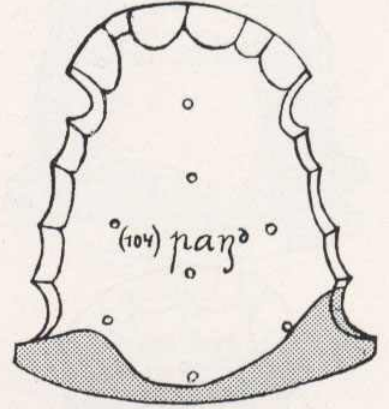
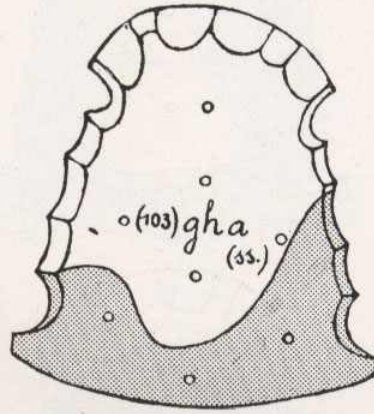
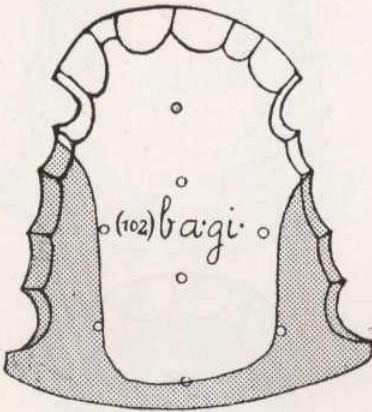
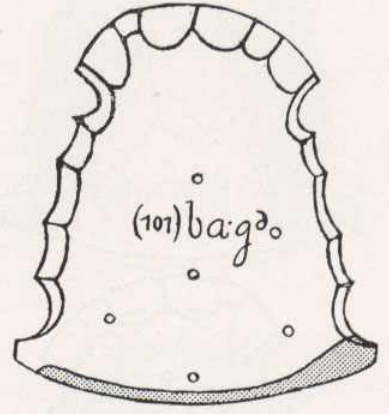
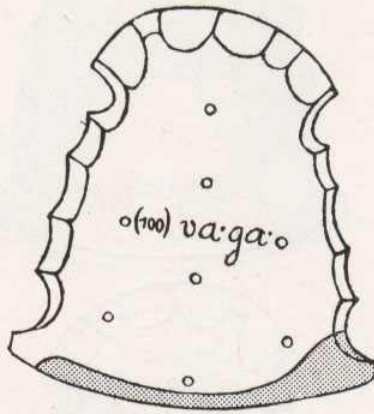
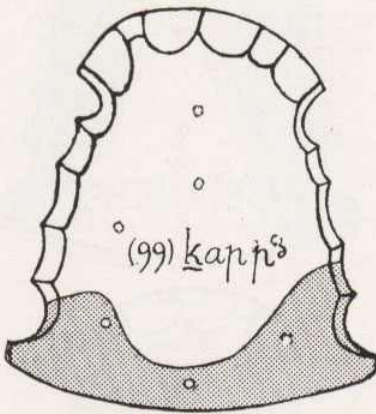












DIARY OF THE 1931 EXPEDITION TO WESTERN TIBET.

BY DR. W. N. KOELZ.

JUNE 7.—At 11 we set out from Naggar with 15 horses. Thakur Rup Chand has marked all the parcels and has written in his diary where are located the mousetraps, old newspapers, blotters, cartridges, medicine packets, silver money, and the other things we will need during the four months before we cross the Great Himālayan Range for home. Gyaltsen has had a stubborn fever for several days and will cover the first stage by the motor lorry. The other servant, Dorje, has bought a kilta to carry home to the family in Lahul dainties acquired from the proceeds of his labour. The Lahuli family is like an ant-hill. All the members labour for the benefit of the rest, with the exception that a little money is reserved by the worker for buying a few cheap cigarettes. Our caravan personnel is temporary. One of the party is going to be married to-night and most of the rest are involved in the festivities. In spite of the innumerable things that had to be put into the baggage at the last minute and the endless additions that Miss L. decided were indispensable for the journey, including rosewater, tan remover and an alpaca muffler, all of which have been surreptitiously removed and stored against possible use at home, only an old tin has been left behind. It is dead sure that my nose will be burned raw when we get above 10,000, with or without all the remedies designed to prevent it. Besides, there is no room on the horses for superfluities. Each servant needs a horse for his provisions, since no food can be had for the first 2 months of the journey, and where will be put the heads of big game, dried plants? Although we have broken up our happy home, everyone was relieved to be on the road, after the months of negotiating and planning and then the 2 weeks of strenuous waiting for the first horses to cross the Rothang La. The road to our first halt Manali, that leads along the precipice above the river and about which I was so thrilled last year, has become common place, so habitual have magnificent views and stirring locations become. The mosquitoes that last year at Manali enforced an all-night vigil have not yet taken up their posts. A raucous-voiced woman that perched on a cliff half a mile above us swore at stray horses or humans that trespassed on her vacant fields amused the company till dark, when she descended and invited us who had been the main offenders to be her guests.

June 8.—The bridegroom, a lad of 18, joined the caravan at 10, together with four of his relatives and we set out from Manali. During the night new

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horses arrived to replace the feebler ones that had been recruited into the service at short notice. Also two animals were added, loaded with tea and shoes for sale to natives en route. The animals now total 17 and the horse-men 5. Our staff numbers 4 but 21 more men will be added in Lahul and one left behind. The horsemen are all Moslems and our men Buddhists. Gyaltzen has got rid of his fever and there is no longer the prospect of having to start with all new help. Dorje, the last recruit to the service, is blissfully good-natured and painfully smiling but doesn't understand Urdu or Tibetan, his native language any too well, and therefore is of limited usefulness. Besides, he sleeps like a stone and can't be awakened short of inflicting bodily harm and is so innocent that he would willingly give all our possessions to any stranger who asked for them. The need for guarding camp is, however, after to-day no longer urgent. The thieves that operate from Manali do not go beyond the Pass and in the territory ahead, except possibly in Leh, thievery is unknown. The Manali thieves have been especially active of late, having carried off 13 sheep loads in daylight, and the Lahulis, their chief victims, are so exasperated that the next bandit caught will probably be roasted alive, a fate that one met before. Once they let the robbers cross the bridge and then they pulled up a couple planks behind them. When the robbers tried to flee back across the bridge, they fell into the river below and were finished. Four of the bridges on the road to-day were out, the timbers snapt from the heavy snow.

June 9.—At 7-15 we left Rahla (alt. 8,850) and arrived on top of Rothang (alt. 13,400) at 12-15; at Koksar (10,431) at 3-15. A fresh breeze began before daybreak and blew until the top of the Pass. From Sum, 2 hours this side of the crest, to near the river on the Koksar side the path has been on snow. Beyond the crest the snow was soft and the horses often broke through the crust. On the lower stretch, over small rivulets there was such ice that a path had to be cut and the horses led across one by one. One animal loaded with a trunk and a bundle of newspaper slipped and rolled 50 feet down a snow-bank, but nothing was the worse for the slide and a revolution or two. Contrary to all reports and expectations there is hay for the animals at Koksar. The tent-dwelling Tibetans, that like the birds move north and south with the season, we left behind a few miles above Manali, excepting one family that has camped near the source of the Beas, on the valley floor. Last year in Mid-July the advance guard in full strength was encamped in streamer-bedecked tents at Sum. The Lahulis with horse and goat caravans are swarming into Kulu and their worn-out grass shoes mark the path. The horses of one of these caravans fled last night from below Rahla, having first eaten up our horses' breakfast, and were recovered only at Koksar where they tarried on their way home for refreshment. A huge herd of sheep

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and goat with dog supervisors also crossed with us and one lamb was born in the snow and had to be carried down. A little later each shepherd will be stuffed with lambs and kids, that cheerfully let themselves be transported in the folds of the herdsman's woollen blouse with only their heads exposed. Two fakirs, completely naked except that one had an umbrella and a thin cotton sheet, also came with us. Barefooted on snow for five hours against a breeze that chilled their proper dress they went on without faltering, but showed signs of discomfort when we stopped to rest on a little area that the people had cleared of snow for the sheep to halt on. Rup Chand offered them hot tea but it was refused. A cigarette was accepted. I am told that these people make free use of various habit forming drugs, most of them unknown in the Occident, which furnish them with delightful stimulation, transforming dream into reality and in other ways enhancing the psychic life. Flowers are few. Only here and there the little royal purple iris (*I. Kumaonensis*) had formed a bed of bloom, and of the salmon pink primrose (*P. rosea*) that above 11,000 feet makes a bright-hued carpet before the retreating snow, only a stray flower has blossomed. For the first time in this country, I have worn coloured glasses and the results are splendid. The colour of the glasses that at first tints everything is soon forgotten and the snow is seen in its natural white.

June 10.—We left Koksar at 8 and got to Sisu (alt. 9,900) at 1. The road is all right except in perhaps half a dozen miles snow extends across the path to the river. The sheep and goats that are daily pouring across the Pass into Lahul are counted at Koksar and a tax of $\frac{1}{4}$ anna per head is levied on all but youngsters of this year. They are exempt. Herds come from as far away as Palampur to feed on the non-pavil grass that grows on the lofty Lahuli slopes. The Koksar bridge bobbed like a cork on the waves as the droves crossed and I speculated on the probability of my being marooned with the broken bridge between me and my baggage. The bridge, however, did not break. A few miles below, the bridge a few years ago crashed into the stream just as the last horse of a caravan got across. On this trip, though we have passed over this road at least half a dozen times, Rup Chand showed me the 'Zangskar Bay', a place where the West Tibetans and Indian hill people used to meet to trade as they do nowadays some 75 miles farther up the Bhaga River. On the way we met a young lama whom I had counted on to be my helper in plant collecting, driving horses to Kulu. To my amazed questioning, he replied simply that his father could not give permission to go along (the boy is past 30)—he had to stay home and decorate the monastery walls in Kyelang. Gyaltzen was seized with such a violent desire to get home that he would have bolted if he could have carried his things, and taking pity on him, (he is a mere child of 21), I agreed to let him off and replace him in

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Kyelang. Now to have no servant in prospect was too much. I inquired from R.C. what one does in the country when an agreement is broken and learned that one goes to court and collects damages. The threat of obtaining justice by this method cleared away all obligation of the father's prohibition and the lama is cheerfully planning the trip. I had to give a written agreement though not to employ him in anything that involved a gun, tobacco, or bird skinning. He will, however, eat grouse (not duck, snipe or pigeon) and any kind of domestic or game animal, except horses, donkeys, yaks or beef. Kolung lama who helped me last year in buying Tibetan paintings and the Sisu abbot called to-day (the latter completely drunk as usual).

June 11.—At 9-30 we left for Gundla (alt. 10,300) and got there at 2. The climate in this area is more tempered. There is even a good growth of pine and birch on the slope facing the village, and muskdeer are said to live in the birch forest. Patches of purple iris, sometimes in a solid bed 100 feet square area, met all along the road from Koksar, and the common cowslip or marshman gold (*Caltha palustris*), that is the glory of our American meadows in spring, lines the banks of the meandering rivulets that from afar look like fissures in the earth with gold inside pouring out. These flowers in places grow 4 feet high. I found some 10 plant species that I did not get last year, mostly tiny things that shortly will dry up. In the Thakur's garden in Gundla the apples were in full bloom. One of the trees was covered with huge deep purple rose flowers, very fragrant and most attractive. I shall try to introduce the species in Kulu and America. The fruit I saw last year, small red apples (mang-kushu), said to be of nice flavour. Such apples as grow here (there are a few other trees in Kyelang and more in the lower valley) are all said to be of superior flavour. Last year pears and apples from the upper Rampur valley at slightly less elevation were of excellent quality, equal to the best American fruit. The natives, however, have little interest in fruit and rarely plant the trees, or when planted can't bother to protect them from the cattle that gnaw the bark. The horsemen bought a sick sheep for Rs. 1/8/- and after performing halal, skinned it and took it along on the march. An invalid goat they put alive on one of the horses for future uses. Cases of foot rot are frequent in the flocks. Sometimes other epidemics seriously decimate the goat and sheep herds and even affect the cattle. A few years ago most of the cows died off and the horses had to pull the plow. The results were bad. The fields are small and stony and the quick movements of the horse don't fit him for agricultural pursuits under such conditions. In Kulu a horse does no work except to haul goods on the highway but in Lahul wood and manure are hauled on horses. Hay or crops from the fields are not thus transported. In Kulu humans, chiefly women, carry the wood, crops, fodder, or manure.

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June 12.—We left Gundla at 9-15 and got to Kyelang (alt. 10,300) at 2-30. Paljor, last summer's coolie, met me a mile before Kyelang with a bouquet of dandelions and in the village I saw the main citizens, the native school teacher, the doctor, the wazir and the white missionary. Some interesting people had arrived from Danupa, a district of Ladak, en route for Trilokanath, a place which it is this year particularly advantageous for both Hindus and Buddhists to visit for their soul's welfare. These people are partial to brass jewelry and wanted to sell me dried turnips. They are said to eat no meat and some say they don't even use milk from cattle or touch the calves until these are a fortnight old. The weather is decidedly cool and the season backward even here. The barley, potatoes and wheat are just out of the ground, so they have been hoed once, and the fields are being prepared for buckwheat. In all the fields can be seen lines of stones that would intrigue an ethnologist but they have no other significance than that they mark the irrigation channels and are used as needed to dig the mud out of them. The big *Eremus himalayica* that from below Gundla to Kyelang grows in masses, often several acres in extent, is in full bloom and the effect of the masses of tall creamy spikes is stunning. Gyaltzen's mother sent me some apples, very well preserved, of nice colour and excellent flavour. His brother brought 2 sets of chikor eggs, nicely marked, 12 in each set. (The chikor is a grouse about as large as the American Ruffed Grouse.) The eggs of this bird are gathered in quantities and are even salted down for summer's use. Chikor have been numerous all along the way, likewise Snow and Blue Pigeons. The large Snow Grouse has gone back to the peaks and none were seen near the road. The ibex have also gone back to the snow line. Sheep are going forward to-day to cross the Bara Latse Pass. There is much snow and the consensus of opinion holds that we cannot cross. Rup Chand's 'Choti Ma' they said sent me milk and invited me to tea. I knew that Rup Chand's mother wasn't here, but the 'little mother' proved to be his maternal aunts. Similarly a child may call his real father his 'little father', since technically his father must be the eldest brother of the family.

June 13.—I spent the day about town, visiting the chief citizens. The sojourn here was not for that purpose, but the men wanted a day at home and the horses were none too fresh for the hard work ahead. The Wazir, a clever lad of 22, gave me tea and the physician a gifted Plains Punjabi invited me to dinner. The physician has become very fond of his adopted country and his brilliant and devoted labours are much appreciated by the populace, who ordinarily take medical aid quite for granted. The Wazir regretted to hear about the childish pranks of his subjects. He explained that they had seen the tactics employed by their more sophisticated brethren across the Pass (many Lahulis come into the Kangra Valley in winter to work and

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it is not uncommon for their employer to disappear after they have finished his work, leaving them nothing for their labour), and observing the success of such methods, many tried on opportunity to emulate them. So excessively simple the Lahulis are for the most part, that their attempts are transparent, often amusing. Theft is almost unknown and lying even is not common. Most of the court cases are the outcome of drunken brawls. The Wazir is very fond of English food, especially tea, cakes, and apologised for the sodden specimens he served by the scarcity of chikor eggs. Ordinarily plenty can be had but this year the birds are in no hurry to lay. I sent him a couple of dozen hen's eggs that the well intentioned family at home had incorporated in the baggage, which so far had served no other use than to make the caravan uneasy. The missionary's wife is fond of flowers and the specimens in her garden would delight any flower lover. I never saw such immense pansies or such tall lupines in my life and the colouring of all blooms was so intense. A lilac bush was in full bloom and the roses were in bud. Tulips, iris and peonies would make a spectacular exhibition under such climatic conditions. In spite of the hard lives they lead and the excessively plain food they eat, many of the Lahulis, I was told, live to be 80 and some to 100. The climate is very healthful and almost no diseases are known. Tuberculosis and cancer, the scourge of the Occident, are totally unknown.

June 14.—We left for Jispa (alt. 10,500) with an over-cast sky which turned into a drizzle and kept on so, for about two hours. At Jispa there is a broad plain with a good growth of cedar trees and at this season good grazing for our horses. As yet we have met pilgrims only from Zangskar across Shingo La, but they say others are on the way across Bara Latse La. Some say there is no grazing on our road above here, which others contradict but all agree that unless the sky remains perfectly clear the snow will be too soft and the horses will not be able to cross the Pass. The Wazir has given orders that coolies are to accompany us to lighten the horse loads, if necessary, but if they sink at all they won't be able to endure the journey, even empty of load. I visited Rup Chand's mother, a tiny quiet woman, who, when I expressed our appreciation of her son, replied as prettily as any woman of superior breeding. She has of course never seen a school and has hardly been outside her little valley. The conversation with her son during the two days he was at home centered chiefly on the subject of his welfare. What sort of food had he had; were his clothes warm enough; he should be careful, etc., from which I concluded that mothers are much alike whether in America or Lahul. The little woman has a tapestry tanka representing the Blue Tārā, done principally in tones of yellow, blue and apricot. It is of so fine weave and of such excellent drawing that except on close inspection it appears the work of the painter. It is apparently of great age but well preserved. The

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lunch served and prepared by an ordinary coolie would have made a first class chef envious. There was a meat stew, prepared with a species of truffle (mokhshe) that grows parasitic on the roots of a species of parsnip (bakhyot). On departure Rup Chand's mother gave him a small silk rag with a knot in that had been sent to her by the Kushog of Hemis and cautioned him to beware of the devil, especially at night. She watched him from the roof till he was out of sight. He is all she has left of a family of three sons.

June 15.—The weather cleared but huge banks of cumulus cloud filled the sky during the afternoon. I gathered some 30 species of plants. The valley is warm and plant growth is advanced. Wild apple trees were in full bloom. In the mouth of a little stream that enters the Bhaga swarms of small fish a species of cyprinid (shiner) were gathering, attracted probably by the warmth of the water. They are said later to collect in still larger schools and are then caught by the natives. I tried to find in the village ancient iron arrows which I heard were occasionally picked up here, but though the natives knew the implements and described their form, no arrows were forthcoming. Around an exceptionally large cedar (*Juniperus*), about 3 feet in diameter, they have built a house with one opening; the walls are about 12 feet \times 12 feet and where the door is about 7 feet high. Behind is a small box-like construction 4 feet \times 4 feet, open to the road, in which is housed a smooth boulder about 2 feet in diameter. On this boulder has been incised the image of a male demon deity riding on a cow, holding in one hand a bellows and in the other a hammar or axe. On the tree are hung numerous rags, these strung mostly in festoons, and in front of the whole on the road edge is a pile of stones and cedar brush, rags, stones and brush—the offering of pious travellers. The figure is the portrait of Tingtingtsi (Lahuli) or Dorje Lekpa (Tibetan), a blacksmith who is feared throughout Tibet as a mischief-maker. If someone wishes to curse an enemy, he comes to the shrine, burns butties and strikes the tree with an axe. It is rumoured that from such a wound blood issues from the tree. To invoke Tingtingtsi is, however, a dangerous practice since he is apt also to do harm to the curser and, furthermore, the populace also metes punishment to those who dare disturb the demon. When a fierce wind blows down the valley the people suspect that someone has thus invoked him and the tree is inspected for wounds. On a certain day in winter, the nearby villagers bring gifts of butter, beer, etc., to the shrine, a mark of respect that is accorded also to Sahibs if the populace is not hostile. A fire had recently been lit inside the house and cedar incense had been burned.

June 16.—We left for Patseo (alt. 12,400). The valley above Jispa grows narrower and narrower till Patseo where there is a broad plain extend-

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ings on both sides of the river. About three miles above Jispa two other streams from opposite directions join the Bhaga and here Sumdo and Dartse villages end. One village lies in the Nulla that comes from the Koksar side and two in the Nulla toward Shingo La, the Pass that opens on Zangskar. Just in front of Dartse there is a huge pile covering several acres, basic metamorphic rock fragments which the natives call Zimuk. There is a legend that on the site there was once a rich meadow with a village. One day the people were having a picnic (the Tibetans are fond of picnics), a strange lama appeared. No one paid any attention to the stranger, except an old lady who treated him with proper respect and gave him food. The lama accepted her hospitality and retired. Shortly after a piece of the mountain fell, burying the plain and all the people except the hospitable old lady. She was carried across the river by the wind. A devil Dergott, against whom no powers on earth can prevail, with teeth from ear, to ear was born out of the souls of the perished and now has quarters in the rockpile. Certain people have seen him and no Lahuli will spend the night anywhere near his domicile. It seems that there was probably a meadow which was buried by a land slide, except that between the front of the mountain and the rock fragments there is a narrow stretch free of rock. There are a few scattered birches on the right river slope up to 13,000 feet nearly to Patseo, but above that no tree growth. For the first time since Rothang Pass the weather has been perfectly clear. Herds of sheep headed for Rupshu have arrived nearly to Patseo. We have brought along a man from Rerig to show us the best route across Bara Latse La. No coolies are available because all the able-bodied men have gone to Kulu for supplies. I bought a beautifully wrought silver brooch from a Rampuri woman who has been spending the winter at Dartse. A horse to-day developed a swelling on his back and the horseman seared the skin around the swelling which was a good foot across. This is the usual method in this country of treating wounds on animals. There is to the left above Dartse a peak, which is the seat of the God Kundru. In the winter a kid, butter, beer, etc., are offered up in front of the hill by certain villages as far as ten miles down the valley. Worship is performed also in the homes of believers at other seasons.

June 17.—Patseo is a fair ground to which traders come from Rupshu, Tibet, Zangskar, Ladak, Kulu, Chamba, Lahul and Rampur. They begin to arrive toward the end of June and some stay till late September. Each district has its own allotted grounds for camping. Not much money is exchanged, trade being effected chiefly by barter. An unlimited supply of chang is brewed, quality considered first class on account of the coolness of the earth in which it is kept buried, and the days are passed merrily. Swarms of sheep and goats, on which the greatest part of the merchandise arrives,

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through the hill sides and from the peak overlooking the site rags flutter. The place gets its name, I am told, from the fact that a stone bridge spans the river (Patharseo, Hind; Dozam, Tibet.). Above Jispa the road is new to me and to two of my Lahulis. Only one of the men has been above Patseo though all have spent all their lives in Lahul. My Kulu grass shoes gave out here after having served some 80 miles of marching. The morning again dawned perfectly clear and continued so through the day. The pensive whistle of the snow grouse began at daylight and kept up till about 9-30 and flocks of snow pigeons gathered on the plains to pick up the grain spilled by last year's trade. The ibex are said also to frequent the ground for salt thus casually left behind. Our guide from some 15 miles below arrived early on foot and says we may cross the Pass if the weather remains clear. We shall have no fuel for the next two camps so the men are now preparing food for to-night and then we will carry fuel for the camp beyond the Pass. Last night the men gathered some two bushels of sheep manure in a pile and made a fire that lasted 24 hours. They prepared their unleavened bread and then after drying it a little in the sun, buried it in the glowing manure for baking. The odour of the fire is very pleasant and the bread appears none the worse for the unusual treatment. When ready to start, the guide said it was late to-day. We will sink in the snow beyond Zingzingbar and beyond Z. We have to go if we are to cross the Pass on the next day. The horsemen are delighted with the delay. They are afraid of snow and say we must wait for the sheep to go ahead, etc.

June 18.—This morning at 2, the alarm went off and the men got out of bed. At 4 they had not yet gone for the horses but by dint of some brisk hustling from Rup Chand they were ready to start at 5. I don't know whether their deliberate movements were due to fear of the Pass or of the dark; the latter is a fearful thing for most hill people, and I have found before now that nothing can induce most men to travel alone at night. We are a company of eleven though and under such conditions few would be afraid. The grass which was very short, insufficient for the horses to graze on when we arrived in Patseo, has become good pasture. On a meadow Gudingding, some two miles above, there was even luxuriant fodder for this season. At Zingzingbar, about six miles up the river, there is a house for servants (serai) but no rest house. A little farther on we struck the snow. In a few places we had to cut a path for the horses but for the most part the going on the snow was excellent. At 11-30, after a gentle ascent all the way, we arrived at the edge of the Pass (16,200) and camped at Chorten Rangjung, a small level area now free of snow. It is so named because a Chorten like formation can be seen on the side of the 18,000 odd foot peak in front of it. A colony of marmots seems to be occupying the underground portions but the

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tenants did not put in an appearance. The horses for the first time to-day sank deep in the last 20 feet stretch of the journey. Five road building coolies are crossing the Pass with us and will help us to-day in constructing a path along the bad places. A few travellers are said to have crossed this season but without animals. We have brought food for our horses from Jispa, for there is no grazing here. Vegetation springs up as soon as the snow melts above Zingzingbar (14,000 feet). I found a little mustard an inch high (*Draba tibetica*) with well-formed fruits and a little purple locoweed (*Astragalus*) was also in bloom though the snow had not retreated from more than a ten rod square. The snow grouse seem to find enough to eat on the occasional bare spots on the lofty peaks that rim the valley. The day has been brilliant, an ultramarine sky and the sun delightfully warm. Streams are gushing out from every snow bank, and horned larks and snow buntings are twittering on the bare places. A bearded Lammergeier soars overhead and three yellow-billed Choughs seem to have business on the Pass or beyond. After two hours rest we all set out to explore the ground to be covered to-morrow. The road is really bad for the reason that by day the heat is so intense that the snow has become granular and the particles are so icy that at night not much solidification occurs. Thirteen men went on about three miles into the Yunnan River bed, one man walking behind the other, each sinking at every other or 3rd step half-way to the knees and for variation, to the waist if some stone chanced to be beneath to absorb the heat and accelerate the melting from below. There is only one bad place, if one does not take into account the sinking, and that is along a little lake near the headwaters of the Bhaga. The banks of snow are very steep and the path must run above. If the horses slip they go into the lake 100 feet below. The lake in its dazzling setting is of exquisite beauty. The winter's ice has broken into irregular plaques of alabaster or purplish snow that float in the sea-green water. All around nothing is visible but the snow plain that forms the Pass crest and the enclosing ranges that are likewise wrapped in a shroud of white. One of the Mussalmans remained behind in the silence and stopping his ears with his fingers burst into a brief musically pleasant chant such as I had heard in the winter twilight from the mosque towers on the Plains of India. In camp we found three more Lahulis who had come from Jispa en route to Kinlung to reconstruct the bridge. They all had a load of provisions and seemed not much fatigued for their march of some 21 miles up-hill. We are now 19 men assembled. All are very congenial together and pass around their water pipes and cigarettes like intimate friends. The hand, however, always intervenes between the pipe stem or cigarette and so the practice is not so chummy as it sounds. The old guide though past 60 is as spry as any of us and knows the Pass well. They say he is not afraid of it in any condition. The fearful winds that make Rothang so hazardous do not blow here and there is only

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the snow to battle. When caught with horses in heavy snow-fall, yaks are brought from the villages below, and their steady plodding opens a path.

June 19.—The night was perfectly clear with a new moon. On all sides peaks of 18,000 feet shut off the view, all wrapped in glistening starched white robes blotched with huge blue shadows where in spring the valley will be. The valley that forms the crest of the Pass stretches to the horizon in the same unbroken white and not a breath or sound disturbs the starlit majesty, except that now and then through the night stray boulders loosened by the frost crash down with fearful roar. Bara Latse is a very easy Pass when there is no snow. For 3 miles or so it is fairly level at the crest, furrowed by several valleys in which 3 rivers rise, the Bhaga, Chandra and the Yunnan. The first two flow on opposite sides of the mountain range for some 40 miles and then join to meet the mighty Sind. The little lake Tso kumtsi of the natives, that is now so lovely and inconvenient a thing, dries up in summer. The camp was again aroused at 2 but in spite of a biting wind the men sat calmly on the snow (there was no fuel for warmth, barely enough to make some tea) and only by virtue of much haranguing on my part did we get off at daylight. The night had been intensely cold but the horses sank deep if they stepped outside the trail we made yesterday. The crest we passed without other mishap than constant sinking, loading and unloading, but the sun had so far risen by the time we entered the Yunnan River bed that the snowbanks were impassable and we had to unload before noon and camp four miles above our destination. There was only a little grain for the horses, no forage of any sort, but we had a bare patch of earth to rest on. The men were not any better off with only a few shavings to make a fire. One of the lads suffered all night from headache and high pulse but was all right after the march to-day. The chocolate bars I distributed to ease the men's starvation diet were almost uniformly despised and all came into the hands of the one man who liked them.

June 20.—The Pass would have been much easier a week ago, or even earlier, as soon as danger of snow slides is over. Every day makes it worse and it will be 3 weeks before it can be crossed without difficulty. The sheep will be on their way to and from Tibet (trading) and to Rupshu (grazing) long before then. This morning we got off at 3. Having nothing to eat and nothing to burn, there was nothing to do but march. Fortunately the night was again fair and the path prepared yesterday had hardened. We crossed the last snow just in front of Kinlung—an almost perpendicular wall—the worst stretch of the trip, and well it was that we were no later. By 8 o'clock the sun had already softened the crust, at best weak, and had we been delayed above, half the horses would have perished. As it was one horse gave

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out a mile above Kinlung and in an hour was dead. To find even scanty grazing, we had to cross Yunnan a mile or two below the rest-house. The bridge had been pulled up last fall to save it from destruction from the snow, and the stream had already become so turbulent that fording was difficult. I slipped while wading and got a little ducking, but nothing worse. Four Ladakis with five donkeys and a horse were camped at the fording place. They had bags of dried apricots and were en route for Trilokanath. The apricots (Chulisor Kumanis) are to pay the expenses of travel. The market will be flooded this year. Many Ladakis will be coming on pilgrimage and they have not anything else to sell. The country at Kinlung though over 15,000 feet altitude is a broad valley, broad for this country, with wide plains on its floor. Huge rubble piles line the mountain sides and in some shales I found sandstone inclusion 6 inches to a foot in diameter. The horses annoyed one another considerably by eating each other's manes and tails, these appendages in some cases having been seriously curtailed. One horse had already lost a great part of his tail while in Kulu. At night a native had cut out a huge hank of hair to use in cleaning his silver jewelry. The animals also ate up all the grass shoes they could find and a rope that had imprudently been left exposed. In spite of the fact that we have marched for two days on snow with soaked feet, with food at a minimum and no shelter at night no one has as much as sneezed. The marmots have become very common here and their colourful alarm whistle is sounded at any provocation. We captured two with great difficulty (they are seldom to be seen except at the edge of their burrow into which they tumble at once unless killed outright). The Moslems were scandalized at our skinning the animals, because they consider them wild dogs. The resemblance between the two kinds of animals is not much closer than that both have fur. The Ladakis suddenly decided to cross the Pass too and in vain we attempted to dissuade them. To our amazement they made for the river, now having grown enormously in volume since we came in the morning, and with difficulty affected a crossing. They did not however, make for the Pass, but hid in some of the side ravines. There is no other explanation of their strange behaviour than that they did not like our looks. Here came a bearded barefooted person, probably not recognizable as a Sahib, with five guns, who inquired too minutely into their doings: what was in the sacks, where were they going, but worst of all did they have no silver ornaments! (Here I have Rs. 350 to spend on native jewelry and I have not seen a piece.) Then everyone was so opposed to their going forward to-day. All this could have but one meaning: We intended to plunder them. They in turn told us not to tarry here: a little further down the valley were large numbers of pilgrims (from whom we could have got much loot presumably), all of which was not so as we learned from a lama and two women who arrived toward dark. It is a relief to be able to cook again after having subsisted three days on tea

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and dry bread with chocolate to flavour the bread. Fuel is a little scarce at this season. The dung is wet but we managed a grand fire from some dead scrubby tamarisks growing in the river bed, and a little sheep manure. There is plenty of plant growth but none of it goes to wood. Along the streams there is a bright green lawn and butter-cups and tiny white eyed purple primroses make exquisite patches in the green. A new kind of pigeon has put in appearance here and we saw a red fox. The bridge builders who will have to send a man back home for provisions in a week have taken a letter to the Headquarters, informing them of our crossing the Pass.

June 21.—We left Kinlung at 9 and arrived at 12-30 at Serchu (alt. 14,000) on the boundary between Lahul and Rupshu. The road is on an old glacial plain but descends now and then into the gorges down which flows the drainage from the enclosing mountains. The Yunnan River keeps mostly to the left wall and has cut for itself at Serchu a bed $\frac{1}{4}$ miles wide with cliff walls 50 feet or more in height. The aspect of the country below Bara Latse is completely changed. It is a new world with new geological formations, new plants and new animals. Instead of the sombre rugged snow-capped peaks and narrow terraced valleys of the opposite slope of the Great Himālayan Range, a broad level plain, a mile wide on the average, is bounded abruptly by old worn-down mountains, chastely coloured in tones of purple, pinkbrown and dovegrey, with white confined to patches of snow left in the ravines. Up the sides sometimes halfway, is designed in black a patterned border of the golden flowered drama (*Caragana* Sp.) a thorny shrub that forms dense low clumps and serves the traveller as fuel. Just below Kinlung and extending for about two miles are scattered on the plain conical mounds of glacial rubble 15 to 60 feet high. These are called Gephan's grain piles. Gephan came from Tibet and camped at this spot. It seems he brought immense stores of grain with him, which the people back home decided to recover. When they came, however, the grain was turned into earth and Gephan went to Lahul taking with him a few seeds of each kind, concealed in his headgear. Buckwheat was thus introduced into Lahul. Gephan now resides on one of the most magnificent peaks in Lahul and is an object of worship. There is a serai at Serchu built on a green meadow with nice streams full now of fish from the river. The horses for the first time have had first class grazing. A river from Zangskar joins the Yunnan and about a mile below they enter the Tsarup. This lower plain is entirely concealed from the traveller on the glacial plain above. He is only aware of a deep gorge which from afar appears like a tranquil lake, the dancing heatwaves which fill it, resembling the water ripples. The plant life is totally new—new species of rhubarb, primrose, smart weed, butter cup, plantain, sedges and grasses, and there are birds that we have not seen before. There are a few old friends: the House sparrow that one finds

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throughout the north temperate hemisphere and the Mongolian Plover that we last saw in winter on the plains near Delhi. Flocks of Tibetan sand grouse feed on the new grass among the gravel of the river banks. Their call sounds like the honk of a goose and can be heard long before the birds arrive. A party of Ladaki pilgrims was met to-day and a herd of sheep has arrived from Kangra. Opposite the serai in the face of the cliff and perhaps 50 feet from the top is a hole, said to be the mouth of a cave in which is concealed a golden vessel. It is called Ser Bum Chen. The place can now be reached only by a rope from above and that not easily. It is said on the plateau above there is a poisonous lake and many animals die from drinking its water.

June 22.—We waited here for the day so that the horses could recover from the strenuous work and starvation of the Pass. The grass is short, but extremely nutritious, they say. The animals swam the river to where the grass was best. I stayed home and gathered plants and made birdskins. Rup Chand went hunting in the Nulla toward Zangskar but did not see a thing. Even small birds were scarce except on the green plain beside the water. On the way back they met the shepherds with three flocks of sheep (we had seen them up the river yesterday) who told them they should have gone into the opposite Nulla. In that place they promised he would find game in herds and of as many varieties as we wanted. They had crossed the Pass just behind us but had come from Zingzingbar in a day. They had five horses and had great difficulty with them. When our men came home it was late and the river was much swollen. With an alpenstock Rup Chand started across with his servant, arm in arm. When in the swiftest and deepest part, Tashi became dizzy and was seized with a violent laughing fit, so that he was with great risk hauled back to shore. Meanwhile horses were being brought from camp but without waiting Domba the lama dashed into the water and the man was towed across. I roared at them in vain from the opposite bank. None of the men can swim and the river is a torrent over slippery rocks so that a man can easily be swept from his feet, as I had found out in the same stream above. I threatened them with all sorts of consequences if they repeat so idiotic a performance but they will do the same thing again, without thinking a thing about it. The Mussalmans went fishing, using a blanket from their bed for a net and got a good meal. I saw a fish in the river that would weigh 2 lbs. but theirs were much smaller. The fish are nice looking and resemble trout from their habit, possibly, of living in swift water, but they are only shiners. Some Ladakis made camp above us. They arrived too late to cross a little stream that separated them from the good pasture but Domba got across to ask them about the Tsarup that we shall have to cross to-morrow.

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June 23.—We had heard that the Tsarup could only be crossed about 9 in the morning. Ordinarily the streams are lowest before dawn but the water source of this one they say is so far away that its low-water stage is later. We got up at 4 but were not on the road till 8-30. They eat only tea and unleavened bread (roti) or tea and roasted barley flour, but from the time taken to cook it, you would suspect a roast ox was in preparation. My men, for example, never begin the preparation of their own food until mine is served. Just before the Tsarup we met the first Tibetan sheep coming to Lahul to trade. These are owned by Lahulis but are kept in Tibet for the winter. In Lahul there is so much snow in winter that animals have to be fed on hay, but in Tibet they can graze. They come back as soon as the Pass opens and are sheared in Lahul. The wool is the herder's wages and amounts to one or two rupees a head. As a rule the animals go right to Lahul but return to Tibet with grain, rice, barley, etc. This is quickly disposed of and they return in full each with a bale of wool. The wool is sold chiefly in the Kangra Valley and the sheep go back to Tibet carrying the herder's winter supplies. In spite of the strenuous athletic lives they lead the sheep do not become unduly tough. In fact Tibetan and Zangskar sheep are considered the best for eating. Lahul sheep are considered good but anything that originates beyond the Rothang Pass is ruled out. Even spending a summer in Lahul does not raise the rating, unless said animal was a youngster of the year on arrival. The Tsarup we crossed without much difficulty and soon reached the pillars that mark the Kashmir boundary. The boundary used to run above Serchu, I was told (a pillar still stands). The valley now closes and the mountain walls, though still rounded and covered with debris, often show strata. These are now horizontal, now vertical, now dipped away from, now toward the river. The path is stony, sometimes all stone. The river has cut a gorge into the old plain some 60 feet deep and the faces show beautifully the strata of gravel and sand (only a few boulders) that were washed down from the ice caps long since melted. Several species of small birds not seen previously were met to-day, but all were so shy that they were collected with difficulty even with a twelve gauge shot gun. Rachogba, our halting place, is only a place where the horses can feed, but the pasture is on the other side of the river. When we arrived about 1 o'clock the current was violent and the horses with difficulty were made to swim across.

June 24.—This morning the water had not markedly abated and one of the horsemen had to swim the icy torrent to get the animals back. A herd of sheep driven by Tibetans en route for Zangskar appeared on the other side about that time, but nothing could induce the herders to start our horses into the water. At 1 we got started. The path runs along the river to a camp ground called Gyan, then ascends sharply for about two miles. After that for

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five or six miles the road runs near the top of a little river valley fairly on the level, until it descends rather abruptly some 500 feet to the bed of this stream. The pass is properly called La Chulung (pass of water and wind). We crossed some twenty streamlets of clear ice water and wind is at you no matter which way the road turns. The wind, however, was neither strong nor cold. Bumble bees now and then hum past, at work on the flowers of the drama that grows on all the hill sides. On the valley's opposite slope can be plainly seen another road, said to have been constructed some eighty years ago by a Lahuli supervisor with forced labour. The site is said to be so hopeless that the route has been abandoned for this one, which is dead easy and has cost a minimum of labour. They did some hard work on the old road, often cutting it into the face of cliffs. It is still apparently in surprisingly good condition. We arrived at 7 at Sumdo, at the foot of the Pass proper, and found a little lawn for the animals to graze on. There is a construction here of walls 5-6 feet high that gives shelter from the wind. A supply of drama left by other travellers gave us quickly a nice fire.

June 25.—At 5-30 we left Sumdo. (There are many places called Sumdo. The word literally means three directions and is applied to places where two rivers meet.) A little snow had fallen during the night. A heavy snow would have blocked passage and starved the horses, a fate that caravans sometimes meet at this place in spring and fall. The ascent to the Pass is easy and the descent very gentle. There were several patches of snow to cross up to the crest and for some two miles below but all were hard, so early in the day, and gave no trouble. Beyond the Pass, we follow the valley of a little stream. It is narrow at the beginning but becomes still narrower until some 8 miles down it turns to the left. Throughout, particularly in the upper half the earth is so stony and barren that not a plant can be seen for half a mile at a time. Here and there along the stream there is a patch of sedge of a few square yards and further down scattered plants of rhubarb or grasses. The slopes are covered with shifting sharp edged gravel and the peaks are towered and turreted. Where the stream bends to the left it loses itself at the foot of a marble peak in a mass of boulders and reappears in a delightful little meadow below. The view at this point is splendid. The peak is somewhat sugar-loaf shaped and rises perpendicularly to a height some 800 feet. Its surface is perfectly smooth except that a huge slab has broken off so that the whole looks like a huge loaf cake with a piece cut out. The mountain is called Gonajil and is worshipped by at least the Lahulis who pass the road. From the base of Gonajil you look down on to the little cliff-bound meadow with the spring stream running through and beyond to a city of steeples and spires carved into the face of the river cliff. The rugged chain of peaks runs straight ahead and a little beyond is buried in snow. The river is bounded

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now by high steep gravel hills on the right and by irregularly terraced earth-covered formations on the left. The stream has cut a gorge some 100 feet deep into the old plain floor and on the steep face of the cliff, set off clearly by the fine gravel of the back ground, are carved fantastic cities; now clusters of finely cut minarets form a mosque of superior architectural beauty; now the lines are broad and firm and you see the clustered houses of an Indian pueblo; or the buildings take on shapes with tilted domes and awry walls that must surely house the goblins that the natives say infest the land. To-day we met a lone native going to Lahul, who inquired whether any Baltis were ahead. The Baltis usually go in a group and plunder any lone traveller they meet, but this is not a route much followed by them. There were also two small flocks of sheep and at the Toze three Tibetans were fording their sheep and loads across with the help of a horse. The perennial wading to and fro must have been too tedious for the poor fellow, who made a desperate effort to join our caravan. The Tibetans began an excited conversation at our approach and then greeted Rup Chand by name, though they had never set eyes on him before. His father had been a powerful and well known figure in West Tibet and the family resemblance was sufficient. The Tibetans had lost their horses' bridle to-day and wanted us to keep an eye open for it. After the Toze we at once crossed another stream, now small, but with a stupendous cliffbound bed running in the direction of Tso Morari. The fairy buildings of the stream above were continued here in beautiful series of castles and cathedrals that stretched to the horizon as far as the eye could reach. At once the stiff ascent of Bong La was begun and we came to the lovely plain of Kyang-chu, encircled by rolling hills. The mountains here appear no longer to be chains but masses scattered at random, chiefly smooth but sharp-crested. The plain is two or three miles wide, strewn with clumps of drama, and with what after the day's march seems a plentiful inter-mixture of other plants: Sedum, Potentilla, Primrose, Sedges, clumpy Sandroots, etc. To the right against the mountain side is a strip $\frac{1}{2}$ to a mile wide that appears light yellow from the dead leaves mixed with the green of a sedge that grows plentifully there. The soil is here a hard gravelly compound so the drama grows flat on the ground and not in mounds as in places hitherto where the shifting sand accumulates among its branches. Here the Kyang, the wild ass of the Tibetan plateau, is first seen. Some half dozen were scattered here and there, apparently feeding on the hard swordlike leaves of the sedge that forms the big yellowish meadow to the right, and Rup Chand dropped one at 400 yards. The Kyang is larger than a mule and very beautifully marked. The Lahulis refused to skin it, saying that dead domestic animals they could not touch and the Mussalmans also refused saying they would have to bathe if they touched it. I said nothing, which the latter interpreted as dangerous (no baksheesh would be forthcoming from an offended Sahib). They held a council and

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sent the man who had swum the river to fetch the horses, he being presumably least opposed to a bath. The bath was afterwards heroically performed though everyone was half frozen from the steady wind and there was no shelter except from blankets held in place by his friends. We marched some 20 miles to-day, but no one seems the worse, though the altitude has ranged from 15,300 to 16,600 feet and most of us have never been so high before.

June 26.—Two of the horses wandered off and could not be found till late. The wind continued all morning and the Lahulis were miserable. The Kuluese who never meet such climate at home were not at all uncomfortable. Nothing came to eat the dead Kyang. Two ravens preferred the morsels from our camp to the more abundant feast of the carcass and though a wolf was seen on the plain, he also scorned such fare. The wolf got our scent at great distance and fled. Everything is shy on the plains, though surely no one hunts here. The marmots (phea) run for their holes long before we are within gunshot and even the small birds are so shy that they cannot be captured except at long range. The wolf in his fright drove four large animals from the plain, which we stalked and found to be young nyen (*Ovis ammon*). The marmots seem to live in pairs in their holes. To-day I saw a pair sitting on their haunches in the attitude of embracing. They sat thus *vis-a-vis* with their arms on each others shoulders for fully a minute. I found two horned larks' nest on the bare plain, both with two eggs. The nests were protected on two sides by stubble and on the other two by flat roundish pieces of mica schist about $\frac{3}{4}$ inch in diameter. These stones were clearly transported by the bird as no other stones of the sort were in the vicinity. They were not piled but flagstoned. This lark, by the way, is the same bird that is so common in Northern America. Our stage to-day was to be almost as long as yesterday. We were going to leave the Leh road to-day and camp at Tso Kar, a large salt lake to the left. But no one knew where to turn off to reach the lake and our start had been late, so we decided to halt at the next water. A Tibetan on the way to Lahul with sheep directed us to such a place and offered to show us the road to the big lake in the morning. We camped in the mouth of a Nulla and were shortly visited by a family of nomads encamped above. They have black yak hair tents and swarms of sheep and yaks and a few horses. Most of the Rupshu nomads are camped at Rogchin, some 8 miles above. These people have only lately come from there, fearful of the yak plague that is rampant in the area. There is after all no reason why they should remain in any particular place as long as there is water and forage for the cattle and the site of camping grounds are in fact determined by the caprice of the native. In winter these people go to Kagzhung with their flocks.

June 27.—The sunrise this morning was magnificent. The clouds in ragged masses banked the horizon above distant snow mountains. A broad tattered

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streamer that loosed itself from the banks below floated lightly above, aspiring toward a squadron of fluffy cumulus clouds that hung below the zenith. With the first light blue black blotches showed against the transparent sky. As daylight grew the sun's first rays transfigured the snow edge and the top-most clouds, staining the rest a clear navy blue and illuminating the fleacy borders with pure colourless light. No other colour showed in the sky but the blue of the heavens and the deeper blue of the clouds, and below the smooth surfaced mountains stretched in uniform pinkish grey with deep blue purple blotches marking their ravines. The Tibetan arrived this morning and piloted us to Tso Kar. At the top of Taksumba La he turned back taking with him two letters for the people at home, which he will relay on from Patseo. He said that we will surely get nyen at Tsaka, and somehow we believe him and will go to Tsaka. Ordinarily the natives will tell you game is either ahead or behind, never near. Why, I can't understand, unless they don't want to be bothered by demands for food and by other importunities from the hunter's servants, usually Kashmiris, who clearly understand their superior position as members of the ruling race. From Taksumba La all of Tso Kar is visible in deep sapphire blue. The gem is set in a border of pinkish hills, capped with red in places to the north and the circle backed by higher hills on whose peaks are expensive caps of snow. Between the water and the encircling hills extends a plain, a mile or more in width on the north and south, but much reduced in width at the east and west. The old lake level can be plainly seen 300 or 400 feet above the plain and runs like a highway along the slope. The recession from this high level seems to have been abrupt. No other beaches are nearly so marked. The lake is divided into two parts, the smaller one $\frac{1}{4}$ th the area of the larger, the parts separated by a stretch of about $\frac{3}{4}$ of a mile. A little lizard, like our American homed toad, inhabits the gravelly plain, and hares were seen off and on all day.

June 28.—Yesterday we made camp beside a beautiful clear stream running through a narrow green meadow south of the end of the big Tso. On the hill above camp is an ancient stonebuilt chorten, a structure striking for its size and method of construction. Two pairs of mendicant Tibetan lamas on their way to Korzok arrived in camp, one pair with a two years' old baby that seemed none the worse for beggar's fare. From one I bought a human thighbone trumpet and an old string of lama beads. Such eagerness to possess coin I have seldom seen. The poor devils see precious little of it all their lives. About 4 P.M. in a cloudless sky toward the south Rup Chand saw a bright blue-green light, which he describes as rapidly moving in a straight line, almond-shaped, the large end foremost and darkest, and larger than an average falling star. It disappeared before reaching the horizon. Last night we reconnoitered the fresh water lake and to-day moved a temporary camp to its

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shore. There are small pools of fresh water, a rod or two across, scattered along the west, south and north-east ends of the fresh water part. In these pools and in the lake itself is an abundant growth of water crow-foot, Potamogeton, Myriophyllum, Ranunculus, etc., and on the shores a more or less dense growth of sedges. Large russet coloured ducks (sirkab) frequent the pools and lake and in pairs flee with musical cry back and to the stony hill sides in which they are preparing their nests. Brown-headed gulls, common terns, crested grebes and barheaded geese also frequent the lake and one or other of two pairs of black-necked cranes is usually in sight grazing among the pools. A dozen Kyang keep to the north-east shore in the valley that runs to Polokonka, the Pass that leads to the Indus Valley. Goa, the Tibetan antelope are usually abundant around the lake, the people say, but this year there is not one. There are four tents scattered here and there on the plain and herds of sheep can usually be seen.

June 29.—The mornings until about 11 are sunny and calm. Then a wind comes out of the south-west and blows briskly till after dark. The nights are calm. There is no fuel but dung, and a very tolerable fuel it is. Some gives off an odor like burning rubber but in the main the smoke is pleasant. This morning a herd of 50 yaks showed up near camp and stayed all day. I have never seen more than the occasional animal the Lahulis keep to cross with their cows, and the herd was a fine sight. A calf lost the muzzle that keeps it from drinking milk that it should not and we saved the object. It consists of two sharpened sticks bound on to the muzzle in such a fashion that when it comes to drink it stabs its mother and gets kicked. I spent half the day wading across the lake inspecting the grebe nests of which there are half a dozen built of water wards, in the west end. The water freezes every night but rapidly warms and is tolerable to bare legs, except that the wind and alkali crack the skin. The water at the west end is not much above knee deep but the rest is too deep to wade. The tent has been erected for the first time on trip. It is not so necessary for comfort as for shelter against the wind when mounting plants and skinning birds. Last night and the night before I experienced a shortness of breath for about an hour, no distress but a noticeable need for air. I recall that last year at a camp at similar altitude (15,300) in Lahul I had the same experience. Appetite and ambition are excellent and there are no other affects of altitude. The Lahulis have become almost black and lips are much cracked.

June 30.—We found the crane's nest last night on a small hump of earth in one of the pools. The old birds are so wary that they do not come into gunrange. The terns were nesting on a little soda island at the east end and more grebe nests were located in the water there. The geese have no young nor can I find nests. Probably they have been robbed by the natives

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and have given up housekeeping. We interviewed three Rupshu men that have been waiting at our neighbour's tent for the arrival of the Thakur of Karzok, and got information about the game and the journey ahead to Tso Morari. The Thakur is a sort of overlord who is coming to meet a Sub-Tehsildar from Leh at Rogchin. The disputes that have accumulated since last year will then and there be settled and the officers will go back home. The natives have rather a hard life apparently, and don't make more than a bare living. Jewelry is nowhere to be seen, though it may not be worn every day. Herds are the only wealth and these may starve in a heavy winter snowfall or be wiped out by an epidemic, such as this year in sections has exterminated the yaks. And to crown everything, any stranger is apt to rob them of anything he can lay hands on, including the precious irreplaceable tent poles. They were so grateful to our men who went to buy butter for giving them a just price that they added a good dab to the weight. Wool they cut with a knife but goat and yak hair, if the yak is small enough to be overpowered, they pull out, not much to the liking of the animal.

July 1.—The lake level is low this year because, the natives say, there was little snow. The water vegetation has been exposed along the shore by the recession. A large shrimp (*Gammarus*) is plentiful in the lake. If a dead bird remains in the water it is soon covered. I intended to make shrimp meat of them but there was always such an abundance of meat. Swarms of a large gnat are a nuisance on the lake border when there is no wind to blow them away. They rise from the earth at your approach and as is their nature, keep just ahead of you or in your ears, eyes and nose. The terns are carrying fish but I have seen none except in the stream that empties at the south-east corner on the north shore. On the old beach is a small building that is the Thugye Gompa. Since ancient times a cell has existed on the lake according to tradition, and now one lama is said to perform worship in the building. We left this morning to camp on the Pass. Rup Chand and his man went on ahead to see if there is game. The ascent from the lake is very gradual but fearfully tiresome. The road is over soft sand till it crosses the stream (now dry) that comes down from the Pass. Then it becomes stony with large boulders, often granitic. Near the top there are small streams and green places, closely clipped; on the last of these we halted. A Tibetan who was taking his flock to Nima Mud stopped for a visit and I bought an old rosary made from human skull bones, a nicely covered old sandalwood image; a few tiny old tankas, a holy medal and a mold for human ashes. A flock of some 20 yaks also went toward the Pass and some fifty came down. The day has been cloudy for the most part but nevertheless the reflection from the sand has been intense. Fuel is mostly dung. Up to the dry stream drama narrowly fringes the base of the hills and is

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scattered above that point. In the floor of the side-valleys there is a thin wash of yellow green where a dry ground sedge grows sparingly but elsewhere there are no plants. Above on the Pass I found a lovely large flowered purple primrose and a lavender stocks, both with intense fragrance. Hares are common and also the Tibetan Snow-Grouse which we have seen for the first time. There are flocks of the birds above camp and their chuckling call can be heard from the rock slopes at almost all hours of the day.

July 2.—We have a clear view of Tso Kar. There are always shifting clouds over the enclosing mountains and the valley with its changing moods is fascinating. Rup Chand went off to a black mountain peak facing the Pass where people said nabo were to be had. He met a flock of seven and brought back one. The poor Mussalmans cannot eat any of the meat because it has not been halaled, and they want some so badly. They have not been able to buy a sheep in all Rupshu. and are tired of an unbroken diet of flour. Toward evening I went up to try for a snow-grouse, but though I saw a flock of nine, they were so shy that I could not come within gunshot. Under a rock where some marauder had hidden it I found a well incubated egg of Hodgson's Partridge though no birds of that species have been met with so far. The sirkabs are flying around on all the rocky hills, undoubtedly preparing their nests. They must carry their youngsters to water. They could not possibly walk. Tso Kar is at least six miles away. Above camp there is a nice stream that loses itself before reaching us and along it and on the hills is an abundant (for this country) growth of plants. In all the country I do not recall a single species of plant that grows in Lahul below Bara Latse La. There is here a delightfully fragrant locoweed (*Astragalus*) among some half dozen species of that genus and an extremely tiny mustard. The mustards are abundant in species, most of them an inch or less in height and most of them white. Three of the men complained of pain in the head and stomach and appeared to be miserable. A dose of aspirin and licorice powder made them in an hour come out of their blankets and guffaw. Another has had a little internal disturbance for two days, due, I suspect, to drinking the alkali water in Tso Kar. A dose of cherry brandy promptly cured that. It is difficult nowadays to eat enough. One is constantly hungry. A Rupshu family bearing all their earthly possessions on some 20 sheep arrived from beyond the Pass and camped beside us. One of the sheep bore the tent poles directed aloft and the rest of the household goods were hung here and there on the obliging animals. The head of the family wore goggles which he did not take off all day. He probably has diseased eyes, though ordinarily all sorts of afflictions are readily brought to any sahib's attention. We gave the family three huge hares and they were so delighted that whenever any member came within hailing distance he salaamed

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and grimaced satisfaction. There have been four or five groups of travellers crossing the Pass in various directions which gives it the impression of being a busy thoroughfare. All are Tibetans—the poor in sheepskin clothes, wool inside, and the richer, or less poor, in cloth. All are friendly but not inquisitive, approaching only at our solicitation and never under any circumstance standing curiously near. On none of them have there been any but wretched ornaments: brass rings or poorly executed silver ones, glass or porcelain beads. Only one, a youth, had a string of turquoise and coral, a few of the former first class. Many have no ornaments of any kind. Our poor horses are busy picking at the tiny grass. If the quality were not extraordinary they would never get satisfaction from the grazing we have had since we have entered Rupshu. The tent was again erected on account of the breeze. The men make barricades out of the luggage.

July 3.—We started off at 10 for Tso Morari. During the night some snow fell to cover the ground but it promptly evaporated in the morning. The weather so far has been chiefly cloudy with a little storm coming now out of this little valley, now out of that, suddenly clearing into sunshine, only to begin over again. It reminds of north Greenland weather in summer. Precipitation is always slight and the winds light and since it is the only kind of weather they seem to have in Rupshu no one minds it. At the top of the Pass (alt. 16,400), in the centre of the valley, is a pile of stones, mostly granitic and schist boulders, in all 6 feet high and 18 feet \times 6 feet in base. Surmounting the pile is a pole 6 feet long, heavily hung with particoloured rags. Horns of various animals, chiefly nabo, some yak and a few nyen ornament abundantly the top of the pile. To either side of this central monument extends a line of small irregular stone-caps at irregular intervals (15–30 feet apart). These small piles are about 4 feet long at the base and 3 feet high. Some 23 are found on each side, ending with one about 25 feet up on the hillside. A string hung with rags runs from the central mass to the first small pile toward the south. The piles mark the jumps, made by a wild yak (drong) that Gyepo Kesar was hunting. He got the yak, it is said. The descent from the Pass is rather steep at least compared with the ascent. The path is stony and between boulders. The hills are yellow-green in large patches where the Kyang sedge grows and do not present the barren aspect of the opposite slope. At the bottom of the Pass runs a stream some 4 feet across and along this and along the beds of a dry torrent are luxuriant growths of drama. The bushes are 3 to 4 feet high and often 15 feet across. They are in full flower and bumble bees are numerous. Several species of butterflies are also evident, one a fine big Tiger Swallow tail, swarms of little pink-rumped Finches (Twites) and of the Kansu Great Rose Finch with a few Brown Hedge Sparrows and Tickell's Willow Warblers inhabit the drama and

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on the plains are numerous pairs of Hume's short-toed harks. Below the drama growth opens a pleasant oasis (the valley has become $\frac{1}{2}$ to $\frac{3}{4}$ mile wide) and ahead a sombre sharp-backed mountain, higher than its neighbours vividly coloured in masses of green and purple, appears to block the valley and to mark another to the south. We have missed the track to Tso Morari and here arrived at Puga. At the approach to the meadow there is a main wall 100 feet long \times 6 feet wide and 4 feet high, built in some past age and still well preserved. Up to now no walls so well built have been seen. The frame is of rock and the filling of earth. Beside it are three large chortens, about 15 feet high, probably of the same date of construction. Several Rupshu tents are erected at the base of the cliff that forms the north border of the valley and small herds of sheep and goats and a large herd of yaks are grazing on the plain. One goat had been captured and was being plucked much against his will. The down under the guard haire is often of fine quality (pasham) and is thus collected. The yaks belong to Korzok people who are carrying in relay Kumanis from Leh to Lhasa. They have come from Rogchin and deliver the load to other carriers at Nina Mud to-morrow. This place is famous for its hot and mineral springs. Each spring used to be labelled for the disease it would cure and there was a spring for most diseases but some malicious person destroyed the labels and now it is generally known only that one is good for stomach disorders. There were minor springs at Tso Kar, one of which gave a strong smell of sulphur. There must be many along that lake's shores, because the character of the water varies, in some places it is strongly saline, or bitter or worse. The natives collect salt in certain sections for sale, but it is fit only for cattle.

July 4.—A drizzle started during the night and continued till 7. A thick white mist bank along the top of the valley walls rolled away and showed a thin veil of snow. The purple and green mountain is heavily blanketed to near the base. A caravan passed in the night en route for the Indus. Their dog stopped to eat our supper bones and then realizing he was belated dashed off without a look at a rabbit we had left lying near. I asked the horsemen why they did not tell me that they did not know the road instead of merrily coming the wrong way. They said they could not, I was always ahead, a perfectly satisfactory answer, though they arrived at Puga a good two hours ahead of me. The natives are never at a loss for an answer but its utter simplicity usually provokes laughter instead of anger. There is a pair of cranes on the meadow but they are very shy, and apparently not nesting. At the lower end of the grassy meadow are the springs. They are mostly small, up to 10 feet in diameter, all the way from lukewarm to boiling, some tasteless, some very bitter. A few make a rumbling noise underground. Most of the springs are beyond the meadow where the valley narrows but

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around some in heavy alkali deposits a grass grows luxuriantly. The cattle apparently do not like this grass, though in other places the pasture is very short. Many plants are in bloom on the meadows and along the stream: a purple violet a large yellow clematis, a most deliciously fragrant pink honeysuckle, a fragrant pink mint, a large pink-flowered onion to mention only the largest. Puga is the warmest place we have met. There was no wind, and our people would gladly have tarried. We had to cross two passes to reach the lake we are bound for. The first is about 18,000 feet, to judge from a neighbouring 21,400 feet peak and Polokonka 16,400 feet, and its ascent is steep. The descent is also sharp and the ascent of the second Pass at once begun. This second one is about 17,000 feet and rather easy. From the crest the view opens abruptly on Tso Morari and Kyagar Tso, and a sight it is for a life time. In the foreground is a yellow-green plateau with grazing herds of Kyang (we counted 114). Below lies Kyagar in sapphire blue, edged with green, in front of smooth pink brown hills clouded with yellow-green and flanked by a rugged range from which rise two magnificent peaks of over 21,000 feet. Beyond extends Tso Morari, a vast expanse of blue, to the foot of distant blue gray mountains deep shadowed and stern. Behind, the lofty snowy ranges of the Great Himālayas, with sharp ragged ridges running down from their snowy domes, run straight along the horizon and block the view. Above, roll loose banks of cumulus clouds, blotched with shadows of purple gray with the sky showing blue between but not half so blue as the water below.

July 5.—One of the horses tired and we had to halt beside Tso Kyagar. On the west side are two places where good springs enter the lake and beside the one near the centre we camped on a pleasant little sward. The lake, about a mile long and $\frac{3}{4}$ mile wide, is completely enclosed in low hills and has no outlet and no visible water source but these springs. The water is perfectly clear but brackish. The shelf of shoal water is about 1-2 rods wide along the western shore and the descent to the lake-basin is abrupt. There are a few Gammarus along shore, and a few sirkabs and grebes on the lake. We left early to visit Korzok a half day's journey away. The day dawned clear and remained calm until the afternoon. The view from the hill that looks down on the big lake had changed. The mountains in the quiet clear morning stood grand and majestic. Yesterday stained with cloud shadows their aspect was sinister and weird and from somewhere on the hill, born by the icy air not yet warmed by the early sun, came a most delightful fragrance, elusive, intriguing, suggestive of lemon and verbena, yet like nothing ever known before. The source of the scent was a little mint just appearing above the soil. Its search revealed more of the dainty little violets that I found first under the dry rocks below Polokonka. At the head of Tso Morari

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a lively stream enters, flanked broadly with a lawn of sedges until the lake is approached and then giving way to a field of drama. The shrubs here, like those at Puga, are 4 feet high but the height is due to accumulations of sand that their branches have arrested. In the stream was a pair of sirkabs with 12 youngsters, the latter scared to death. Their mother headed downstream and the ducklings followed in file, flapping their wings as if the stream were not already taking them fast enough. The father headed off across our path to divert our attention, but rejoined the family when the situation seemed safe. At the mouth of the stream there is a meadow called Pelds (on the map this and many other places have Le suffixed but none of the people could tell why it was added and none make use of the addition) where several herds of sheep were grazing. The herders and their family had put up their tent nearby. The lake has latterly risen considerably. Sedge-rocks are now covered by 3 feet of water. A native said that the water has been rising for five years and they cannot suggest a reason. Some prayer walls are at the water's edge, but probably they were formerly along the path that ran on the narrow beach between the water and the hillside. Our road ran high up the hill. The few scrubby bushes of honey-suckle on the hillside were in full bloom and scented the air with a pleasant fragrance. The climb was tedious and trying, chiefly because we did not know where we would arrive or whether we would arrive anywhere, but the view finally opened on a closed valley, plentifully green. About thirty black yakhair tents (15×15×6 feet) were scattered on the meadow, and in these dwelt a good percentage of the population of Rupshu. A whitewashed chorten about 20 feet high and a crude rectangular one-story stone hut (15×30 feet) were the only other constructions. Adjoining the hut is a stone foundation on which they said the Thakur, the Raja of Rupshu, spreads a tent. The hut is his too, but they say he prefers to live in his tent and store things in the house. We tried desperately to buy something as a souvenir but there was not a thing but rubbish and very little of that, except one nice turquoise and silver ring which the owner would not part with on reasonable terms. A few Baltis had brought Kumanis and were exchanging them for wool. Though we had had our usual lunch, each man consumed a pound of the dried fruit, including the nice almond-like kernels. A few safety-pins distributed among the children created much satisfaction. A pretty little girl of perhaps 8 who seemed to own not much else but the safety-pins was so thrilled that she whispered 'Thank you, Thank you' all the time it took to fasten the article in her miserable rags. There is a path from the encampments that leads down a narrow valley to the lake. The view opens unexpectedly on the plain at the broadened mouth. A huge building appears on the hillside to the left and beyond it a rather pretentious two storied structure, both buildings architecturally pleasant, as in fact, are all constructions of the Tibetan races in

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Indian Tibet. The appreciation of line is keen in these people and even the humblest hovel will stimulate one to pull out his camera. The larger building is the monastery and the other the Thakur's house. Wood for both was brought from Ladak, a good week's journey by horse. On the slope below are tiny fields of barley, apparently thrifty at an altitude of over 15,000 feet. Small radishes and turnips of excellent quality complete the list of agricultural produce. This year things are bad with the people because of the yak epidemic. Over 1,000 animals died at Korzok and less than 5 per cent. are left. The disease comes about once a generation but none of the old times know of such a holocaust as this. Blood is voided from the intestines and the animal dies. They find the bile enlarged after death. The disease has spread from Tibet where it has killed also the wild yaks. The notice of arrival preceded us and the Thakur at our approach ran hastily to don some particular garment to receive us. He gave each of us a pound of Kumanis, me a goose egg and Rup Chand a white yak tail. We ate half of the fruit and then went home and ate a snow-grouse apiece (a snow-grouse is as large as an average hen) and accompanying rice, such an effect on the appetite has the air of these uplands. Nyen are to be found on the hills near camp, which to-day was brought to Peldo, and the Thakur sent his servant to show us where they stayed. Geese stay at Peldo and sure enough, we bagged two on the way home and wounded two more that will probably drift ashore to-morrow. The birds of this country, in addition to being so extraordinarily shy that even the smallest must often be killed at long range with a shotgun, are very tenacious of life. There were about 15 wild monks in the monastery. The abbot is meditating in a cell in the hills somewhere, and will stay a year. The monastery has a complete set of the Kangyur and some 30 thangkas, none good, and not much else of interest. The monastery owns the fields we saw; the rest of the populace go to Spiti and Patseo to barter salt for grain. One such man was en route for Patseo and his wife preceded him for some rods of the journey holding a pot of burning incense. The Lahulis also have the custom. The Korzok people live in winter at Tega, but this year had great difficulty in moving because of the yak distemper. The Thakur's things have not yet arrived and will have to come on horses. The lake, they say, freezes in winter to 6 feet of ice and the average snowfall is to the knees, occasionally to the hip. The birds are here as at Tso Kar except there are no cranes, and the numbers are much fewer.

July 6.—Rup Chand left this morning with the guide to hunt on the hills beside camp. The Thakur and the guide say that nyen are sure to be found there, at this season on the peaks. What precipitation there is falls on the mountain summits and the plant growth is much richer there. Possibly the men have spoken the truth. It seems a fact that the natives do not like to

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tell about the game, I believe, not so much because they dislike us but because they hunt themselves. The tent-dwellers above the monastery, who knew none of us, said there was no game hereabouts, but one little boy piped up that there were nabo on the hill in front of us. Yesterday a Nina Mud boy said there were plenty of nyen and nabo at and within a day's journey of his village at Tsaka, which agrees with what our Tso Kar guide told us. But the Nina Mud people send all hunters to Lenapa, two day's journey toward Spiti. Our Lama went to the monastery to-day and discovered several good tankas and images I had not seen. The monks told him they had not shown them to me for fear I would carry them off. He learned that the monastery was built in the time of the present Thakur's grand-father. Rup Chand says I committed a breach of etiquette yesterday, by stepping over something covered with cloth on the floor. I recalled that there had been tittering and grumbling when I did it. There was food under the cloth and it will now have to be thrown away. The water at this end of the lake is better and to drink it gives stomach distress, we were told, but lower down it is drinkable. There are some fish in the lake, mostly tiny little bottom dwellers with four barbels. I spent the day in camp making up skins. I finished 40, including two bar-headed geese, four Tibetan grouse, three sheldraks, a raven, twelve Kansu Rosy Finches, six Twites, three Tibetan mountain Finches, two yellow-headed wagtails, a willow warbler and three Brandt's mountain Finches. For supper I devoured a goose with a quart of boiled rice—a fact given not for epicurean considerations but for physiological. The forenoon was fair and warm but in the afternoon it clouded and a stiff breeze blew from the south for a few hours around sundown. The winds have been chiefly from the south since we have been in Rupshu, descending probably from the Great Himālayan Range. To-day ends a month of our journey.

July 7.—The hunters came back toward evening without having seen an animal except Kyang, or even tracks of any. There have not even been snow-grouse since Polokonka. The guide furnished Rup Chand with an account of the funeral rites practised by the population. Corpses are either burned, fed to carrion animals, thrown in the lake or buried. The first two methods are considered best, but the lamas have to consult their books to ascertain which is suited to the corpse at hand. If fed to vulture, the head has to be crushed by a stone or the birds probably assume the person is sleeping, at any rate they won't come to the feast. In any case the corpse is retained in the house for four days, or if the family is rich and the season is cold 21 days. At death a lama is summoned and the lama ties the corpse in a sack. A structure of butter and flour is made and put beside the body and butter burned night and day. Prayers are also read. 49 days after death, if funds permit, a feast is prepared for all the neighbourhood and as much property as possible

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is given the lamas, because property so given will be of use to the deceased in the hereafter. Money is also sent to Lhasa and on the death anniversary for 12 years the local lamas are provided with the wherewithal for reading prayers for the repose of the dead. The stream in front of camp runs very low in the day time but last night at 7 with a rush a torrent filled it, just as if a dam above had given way. The night before the same thing happened, though later. The Mussalmans informed me I would have to pay for the horse that died on Bara Latse La in spite of the fact that it was specifically stated in the contract that all dead horses were to be owner's loss, at the same time asking that I engage their extra horse, now free of its load of tea. I told them if I had to pay for all the horses that died and it looked as though half of the poor old fellows might expire, I should have to save my money and could not afford to pay Santa Claus by hiring animals for which I had no use. They appealed to Rup Chand and finally decided to supplant the old horse that broke down on the road from Puga with the tea carrier. This morning Ram Tulla departed with the poor beast, but shortly traded it off to some guileless native for some sheep and goats. He asked a certificate from me addressed to a native, going the same way, to the effect that he was going home on my business and requesting that the native grant him his company. What use he made of it I cannot imagine, since neither the native nor the bearer could read a word of it. Ram Tulla was the laziest man in the caravan and I hope now to get the outfit started in less than four hours. I must first train the cook how to boil rice in less than $2\frac{1}{2}$ hours, the period he usually requires.

July 8.—This morning the men were called and recalled but no stir. Finally I pulled off their bedding, at first to their consternation and later to their amusement. The guide to Unti, the next station, who should have come last night did not appear and finally this morning a lame old lady arrived with butter for the men. She denied she was the guide but certain of the men insisted that by the butter the guide was to be known, but all agreed she would not do. The road is at least 18 miles with a pass and the poor old creature had already come five. The hunting guide had been retained by persuasion and when that wore out by bribery, pending the arrival of this person, and now every attempt was made to induce him to lead the way. Everything was in vain, because he said he had to take salt to Spiti to exchange for grain. I remained firm and when he started off tied him up. Then the old lady confessed that she was deputed to be the guide. There was no one, it seems, willing to undertake the job, so they drew lots (gyen) and she was it. Our men still insisted she would not do and Rup Chand started out to get a man from the village. The woman walked with difficulty and as clearly was past 50. When asked her age she said she had not the faintest

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idea. Over one knee-cap were three old scars. I bethought myself of my 75 years old mother who though not lame would have done the job with honour and was willing to give the guide a trial. The roads throughout this area are very poorly marked, except those that are frequented by the traders and it is very easy to follow a sheep trail up the wrong valley. So the lady joined the caravan and we started off. I reflected on what the Travellers Aid Society and kindred organizations would say when they found it out, but there was not anything else to do if we were to get to Unti to-day. For the first 10 miles the guide rested considerably but after that she warmed up and outstripping all but the two best men arrived at Unti in splendid trim. She even wanted to go back that night, but was persuaded to rest, and made camp with the Mussalmans, preferring their society to that of the young men of her race and religion. The road ran some 10 or 12 miles along the east shore of the lake, mostly over torrent plains with no green except at one place a few miles from Peldo. Where a blunt peninsula extends into the lake we turned east up a long Nulla to Chagarchan La. The descent is rather abrupt and one arrives at a little lawn along a stream—Unti. It is evident that the lake has had a level higher than the present one, beach cutting being visible at least 15 feet above, so it may be a habit of the lake to rise and fall periodically. There was evident along the shore a fresh irregular sinuous row of gravel, about 3 feet high at the highest, pushed up by the ice. Being above wave action and there being no rain the formation has persisted. We drank from the lower end of the lake and found the water not bad. The guide said it is better only near the head. We were promptly thirsty again and thirstier than before but there was no help. There is no other water between Peldo and Unti. On the various crests we crossed (of the various nullas debouching on the lake) the natives have, as is usual throughout the Himālayas in this region, erected cairns. These are from 4 to 6 feet high, made of small stones, with preference shown to quartz fragments that crop out here and there between. Quartzitic Shales, and ornamented with all sorts of available horns: yak, sheep, goat, nyen, nabo. Our friend passed not one without adding a stone, sometimes muttering something and once circumambulating with much verbiage.

July 9.—The weather yesterday and to-day was clear, cloudless and warm with a gentle west breeze. Two nyen with two lambs were sighted yesterday on the hills above the lake, the first game seen since Polokonka. Unti and Tega, a few miles down the stream, are the winter quarters of the inhabitants of this region. At Tega there is a broad valley in which a good-sized stream meanders. Our guide called us early for her pay and departed. Nothing could induce her to go to Tso Khyung, the next stage, though money here cannot possibly be earned and no one has any. She even pretended she never

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had heard of the place. Cattle here constitute the chief or sole wealth and the tenure of life of an animal is very uncertain. All may die from epidemics or starvation caused by heavy snowfall but it is not customary to work and no one wants to break the tradition. All through the region among Hindus or Tibetans you meet with inexplicable confessedly idiotic waste of opportunities or materials and the only answer is that it is the custom. The road to Khyung Tso is a steep ascent to either Kyensa La or Salsa La. These passes and the ridge they lie on must be to judge from a 22,000 feet peak in front about 19,000 feet. But such a magnificent view! Below two days' march away the straight awesome row of snowcapped peaks of the Great Himālayas in Spiti bound the horizon. Below them are the somber purple grey hills of the Rupshu frontier that melt into the gentle rolling pink brown hills of the plateau. Two huge masses of these flank the broad green valley in the centre of the vista. This is the valley on which the Rupshu cattle pasture in winter. On the other side of the Pass everything in the foreground is yellow-green, the broad valley and the slopes that bound it. A large hill just below the Pass is grass-green from the loose-green rock fragments that cover it. In this emerald setting lie the two lakes Kyang and Khyung. Kyang in the right foreground is of pastel blue; Khyung is turquoise blue. It lies at the far end of the plain, hard against a range of madder hill, that even tint the loose cumulus clouds above them. Beyond them is a higher range of lighter colour, with crests and patches of snow. Kyang occur on all the hills and we spent much time convincing ourselves they were not something we wanted. And the plants! so interesting and so abundant at 19,000 feet. Even the horsemen got interested and helped to gather them. I have never been so stimulated on the whole journey as on the peak to-day. The altitude and the unparalleled view produced an exhilaration, that approached transport. There are several tents of nomads on the plain and herds of sheep and yaks. The yak epidemic has not reached here. Rup Chand recorded from the Korzok hunter guide an account of the marriage customs here. The groom sends a relative to the father of the girl that has caught his eye, with money and a piece of white cloth, about a yard. If the proposal is acceptable the gifts are retained. In that case, in a few days, if wealthy; the groom sends the girl's father 10-12 maunds (800-1,000 lb) of chang, five sheep and Tibetan tea. These gifts are divided with the bride's relatives, according as these relatives gave presents at previous weddings in the family. The date of the marriage is now decided on this day. On the wedding day, if the distance is far, the groom sends a man with a horse decked out as well as possible; if near, the bride comes on foot. In front of the bride's tent, if rich, they put up 80 stones in a row, if poor, less. The groom's relatives now approach, sing a song for each stone and kick it over. If they cannot sing an appropriate song they pay a fine and kick it over also. The bride's relatives are of course assembled. The final large stone in front of the

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tent is not to be had for less than Rs. 12 if there is no suitable song. A singer is usually imported for the occasion. Seven paces beyond this stone is buried an image in devil's shape made of flour. The victor of the last stone then advances seven paces and tries to unearth the image. Failing more fine. Then everyone goes inside to eat, drink and dance. When it is time to go the bride's parents give her clothes and ornaments that are first displayed hung on a white cloth. The bride weeps and the parent's give advice, chiefly in the form of proverbs. The groom must now give the bride's mother Rs. 4 for the milk her breasts have furnished his wife. At the door the neighbour's girls stop the bride's going out and have to be given Rs. 5. And that is not all. The groom of the community (each community has one, not a bridegroom) has bound the bride's horse's legs so that he has to be paid to loosen them. Near her future home the bride is met by a lama bearing an earthen pot in which are samples of all metals, precious stones, etc. The pot is covered with white cloth on which are drawn two crossed dorjes. On the ground is a piece of slate with the same design. At the proper moment the lamas read loudly, and violently throw the earthen pot on the slab, which is then over-turned. Everyone now goes inside. A woman and man are sent from home with the bride. The man bears in his hand an arrow with particoloured rags and cheap ornaments. This man is considered henceforth the bride's brother. At the door of the tent the groom's mother stands with a bracelet, a bucket of milk and a rope for tying up yak calves. The bride enters, her hands are washed in the milk, the bracelet put on and the rope put on her neck. This is a symbol of her future work—looking after the cattle. The bridegroom dressed in his best is seated with a vacant place at his side in front of a table on which is a container ornamented with butter-figures and filled with chang. The bride seats herself in the vacant place. Then a youth whose parents are living, enters bearing in one hand an ornamental image of flour and in the other a piece of sheep intestine, filled with meat and fat. Not an indiscriminate intestine is this but the junction of the large and small intestines. He crosses his hands before the couple who touch the contents and then departs. A little later another man enters with a plate on which there is a little grain. He sits in front of the couple and sings a peculiar song and removes from the heads of both a piece of white cloth they have been wearing for the occasion. These he puts on the plate. A representative of the groom's relatives and the arrow-bearer of the bride collect money for the couple, according as the couple's parents have given to the children of their relatives on previous marriage occasions. This ends the wedding proper. A few days later the bride invites the inmates of her former home to dinner and then goes home with them. She remains some days and on her return brings some cattle as a present.

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July 10.—The plain in which the two lakes lie is roughly 4–6 miles wide, girded with smooth hills that rise to 17-18,000 and even to 22,000 feet. The plain is at an elevation of about 16,000. The soil is sandy and the dominant vegetation is the yellow-green sedge often mentioned before. Some half-dozen small streams 2 feet wide and 6 inches deep come down from the hills to the west and flow into Tso Kyang. This lake is perfectly fresh, about two miles long, oblong, and lies on the plain floor into which it has ploughed beaches of gravel 3 feet high. These beaches are removed from the present shore line by one to two, in places three rods, particularly on the west and north shores. On the east the water is apparently shallow and various spits, lagoons and islands have been formed in this section. The south side to the water's edge is bounded by the carpet of sedges of the plain. The winds apparently are chiefly from the south or east and are sometimes violent to judge from the magnitude of the beaches for so small a lake. The water level has recently subsided a foot or two, and has left behind some water crowfoot plants, now dried in the mud. There are Gammarus in the lake and at least a few Potamogeton plants. The midges that have been present in swarms on all Tsos are here too but to-day on account of the stormy weather (sky overcast all day with squalls from the south and slight precipitation) have taken refuge in the yak tracks. These are full of the black insects. A rich flora of tiny plants flourishes on the plain. Sand-grouse in flocks are feeding along the streams. Two or three pairs of sirkabs are on the lake and on the plains the usual small birds, except that we got a large Sand-Plover, not previously known to breed in the country. Kyang pasture among the flocks of domestic animals. We tried to find a guide for Hanle but no one would work for more than a day, no matter what the compensation and regardless of abundance of leisure. We had yak milk this morning but could not get more from the same people. They said 'ask someone else now!' Money is apparently of no object. We circumambulated Tso Kyung and acquired considerable merit because the lake is sacred, containing the left eye of the deity that makes Tso Mapham so holy. I saw two marmots again embracing as I had seen at Kiangchu.

July 11.—Three Spiti lamas headed for Hanle this morning and we went along, believing it best to have someone to tell us where to stop for the night. Ordinarily places where water and grass can be found are far between but it turned out that we could have stopped almost anywhere after the first 8 miles. The lamas were of the type of minstrel that yearly come out of Spiti in flocks of three or four and entertain their neighbours with various types of performances, such as supporting the body on swords, the points of which rest against the bare belly, thrusting a long needle through the cheek and tongue, splitting a huge rock on the belly of a man, etc. The lamas

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to-day had a few goats and sheep, dyed in part yellow and red, that did not want to go to Hanle; so we left the company far behind and did not see them the rest of the day. I looked over Tso Kyang before leaving the plateau, which is our last high camp ground for some time. We descend now daily till the Indus. The lake is irregularly elongate, with maximum dimensions of perhaps one and three miles, its shores much interrupted by sandbars and spits. Though apparently shallow there are no evidences of water plants, probably because of the slight salinity. It lies on a bed of sandy clay with no gravel apparent on the west or north shores. Sedges grow to the edge. Its highest level was some 50 feet above the present one, to judge by extreme wave cutting on steep banks of the east shore. At present it is some 1 or 2 feet deeper than it has been for some time past but has receded 3 feet from a previous recent expansion. This is evident from stumps of drowned sedges on shore and under water. There are several feeders now nearly dry. A few sirkabs were on the water and a coot. The ascent to Da La is easy, amounting to perhaps 1,000 feet. The path then descends in a closed valley along a stream bordered in places with stretches of green. After 2 or 3 miles the stream dries up but reappears 5 or 6 miles further where there is a long-sedge lawn and a cluster of four tents, called Da. The valley was once the bed of a powerful torrent but nowadays little water passes down it. Drama which was absent on the Khyung plain is here abundant. The weather is clear and warm. It froze heavily last night, in fact it has frozen every night since Bara Latse La. Everyone slept lightly last night but was in excellent spirits this morning. Pulses high.

July 12.—We got yak milk again this morning at Da. The milk is a very superior substance, better than any milk one can find from ordinary domestic animals. It is only obtainable in the morning before the calves are turned loose. The mothers impatient for the reunion grunt like pigs. When free, young and old cavorted on the plain with tails in the air, brandishing horns, bumping heads, giving the impression that they knew how to play. One sees the same phenomenon among dogs, and sometimes among goats, but seldom in cattle. The Spitiens arrived and stopped at the village to prepare breakfast. They may give a performance here, in which case they will not go to Hanle with us. They always came above our camp to get water, whether from spiritual or sanitary reasons, probably the former. There is a nice closed valley above Da with one side an amphitheatre wall of snow, that probably does not melt. The path to Hanle still continues down the stream in the bare-walled valley. The petrography is bewildering. In one place a stratum of conglomerate, with inclusions a foot in diameter, the whole with the appearance of a concrete pouring, joins a horizontal bedding of quartzitic shale with an interruption vertically of 100 feet of rubble brought down from above.

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The path leads along a sedge-lawn for miles with a clear streamlet meandering in the bottom. Drama is abundant on the valley-floor and fish are numerous in the stream. The Mussalmans did not see these until we were on the march and longingly tried to spear them with my alpenstock. After 6 or 8 miles the stream enters rougher country and the lawn vanishes. The running water now changes to a series of lovely crystal pools on and among clean smooth granite boulders and the vegetation grows chiefly on their banks. Instead of drama above, a magnificent golden clematis and the fragrant honeysuckle claim equal ground, transforming the desert into a glorious garden. As if this were not already enough, but other plants grow abundantly along the water's edge, plants such as we have not seen before. One huge plant of rhubarb, 3 feet in diameter, with stalks as luxuriant and as well-flavoured as the best improved varieties, had somehow come into being among the dwarfed tough plants of the common species. We gathered an armful of the stalks, intending to cook them but ate them all before arriving at camp. When the valley opens, another stream enters it from the hills to the right and an enormous outwash plain, 3 or 4 miles wide, opens to view, furrowed by torrent and lined with rows of huge granite boulders that the raging water has thrust aside. On the floor in the distance are two large chortens and on the edge of the crest of the opposite mountain are visible the ruins of an old monastery. No one knew where to go to reach Hanle, though two of the men claimed to have been here before, so we camped on a little pang where for the first time our horses did not leave the little green all night, but when full, walked from one end to the other to see where it was best, the tinkling of the bells of two that regularly strayed announcing the course of the march. In one of the linnet's (Twite) nests to-day had been incorporated in the soft lining a rabbit's tail. The tail was so prominent that the four eggs had to find a place around it.

July 13.—The valley is the largest and broadest we have seen. Our camp is against the bare west wall, a quartzitic formation so crushed and distorted that its surface is a fascinating confusion of lines. This extends around to form the north wall. Beyond the big outwash plain to the right down which we came are snow peaks. Except for the tip of a Spiti peak to the southeast no other snow is visible. In the centre of the plain is another low rough hill with 2 or 3 miles of plain surrounding it in all directions. The east boundary is a lofty sharp-crested chain that divides the Hanle River Valley from that of the Indus. This is a magnificent range. It is the first ordered range we have seen in Rupshu. The rest of the mountains start off in a given direction but are at once blocked by others coming from other directions, any other direction. No other range has displayed such varied and beautiful colours or such dissected formation or lofty structure. From the

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deep purple crests a wash of yellow-green has been poured reaching half way down the sides to where a series of pink pyramids are flanked against the slope. Below these run irregular rolling hills of dark green that merge into the outwash plain of marbled pink and brown. Here and there among the pyramid formations are splashes of blue, gray and madder, to complete the range of colour that adds glory to the grandeur of the stupendous chain. Rup Chand went hunting for the Tibetan gazelle, and I stayed home to gather plants of which a dozen new ones grew in front of the tent, among the small spring pools that lined the sward. A lovely fragrant pink primrose, a royal purple aster, and a golden *Pedicularis* would be the pride of any garden but none had seeds. In the pools grew a tiny *Utricularia*, an inch long, with huge traps. And the birds also provided a thrill. The large Tibetan lark *Melanocorypha maxima* had a nest with three eggs on our lawn and its unrivalled song could be heard here and there over the plain. This bird has not been previously known from the Indian Empire. The big cranes and the usual water-birds are here, also the Hodgson's Partridge, now with flocks of downy chicks and one of the tiny Kingfishers (*Alcedo attis*). Toward evening I started off for the monastery on the north-east edge of the plain, a good 4 miles away. I met Rup Chand on the way and he went along. He saw no game. As usual, one had said, go here, another, go there; one even directed him to our camp. I almost believe the people see very little game, because they do not often go far from their tents. The monastery from my path was not visible until I had come nearly beneath it. The view of the huge white structure on the crest of the ridge 4 or 5 hundred feet straight above the meadows in a country where there are no buildings and where you do not expect to see any, is a sight to bind the traveller. I photographed at every 100 paces and then hastily struggled up the steep ascent behind a yak herd that was bringing drama from the surrounding hills. The abbot is a Tibetan, a man of good parts and very friendly. We were shown all over and allowed to inspect everything. This monastery, he said, was over 800 years old and antedated its superior, Hemis. Previously the river we had seen on entering the valley had been the monastery. The present structure was really a fortress, as all monasteries had to be before English rule, with retainer's quarters below and with a wall and guard turrets on the easiest slope in front. To the east and south are cliff faces and no defence was necessary in that quarter. In the upper temple are a number of brass images, one or two temptingly beautiful. We were allowed to handle the figures but were cautioned not to touch their faces. One of the many-handed or many-headed figures, I forgot which, speaks from time to time. In this room are beautifully executed and beautifully preserved frescoes, that the monks said dated from the building's construction. The drawing and composition remind one of the Tashi Lhunpo Rabjor series and the colour is of requisite richness. I tried to photograph

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one but it was very dark and I fear there will be no result. In the temple below this are more frescoes, likewise old and well preserved but not so pleasant. They are of huge figures representing various lamaistic deities and devils. In this room at the far end is a shrine in which only one priest is permitted to enter. The room is totally dark except for the door and it was difficult to see the tankas that hung abundantly from the ceiling. It was growing late but we stayed to tea, meanwhile expecting our horses to bring camp to the monastery as ordered. The tea was Tibetan and very good of its kind. Sugar was served in abundance and Kumanis, the last always acceptable, no matter that their past history would not conform to our sanitary notions. A man reported that the caravan was visible from afar and fearing that they would lose their way in the bog that makes up a good part of the plain, we sent him to guide the flock to the selected camp ground. We meanwhile had a pleasant visit with the abbot. He said I could not be an Englishman, pointing to my eyes, and when told him I was American wanted to know about the country's size and produce. The scene was illuminated by a lantern and when I suggested we take it to look at the frescoes again they said the temple should not be disturbed at night. Now again in full darkness arrives our messenger to the horses and instead of announcing their presence at the gates said they had pitched camp 3 miles away in the morass but sent a lantern. The march through the marsh to an unknown locus (three fires were visible, as many miles apart). We fired the gun, hoping they would answer from the camp that was ours, but they assumed we were hunting or shooting out of exuberance, or some other assumption and gave no reply. Pulling wearily one leg and then the other out of the mud holes splashing out of the mud puddles that we fell into in the dark, we finally arrived at 10-30 with not many kind thoughts toward our fellowmen. We were told by way of consolation that we had ordered camp to be pitched on that spot.

July 14.—Rup Chand and I went early to the monastery to see if the hunter whom the abbot summoned yesterday, had arrived. He had not, so when our horses showed up we marched. The abbot again gave tea and on parting gave both of us sacred scarves, me a Tibetan sheath knife and Rup Chand a cake of Tibetan tea. First we bought an ancient curiously carved tea-table from the custodian of the monastery. The carving is bold and graceful and of a totally different character from that of the tables nowadays manufactured. The top was soaked in generations of butter imbibed from the tea that had been spilled by the guests of the ages and the gay paint that the people in this country apply to all carvings has been toned to grey-black by similar agencies. The view from the monastery is perfect. To the west the whole green plain with the numerous meandering streams, just wide enough so that in proper places a man can jump, and full of fish. To the east and

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north the Hanle River plain for miles, flanked by the line of majestic peaks that stretches toward the Indus as far as eye can reach. There are fields on the southern plain but there are chiefly weeds in them. A field below the monastery had a few healthy turnips and many weeds and one had thrifty barley but the cattle and rodents had eaten half already. The nights, though cold enough to allow the formation of ice, are much warmer than at other places we have been and they could undoubtedly grow things if they knew how. They have recently planted a willow below the monastery and it has grown in a few years into a flourishing shrub, the first shrub larger than a drama bush we have seen since leaving the Tsarup where from afar we saw a similar tree in its valley. The people at Hanle were sometimes good-looking and much friendlier than any we had met in Rupshu. There are perhaps fifty on the plain. Among them was a beggar, a Kashmiri they said, who refused money and begged for flour. We had no flour at the moment but the money was nevertheless not accepted. Our road ran all day along the Hanle River that flows through a plain $\frac{1}{2}$ to 1 mile wide. It is green all the way, from the various sedges. There are shrubs of drama in large patches and on gravel alluvial plains often clumps of pinkish fragrant tamarisk, 6 feet high. In one of the pools was a great growth of tiny butter-cups so fragrant that the passing traveller caught the scent. One of our horses that are now feeling the stimulating effect of the upland grass took fright at some pots he was carrying and stampeded the caravan. Two native boys ahead knew how to stop them and we then collected our effects from various places on the greensward. All but the two mules that had not even seen fit to run had thrown off even the saddles, yet nothing appeared to have suffered but the lantern; fragments of glass and metal from it strewed the landscape. One of the lads gathered these, glass included, and cached them under a rock. There are several clusters of tents scattered along the river and herds of sheep and yaks are numerous. The yak disease has not reached Hanle. A tent or two of tent-dwellers that spend the winter in Kulu were camped near our halting place and we bought several rings. The Rupshu people display very little jewelry but these, male and female, have their fingers laden if they have any standing at all. We selected a place near water and grass to pitch camp, having already marched some 22 miles, but the horsemen arrived and said beyond the Pass was excellent grass, so on we went. The Pass, Kugzil La, was about 1,000 feet above the plain, and 2 or 3 miles long, of beautiful (from the agriculturist's point of view) soil, no stones and little gravel but not more than half-dozen plants grew in sight all the way. We knew the horsemen had never seen the ground ahead and that they must have got the information from the natives, who by the way, always want to send you on ahead, either from fear of you or to save the grass for their own animals, so we were uncertain as to what we should find after our long trek. But sure

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enough, it was a lovely place—a green meadow against the mountain-wall with the river in three meandering parts in front. We arrived at 6 after eleven hours of march. There are now abundant growths of Ephedra on the hills from Hanle. The British chemists have found the Lahuli Ephedra to be of high virtue and possibly this is also superior. Our lama stayed behind at Hanle to copy a book in which he was interested, and incidentally made inquiries about the diet of the natives. In the morning they make a soup from meat or cheese with some roasted flour (sattu). About 10 they make tea; those well-to-do drink Tibetan tea with butter, the rest drink Kangra tea. Sattu is again mixed with this and is eaten with the bent finger. Spoons are unknown in the hills. The evening meal may be of (1) Kiu-dumpling of flour (atta) with fat or meat broth (2) Momo—pounded meat spiced wrapped in unleavened bread (roti). Poorer people eat more simply with more soup and nettles or other weeds. A great luxury is rice on which melted butter and sugar are poured. All grain must be imported. The men go to Tibet for salt, a 2 month's journey. For Rs. 5 and a sheep they get from the Tibetan Government permits to take out 100 sheep loads of salt. This they barter in Lahul, Spiti or Rampur for flour. Everyone must therefore have sheep—sheep are as basic here as land is below. The men's work is this traffic. The women stay at home looking after the flocks that remain and weave clothes and tents. The wool that is sold is usually cut by the buyer. (At Tsultak a Tibetan agreed to sell his wool at 12 As. (about 25 cents) a head. The cutter gets $\frac{1}{2}$ cent.) The buyer promises to come the ensuing year at a certain date.

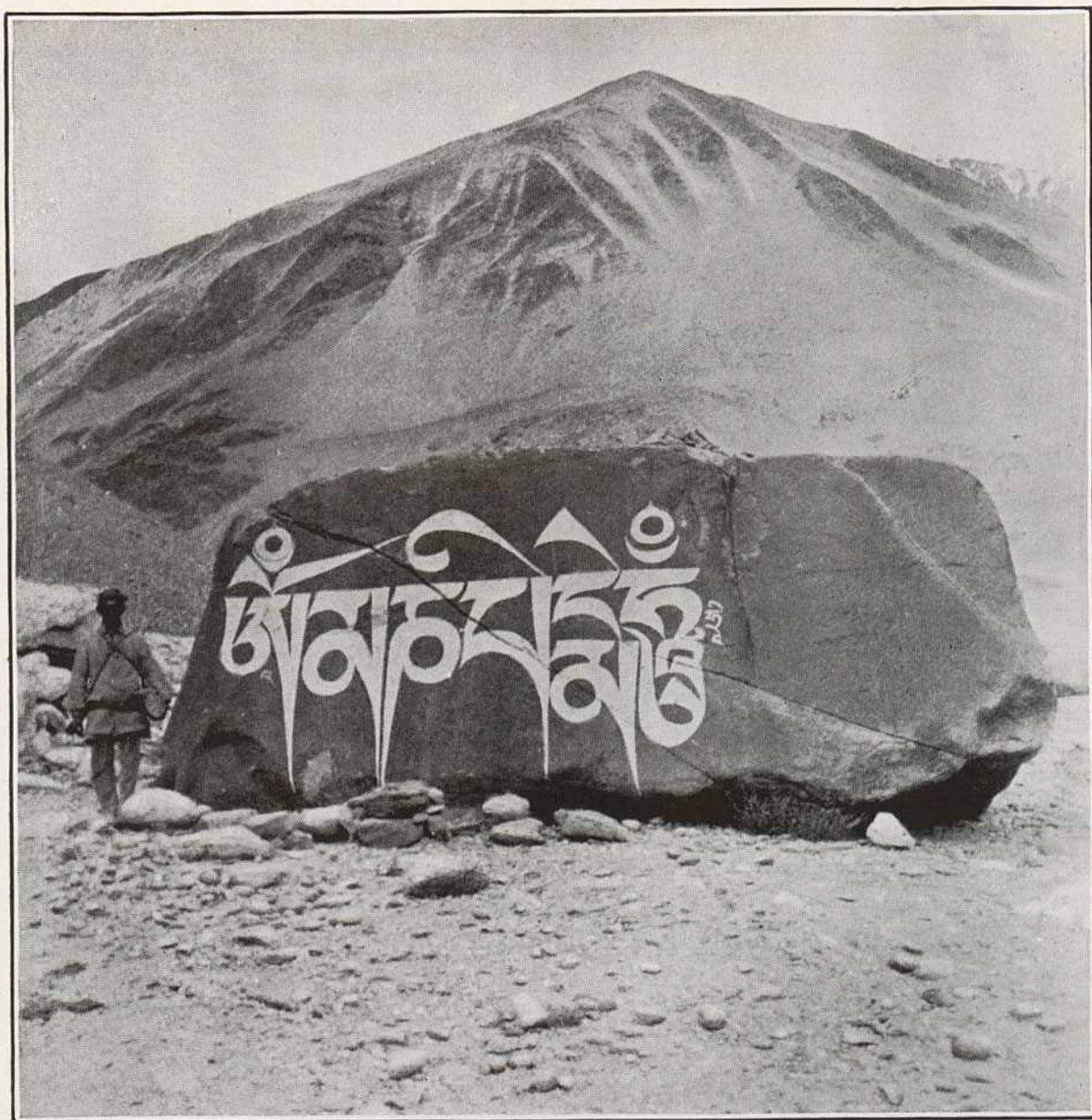
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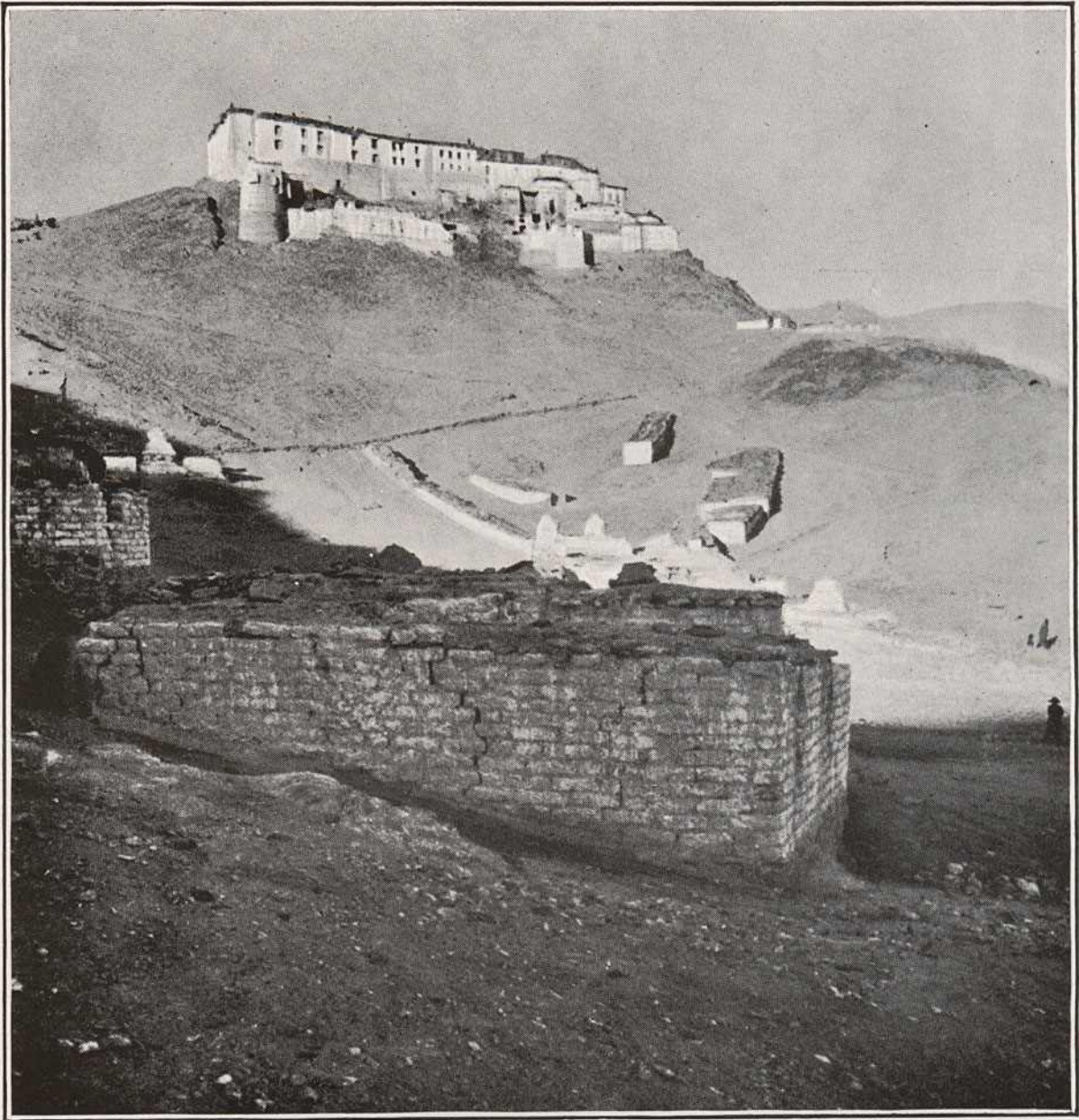
THE ROTHANG PASS.



THE EXPEDITION ON THE BARALATSE PASS, LAHUL.



ŌṂ MAṆI PADME HŪṂ FORMULA CARVED ON A ROCK ON THE TIBETAN UPLAND.



HANLE MONASTERY.

ON LECETHIN.

V. A. PERTZOFF AND M. AISNER.

INTRODUCTORY.

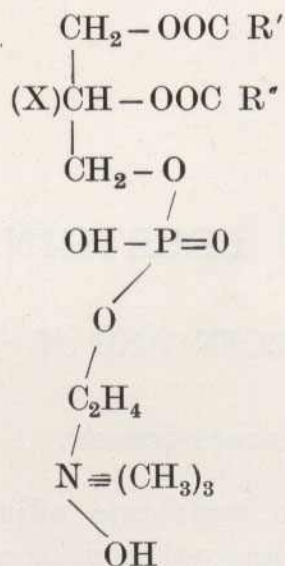
THE organism of the higher vertebrate adjusts itself in many ways to changes of external and internal environment. The brain, the spinal cord and the nervous system in general are involved directly or indirectly in all these adjustments. The chemical components of this great system are predominantly lipoids. It is, therefore, in the careful study of the chemical constituents composing the nervous system, their structure, their decomposition products and, perhaps later, their proper place in the structure of the whole, that an answer may be found to the physico-chemical mechanism underlying nervous processes.

It is not our purpose to survey the history of lipoids, but only to mention briefly those contributions which seem to have a greater bearing on our work. A definite order in the chemistry of lipoids was brought about by extensive and painstaking investigations of Thudichum (1). He not only contributed much to the knowledge of individual lipoids, but proposed a scheme for their classification. His division is as follows:—

1. Monoaminophosphatides (one atom of nitrogen and phosphorus per molecule: lecethin and cephalin).
2. Diaminomonophosphatides (sphingomyelin).
3. Diaminodiphosphatides (assurin).

Perhaps of all lipoids the most widely distributed is lecethin. Gobley (2) was first to obtain and name it. Ulpiani (3), Begell (4), Thierfelder and Stern (5), Maclean (6), (7), (8), (9), (10), Paal and Oehme (11) and Ritter (12) contributed to its isolation, purification and structure. Recently Levene and his co-workers, in a series of investigations (13), (14), (15), (16), (17), (18), (19), (20) have clarified the composition of lecethin and firmly established the nature of the fatty acids bound to its molecule.

These and other investigations have shown that lecethin has probably the formula :—



in which choline, the nitrogen yielding part of the molecule is bound through an ester linkage. The carbon atom (X) is assimetric (21) being bound to four different atoms or radicles. The symbols R' and R'' stand for different fatty acids attached to the molecule.

The number of fatty acids isolated from different lecethins is quite large. Since our starting material was lecethin derived from egg, we shall restrict ourselves only to the fatty acids of this lecethin. Palmitic $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$, and stearic, $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, acids have been found. Among the unsaturated acids oleic $\text{C}_8\text{H}_{17}\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ is invariably present. Linolic acid, together with the highly unsaturated arachidonic acid, have been also identified. It is interesting to note that the saturated and unsaturated fatty acids are present in about equimolar proportion, indicating that on the average there is one saturated acid to every unsaturated one in the lecethin molecule.

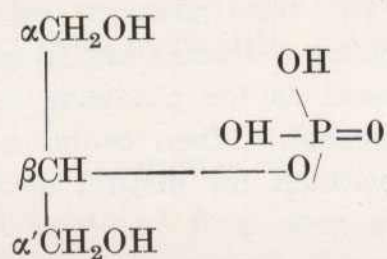
If we now fix our attention on the disposal of the available fatty acids it will be evident that we must have more than one lecethin. The number of available positions is two (R' and R'' in the formula) while there are five fatty acids. As we have noted, one of these positions should be occupied by a saturated fatty acid. It follows that six different lecethins are possible.

On examination of the probable formula of lecethin, it will be noticed that a fatty acid located at R'' will be nearer to the phosphoric acid part of the molecule than in position R'. Since the acid in position R' and R'' are not the same they will affect the chemical properties of the phosphoric acid part of lecethins molecule differently. The reverse is also true—the acids being at different distances will be affected to a different extent by the

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neighbouring group. It follows that for every combination of fatty acids there must be two different lecethins: one in which the saturated fatty acid will occupy the position R' and one unsaturated R'', and another in which the positions will be reversed. This possibility will increase the total number of lecethins to twelve.

Tutin and Hann (22), Grimbert and Bailey (23) (24), and Bailey (25) have pointed out, both on theoretical and experimental bases, that there should exist another symmetrical form of lecethin, in which the phosphoric acid is joined to β -carbon atom of glycerol:—



Since lecethin is optically active, the symmetrical form must be present as an admixture. In this kind of lecethin the relative position of the two fatty acids is immaterial, and therefore adds to the total number of lecethins six more, making in all, if we assume that only one optical isomer is found in nature, eighteen lecethins.

TABLE I.

Molecular Weights and elementary composition of various lecethins.

No.	Compound	Mol. wt.	Percentage by weight, of :				
			C	H	O	P	N
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I	$\text{C}_8\text{H}_{22}\text{O}_7\text{PN}$	275.2	34.88	8.05	40.70	11.27	5.09
II	$\text{I} - \text{H}_2\text{O} + \text{C}_{16}\text{H}_{32}\text{O}_2$	513.5	56.10	10.13	24.93	6.04	2.73
III	$\text{I} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{32}\text{O}_2$	537.5	58.04	9.75	23.81	5.77	2.65
IV	$\text{I} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{34}\text{O}_2$	539.5	57.80	10.08	23.74	5.75	2.60
V	$\text{I} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{36}\text{O}_2$	541.5	57.61	10.42	23.64	5.73	2.59
VI	$\text{I} - \text{H}_2\text{O} + \text{C}_{20}\text{H}_{32}\text{O}_2$	561.5	59.84	9.33	22.79	5.52	2.49
VII	$\text{II} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{32}\text{O}_2$	775.7	64.96	10.66	18.56	4.00	1.85
VIII	$\text{II} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{34}\text{O}_2$	777.7	64.80	10.89	18.52	3.99	1.84
IX	$\text{II} - \text{H}_2\text{O} + \text{C}_{20}\text{H}_{32}\text{O}_2$	799.7	66.00	10.33	18.00	3.88	1.75
X	$\text{V} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{32}\text{O}_2$	803.7	65.69	10.79	17.92	3.86	1.74
XI	$\text{V} - \text{H}_2\text{O} + \text{C}_{18}\text{H}_{34}\text{O}_2$	805.7	65.51	11.01	17.87	3.85	1.73
XII	$\text{V} - \text{H}_2\text{O} + \text{C}_{20}\text{H}_{32}\text{O}_2$	827.7	66.68	10.50	17.39	3.74	1.69

In Table I we have calculated the elementary composition of various lecethins which are analytically different. For comparison we have also calculated the analytical figures for lecethin deprived of fatty acids, as well as for lecethins having only one fatty acid. The latter, though not included in the total estimate of the number of possible lecethins, may be, as we shall see, really existant.

EXPERIMENTAL.

I. Analysis.

In the course of the investigation the following analyses were carried out:—

Total Nitrogen: The total nitrogen was determined by the method suggested by Pregl (26), using a Parnas and Wagner (27) apparatus for distillation. Copper sulphate was used as the oxidizing agent. For sampling, lecethin was dissolved in methyl alcohol. When cadmium chloride salts were used, carbon tetrachloride was substituted for methyl alcohol. Our analysis usually agreed within two per cent.

Amino Nitrogen: The amino nitrogen was determined in the micro apparatus designed by D. D. Van Slyke (28). The solvent used for samples of lecethin was glacial acetic acid, and for the cadmium chloride salt-lecethin, carbon tetrachloride or water. The determination of the amino-nitrogen in cadmium chloride salts is a troublesome procedure. The best method was found to be transference of 1 c.c. of the suspension of the salts in carbon tetrachloride or water to the measuring tube of the apparatus, washing it in with another c.c. of the solvent. A much prolonged period of shaking is necessary to complete the reaction—at least one hour or more. A blank was carried after every determination and shaken for the same period of time. The temperature was about 20°C. The determinations agreed within about 3-4 per cent.

Carbon and Hydrogen: These elements were determined by the procedures recommended by Pregl (29). Results are accurate within about one per cent in the case of carbon and two per cent in the case of hydrogen.

Phosphorus: The phosphorus was determined according to the method described by Pregl (30). The lecethin was decomposed by the procedure recommended by Lieb and Wintersteiner (31). The analysis agreed within two per cent.

Determination of the Iodine Number: The iodine number was determined by the method of Wij. The analysis agreed within about two or three per cent.

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Determination of Cadmium Chloride: The cadmium chloride bound to lecethin was determined either by analysis of chlorine by Pregl's method (32) or by the electrolytic method described below.

Molecular Weight Estimates of the Cadmium Chloride Salts of Lecethin: K. Rast's method described by Pregl (33) was used. It consists in determining the melting point depression of a known quantity of the camphor in which a known quantity of the unknown has been dissolved. The molecular depression of camphor was taken as 38°. The cadmium chloride salts were not perfectly stable at the temperature employed and had a tendency to give diffuse melting points. The experimental error is therefore considerable and probably amounts to about ± 10 per cent. The method is, however, valuable in fixing the general size of the molecule.

II. Preparation.

A commercial preparation of lecethin¹ from eggs was used as a starting material. It was dried by being dissolved in ether and precipitated with acetone. The supernatant liquid was then decanted and the lecethin dried over sulphuric acid in vacuo until constant weight.

Preparation of Cadmium Chloride Salts of Lecethin: 230 gms. of lecethin were dissolved in about 2,200 c.c. of 95 per cent ethanol. The mixture was filtered through cheese cloth and to the filtrate 4,800 c.c. of saturated solution of anhydrous cadmium chloride in absolute methyl alcohol were added. During this operation the solution was stirred mechanically. The precipitate of the cadmium chloride salts of lecethin was then left to settle and the supernatant liquid syphoned off and discarded. To the salts, one liter of absolute ethanol was added and the solution stirred again for five minutes. The precipitate was then allowed to settle and the supernatant liquid was syphoned off. The salts were then washed three times with one liter portions of anhydrous ether and dried in vacuo.

Recrystallization of Lecethin Cadmium Chloride from a Mixture of Ethyl Acetate and Ethyl Alcohol: About 60 gms. of salts were dissolved in one liter of a solution made up of two parts of ethyl acetate and one part of 80 per cent ethyl alcohol. The mixture was warmed in a water bath to 55°. A small part of the lecethin remained undissolved and was discarded. The solution was placed in a refrigerator at 5° overnight. Crystals of lecethin cadmium chloride separated and these were removed from the mother liquid by decantation. The procedure was repeated once more. The crystals were then washed twice

¹ Throughout this investigation, the word lecethin has been used as referring to certain preparations and not to the pure substance.

with 500 c.c. portions of absolute ethanol, once with anhydrous ether and dried in vacuo over sulphuric acid.

An Electrolytic Method for the Determination of Cadmium in the Cadmium Chloride Salt of Lecethin.

Any gravimetric method for the analysis of the amount of cadmium chloride found in lecethin requires a considerable amount of labor. We therefore have attempted to substitute for this method the usual electrolytic deposition of cadmium and have found that with a few minor changes it works well.

The apparatus consisted of a 150 c.c. beaker into which two platinum electrodes were inserted, the one an ordinary platinum wire, the other a piece of platinum gauze, approximately $1\frac{1}{2} \times \frac{3}{4}$ inches. The former served as the anode, the latter as the cathode. The electrodes were connected to a source of direct current having the pressure of about four volts and of such a density that it produced a steady flow of gas bubbles from both electrodes.

After several trials, the following procedure was adopted. About 0.5 grms. of finely powdered cadmium chloride salts of lecethin were transferred to the beaker and stirred with 50 c.c. of water. A few drops of phenolphthallin were added and the solution made distinctly alkaline with sodium hydroxide. Then 10 c.c. of potassium cyanide (freshly prepared 100 grms. in 100 c.c. of H₂O) were added and the solution carefully stirred. A few drops of caprylic alcohol were then added to prevent foaming during electrolysis.

Prior to electrolysis the cathode was washed with water, then with absolute alcohol and ether and dried. Its weight was recorded. This procedure was repeated after the deposition of cadmium. Table II gives the details of a typical determination. 0.4992 grms. of salts were used in this analysis and the cathode, prior to electrolysis, weighed 1.5020 grms. Using the last figure of this table, the percentage of cadmium in the salt was

$$\%Cd = \frac{0.0630}{0.4992} \times 100 = 12.62.$$

TABLE II.

Electrolysis of cadmium chloride salt of lecethin.

Time for electrolysis hrs.	Weight of the electrode g.	Weight of cadmium g.
(1)	(2)	(3)
2.45	1.5624	0.0604
3.30	1.5635	0.0615
4.45	1.5643	0.0623
5.30	1.5651	0.0631
6.30	1.5650	0.0630

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In routine analysis the solution was, during the first hours of electrolysis, occasionally stirred with a glass rod and then left overnight to remove the last traces of cadmium. The length of time for electrolysis may easily be found by reweighing the electrode during the course of electrolysis until a constant weight is obtained.

There is little doubt in our minds that the determination of cadmium in lecethin salt depends upon a partial decomposition of this salt in water, and a subsequent ionization of the liberated cadmium chloride. The electrolysis of the salts is also possible from a 50 mol. per cent solution of ethanol in water. Small amounts of water are thus sufficient to produce a decomposition of the salt. It follows that in preparation of the salts, water must be avoided, unless care is taken to wash out, with some solvent, the free lecethin thus liberated.

It was interesting to see whether electrolysis could be affected from solvent in which the cadmium chloride salts of lecethin are noticeably soluble. Benzene dissolved the salts extremely well. Carbon tetrachloride and chloroform no doubt dissolved a considerable amount.

A number of experiments indicated that in solvents in which salts form apparently true solutions (benzene for instance) no electrolysis takes place. The better the solution from the point of view of absence of colloidal formation, the worse is its electrolytic decomposition.

This leads us to believe that the cadmium chloride salts of lecethin, not unlike other salts of lipoids, are completely unionized in solvents in which they are particularly soluble and that the colloidal nature of watery solutions, in this case, is primarily due to a decomposition of the salts and the liberation of free lecethin.

The result of an electrolysis of cadmium chloride salts of lecethin is free lecethin. The electrolysis is therefore a method of obtaining free lecethin from its salt. It is, however, doubtful that such a lecethin will retain its original degree of unsaturation, since it necessarily will come in contact with gas generated by electrolysis. This, however, may be avoided by surrounding the electrodes with membranes permeable to crystalloids, but impermeable to lecethin. If this can be achieved the method may become of considerable use, since the liberation of lecethin electrolytically does not involve any loss of material, while in the usual procedure (through the decomposition of the salt with alkali in some organic solvent), wastes a considerable amount of the material.

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The Solubility of Cadmium Chloride Salts of Lecethin in Various Solvents and the Composition of the Final Products.

The original lecethin, the cadmium chloride salt prepared from it and the same salt recrystallized from an ethyl acetate and ethanol mixture were subjected to analysis. The results of these are found in Table III.

TABLE III.

Analysis of lecethin preparations.

Preparation	Per cent by weight				
	Amino-N	N	P	CdCl ₂	Iodine No.
(1)	(2)	(3)	(4)	(5)	(6)
Original dried	0.48	2.00	3.81		66.5
CdCl ₂ -salt	0.345	1.91	2.96	20.7	47.1
CdCl ₂ -salt recrystallized from ethyl acetate-ethanol	0.338	1.89	2.97	22.40	43.4

Neither of these preparations fulfil the requirements of pure lecethin, since all of them contain amino nitrogen. Neither nitrogen nor phosphorus are present in the quantities expected in lecethin.

It has been of interest to investigate what would be the effect of washing such preparations with various solvents or mixture of solvents. If the impurities have different solubilities, we will end with products differing in elementary composition from the original substance. This has been already amply proved in the case of cephalin salts which are more soluble in ether than the lecethin salts.

The experiments were carried in the following way. 0.50, 1.00 or 2.00 grams portions of cadmium chloride salt of lecethin recrystallized from ethyl acetone-ethanol were placed in small flasks which were then filled with 75 c.c. of various solvents. To the flasks were added five or six small glass balls and the flasks subjected to vigorous shaking in an air thermostat at $25 \pm 0.5^\circ\text{C}$. for twenty or more hours. Under these conditions the salt is broken up into a very fine state of subdivision, the glass balls acting quite efficiently as a ball mill. Such a suspension passes readily through ordinary filter paper. The separation of the solid phase from the liquid one by filtration was found to be impractical.

It is, however, possible to affect the separation by letting the flasks stand for a certain length of time. After an elapse of 48 hours or more (in a

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water thermostat kept at $25 \pm 0.1^\circ$) the settling was complete except where ether was used as a solvent. In this case, a noticeable opalescence persisted almost indefinitely.

After the precipitate has settled down 50 c.c. of supernatant liquid were carefully syphoned off, aliquot parts transferred to weighed beakers and the beakers placed in a vacuum dessicator at room temperature until dry. Then they were reweighed and the weight of the solids determined.

The flasks were refilled with 50 c.c. portions of fresh solvent and the procedure of equilibration, settling and analysis repeated. Thus, every time 50 c.c. out of 75 c.c. were removed and replaced with fresh solvent.

The amount of solid phase at any saturation may be calculated from the following considerations:—

Let P_n be the amount in mgs. of solid phase at saturation n and the solubility (mgs. dissolved in 75 c.c.) S_n . At the next saturation, we similarly have P_{n+1} and S_{n+1} . P_{n+1} would be equal to $P_n - S_{n+1}$ if all of the 75 c.c. of solvent were removed at n saturation, but since we left in the flask 25 c.c. at this saturation, we must subtract from $S_{n+1} - \frac{2}{7}S_n$ and we have:

$$P_{n+1} = P_n - (S_{n+1} - \frac{2}{7}S_n)$$

or
$$P_{n+1} = P_n - S_{n+1} + 0.333S_n.$$

In Table IV is found a summary of these experiments. In column (5) will be found the values of solid left undissolved, calculated by the equation just derived. Column (6) gives the percentage of the salt dissolved and was calculated as follows: From the initial amount of salt [Column (3) No. 1, 2, and 3] the amount left in the flasks at the final saturation [Column (3) No. 4, 5, and 6 for ether] was subtracted, giving thus the amount dissolved, in all flasks for all saturations. The per cent. of the salt dissolved, with reference to the initial amount, was then calculated.

The cadmium chloride salts left undissolved were dried and subjected to the analysis reported in Table V. We are indebted for some of the data reported in this table to Dr. G. Weiler and Dr. A. Schöeller, Berlin, Germany. The values for oxygen were, as usual, calculated by difference.

From inspection of Table IV, it is apparent that our preparation behaved differently in different solvents. The solubility is least in ether. The values recorded in the table are probably too high, due to the difficulty in separating the last trace of the precipitate. Replacing carbon tetrachloride in a mixture with ethanol with benzene increases the solubility. The factor is from 1.22 to 1.25.

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TABLE IV.

The solubility of cadmium chloride salt of lecethin in various solvents.

No.	No. of saturations	Initial amount of CdCl ₂ -lecethin g.	Solubility : mg. CdCl ₂ -L dissolved in 75 c.c.	Amount of solid phase mg.	Per cent dissolved
(1)	(2)	(3)	(4)	(5)	(6)
75 c.c. (C ₂ H ₅) ₂ O					
1	1	0.50	14.0	486	(1+2+3) - (4+5+6)
2	1	1.00	25.5	974.5	..
3	1	2.00	47.0	1953	11.8
4	9	0.50	8.0	409	..
5	9	1.00	20.0	874	..
6	9	2.00	24.0	1806	..
55 c.c. (CH ₃) ₂ CO + 20 c.c. CHCl ₃					
1	1	0.50	63	437	(1+2+3) - (4+5+6)
2	1	1.00	92	908	..
3	1	2.00	126	1874	34.6
4	11	0.50	24	217	..
5	11	1.00	32	611	..
6	11	2.00	46	1464	..
50 c.c. C ₂ H ₅ OH + 25 c.c. CCl ₄					
1	1	0.50	141	359	(1+2+3) - (4+7+8)
2	1	1.00	173	827	..
3	1	2.00	228	1772	..
4	5	0.50	76	127	58.5
5	5	1.00	111	520	..
6	5	2.00	146	1408	..
7	9	1.00	70.5	283	..
8	9	2.00	115	1402	..
50 c.c. C ₂ H ₅ OH + 25 c.c. C ₆ H ₆ (after 2d sat. changed to 66.67 c.c. C ₂ H ₅ OH + 8.33 c.c. C ₆ H ₆)					
1	1	0.25	143	107	(1+2+3) - (4+7+9)
2	1	0.50	172	328	..
3	1	1.00	216	784	..
4	3	0.25	69	7.5	..
5	3	0.50	101	167	85.4
6	3	1.00	127	580	..
7	6	0.50	67.5	24.5	..
8	6	1.00	91	398	..
9	9	1.00	85	224	..

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It is doubtful if the dielectric constant of the solvent governs the solubility of the salts in this instance. The dielectric constants (20°) of these two solvents, as determined by King and Patrick (34) is about the same: 17.0 for $C_2H_5OH-CCl_4$ and 16.6 for $C_2H_5OH-C_6H_6$. We must therefore look for an explanation elsewhere, since, furthermore, a lowering of the dielectric in this case results in an increased solubility, while in ether, which has a dielectric constant of about 4, the solubility is less.

TABLE V.

The composition of cadmium chloride salts of lecethin.

Source: Table IV column (5). No. of table IV and sol- vent: (1)	Element or compound (2)	Per cent by weight in the $CdCl_2$ salt (3)	Per cent by weight in lecethin (4)	G.-atom per 100g. (5)	$\frac{P}{N}$ (6)	Weight of lecethin con- taining one gram-atom. 100/(5) (7)
4 + 5 + 6 $(C_2H_5)_2O$	P	2.90	3.70	0.119	0.81	840
	N	1.62	2.06	0.147		680
	$CdCl_2$	21.50	..	0.1173	..	850
	C	48.95	62.35	..	..	..
	H	8.20	10.45	..	..	..
	O	16.83	21.44	..	..	..
	Amino-N Mol. wt.	0.265
4 + 5 + 6 $(CH_3)_2CO +$ $CHCl_3$	P	2.95	3.93	0.127	0.82	790
	N	1.70	2.17	0.155		650
	$CdCl_2$	24.95	..	0.1362	..	735
	C	48.05	64.10	..	..	..
	H	8.15	10.90	..	..	..
	O	14.20	18.90	..	..	..
	Amino-N Mol. wt.	0.35
4 + 7 + 8 $C_2H_5OH +$ CCl_4	P	3.34	4.72	0.152	1.03	660
	N	1.46	2.06	0.147		680
	$CdCl_2$	29.25	..	0.1595	..	630
	C	44.50	62.90	..	..	..
	H	7.52	10.65	..	..	..
	O	13.93	19.67	..	..	..
	Amino-N Mol. wt.	Trace
4 + 7 + 9 $C_2H_5OH +$ C_6H_6	P	3.06	4.19	0.135	0.94	740
	N	1.44	2.01	0.144		700
	$CdCl_2$	27.00	..	0.1473	..	680
	C	46.70	64.00	..	..	..
	H	7.50	10.27	..	..	..
	O	14.30	19.53	..	..	..
	Amino-N Mol. wt.	None

An inspection of Tables IV and V leads us to the following conclusions:—

The monoaminophosphatides are less soluble in all of the solvents investigated than the impurities associated with them. The $\frac{P}{N}$ ratio of our starting material, calculated from Table III for free lecethin is 0.71. All the ratios recorded in Table V are higher than this.

One of the most troublesome impurities of lecethin is cephalin which is very similar in composition to lecethin, but its nitrogen is in the form of amino nitrogen. Therefore, the amount of amino nitrogen serves as an index of the freedom of lecethin from that impurity. The per cent in our starting material, calculated with respect to free lecethin, is 0.435 per cent. The per cent for ether washed lecethin is 0.34. For lecethin extracted with $(\text{CH}_3)_2\text{CO} - \text{CHCl}_3$ mixture the amount is 0.47. The other two samples contained either a negligible amount or none at all. These findings show that in acetone-chloroform mixtures, lecethin is probably more soluble than cephalin, since the amount of amino nitrogen in the sample increased. This solvent cannot be used for purification of lecethin. The relative solubility of these two substances, according to our determinations, confirms the fact that cephalin is more soluble in ether than lecethin. All these considerations, it is understood, apply only to the cadmium chloride salts of these substances.

The next point of interest seems to be the evaluation of the relative efficiency of the solvents used. A complete solution of the problem cannot be given without an elementary analysis at every saturation, but the following approximate calculation may serve as a useful index. The amino nitrogen content cannot serve as a basis of comparison since in two of the four samples we found practically none, but the $\frac{P}{N}$ ratio may serve well this purpose. The efficiency of a given solvent in this case is directly proportional to the increase in the $\frac{P}{N}$ ratio and is inversely proportional to the amount of material dissolved which is necessary to effect it. In other words:—

$$(\text{C}_2\text{H}_5)_2\text{O} : \frac{0.81-0.71}{11.8} = 0.0085$$

$$(\text{CH}_3)_2\text{CO} + \text{CHCl}_3 : \frac{0.82-0.71}{34.6} = 0.0032$$

$$\text{C}_2\text{H}_5\text{OH} + \text{CCl}_4 : \frac{1.03-0.71}{58.5} = 0.0055$$

$$\text{C}_2\text{H}_5\text{OH} + \text{C}_6\text{H}_6 : \frac{0.94-0.71}{85.4} = 0.0027.$$

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Using these criteria, we must conclude that ether is the most efficient solvent. Next to ether the best of the solvents is $C_2H_5OH + CCl_4$. This comparison does not include the separation of lecethin from cephalin. The ratio of phosphorus over nitrogen does not distinguish between the two, but it serves only as an index of the relative quantities of monophosphatides in the material investigated.

A further insight into the nature of the products obtained may be gathered from an inspection of column (7) of Table V. There can be very little doubt that the substance isolated from the $C_2H_5OH - CCl_4$ mixture is a pure monophosphatide, free from amino nitrogen, excepting a trace of it, and therefore practically free from cephalin. These conclusions are formed from the good agreement of the weight of lecethin per one gram atom of elements or compounds analyzed. The molecular weight estimate agrees very well with the analytical figures.

The product obtained from $C_2H_5OH - C_6H_6$ is of considerable purity, the analyses, considering our experimental error, agree satisfactorily.

A comparison of elementary compositions of lecethin found in Table I with the one obtained (Table V) reveals that none of the two lecethin preparations agree with the elementary composition required by a single lecethin. This is not surprising in the light of the review of the whole problem in the introductory part of this paper. The curious part of this comparison is that none of the lecethins having two fatty acids attached to the molecule will satisfy the requirements of the analyses obtained for the sample from $C_2H_5OH - CCl_4$. The good agreement of the molecular weight estimate precludes the presence of any impurities of smaller molecular weight. Even if this is not admitted, these impurities must contain P and N in the same proportion as the lecethin, and in addition, bind $CdCl_2$ to the same extent, which makes their existence highly improbable. The more plausible explanation to our mind is that the preparation isolated contains not only lecethins containing two fatty acids, but one or more lecethins containing only one fatty acid. As far as we are aware, this is the first indication of the possibility of the existence of such a compound.

The preparation derived from $C_2H_5OH - C_6H_6$ consist probably of lecethins containing two fatty acids with a small admixture of lecethins containing one fatty acid.

Beside the consideration derived from these analyses, there is an independent way of judging the purity of a chemical substance. For a single

chemical individual the phase rule predicts that in a system containing a liquid phase and a solid phase, the temperature, composition of the liquid phase, etc., being kept constant, the solubility can have but a single value which should be independent of the amount of solid phase.

Consulting Table IV and comparing the solubilities in $C_2H_5OH-CCl_4$ at final saturation (Nos. 4, 7, and 8), and similarly the solubilities in $C_2H_5OH-C_6H_6$ (Nos. 4, 7, and 9), we come to the following conclusion: neither of these substances could be single chemical individuals since their solubility depends upon the amount of solid phase. It is curious to note that there is a far better agreement between the solubilities in $C_2H_5OH-C_6H_6$, than in $C_2H_5OH-CCl_4$. The explanation seems to lie in the considerable chemical differences of the lecethins composing the first preparation, while the second, containing chiefly lecethins with two fatty acids, is more chemically homogeneous.

No doubt in the years to come, the chemistry of lipoids will deal with single species of molecules. To our mind, the application of the Phase Rule to such preparations is highly desirable. In any preparation, it should be considered one of the final criteria for a single chemical individual.

SUMMARY.

1. On the basis of the present knowledge of lecethin, the total number of possible lecethins derived from egg was estimated and found to be not less than eighteen.

2. An electrolytic method for the determination of cadmium in the cadmium chloride salt of lecethin is described. The electrolysis of these salts was tested in various solvents and certain conclusions concerning the nature of such solutions drawn.

3. The solubility of the cadmium chloride salts of lecethin obtained from a preparation of lecethin from eggs was studied in several solvents. After extensive washing of the salt with these solvents, the residue was subjected to complete elementary analysis as well as molecular weight estimates. Upon a simultaneous consideration of analytical data and solubility measurements, the following conclusions were drawn.

(a) Ether is the most efficient solvent for separating impurities from monoaminophosphatides.

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(b) It is possible to obtain lecethin free from cephalin and having a $\frac{P}{N}$ ratio equal to one, by extracting the cadmium chloride preparation with ethanol-benzene and ethanol-carbon tetrachloride mixtures.

(c) The product obtained from ethanol-carbon tetrachloride indicated that it was composed not only of lecethins having two fatty acids, but also of a large proportion of lecethin having but one fatty acid.

(d) The phase rule test was applied to the products obtained. The importance of this general law to the chemistry of lipoids is emphasized.

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Harvard University, Cambridge, U.S.A.*

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ANNUAL REPORT, 1931.

THE year 1931 was a period of continuous growth for the Institute. The research programme of its departments has been carried out without obstruction, and important collections and scientific datae obtained which augur well for the future of the institution. The Institute has strengthened its relations with numerous scientific institutions, many of which actively co-operate with the Institute in its various fields of research.

We are glad to report that a number of distinguished savants have joined the Institute. Dr. E. D. Merrill, Director-in-Chief of the New York Botanical Garden; Sir C. V. Raman; Professor S. I. Metalnikoff, of the Pasteur Institute, Paris; and Professor Baron Michel de Taube, Member of the Institute of International Law, have joined the Honorary Advisors' Board of the Roerich Museum / Division of Science / . Compte du Mesnil du Buisson, Director of the Archæological excavation at Qatna, Syria, and Lecturer at the Ecole du Louvre, and Professor Guisepe Tucci, Member of the Royal Italian Academy, have become Corresponding Members of the Institute.

It is a pleasant duty to express here the sincere gratitude of the Institute's Staff to our Founders, Madame and Professor de Roerich, and to the Board of Trustees of the Roerich Museum, for their constant assistance and furthering of the Institute's plans.

DEPARTMENT OF ARCHÆOLOGY, RELATED SCIENCES AND ARTS.

During the past year, the department was engaged in the following activities :—

1. Linguistic, Ethnographical, and Archæological exploration in Lahul / N.-W. Himālayas / , the cost of which was donated by Professor de Roerich.

2. Work on the large Tibetan-English Dictionary to be published by the Institute.

3. The preparations of the first volumes of the series 'TIBETICA'. In June, 1931, the Institute's Staff was joined by Lama Lobzang Mingyur Dorje, a noted Tibetan scholar, and author of several publications on Tibetan grammar.

The Expedition left the headquarters of the Institute at Naggar, on the 10th of July, and after a rapid journey across the Rothang Pass, established

its headquarters at Kyelang, Lahul, from which place numerous excursions were undertaken to various places of interest.

1. (a) *Linguistic Survey*:—The work in this field was limited to the Tibetan dialect of Lahul, and was not concerned with the other Himālayan dialects found in the mountain valleys of the Bhaga, Chandra and Chandrabhaga rivers. The material collected contains a grammar of the Lahul dialect, a vocabulary, texts of songs and descriptions of ceremonies. It was observed that the Lahul dialect has two sub-dialects: that of Kolong in the upper Bhaga Valley, and that of Koksar in the upper Chandra Valley. Both the sub-dialects were found to possess a distinct system of tonemes—a fact previously left unrecorded.

(b) *Ethnographical collection*:—Every effort was made to secure a representative collection of objects illustrating the everyday life of the Lahul hillmen. This summer's work resulted in an interesting collection of wood-carved Tibetan furniture, some of whose ornamental motifs curiously remind one of Nordic wood-carvings.

(c) *Archæological Survey*:—Work has begun on the archæological survey of the region. For many years numerous burial grounds in Lahul have been known to exist, popularly designated under the local name of čji-wej rom-k'añ / colloquial for phyi-ba'i ro-khañ / - The late Dr. A. H. Francke in his 'History of Western Tibet' / London, 1907 / and the Kangra District Gazetteer / (Kulu, Lahul, Spiti). Lahore, 1917 / mention the existence of ancient burial grounds, which according to them were left behind by some invaders coming from the North. No attempt was made to survey or investigate these burial grounds, or to classify them according to their respective types. In view of the importance of ancient burial grounds for the early history of Tibet, the Director conducted a rapid survey of the sites. This survey in the Bhaga and Chandra river valleys convinced him of the existence of at least three kinds of burials. It is still impossible to ascertain the dates of these burial grounds, for this would necessitate proper excavations, and not the mere examination of graves opened by inhabitants. The known burial grounds can be classified according to three definite types of burial:

(a) Graves representing a hole, about 2-3 feet deep, covered by a large stone slab. Average length of stone slab about 5 feet, breadth about 3 feet. The orientation of the graves is very uncertain, most of the graves so far discovered seem to be orientated from North to South. There is nothing on the surface to tell of their existence, and most of the known graves have been discovered during field works, excavations of house foundations, and road building.

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Graves of this type were discovered in the vicinity of Kyelang village. Their inventory is extremely poor. Most of the iron implements found in the graves have rotted away beyond recognition. The human remains turned to dust, and a few insignificant bone fragments is all that is usually found.

A second similar burial ground is found at the confluence of the rivers Chandra and Bhaga. Here the graves are surmounted by small tumuli of an average height of 1-2 feet / length 7 feet, breadth 4 feet /. Popular tradition says that these graves were left behind by invaders from Guge.

(b) The second type of burial is seldom found, and probably represents the most ancient type of burial, so far discovered in Lahul. As far as I know only one grave of this kind was discovered near Kyelang by the road side from Kyelang to Gumrang village / about two miles from Kyelang /. It represents a circular hole inlaid with large flat stones. The shape of the grave bears a striking resemblance to an urn. The grave was excavated by some local inhabitants, and according to them nothing was found in it, except some decayed fragments of human bones, and some small fragments of pottery. The utter state of decay of human remains, and the almost total absence of inventory, may indicate the fact that we find ourselves in the presence of a burial in which the human body was cut to pieces and the flesh separated from the bones—a common type of ancient Tibetan burial of the pre-buddhist period. This last type of burial should be connected with the Ladak graves discovered by the Moravian Missionaries at Teu-ser-po in the vicinity of Leh. Further researches will no doubt discover other graves of similar type and will help to solve the problem. The Leh graves belonged to a long-headed race, closely akin to the nomad races of Tibet.

(c) The third type of burial is represented by groups of large tumuli, and is said to have been left behind by a body of Mongol-Tibetan troops who raided the Bhaga and Chandra valleys, during their attack on Ladak in the reign of king bDe-legs rnam-rgyal / about 1640-1680 /. According to popular tradition / no written account exists of the raid to Lahul, as far as I know / a detachment of Mongol-Tibetan troops invaded Lahul across the Baralacha Pass, and remained in the country for several years, or, as says the oral tradition, 'such time as was needed for an apricot seed planted by the invaders to grow into a young tree'. According to the same oral tradition the Mongol-Tibetan troops built a fortified camp at the confluence of the Bhaga and Chandra rivers on a high river terrace facing the ancient Buddhist monastery of Ghandhola. The place is still called K'ar-ga / mKhar-ka / and is characterized by the remains of an ancient fort. Whether this fort belongs to this period / XVIIth century /, or was built by Lahulis remains to be seen. The

second site connected with the name of the Mongols is situated two miles from Koksar, not far from the Rothang Pass. According to the oral tradition, the Mongols were forced to abandon their camp at Koksar because of some disease during which time some 1,000 men died from it. The larger tumuli found in the vicinity of Koksar are said to contain each from 5 to 10 bodies of dead warriors. According to the same oral tradition the local inhabitants had to abandon their villages during this Mongol-Tibetan raid, and fled to remote places high up the surrounding mountains, seeking shelter in caves and well-protected places. The present inhabitants of Lahul know of several such places up the Bhaga river Valley, which still bear traces of a prolonged occupation.

Interesting material was gathered on the history of the buddhist monasteries in the Bhaga Valley. The material collected consists mostly of monastery records, and biographies or rnam-thar of the founders of the monasteries. This material throws new light on the introduction of Buddhism into Lahul and the adjacent regions of Western Tibet. The Library of the Himālayan Research Institute is now in possession of a good collection of Tibetan xylographs dealing with the 'Lives' of the early teachers of the 'Brug-pa bKa'-rgyud sect.

2. A good Tibetan-English dictionary, embodying the results of modern researches in the fields of Tibetan linguistics and philology, has long been a great desiderata. Such a dictionary has now been undertaken by the Institute, and Lama Lobzang Mingyur Dorje and the Director have been placed in charge of this important task. The new dictionary will include besides the printed material found in the already existing Tibetan-English dictionaries, the rich material found in the Sanskrit-Tibetan and Tibetan-Sanskrit dictionaries printed in Tibet, the Mongol-Tibetan dictionaries printed in Mongolia, and Transbaikalia and the several important polyglot dictionaries published in China. Besides the above printed material, the compilers will add a vast material collected by them in the course of their researches. The Dictionary will include the Sanskrit equivalents of philosophical terms; loan-words, which will be traced to their origins wherever possible, and an extensive material from the colloquial language and the various living dialects of Tibet. Work on the dictionary was begun in June, 1931, and it is hoped to bring it to completion towards 1934.

3. The first volume of the series 'TIBETICA,' dedicated to the study of Tibetan antiquity and related subjects, will contain the Director's Study of the Tibetan Dialect of Lahul. This study will be accompanied by a collection of phonetically transcribed Lahuli texts and a vocabulary / Lahuli-English /. The volume will be issued in the course of 1932. Two more volumes are in preparation :—

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(a) Life of Atiṣa, by the mKhan-po mčhims thams-čad mkhyen-pa.

(b) The History of Buddhism / čhos-'byuñ / by Padma dkar-po. This important text will be edited in Tibetan, and followed by a translation, accompanied by a copious commentary.

We express our sincere thanks to Professor de Roerich who laid the foundation of the series, by donating a sum of money to start a fund.

The following publications were prepared and issued in connection with the department:—

Col. A. E. Mahon, D.S.O.: Recent Archæological Discoveries in India.

This article appears in this issue of the Journal.

G. de Roerich: Trails to Inmost Asia, Yale University Press, 1931.

A French and German edition of the same work are in preparation.

G. de Roerich: Notes on the Ethnography of Tibet.

G. de Roerich: Studies in the Kālacakra.

The Institute was represented at several important scientific Congresses held during the year. Madame de Vaux-Phalipau represented the Institute at the XVth International Congress of Anthropology, held in Paris in September, and read two papers by the Director entitled: Problèmes ethnographiques du Tibet: les tribus Goloks, and 'Origines ethniques et composition des populations nomades du centre de l'Asie'. At the same Congress the well-known scholar Dr. Bashmakov read a paper on the recent discovery of megalithic monuments in Tibet by the Roerich Central Asiatic Expedition. At the XVIIIth Congrès International des Orientalistes, Dr. J. Rahder, Professor at the University of Leiden, read a paper entitled: The Activities of the Himālayan Research Institute of the Roerich Museum.

DEPARTMENT OF NATURAL SCIENCES AND APPLIED RESEARCH.

The year's work of the Biological and Botanical Section of this Department, is described in the following report by Dr. Walter N. Koelz:—

'The biologist's work during the year 1931 was chiefly carried on through three expeditions: one through the Kangra Valley into the Great Indian Plains, one to Western Tibet, and one to the domains of the Rāja of Rāmpur Beshahr. In addition several of the side valleys of the Beas Valley were explored.

From January 18th to March 15th was spent in the first expedition. Extensive collections of birds and plants, and a few mammals were made in the

Kangra Valley at Negrota, on the Plains at the Gurdaspur marshes, around Lahore, and at Sirsa on the border of Rājputana. The plants of the Plains are of a totally different flora from that of the northern mountains, among them are found many of the drugs that the great Indian medicine men employ, and their study is of no less interest than the alpine plants of the Tibetan Pharmacopoeia. Big game is not abundant in this region, but fine representatives were obtained of the Indian Red Deer and the Black Buck, the game par excellence. The birds during the winter months are of the greatest interest. Mixed with the regular population are visitors from Persia, Afghanistān, Siberia, Tibet and all the lofty mountain ranges between. Specimens that one may find singly or in scattered pairs in their breeding haunts are here assembled in flocks. Huge blue cranes from Eastern Siberia may literally fill a five acre field, the magnificent Imperial Sand Grouse from Persia visits its watering places in thousands, the Accipitrines, among the rarest of birds in collections are assembled in great variety / of the 1,000 specimens of birds secured over 10 per cent. were of this group / , duck, geese, and snipe of many species, and other enormous flocks tarry here till spring calls them to their nesting grounds in Siberia and Tibet. Among the birds of the Plains the Ibis, the Spoonbill, Egrets, Bitterns, Storks, Cranes, Parrots, Barbets, Bustards, and Partridges constitute an interesting part of the collection. The Expedition to Western Tibet left headquarters on June 7th and returned on October 8, having covered 1,000 miles chiefly in the provinces of Rupshu, Ladak and Zangskar. Over 1,000 plant numbers constituting some 10,000 specimens, more than 1,000 bird-skins and 25 big game heads were collected. The big game included all the large mammals of the region: *Ovis ammon*, shapu, nabo, ibex, Tibetan gazelle, Kyangs, etc. The plant growth, as all Tibetan explorers have described it, is phenomenal. Up to 20,000 feet and more the vegetation ascends. It is a singular fact that of the flora of the snow line on the outside of the Great Himālayan Range practically none occurs on the great plateaus, not even the little *Saxifraga flagellaris* that extends all over the boreal world, even to the land below the North Pole. Unlike most plants of high altitude, the plants are often not dwarfed and insignificant. At 15,000 to 18,000 feet elevation there are many showy, well-grown, and often very fragrant representatives of the genera *Potentilla*, *Ranunculus*, *Saxifraga*, *Pedicularis*, *Primula*, *Rosa*, *Clematis*, *Aster*, *Gentiana* to mention only the most striking. The bird collection contains many things of scientific interest, among them several new records for the avifauna of the area and a new bird for the Indian Empire, the Giant Lark, *Melanocorypha maxima*, taken with its eggs at Hanle. A further report of the itinerary of the Expedition appears as the "Diary of the 1931 Expedition to Western Tibet" in this issue of the Journal, and detailed reports on the scientific results will appear when the various collections have been studied.

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From November 4th to December 7th was spent in the Sutlej Valley in Rāmpur Beshahr. A collection of 165 plant numbers, about 2,000 specimens, 5 big game skins, and over 600 bird-skins was brought back. Among the birds were representatives of the grouse and pheasants of the area and a number of species of other groups that range chiefly to the East and meet the limit of their range in the Sutlej Valley. Many species of plants were found in bloom, among them a good series of the bamboos and other grasses and several very attractive and fragrant flowered shrubs. Several interesting horticultural products were also obtained, among them a squash of very fine flavor that grows to more than 40 lbs. and seems to be confined to a very small cold valley. Seeds of these were gathered for distribution.

During the year by request of the various institutions the following material has been distributed abroad:—

Roerich Museum—an ornithological collection and 7 big game.

New York Botanical Gardens—a collection of 700 plant numbers representing 3,000 specimens, and 35 packets of seeds.

United States Department of Agriculture—45 packets of seeds.

Museum of Comparative Zoology, Harvard University—an ornithological collection.

Natural History Department, British Museum—one bird skin.

Jardins des Plantes, Paris—35 packets of seeds.'

Throughout the year, the New York Botanical Garden continued to cooperate with the Himālayan Research Institute in the study and classification of its botanical collections. The experiments with seeds sent to New York by the Himālayan Research Institute have given some very good results, and Dr. E. D. Merrill, Director-in-Chief of the New York Botanical Garden in his letter of June 9th, 1931, writes as follows:—

'Our Head Gardener reports that he is getting excellent results from the seeds sent by you; a great many of them have germinated, and we shall deliberately place the young plants out of doors this summer, with view to testing whether or not the perennial species will stand our winter climatic conditions. Needless to state, we shall be very glad indeed to receive further seeds from medium and higher altitudes in the Himālayan region and in Tibet. I am quite confident that many of the native species there will thrive under our climatic conditions.'

On March 10th, 1931, the botanical collection sent by the 'Urusvati' Himālayan Research Institute of the Roerich Museum was handed over to the

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Jardin des Plantes of Paris. The Delegation of the French Association of Friends of Roerich Museum, headed by the Marquis d'Andigné, Member and former President of the Municipal Council of Paris, presented the collection to M. Louis Mangin, Member of the French Academy of Sciences, and Director of the National Museum of Natural History. Other speakers on this occasion were Madame de Vaux-Phalipau, President of the European Center of the Roerich Museum, and Dr. Georges Chklaver, Secretary-General of the European Center of the Roerich Museum, who pointed out the importance of the work accomplished by the Himālayan Research Institute. M. Louis Mangin expressed the gratitude of French science for the 'precious contribution made to their collection by the Himālayan Research Institute'.

BIO-CHEMICAL LABORATORY.

One of the aims of the Himālayan Research Institute is to conduct scientific research in the field of native pharmacopœia. It is our firm belief that the ancient medicinal usages of Tibet, China and India, representing centuries of unbroken tradition, have something to teach us and in some respects can furnish new data which will throw fresh light on pharmacological problems. This field is almost virgin, and the importance of this kind of research is recognized by the foremost specialists. The difficulties of this field of research are manifold. One has to gain the confidence of native medicine men, patiently work over thousands of pages of written records often compiled in an extremely difficult technical language, make oneself familiar with the native point of view, and above all to preserve to the last an open-minded attitude, for before one obtains precise data, one has to investigate a rich folk-lore material in which popular knowledge is frequently combined with phantastic legends of primitive religious creeds that crept into the technical text-books of native medicine. In many cases this medical knowledge is considered a sort of tabu, and the teacher will impart it to his pupil only on his deathbed. Frequently medical training is preceded by a rigorous observance of obscure religious practices which in their turn require investigation. In existing medical colleges the students have to work through an intricate system of learning, the outward difficulties of which often screen its real value. The text-books themselves can only be understood with the help of an experienced native scholar, well versed in all the technicalities of his subject. Each of these text-books belong to a particular system of medical knowledge and one has to make oneself familiar with the fundamental tenets of the system before one can successfully work through the text. These tenets are often given out orally or in the form of sūtras, that is short statements compiled in an extremely brief style which are incomprehensible without a commentary.

In order to successfully accomplish this task and to furnish a complete survey of the subject, the Himālayan Research Institute has established the

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following programme of research work, which is now being carried out at the Institute's Headquarters at Naggar. The work can be classified under two divisions :—

- (1) Gathering of the material, and
- (2) The study of this material in the laboratories of the Institute.

For the first purpose, the Institute has established a herbarium of medicinal plants in local use; a collection of local materia medica with data furnished by native medicine men; a collection of native text-books on medicine and pharmacopœia. Native medicine men are invited to participate in research work and assist in the classification and interpretation of the available material. It is hardly possible to secure a good medicine man outside his native country and it is quite impossible to induce such a man to undertake a journey abroad; hence the necessity of establishing a research centre in the region itself and equipping it with modern means of scientific research. The Himālayas and the high table-land of Tibet have for centuries attracted the medicine men of China and India. A very large section of Chinese Materia Medica is constituted with herbs that grow in the Tibetan highlands. The same is true of Indian Pharmacopœia. The Himālayan Research Institute is well located to study and record these ancient traditions. The pressure of modern civilization causes the keepers of ancient traditions to retreat into the fastnesses of their mountains, with the result that local traditions are rapidly vanishing. What can be done to-day, will be impossible in a few years. This one has constantly to bear in mind. In the near future the Institute will begin the publication of a series of monographs, containing the results of the Institute's research work, translations of Tibetan Medical works and commentaries thereon.

The second purpose is the detailed study of this material in the light of modern research. This will be done in the laboratories of the Himālayan Research Institute, which it is hoped will be completed about the spring of 1932. These laboratories consist of the following divisions :—

- (a) General Bio-chemical Laboratory,
- (b) Organic and Pharmacological Laboratories,
- (c) Physical Laboratory.

A special section of the department is devoted to Cancer Research for we are in possession of interesting data which justify researches in the cancer field in this part of the world, in which cancer is relatively seldom found. The study of the local diet may bring important revelations.

The above laboratories will give ample opportunities to the members of the staff to test these ancient medical usages by modern scientific means and

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will perhaps bring new solutions to some of the urgent problems of the Science of Life.

During the 1931 Expedition to Lahul / North-Western Himālayas /, the Director and Lama Lobzang Mingyur Dorje have collected a number of valuable Tibetan texts on native therapy and pharmacology, including the rGyud-bši, the Baidūrya sñon-po, biographies of famous Tibetan doctors, commentaries on the rGyud-bši, and several interesting gter-ma or 'hidden' books on medicine. All these works are at present deposited in the Research Library of the Institute.

A collection of medicinal herbs and drugs / containing 195 numbers / was also made with the help of native Tibetan lama-doctors.

Dr. C. Lozina, Medical Adviser to the Institute, who was in charge of this work, had to discontinue his work at the Headquarters due to family reasons. He left the Headquarters in March, 1931.

During the past period this department of the Institute was represented at the International Congress of Pharmacology, held in Paris during the summer of 1931. Dr. N. A. Dobrovolsky-Zavadsky has acquainted the members of the International Radiological Congress in Paris with the activities of the Himālayan Research Institute.

The Institute is very gratified to report that its Bio-chemical department has received liberal support during the past year. \$ 9,200 was donated by a friend of the Institute towards the erection of the Bio-chemical Laboratory at the Headquarters, and another sum of \$ 2,500 was presented by Mrs. Lionel B. Sutro for the Institute Fund for Cancer Research.

The building of the Bio-chemical Laboratory is well under way, and it is hoped to complete the construction before the monsoon period. The construction of the laboratory is supervised by Mr. V. A. Shibayev, Secretary of the Institute. An unfortunate delay of two months was experienced owing to difficulties in obtaining the needed supply of timber. This has been now secured and the construction can now proceed without further delays.

Plans are being made to erect a hydro-electric plant on a plot of land, the sale of which was sanctioned by the Government. Professor de Roerich has very kindly given the use of this plot of land to the Institute for the purpose of erecting the Institute's hydro-electric plant.

Madame and Professor de Roerich have also donated an additional plot of land for extension of the Institute's building in connection with the Bio-chemical Laboratory constructions.

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During the past year Colonel A. E. Mahon, D.S.O., has conducted, as the official representative of the Institute, various negotiations with Governmental authorities, and we take this opportunity to express to him our sincere appreciation.

RESEARCH LIBRARY.

During the past year the Library of the Institute was considerably increased through grants of books and book-exchanges. Grants of books were received from the following and are here gratefully acknowledged by the Institute :—

Carnegie Institution, Washington, D.C.; the Ethnographical Society of Paris; Professor de Roerich; Dr. Rabindranath Tagore; Commandant C. J. Cauvet; Colonel A. E. Mahon, D.S.O.; Professor Perrot; Dr. Bernard Read, of the Peiping Medical College; Dr. Dobrovolsky-Zavadsky; Mr. T. E. McCullagh, and Georges de Roerich.

The first issue of the Journal of 'Urusvati' Himālayan Research Institute, edited by the Director, was published in July, 1931, by the Roerich Museum Press, New York. The first issue comprised articles by Dr. R. V. D. Magoffin, President of the Archæological Institute of America; Count du Mesnil du Buisson, Director of Excavations at Qatna, Syria; V. A. Pertzoff, M.A., of Harvard University; Dr. C. C. Lozina; Dr. E. D. Merrill, Director-in-Chief of the New York Botanical Garden; Mr. V. A. Shibayev, and the Director. This first issue was dedicated to Professor Charles R. Lanman, the eminent Indologist.

During the past year the Institute established an exchange of publications with the following Institutions :—

Carnegie Institution, Washington, D.C.
Smithsonian Institution.
U.S. Museum, Washington, D.C.
U.S. Dept. of Agriculture: Bureau of Plant Industry.
U.S. Dept. of Agriculture: Bureau of Entomology.
U.S. Dept. of Interior: National Park Service.
Union of American Biological Societies (University of Pennsylvania).
Association of American Medical Colleges.
American Institute of Chemists, Inc.
American Chemical Society (Ohio State University).
American Council of Learned Societies, Washington, D.C.
American Geographical Society.
American Library Association.
American School of Prehistoric Research (Yale University).
Oriental Institute (Chicago University).

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American Oriental Society Journal.
School of American Research, Santa, Fe, New Mexico.
Mayo Foundation for Medical Education and Research (University Minnesota).
Elisha Mitchell Scientific Society (University of North Carolina).
Hahnemann Medical College and Hospital (University of Chicago).
New York Academy of Medicine.
National Medical Association, Newark, N.J.
Minnesota State Pharmaceutical Association.
Missouri State Medical Association.
Colorado State Medical Society.
Academy of Medicine, Cleveland.
Rhode Island Medical Journal.
Tropical Plant Research Foundation, Washington, D.C.
Gorgas Memorial Institute, Ancon, Canal Zone.
Panama Canal Zone Experiment Gardens.
Pacific Institute of Tropical Medicine (University of California).
Chicago Academy of Sciences.
Academy of Natural Sciences, Philadelphia.
California Academy of Sciences.
Kansas Academy of Sciences.
Colorado Scientific Society.
Tennessee Academy of Sciences.
Connecticut Geological and Natural History Society.
Nature Association, Washington, D.C.
Oklahoma Agricultural and Medical College.
Agricultural Experiment Station (University of Penn. State).
Agricultural Experiment Station (New Jersey State).
Agricultural Experiment Station (University of North Dakota).
Agricultural History Society, Washington, D.C.
American Museum of Natural History, New York.
Field Museum of Natural History, Chicago.
Metropolitan Museum, New York.
Colorado Museum of Natural History, Denver.
Natural History Museum, San Diego.
Los Angeles Museum of Natural History, Sciences and Arts.

Exchange of publications has also been started with the following Universities—(Depts. of Botany, Zoology, Bio-chemistry, Medicine, Pharmacology, or Archæology):—

Columbia University, New York.
Harvard University, Cambridge, Mass.

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Yale University, New Haven, Conn.
Cornell University, Ithaca, N.Y.
Rutgers University, New Brunswick, N.J.
Brown University, Providence, R.I.
Pittsburgh University, Pa.
Pennsylvania University, Phila., Pa.
Medical College of Virginia, Roanoke, Va.
Duke University, Durham, N.C.
University of North Carolina, Chapel Hill, N.C.
Purdue University, Lafayette, Indiana.
Saint Louis University, St. Louis, Mo.
University of Missouri, Columbia, Mo.
University of Illinois, Chicago, Ill.
Stanford University, Stanford, Cal.
University of California, Berkeley, Cal.
Ohio State University, Columbus, Ohio.
Marquette University, Milwaukee, Wisc.
Indiana University, Bloomington, Ind.
State Univ, of Iowa, Iowa City.
University of Michigan, Ann Arbor, Mich.
University of Minnesota, Minneapolis, Minn.
University of Oregon, Eugene, Oregon.
University of Oklahoma, Norman, Okla.
University of Nebraska, Lincoln, Neb.
University of Nevada, Reno, Nevada.
Vanderbilt University, Nashville, Tennessee.
University of Texas, Austin, Texas.
University of New Mexico, Albuquerque, N. Mexico.
University of Washington, Seattle Wash.

An exchange of publications was established with the following learned institutions in France :—

Institut International d'Anthropologie.
Société d'Ethnographie de Paris.
Société de Géographie Commerciale.
Office National des Plantes Médicinales.
Muséum d'Histoire Naturelle.

The Institute has also established an exchange of publications with the following scientific institutions in India :—

Government of India, Geological Survey.
Royal Asiatic Society of Bombay.

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Journal of the Andhra Historical Research Society.

Proceedings of the Bose Institute, Calcutta.

Viçvabharati.

Kashmir State Forest Department.

MUSEUM.

During the past period the Natural History Collections of the Institute have been considerably increased. A second room will be added to house the zoological collections. An Ethnographical collection has been started, and we gratefully acknowledge the gift of several objects of local ethnography donated by Professor de Roerich.

The nucleus of a museum has been started at the New York premises of the Himālayan Research Institute. At present two galleries are being organized: One to house the collection of Tibetan art brought back by the Roerich Central Asiatic Expedition, and another to house the botanical and zoological collection, gathered by Dr. Walter N. Koelz, biologist of the Institute.

During the year the Museum of the Institute in New York has received several important donations, which are here gratefully acknowledged:—

A Collection of butterflies from Sikkim, numbering 808 specimens donated by Mr. Svetoslav N. Roerich.

A mineralogical collection donated by Mr. Svetoslav N. Roerich.

A mineralogical collection donated by Mr. John Vlismas.

A mineralogical collection donated by the Paterson Museum, N.J.

One Tibetan dancing mask donated by Miss Esther J. Lichtmann.

ACTIVITIES IN NEW YORK.

The activities in New York during the past period have been supervised by Mr. Louis L. Horch, President of the Roerich Museum, and Mrs. S. G. Lichtmann. The office has been in charge of Miss Kathryn Linden. On November 10th, Miss Esther J. Lichtmann arrived in New York after a prolonged sojourn at the Himālayan Headquarters of the Institute, and took over the supervision of the activities of the Institute in New York. During her stay in India, Miss Lichtmann took an active part in the activities of the Institute, both at Naggar, Kulu, and Lahul, and her return to New York will no doubt help to further the Institute's future plans of research. It is a pleasant duty to express our sincerest thanks to Mrs. S. G. Lichtmann for her devoted care during the past period.

During the past period the following lectures were given under the auspices of the Himālayan Research Institute in New York: April 23rd,

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Dr. E. D. Merrill spoke on 'Twenty-two years in the Philippines', dealing with the historical and ethnographical aspects, as well as the vegetation of these islands. On November 23rd, Dr. Clyde Fisher, Curator of the American Museum of Natural History, gave an address entitled 'With John Burroughs in his Favorite Haunts'. This last lecture was held under the joint auspices of the Himālayan Research Institute and the Master Institute of Roerich Museum. Mrs. Louis L. Horch, President of the Roerich Society, who lectured on Kulu Valley and the work of the Himālayan Research Institute during the past session, gave further addresses this year before the Washington Heights Woman's Club on March 24th, and the Book Club of Riverside Church, New York, on May 18th.

In the Autumn of 1931, the following campaigns were inaugurated for the purpose of promotion and acceleration of the wide programme of the Himālayan Research Institute:—

1. Fund for the Bio-chemical and Cancer Research Laboratories.
2. 'Urusvati' Himālayan Research Institute Fund.

Professor Nicholas de Roerich has graciously donated for these two campaigns, his painting 'Saint Pantaleimon, the Healer', post-card reproductions from his paintings 'Saint Pantaleimon, the Healer', and 'Agni Yoga', as well as his new book 'The Realm of Light'. The proceeds from the sale of these will be given to the above funds.

A special leaflet for the Bio-chemical Laboratory Campaign Committee was written by Mr. J. G. Phelps-Stokes, Chairman of the Committee.

The rapid growth of the Institute necessitates further efforts in order to carry out the whole programme of its manifold activities. After two successful years of field work, the Institute confidently enters the third year of its research work. In closing this Annual Report, let me quote from our President-Founder's address for the Anniversary of 'Urusvati' Himālayan Research Institute:

'Thus we enter the next year in full realization that our work is undeerably needed, that the field of activity has been selected rightly and that the sympathy of friends and widest cultural circles promises a mighty expansion of the constructions for general usefulness. There, where is such general usefulness, we shall not withdraw and we shall uphold that enthusiasm which turns all obstacles into radiant possibilities.'

The Director.

BOOK REVIEWS.

JÄSCHKE: *Tibetan Grammar*. Addenda by A. H. Francke assisted by W. Simon. Walter de Gruyter, Berlin and Leipzig, 1929, pp. VI, 161.

THIS book is a reprint of Rev. Jäschke's Tibetan Grammar with Addenda by the late Dr. A. H. Francke and Dr. Walter Simon. The Addenda occupy pp. 105-161 of the present edition. Jäschke's Grammar, a highly commendable piece of work for its time, has long been in need of a revision. This has now been done by the authors of the Addenda.

Jäschke drew his illustrative material mostly from West Tibetan dialects with which he made himself familiar during his long sojourn in the provinces of Western Tibet. Students of Tibetan will be rather disappointed to find that the same thing was done by the authors of the Addenda. Most of the illustrative material embodied in the Addenda and a great many of the formulated phonetic and grammatical rules are based solely on West Tibetan dialects. In other words, the new edition of Jäschke's Grammar is an indispensable instrument of work in the study of the dialects of Western Tibet, but is hardly adequate for the study of the literary Tibetan as preserved in the provinces of Central Tibet / that is dbUs and gTsañ / . A number of statements made in the Addenda need correction and further investigations.

Dr. J. Vogel's researches indicate that the Indian form of writing which is most closely related to the Tibetan script, is the North-West Gupta alphabet / Cf. *Epigr. Indica*, Vol. XI, p. 266 / and seem to be supported by the following passage found in the Tibetan historical work, the Pad-dkar čhos-'byuñ, fol. 98 / Bhutan edition / :

དེའི་ཚེ་བོད་ལ་ཡི་གེ་མེད་པས་ཐོན་མི་ཨ་ཀུའི་བྱ་འཇམ་དབྱངས་ཀྱི་སྐུལ་པ་སྐྱོ་ཏེ་ཁ་
 ཚེར་ཡི་གེ་སྐོབ་དུ་བཏང་། དེས་སྐོབ་དཔོན་ལྷའི་རིག་པ་སེང་གི་བྱ་བ་ལས་སྐོ་ལེགས་པར་
 བསྐྱབས། བོད་དུ་ལོག་ནས་བོད་ཀྱི་སྐད་དང་བསྟུན་ནས་གསལ་བྱེད་སྐུམ་ཅུ། དབྱངས་གྲགས་
 ཀྱི་དབཞིར་བསྐྱབས། དབྱིབས་ཁ་ཚེའི་ཡི་གེ་དང་བསྟུན་ནས་ལྷ་སའི་སྐྱ་མཁར་མ་རུར་བཅོས།
 ལྷའི་བསྟུན་བཅོས་བརྒྱད་མཛོད་॥

'In those days, there was no script in Tibet. Thon-mi Sambhoṭa, son of Anu, an incarnation of Mañjuçrī, was sent to Kashmir to study writing.

From the Teacher Lha'i rig-pa señ-ge he acquired a perfect knowledge of the grammar. On his return to Tibet, he codified the Tibetan language, and made a script of thirty consonants, and four vowel sounds. He made the script similar in form to the script of Kashmir. He erected the Maru Castle in Lhasa, and composed eight treatises on grammar.'

The question of the origin of the Tibetan script is by no means settled, but it seems possible to assert, that the Tibetan script was modelled on an Indian script current in the North-West in the VIIth century A.D.

P. 106. The authors very appropriately refer to Dr. J. van Manen's statement, reproduced by F. O. Schrader in *Asia Major*, I, p. 56. The 'a-čhuñ / འ་ཅུའོ / represents a soft guttural spirant / h / , which in some dialects has developed a nasal pronunciation, while in others it was softened to a semi-vowel. In many dialects the pronunciation of the 'a-čhuñ has disappeared, and the initial is treated very similarly to the French homme, pron. om and the Italian uomo < lat. homo.

Ex. འ་མ, 'o-ma, 'milk': Lahul / Koksar sub-dialect / ho-ma; Lhasa: o-ma; Khams: ʊo-ma / in some Khams-pa dialects the word is pronounced with an initial velar; ʎo-ma /.

འུག་པ, 'ug-pa, 'owl'. Lahul / Koksar sub-dialect / hug-pa; Lhasa: uk-pa; Khams: ʊuk-pa.

I propose to treat the question of the 'a-čhuñ more fully in my forthcoming Comparative Grammar of Colloquial Tibetan which is in the course of preparation.

P. 107. The change of the pronunciation of Tibetan kya, khya, gya to ča, čha, ja / or more correctly č'a, č''a, j'a / is the usual pronunciation of these syllables in the dialects of Central Tibet. A guttural pronunciation subsists, however, side by side with the palatalized pronunciation.

P. 108. The pronunciation of the superadded 'r' as 's' is observed in the West Tibetan dialects only / rta, horse, pron. ṣta /.

P. 108. The triangular va-zur placed under certain letters usually lengthens the vowel of the syllable. Ex. མོ་ཤེའོ་མ་, 'salt' pron. ṭš'ā. According to

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native grammarians the va-zur in this instance is a mere mark to distinguish the word tshva 'salt' from tsha-(ba), 'heat'.

The assimilation of a superadded s-sound to the class of the following consonant is observed in the dialects of Western Tibet only.

P. 109. The evolution from affricates to fricatives is observed in the dialects of West Tibet only.

P. 110. With regard to the Tibetan accent it must be added that the syllables representing the article have a secondary accent:

འགྱུར་བ, 'gyur-ba, to become, pron. j'úr-wà.

P. 110. Modern Central Tibetan possess a definite system of five tonemes. The different dialects and sub-dialects spoken in Tibet seem to agree on the main points of the system and the only difference noticed lies in the distribution of high and low pitch among the four fundamental tonemes of the system. As in ancient Chinese, all syllables with an initial surd are generally pronounced with a high-pitched tone, and all syllables with an initial sonant with a low-pitched tone. Words ending in a guttural-g in the Tibetan dialect of Lahul have invariably the high rising tone. See my article on Tibetan Tonemes in the Sir George Grierson's Commemoration Volume, ed. by the Linguistic Society of India.

P. 112. The authors of the Addenda state:—'It is very extraordinary that the word bla-ma, priest, is furnished with a feminine article'. The word bla-ma is properly speaking a compound, which the native grammarians explain as follows:—

ལྷ་མ་ཞེས་པའི་སྐྱེ་བཤད་ནི། སྐྱེ་བའི་ཚོགས་བསམས་པའི་ཞིང་དེའི་གོང་ན་གཞན་
མེད་པས་ན་ལྷ། མས་རང་གི་བྱ་ལ་འོ་མ་སྦྱར་བ་བཞིན་ཡིན་ཏེ་གྱེ་འོ་མ་སྐྱེད་པས་ན་མ་
བཞིན་ཡིན་པས་ཕྱིར་རོ།།

'The explanation of the expression bla-ma:—

bla / lofty, high / because there is nothing higher than the toil of giving knowledge to pupils.

ma-because the imparting of the milk of knowledge is like the giving of milk by a mother to her child.'

P. 112. རྣམ་པ, nam-pa, section, form, is often used as a plural sign with

pronouns. Ex. བྱིན་རྣམ་པ།, khyed rnam-pa, you. It is possible that tsho < tshogs, but I failed to find any hints in Tibetan grammatical works to support this statement. The same is true for ཐམས་ཅད།, thams-čad, all, which according to the authors of the Addenda is related to the verb འཇམ་པ།, 'tham-pa, to seize, grasp.

P. 114. The authors say:—'The dative is not only the case of the indirect object, but an intensified form of the direct object, khos mi-la rduñ, he beat the man.' The case illustrated by the above sentence is an accusative / las-su bya-ba / . It is ambiguous to speak of 'a dative case often used instead of the locative and terminative case'. Khañ-pa-na yod — is a proper locative.

P. 115. I never heard ལགས།, lags / in such sentences as bla-ma-lags / pronounced le. The common pronunciation of the syllable, both in Western and Central Tibet, is lā.

P. 116. Synonymous compounds play an important part in Tibetan. Some of the honorific expressions are properly speaking synonymous compounds.

P. 118. The explanation of བུད་མེད།, bud-med, woman, as bu-dmad 'the low child, girl, woman' is erroneous. The correct explanation of the word is given in S. C. Das' Dictionary, P. 872:

མཚན་མ་ཕྱི་ལ་མ་བུད་པས་བུད་མེད་ཅེས་བ་ཡིན།

S. C. Das' English rendering of this sentence should be rejected.

P. 119. Compounds of more than two members are very frequent in Tibetan.

P. 128. It is very doubtful whether བྱིན།, khyed, you, can be considered a contracted form of བྱིན་ཉིད།, khyod-ñid. Khyed is a pronominal form used in the modern strata of the language, and is nowadays pronounced -k'ie, with the nasalization of the vowel.

P. 136. The subject of Tibetan transitive and intransitive verbs deserves to be studied in the light of a comparative study of the Tibetan-Burman verbal system.

BOOK REVIEWS

P. 138. The Tibetan causative needs further investigation in the light of native grammatical works.

P. 142. The present stem of the verb to give is གཏོང་བ, gtoñ-ba btañ is used in the present tense only in the colloquial language.

P. 142. The different forms used for the verb 'to be' vary according to dialects.

P. 152. The authors state:—'The future with bya is not found in ancient texts'. What is the date of these ancient texts? The future in རྟེན, bya is regularly used in literary Tibetan.

P. 153. 'The word gis / gyis / is probably related to the verb bgyid-pa, bgyis, bgyi, to make'. This is hardly the case, and the native grammatical works contain no hint to the possibility of such an explanation.

P. 154. The authors mention an imperative in 'añ. Is the use of this form limited to the West Tibetan dialects? Or is it a vulgarized form of the literary imperative in dañ / Ex. གསུང་དང་, gsuñ-dañ, say! / ?

P. 160. The Tibetan Bible translation should be revised with the help of a competent native scholar.

The death of Dr. A. H. Francke is a severe blow to Tibetan studies. With his passing away, Tibetology lost one of its best scholars in the fields of West Tibetan history and Tibetan folklore. Dr. Walter Simon has published recently a work entitled 'Tibetisch-Chinesische Wortgleichungen' / Mitteilungen des Seminars für Orientalische Sprachen, Vol. XXXII, 1929, abteilung I; also published separately, Verlag von Walter de Gruyter & Co., Berlin-Leipzig, 1930 / which represents a courageous attempt to penetrate a new and as yet almost unexplored field of linguistic research.

G. DE ROERICH.

E. OBERMILLER: *History of Buddhism / čhos-hbyung* / by Bu-ston, Part I, The Jewelry of Scripture. Materialien zur Kunde des Buddhismus, Heft 18, pp. 188, Heidelberg, In Kommission bei O. Harrassowitz, Leipzig, 1931.

Dr. E. Obermiller has been very active in translating and editing Buddhist texts. He had already given us two extremely useful Indices Verborum /

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Sanskrit-Tibetan and Tibetan-Sanskrit / to the Nyāyabindu of Dharmakīrti, and the Nyāyabinduṭīkā of Dharmottara / published in the Bibliotheca Buddhica, XXIV-XXV / 1927-28 / , and an important translation with commentary and notes of the Tibetan text of the Uttara-tantra, published in the Acta Orientalia, Vol. IX, 1931, under the title of 'Sublime Science of the Great Vehicle to Salvation, being a Manual of Buddhist Monism, the work of Ārya Maitreya with a commentary by Āryāsanga'. These important works are now followed by a translation with copious notes of the čhos-'byuñ of Bu-ston Rin-čhen-grub / 1290-1364 / . (The name of the historian is never pronounced Bu-don in Tibet, which represents a Mongol pronunciation. The correct Tibetan pronunciation is Pu-tön, or with the lengthening and nasalization of the vowel in the second syllable -Pu-tō / .

The voluminous historical literature preserved in Tibet is an important source for the history of the Buddhist Doctrine in India and Tibet. Unfortunately the study of this class of literature has been long neglected in the West, and the result is that we know almost nothing concerning the history of the different religious sects in Tibet. The present volume contains Book I and part of Book II of the čhos-'byuñ. The first book, in common with other similar histories in Tibet, contains a review of the Buddhist teaching, and a discussion of numerous dogmatic points, with extensive quotations from Mahāyāna texts. The second book deals with the origin of the Buddhist Doctrine in India and its spread in Tibet. We hope that Dr. Obermiller will shortly give us the rest of his translation, which contains the most valuable parts of Bu-ston's History, namely the spread of the Doctrine in Tibet, and a systematic catalogue of works included in the Tibet Känjür and Tänjür.

Dr. Obermiller's translation is on the whole extremely successful. All through the text, the technical terms have been rendered in English. In itself it is a highly commendable way of translating Buddhist texts. The difficulty lies, however, in the fact that so many of the technical terms have no exact corresponding expressions in other languages, and that in consequence a literary rendering may sometimes obscure the true philosophical meaning of the text.

The translation is preceded by an introduction by Professor Stcherbatsky on Bu-ston and his work.

We must be grateful to Dr. Obermiller for having given us an excellent translation of one of the most important historical treatises of Tibetan literature.

G. DE ROERICH.

BOOK REVIEWS

C. LEONARD WOOLLEY: *Digging up the Past*. Charles Scribners Sons, New York, 1931, pp. IX, 138, with XXX plates.

Mr. C. Leonard Woolley's name needs no introduction. His remarkable excavations at Ur in Southern Babylonia, and other sites in the Near East have opened new vistas to antiquarian knowledge. The present little book, written for the general public, is a series of talks on field archæology scientifically conducted. The past decades of archæological explorations have established the necessity of scientific methods in field archæology, the value of chronological evidence, and the importance of minute observations and recording. In its essence field archæology is the application of scientific methods to the excavations, for the scientific value of an object depends not so much on the nature of the object itself, as on its associations which can be discovered only by a careful study of its environment. Museums and other scientific institutions have endeavoured to enlist the co-operations of the general public in the important task of recording archæological sites and monuments. Proper text-books on field archæology are badly needed. Sir Flinders Petrie's 'Methods and Aims in Archæology' has long been out of print and inprocurable. A few years ago the British Museum published a small booklet under the title 'How to observe in Archæology', 2nd edition, London, 1929, which gives a great deal of extremely valuable information in the different fields of Near Eastern Archæology / the chapter on Stone Age in the booklet is supplemented by a short pamphlet entitled 'Flints, an illustrative Manual of the Stone Age for beginners', British Museum, London, 1928 /. Many years ago, the Société Préhistorique de France issued an extremely useful Manuel de Recherches Préhistoriques / Paris, Alfred Costes, Editeur, 2nd edition, 1929 /, which serves the same purpose. The present book by Mr. Woolley gives a fascinating account of excavations illustrated by examples from Mr. Woolley's own excavations in Mesopotamia, Egypt and elsewhere, and will no doubt awaken a greater interest in the aims of field archæology to whose painstaking toils we owe the reconstruction of the ancient civilizations of the Near East.

Much in archæology depends on mere chance, and hazard has played an important part in the discovery of famous archæological sites. It is therefore of utmost importance to spread the knowledge of archæological methods among the general public and equip new recruits for this important work. Mr. Woolley's book is eminently suited for this purpose. It is to be hoped that the other branches of Eastern Archæology will imitate this example and give us accounts based on excavations of sites left behind by the great civilizations of India, Central Asia and the Far East.

G. DE ROERICH.

URUSVATI JOURNAL

CHARLES G. COOK: *New Type Questions in Chemistry*. Globe Book Co., New York, 1927.

ERNEST L. DINSMORE: *Chemical Calculations*. Globe Book Co., New York, 1927.

The purpose of the first of these two little books is to assist the high-school teacher of Chemistry. The book contains the following types of questions:—

1. The old type questions requiring the answer in essay form.
2. True-false questions.
3. Completion questions.
4. Evidence questions in which the pupil gives the reason for the truth or falsity of the statement.
5. Wrong statements to be corrected.
6. Home tests. These involve much thought on the part of the student as well as careful searching of the text.'

The reviewer belongs to the class of person who dislikes asking true-false questions as well as completion questions. Though they both may be stimulating to the mind—when carried too far they are prone to do more harm than good. However, this is a matter of opinion. There is no doubt that the author, in less than 100 pages, has succeeded remarkably well in covering the field of elementary chemistry.

'Chemical Calculations' unquestionably is a great help to those who are taking the first steps of a chemical education. The book consists of accurate and carefully selected descriptions of definitions and laws of chemistry followed by a number of problems. The intricate field of chemical equations is not forgotten nor are the problems involving weights and percentage composition neglected. At the beginning is found a concise table describing the periodic arrangement of atoms in terms of electrons and protons. Teacher and pupil alike will find this book most useful.

V. A. PERTZOFF.

HUNTIGTON AND CARLSON: *Environmental basis of Social Geography*. Prentice-Hall, Inc., New York, 1929, pp. XXIII, 495, illustrated.

Since the recent tendency among geographers to emphasize the social and humanistic aspects of geography, the problem of environment has again come to the foreground. Geography, essentially a science of relationships between man and his environment, is an indispensable introduction to the study of mankind's Past and Present.

BOOK REVIEWS

The present book serves as a good introduction to social geography, and describes the various problems of the influence of environment on the population of a region, its economic life and tendencies, with a sound and scientific method.

G. DE ROERICH.

CHI LI: *The formation of the Chinese People: an anthropological inquiry.* Harvard University Press, Cambridge, 1928, pp. 283.

In this book, Dr. Chi Li, of the Tsing Hua Research Institute, makes an attempt to solve the very complex problem of the ethnic formation of the Chinese people. The author's conclusions are based on his observations conducted among Chinese students in the U.S.A., and Chinese laborers / natives of Kuangtung / in Boston. The author quotes extensively from Chinese literary sources, and especially from the great Encyclopedia Ch'in Ting Ku Chin T'u Shu Chi Ch'êng, and the Dynastic Histories. He divides the mass of China's population into two large groups: The We-group or Chinese properly speaking, and the You-group or barbarians, that is tribes of foreign origin with whom the Chinese came into contact during their expansion.

P. 259. Hala-wusu is not a Tibetan name, but represents the Mongol qara-usu 'Black water'—a common Mongol name for rivers. The upper course of the Luchiang or Salween is called Nag-čhu 'Black water or river' by the Tibetans. The Yunnan tribal name of Hala can hardly have anything in common with the Mongol qara 'black'.

Extensive explorations of prehistoric sites in China proper and along the Chinese border will no doubt throw new light on the problem of the ethnic constitution of the Chinese race, and until this has been done we can hardly expect a satisfactory solution of the problem.

G. DE ROERICH.

CHRONICLE OF CENTRAL ASIATIC EXPLORATION FOR 1931.

THE year 1931 has seen several large expeditions in the field in Central Asia.

The veteran explorer, Sir Aurel Stein, accompanied by his Surveyor Khān Sahib Mian Afraz Gul Khān, started in the summer of 1930 on his fourth great journey to Central Asia. This expedition, whose object it was to continue archæological explorations in the Lop desert, and in a specified portion of the T'ien Shan Mountains, was largely financed by Harvard University and the British Museum. Unfortunately the sad realities of present conditions in innermost Asia, prevented this scientific enterprise from being carried out. After proceeding to Kāshgar from its base in Kashmir, the expedition was held back by prolonged negotiations with the Provincial Government at Urumchi. By the middle of November, Sir Aurel Stein secured permission to follow the caravan route skirting the southern edge of the Takla Makan desert. Permission was given to conduct scientific work and needful surveys along the route. On reaching the site of Domoko obstruction began to manifest itself. The Expedition was prevented by the local officials of the Keriya district from conducting excavations or making plans of ruined sites. On his arrival at the oasis of Charchan the explorer received the news that the Nanking Government had cancelled his passport and insisted on the Expedition's return to India. For his return journey to Kāshgar, Sir Aurel Stein chose the route leading past the Lop tract to the northern caravan route along the T'ien Shan mountains. Interesting observations were made during this trip. On his return to Kāshgar, Sir Aurel Stein resumed his negotiations with the local authorities, and after another considerable delay, the explorer was obliged to decide on his return to Kashmir. All objects of archæological interest collected during the journey were deposited at the British Consulate-General at Kāshgar, awaiting the Chinese Government's decision as to their disposal.

On his return journey, Sir Aurel Stein had the good fortune to examine a large find of ancient manuscripts, discovered by local inhabitants in a ruined Buddhist stūpa above the Naupūr Village, some two miles west of Gilgit Cantonment. Sir Aurel Stein's examination has shown that the bulk of the manuscripts are written in the Central Asian Brahmi script on oblong birch bark leaves. Of special interest is one manuscript written on paper, and probably imported from Chinese Turkestān. Palæographic indications suggest that some of the manuscripts may date back to the VIth century A.D. The

complete excavation of the site, and of three smaller stūpas immediately adjoining it, is awaited with great interest.

Another vast enterprise is that of the Citroën Expedition 'Centre-Asie', which represents an attempt to conquer by means of modern mechanical transport the continent of Asia. This expedition organized and financed by M. André Citroën, is commanded by M. Georges Haardt, assisted by M. L. Audouin-Dubreuil, and a numerous staff of scientists, mechanics, cinema-operators, and photographers. The scientific side of the enterprise is directed by the Rev. Teilhard de Chardin, paleontologist and discoverer of a Palæolithic culture in the Ordos; M. Joseph Hackin, Keeper of the Musée Guimet and well-known archæologist; and M. André Reymond, biologist. Surveys will be conducted by Lt. Point, commanding the China group of the expedition, and Lt. Pecqueur. An artist is added to the staff in the person of the well-known Russian artist Alexander Iacovleff. In connection with the Expedition a pamphlet was issued entitled 'L'Expédition Citroën-Centre-Asie', which tells about the organization of the expedition and its programme. This pamphlet is accompanied by a booklet containing a popular historico-geographical account of innermost Asia / Chinese Turkestān, Mongolia and Tibet / by Professor P. Pelliot / *La Haute Asie, par Paul Pelliot* /.

The purpose of the Expedition is to cross Asia from Beyrouth to Peking on caterpillar cars, specially constructed for this purpose by the Citroën Automobile Works. From Peking, the Expedition plans to strike south to Hanoi and Saigon in French Indo-china, and from there to cross Siam, Burma, Northern India, Beluchistān, and rejoin the first route somewhere in Persia. From the outset the Expedition was divided into two groups: Groupe-Pamir, commanded by M. Haardt with a convoy of light caterpillars, and Groupe-Chine, commanded by Lt. Point with a convoy of seven cars. The second group was despatched from Marseilles to China with instructions to meet the first group in Chinese Turkestān. The first group started its motor journey from Beyrouth and after an uneventful journey across North Mesopotamia, Persia and Afghanistān reached Srinagar on the 24th of June, 1931. / During the Expedition's stay in Kabul, a brief reconnaissance was conducted in the famous Bāmiyān Valley /. In Kashmir the Expedition made a prolonged stay in order to prepare the further route across the mighty mountain barriers to the North. This portion of the route presented most of the difficulties for mechanical transport. After a strenuous effort to bring some of the cars over the narrow Gilgit route, the expedition was forced to abandon its cars and proceed to Kāshgar on caravan animals. Misgar, the terminus of the Indian Telegraph, was reached on the 1st September. Then across the Kilik Pass / 15,844 feet /, in the westernmost offshoots of the great Karakorum Range, the Expedition

CHRONICLE OF CENTRAL ASIATIC EXPLORATION

journeyed towards Tāsh-kurghān, and reached Kāshgar on the 19th September. Meanwhile the China group of the Expedition journeyed along the Peking-Hsinchiang trade route, and duly arrived at Urumchi, capital of Hsinchiang, where the authorities deprived it of the car with the wireless installation. From Kāshgar, the first group proceeded along the caravan route to Aksu, where it was met by four cars sent from Urumchi by Lt. Point. The last available news tells that the first group joined the second group at Urumchi on the 26th October.

During the past years several attempts were made to open up innermost Asia by motor transport. One of such Expeditions starting from China succeeded at the close of the Great War to cross the Gobi and to reach Urumchi.

The great scientific expedition to Central Asia, organized and directed by the eminent Swedish Explorer Dr. Sven Hedin, after four years of highly productive work is still in the field. A welcome and significant characteristic of this expedition is its close co-operation with Chinese scholars. A number of Chinese scientists took part in the expedition and contributed greatly to its success. Dr. Yüan discovered in the northern slopes of the T'ien Shan, east of Urumchi, rich deposits of dinosaur remains, and T. H. Ting conducted important explorations in the western section of Chinese Turkestan.

In a letter to the writer of the present note, dated September 8th, 1931, the great explorer writes:—

‘My expedition, to which I soon will return, is working in eight different groups in Hsin-chiang, Khams, Gobi and Mongolia. My Swedish archaeologist, Dr. Folke Bergman, has found over 10,000 MSS. on wood from the early Han dynasty—at Etsin-gol. Dr. Erik Norin has discovered the Permo-carboniferous ice age and has definitely settled the question of dessication in Central Asia. Dr. Nils Hoerner has discovered and surveyed the new Lop-nor. Nils Ambolt has determined with Invar pendulum the gravity of many places of Eastern Turkestan. Dr. W. Haude has sent up 353 pilot balloons to a maximum altitude of 21,000 metres. I have four very able Swedish geologists working in Central Asia and they will give a quite new idea of the structure and stratigraphy of the great continent.’

The important discovery of Han documents is the largest of its kind, and the material will be studied by Professor Bernhard Karlgren of Goeteborg in Sweden, and Professor Liu Fu of Peking. The collection will be preserved in Peking. Besides these Han documents, the expedition discovered several hundreds of funeral inscriptions of V–VII centuries, and numerous inscriptions of the Mongol epoch.

URUSVATI JOURNAL

Interesting discoveries are reported by Dr. Erich Schmidt, field director of the Persian Expedition of the University Museum and the Pennsylvania Museum of Art, on the site of Tepe Hissār, a few miles from Dāmghān, lying some 60 miles south-east of the Caspian Sea. The civilization discovered during the excavations may prove to be one of the connecting links between the Indus civilization and Mesopotamia.

G. DE ROERICH.

We shall be glad to publish accounts of every exploration in Central Asia and adjacent regions, which will be brought to our notice.

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